Participation of the Poorest and Distributional Effects of Conditional Cash Transfer Programs*

Carlos Rodríguez Castelán†
Cornell University

November 17, 2010

Abstract

Conditional Cash Transfers (CCTs) are now a widespread policy tool. They are seen as an answer to short term income poverty through the transfer component, and a support to longer term human capital formation among the poor through conditioning the transfer on educational enrollment (and enrollment in health schemes). However, CCTs condition income transfers on the consumption of normal goods—richer households are more likely to consume more educational and health maintenance opportunities than poorer households. This suggests that the poorest households may benefit least from CCTs, even to the extent that the very poorest may not participate at all. Using household survey data from rural Mexico, this paper establishes that participation rates in the *Oportunidades* program are indeed significantly lower for the very poorest households, after controlling for a number of variables which might independently affect participation. With this empirical finding as a basis, I develop a model to conduct policy analysis comparing CCTs with Unconditional Cash Transfers (UCTs), deriving precise conditions under which one dominates the other if the objective is poverty reduction. In particular, it is shown that UCTs could be preferred over CCTs when a government has a sufficiently high degree of poverty aversion. It is also shown that these basic arguments carry over from income poverty to "education poverty."

JEL Classification: D11, H42, H53, I32, I38

Key words: Cash transfers, Participation, Porverty, Education, *Oportunidades*, Mexico

---

* I am especially grateful to my advisor, Ravi Kanbur, for numerous discussions, revisions, and insightful comments. Also I have benefited from helpful comments and suggestions from Kaushik Basu, Peter Brummund, Joerg Ohmstedt, Eswar S. Prasad, Jeffrey T. Prince, Mario Ramirez Basora, David E. Sahn, Liliana Sousa, Russell Toth and seminar participants at Cornell University.
† Department of Economics, Cornell University, 404 Uris Hall, Ithaca, NY 14853. Email: cr228@cornell.edu

1 Introduction

Conditional Cash Transfers (CCTs) are now a worldwide phenomenon.[1] The main objectives of CCT programs are immediate poverty alleviation through cash benefits and long-term poverty reduction through human capital formation. Programs such as *Oportunidades* in Mexico, *Bolsa Familia* in Brazil, and *Familias en Acción* in Colombia, transfer cash to targeted poor households conditional on school enrollment, as well as on periodic health and nutrition checkups. An extensive body of literature evaluating these interventions has found significant positive effects of participation in CCT programs on families' use of education and health services while concurrently reducing poverty and child labor.[2] It is therefore essential for families to participate in CCT programs to benefit from their positive impacts.

That CCTs condition income transfers on the consumption of normal goods suggests that the poorest households may benefit least from CCTs, even potentially resulting in the very poorest not participating at all. This paper examines the extent to which household income plays a role in a family's decision to participate in a CCT program.[3] Knowledge of the nature of the household's decision to enroll in CCTs would have important implications for public policy. In particular, a better understanding of the determinants of CCTs' enrollment could help to increase participation rates of the poorest households, thereby increasing public spending effectiveness, and improving the progressivity of CCTs.

The central question addressed by this paper is the following: do the very poorest households participate in CCT programs? Using cross-sectional household survey data from rural Mexico, I estimate a discrete dependent variable model on the household's decision to participate in the

[1] At this point the majority of the Latin American countries have a CCT program, while countries outside the region include Turkey, Indonesia and Bangladesh. In addition, there have been pilot programs in several U.S. cities including New York City (See Riccio *et al.*, 2010).

[2] See, for example, Bourguignon *et al.* (2003); Cardoso and Souza (2003); Schultz (2004); Glewwe and Olinto (2004); Behrman *et al.* (2005); Attanasio *et al* (2005); Maluccio and Flores (2005); Todd and Wolpin (2006): De Janvry and Sadoulet (2006); Leon and Younger (2007), and; Schady and Araujo (2008).

[3] The term 'income' is used throughout the discussion, but in the empirical implementation I use household expenditure instead of household income since in the development economics literature the preferred metric for defining well-being and poverty is predominantly household expenditure.

Oportunidades program. This estimation focuses on the effects of household income on the participation decision of the poor and controls for a comprehensive set of household and community characteristics and school- and teacher-quality variables.[4] I find that the probability of participating in *Oportunidades* is indeed significantly lower for the very poorest households. It increases as income rises to a certain level and then declines as we move closer to the poverty line.[5] I show that this finding is not explained by measurement error and is robust to an alternative specification for household income only for the subsample of extremely poor families.

There are several reasons why we may observe a lower probability of participation for the very poorest families.[6] The most appealing is that CCTs condition monetary benefits on the consumption of normal goods which implies richer households are more likely to make use of more education and health services than poorer households. Alternative explanations for the low take-up rate among the poorest are linked to weak preferences for schooling, and high costs of participation. [7]

This paper complements the previous literature in development economics on the determinants of participation in anti-poverty programs (typically CCTs and public works programs).[8] In general, most of the previous empirical work analyzes the linear relationship between CCT program participation and household income as a first-stage regression strategy to estimate impacts

[4] Since I am using cross-section data, the participation choice is modeled as a static decision.
[5] By incorporating into the analysis a second degree polynomial of household income, I am able to identify a non-monotonic (and concave) relationship between participation in the *Oportunidades* program and income.
[6] Some reasons that might cause a lower probability of participation for those poor households closer but below to the poverty line are: first, the targeting mechanism of *Oportunidades* may generate uncertainty about eligibility for those families; second, higher opportunity costs of time associated with visiting the health center for periodic check-ups may lead to self-selection out of the program of relatively richer eligible households, and; finally, this phenomenon may also be the result of measurement error and administrative problems.
[7] In deciding whether or not to enroll in the CCT program, families need to compare the costs associated with fulfilling the conditions of the program to the expected benefits of receiving the CCTs. To account for parents' preferences for schooling, I incorporate in the analysis information on parents' years of education, the ratio of income spent in education, school- and teacher-quality variables, and a dummy variable for access to a high-quality health provider. To account for costs of participation, I consider in the analysis proxies for both direct costs (e.g. relative price of schooling and transport cots) and opportunity costs of participating (e.g. child work and migration).
[8] Gaiha (1996); Jalan and Ravallion (1999); Chirwa *et al.* (2002); Heinrich (2007); Oosterbeek *et al.* (2008); Alvarez *et al.* (2008); Angelucci and Attanasio (2009); Berhman *et al.* (2010), and; Berhman *et al.* (2010). In addition, Currie (2006) presents a comprehensive review of recent literature regarding the take up of social programs in U.S. and U.K.

on outcomes using propensity score models (see, for example, Heinrich, 2007; Oosterbeek *et al.*, 2008; Berhman *et al.*, 2009, 2010). These studies find that participation is inversely related to individual wealth, and that key correlates of poverty (such as few assets, no land ownership, dirt floors in the home, etc.) are associated with a higher probability of participation in welfare programs. My results are comparable when examining the linear relationship between wealth and participation, but when my empirical strategy incorporates a more flexible function of household income, the data show that the poorest families are less likely to enroll in CCTs than previously believed.

Previous studies addressing the issue of non-participation in CCTs have some data limitations, and correspondingly may suffer from omitted variable bias. Unlike these studies, I estimate a model of participation controlling for a set of covariates which are key determinants of the household's decision to participate in CCTs. These covariates include distances from the center of the community to the closest schools and health center, costs of schooling, and school- and teacher-quality variables.[9]

In the final part of this paper, I develop a model to investigate the broader policy implications of the empirical finding that the poorest households are less likely to participate in CCTs. Could Unconditional Cash Transfers (UCTs) be superior to CCTs if the objective of the government is to minimize income poverty measures given a fixed budget? I identify conditions under which CCTs dominate UCTs and vice-versa.[10] Specifically, I show that UCTs could be preferred over CCTs when a government has a sufficiently high degree of poverty aversion. Some might argue that the ultimate

[9] Moffitt (1983) was one of the first to model non-participation in social programs as a utility-maximization decision. His model emphasizes "stigma" as the main cost of participation in means-tested programs, but the model can easily be extended to include other types of costs, such as transaction costs. However, Fiszbein and Schady (2009), suggest that in assessing whether to send their children to school in response to a CCT program, parents take into account the quality of local schools, and so are more likely to enroll their children in school if the quality is higher.

[10] The idea of making meaningful comparisons between redistributive schemes has been noted previously. Blackorby and Donaldson (1988), for example, analyze Pareto efficiency under incomplete information for cash and in-kind transfers. Besley and Kanbur (1988) compare the poverty alleviation effects of marginal and infra-marginal subsidies. Besley and Coate (1992) analyze incentive arguments to compare workfare and welfare programs to alleviate poverty. Currie and Gahvari (2008) contrast transfers in cash and in-kind, concluding that paternalism and interdependent preferences are leading overall explanations for the existence of in-kind transfer programs. Cunha (2010) compares measured consumption and health outcomes under both in-kind food and cash transfers.

objective of CCT programs is not only short-term poverty alleviation but also the long-term benefit provided by increased consumption of a particular merit good, e.g. education. However, I show that the analysis and results carry over broadly for "education poverty."

The remainder of this paper is organized as follows. Section 2 provides an overview of the Mexican *Oportunidades* program. Section 3 describes the data and presents an empirical model of program participation. With the empirical results as basis, in Section 4 I develop a model to conduct policy analysis. Finally, Section 5 contains concluding remarks.

2 The Mexican *Oportunidades* program

In 1997 the Mexican government introduced a CCT program called *Progresa* (Program of Education, Health and Nutrition) in rural areas providing assistance to approximately 300,000 poor households. This program aimed at alleviating poverty by providing monetary transfers to poor families and increasing investment in human capital by means of higher school attendance and better health. Originally, the program provided grants only for children enrolled in school between the third and the ninth grade. In 2001, the cash benefit was extended to upper secondary school (grades 10 to 12), and in 2002 this CCT scheme rapidly expanded into urban areas and was renamed *Oportunidades*. By the end of 2005, five million families living in 92,672 communities were receiving the transfer, corresponding to more than one-fifth of the total households in Mexico. According to the Ministry of Social Development of Mexico (SEDESOL), approximately 86.3% (4.3 million) of those beneficiary families were living in rural and semi-urban communities, while the remaining 13.7% (700,000) were located in urban areas.[11] At present, the *Oportunidades* program covers more than 5.8 million poor

[11] According to SEDESOL (2006), rural communities are defined as those with less than 2,500 inhabitants. Semi-urban communities are those between 2,501 and 14,999 inhabitants. Urban communities are those with more than 15,000 inhabitants.

families, and its budget for 2010 is MX$42.5 billion,[12] approximately equivalent to US$3.26 billion, corresponding to 1.33% of the public budget, and 0.34% of the GDP in Mexico.[13]

Oportunidades is targeted at households with a marginality index score above a cutoff point, known as *puntaje*. To determine a *puntaje* for each household in rural areas, the government implemented the following targeting mechanism. First, potential recipient communities were ranked based on both an index of marginality (from principal component analysis of census data) and the availability of educational infrastructure. Second, the beneficiary families within each village were selected based on proxy means tests calculated with discriminant analysis on data collected from household census. All families who met the eligibility criteria in rural areas were informed of their eligibility status. This targeting procedure was altered with the program expansion to urban areas. Potential beneficiaries in urban areas had to visit sign-up offices where their socioeconomic condition was assessed. Then, families identified as potential recipients were visited to confirm their poverty status based on observable household assets that indicate relative wealth and, finally, discriminant analysis was used to determine eligibility.[14]

The *Oportunidades* program delivers the monetary payment to eligible households every two months, and it has two main components: a nutrition transfer associated with non-monetary health care benefits, and an education transfer.[15] To receive these payments, families have to fulfill a number of conditions related to both health and education. First, in order to receive the nutrition subsidy, all household members have to attend local health centers for regular nutrition and health checkups, and the transfer recipients (usually the female head of household) have to attend informational health and

[12] The total amount of the *Oportunidades* program budget in 2010 includes the nutrition (MX$14.4 billion), health (MX$4.9 billion), and education components (MX$23.2 billion).
[13] Sources: *Oportunidades* budget, SEDESOL (2010); total public budget in Mexico, SHCP (2010); nominal GDP in Mexico, INEGI (2010), and; real exchange rate, Banco de Mexico (2010).
[14] According to Behrman *et al.* (2010), this alternative method led to about 40% of households who met the eligibility criteria in the program to not enroll in *Oportunidades*, which contrasts with the very high participation rates observed in rural communities.
[15] The *Oportunidades* program also provides basic health care for all members of the family, with emphasis on preventive health care (e.g. vaccinations, nutrition and children's growth check-ups, anti-parasite treatment). Besides the monthly nutrition cash transfer, the participant families receive nutritional supplements targeted to infants between four months and two years old, and pregnant and lactating women.

hygiene talks.[16] Secondly, in order to receive the education transfer, children in eligible households must register in one of the subsidy-eligible school grades (3 to 12), and ensure a monthly attendance rate of 85% of school days.[17] Program rules allow children to fail each grade once, but the education benefits are suspended permanently if a student repeats a grade more than once. After three years of enrollment in *Oportunidades*, beneficiary families participate in a re-interview process either to renew their beneficiary status or to transfer the family into a scheme of partial benefits.[18]

3 An empirical model of participation in *Oportunidades*

3.1 The participation decision of the poor

According to the National Council for the Evaluation of Social Development Policy of Mexico (CONEVAL), in 2006 the capacity poverty line was MX$707.69 per month for a single individual in rural areas (about US$64 or PPP$98), and MX$993.31 per month for a single individual in urban areas (about US$90 or PPP$138).[19] For the period of July-December of 2006, the monthly nutrition subsidy of *Oportunidades* was MX$180 (about US$16 or PPP$25), which is well below the poverty line.[20] Table 1 details the monthly education transfer valid only for the school calendar year (ten months). As depicted in this table, the *Oportunidades* benefits increase with school grade. The transfer is slightly higher for female pupils enrolled in lower and upper secondary school.[21] There is also a once per year transfer to purchase school supplies in the amount of MX$240 for children enrolled in primary school, MX$295 for children attending lower secondary school, and MX$300 for

[16] Families set up a schedule of health appointments for all household members for the year. The health center officials have the responsibility to verify attendance.
[17] School officials are responsible to certify registration and attendance, and report it to proper federal authorities.
[18] *Esquema Diferenciado de Apoyos* (EDA), which includes the education component for students in lower and upper secondary school, but excludes the nutrition and education subsidies for students in primary school.
[19] The capacity poverty line represents the disposable income necessary to acquire a basic food basket and cover health and education expenses. Poverty lines in Mexican pesos (MX$) of August 2006.
[20] Sources: *Oportunidades* transfer size, SEDESOL (2007); real exchange rate, Banco de Mexico (2006), and; estimates for Purchasing Power Parities, OECD (2009).
[21] Higher grants for girls were originally motivated by the fact that in rural areas girls tend to have a higher dropout rate than boys after finishing primary school.

pupils in upper secondary school. Table 2 shows the maximum monthly transfer an eligible family could receive.[22] If the household has more than one child, and at least one of them is enrolled in upper secondary education, the eligible family may receive a maximum subsidy of MX$1,855 per month; otherwise the maximum transfer must be MX$1,095 for both the nutrition and the education components. Finally, families with elderly members may receive extra MX$250 on the maximum transfer.

If utility maximization holds, a household must participate in the CCT program when the utility associated with receiving the cash transfer, minus the cost of fulfilling the condition, is greater than the utility derived from non-participation. To help in providing a discrete dependent variable model, let us consider a single period model of a parent's investment in education. For purposes of this study, I work with a "representative child" and so ignore issues of intra-household inequality in education. Parents are treated as individuals in that they are assumed to maximize a single utility function and face a budget constraint based on their joint income. The preferences of the parents in household i is represented by a utility function

$$U_i = U(x_{i1}, x_{i2}, a_{i1}, a_{i2}) \tag{1}$$

where $U(\cdot)$ is a quasi-concave and continuous function representing a strongly monotone preference relation defined on the consumption of the bundle (x_{i1}, x_{i2}), so that x_{i1} and x_{i2} are normal goods and denote the demand for schooling and the consumption of a composite good, respectively. The parameters a_{i1} and a_{i2} represent the parents' preference for schooling and all other goods.

The parents maximize U_i subject to the budget constraint

$$p_1 x_{i1} + p_2 x_{i2} \leq y_i \tag{2}$$

where y_i denotes household i's income, p_1 represents the cost of schooling, and p_2 is the price of the composite good. Assuming an interior optimum, combining the first-order conditions

[22] This upper limit is intended to mitigate any incentive the program might provide for parents to have additional children.

$$\frac{\partial U(x_{i1}, x_{i1}, a_{i1}, a_{i2})/\partial x_{i1}}{\partial U(x_{i1}, x_{i1}, a_{i1}, a_{i2})/\partial x_{i2}} = \frac{p_1}{p_2} = p. \quad (3)$$

Equation (3) establishes that household i's marginal rate of substitution between schooling and the composite good must be equal to the relative price of schooling, p.

After solving for household i's demand for schooling, I get a function x_{i1}^* that is increasing in income and parent's preferences, and decreasing in the relative price of schooling

$$x_{i1}^* = x_1(y_i, a_{i1}, a_{i2}, p). \quad (4)$$

Now assume that the household i is offered a cash transfer t_i, conditional upon consuming a schooling quantity greater than or equal to $\bar{x}_1$ (determined by the government, and usually requiring a monthly attendance rate of 85% of school days). The parents maximize equation U_i subject to a new budget constraint

$$p_1 x_{i1} + p_2 x_{i2} \leq y_i \qquad \text{if } x_{i1}^* < \bar{x}_1 \quad (5)$$

$$p_1 x_{i1} + p_2 x_{i2} \leq y_i + t_i \qquad \text{if } x_{i1}^* \geq \bar{x}_1. \quad (6)$$

So, when the household i's demand for schooling exceeds the minimum required for the CCT program rules, the new demand for schooling will be an increasing function of the transfer

$$x_{i1}^* = x_1(y_i, a_{i1}, a_{i2}, p, t_i). \quad (7)$$

Thus, the decision of the parents in household i to send their child to school in response to the conditional transfer depends on the utility derived from participation. Parents in household i choose to enroll in the CCT program if the difference between the utility of participation and non-participation defined as ΔV_i^*, is greater than zero.[23] This difference depends on the pre-transfer income, y_i, the expected cash transfer, t_i, the relative price of schooling, p_i, and other

[23] Where V_i^* is a continuous but unobservable response variable often defined in the literature as 'latent' utility function.

characteristics which might independently affect participation, X_i (e.g. economic status and parent's preferences). Thus

$$\Delta V_i^* = V(y_i, t_i, p_i, X_i) \tag{8}$$

where ΔV_i^* is not directly observed, and one only observes the final decision of participation, V_i, which is an indicator variable equal to 1 if the household participates in the CCT program and zero if it does not, therefore

$$V_i = \begin{cases} 1 & if \quad \Delta V_i^* > 0 \\ 0 & otherwise. \end{cases} \tag{9}$$

3.2 The data: The Mexican Household Income and Expenditure Survey

The data analyzed in this paper comes from the 2006 cross-section of the Survey of Household Income and Expenditure (ENIGH) conducted by the National Institute of Statistics and Geography of Mexico (INEGI).[24] This data set, a longitudinal survey at the household level, is nationally representative, for rural and urban areas.

The ENIGH reports both monthly household income and expenditures. The analysis uses the *per capita* current disposable expenditure (monetary and non-monetary) to determine whether a household is poor or not.[25] Moreover, the ENIGH includes information on the characteristics of the family members that allows me to indentify every eligible school-age child in each household. This information comprises the number of children in each family, their age and gender, the exact school

[24] The ENIGH data is available at http://www.inegi.org.mx/. Although the data from the 2008 ENIGH is presently available, I use the 2006 data in order to merge it with more contemporary data on community marginality (only available for 2005).

[25] The empirical analysis uses an expenditure-based measure instead of an income-based measure since, as noted by Sahn and Stifel (2003), "The choice of expenditures over income is dictated by a variety of difficulties involved in measuring income in developing countries, including the seasonal variability in such earnings, and the large shares of income in developing countries that are from self-employment both in and outside of agriculture."

grade they were attending, and whether or not they received the *Oportunidades* education transfer in the school period 2005-2006. This allows me to recover accurately the total monetary transfer that each household received according to the *Oportunidades* program's rules (from Tables 1 and 2). Thus, I can generate household-specific estimates of pre-transfer expenditure, and then identify those households with a pre-transfer *per capita* expenditure less than or equal to the poverty line.

This data set contains comprehensive information on family owned assets. Although asset information is necessary to construct the marginality index (*puntaje*) that ultimately determines eligibility, the information to recover this asset index is not completely available in this data set. However, since the objective of this paper is to estimate the participation of poor households in CCTs rather than the participation of eligible households, I construct a proxy of the marginality index to confirm that the poorest households in the data are precisely those with an asset index score below certain cutoff point. The ENIGH also provides rich information on adult members' characteristics that include years of education, labor income, migration and marital status.

The ENIGH data is complemented with useful information from the Survey on Household Socioeconomic Characteristics (ENCASEH) conducted by SEDESOL that allows me to identify those communities in which the *Oportunidades* program was available during 2005. This data set also contains information on the total years of availability of *Oportunidades* at the community level, as well as distances from the center of the community to the closest schools and health center. In addition, I merge these data with the 2005 Community Marginality Index published by the National Council of Population in Mexico (CONAPO), and with the 2006 Survey on Characteristics of Primary and Secondary Schools (Formato 911) produced by the Mexican Ministry of Education (SEP), which includes a rich set of school- and teacher-quality variables.

The analysis focuses on the rural sub-sample for a number of reasons. First, as discussed in the description of the *Oportunidades* program in Section 2, the screening process of *Oportunidades* in rural communities provided more accurate information to each household about its own eligibility status with respect to the urban program. Second, the targeting process, based on advertisement and

sign-up offices adopted in urban areas, included an element of self-selection, which caused a large number of families who met the eligibility criteria not to apply for enrollment in the program. By focusing on rural areas I circumvent this element of potential bias from my analysis. Finally, studying the effects of household income on CCTs participation solely for rural areas is relevant, since the poverty headcount ratio and other more sensitive measures of poverty and inequality are larger and more concentrated in rural communities in Mexico. It is precisely in rural areas where the vast majority of the resources for the *Oportunidades* program are used.

From an initial sampling size of 20,875 households in 946 communities, I include only those households I determine to be poor and eligible to receive the *Oportunidades* educational transfer. The first condition of eligibility is that a family must be living in a rural community where *Oportunidades* was available in December of 2005. The second condition stipulates that a family has at least one child of eligible school-age (between 8 and 20 years old) and an asset index score below an arbitrary threshold. To be included in the sample I also require household pre-transfer *per capita* expenditure to be under the poverty line for rural areas. The remaining sample consists of 1,478 poor households living in 382 communities, of which 1,025 were recipients of *Oportunidades*.[26]

The data only report whether or not pupils received the *Oportunidades* education transfer in the school period 2005-2006. Using information on the characteristics of the household members, I calculate expected monetary education transfers to which each poor household is entitled under program rules (following Tables 1 and 2). However, the data do not indicate whether or not the household received the nutrition subsidy. According to the rules of operation of the *Oportunidades* program, those beneficiary families receiving the education transfer may also receive the food subsidy.

To calculate the expected monetary transfer, I assume that all households who reported in ENIGH that they received the education transfer also received the nutrition transfer. The mean

[26] Since the determination program eligibility and poverty is based on a number of assumptions and relies on the accuracy of reported expenditure, this classification is subject to error. Later in this paper I address this potential source of bias.

calculated expected transfer is MX$857.39 for participants and MX$439.38 for non-participants. This difference is consistent with the hypothesis that those with higher expected transfers are more likely to participate than those with lower expected benefits. The mean calculated actual transfer is MX$794.69 for participants and zero for non-participants. The difference between reported household's expenditures and the actual transfer is defined as pre-transfer expenditure. Thus, when estimating the participation model, I use both the expected value of benefits and the pre-transfer expenditure for both program participants and non-participants.

Figures 1 and 2 plot the smoothed density function using a Gaussian kernel of the distribution of monthly pre-transfer household expenditure and monthly pre-transfer *per capita* expenditure, respectively, for both participant and non-participant poor households in *Oportunidades*. Since the density (and the mean) of the non-participant group, in the case of the monthly pre-transfer *per capita* expenditure, is noticeably to the left of the density of the participant group, the absolute poverty is greater in the participant cohort. However, the empirical analysis focuses on household expenditure rather than on *per capita* expenditure given the presence of scale economies within households.[27]

Poor households which participate in *Oportunidades* may also have a substantial disparity in their relative economic well-being. Similarly, we should also expect poor families to have heterogeneous preferences over schooling and other goods. Thus, the utility derived from a given CCT may differ widely across poor families. To account for this difference in the empirical estimation, I include a set of variables which are indicators of both economic status and parents' preferences. On one hand, as proxies for economic status I use dummy variables including ownership of a car and a dwelling with a dirt floor, as well as the ratio of the pre-transfer *per capita* expenditure of the household to the poverty line. On the other hand, to account for parents' preferences I include parents' years of schooling, the ratio of income spent in education, school- and teacher-quality variables, and a dummy variable for access to a particular type of public health provider. In particular,

[27] Household scale economies may be credited to shared household public goods which make larger households better off at the same level of *per capita* resources.

the vector of variables of school-quality contains class size, repetition rate, failure rate, pupil-teacher ratio and pupil-classroom ratio. The teacher-quality variables include the ratio of teachers with a professional degree or higher to the total number of teachers, and a dummy variable that indicates whether or not the director of the school has professional degree or higher.

Poor families who participate in the CCT program may also incur a number of costs. Ideally one would observe all these costs. To account for direct costs I use cost of schooling and distances from the center of the community to the closest schools and health center. In addition, holding everything else constant, if households do not participate because the application process itself is too complicated, then those with more years of schooling might be more likely to participate. It is also possible that households who are beneficiaries of other social protection programs (e.g. *Seguro Popular*) may be better acquainted with the type of bureaucratic procedures involved, and therefore more likely to enroll. As proxies for opportunity costs I use indicator variables for both child work and migration.

Descriptive statistics of the variables used in this study are reported in Tables 3 and 4. The values are reported for the complete sample of poor households and for participants and non-participants. There are non-trivial differences between the two groups, given that they all have *per capita* expenditures below the poverty line. From Table 3, I cannot reject the null hypothesis that the differences in pre-transfer expenditure have a mean value of zero. In particular, households in the non-participant group have slightly higher than average pre-transfer expenditures. In contrast, I can reject the null hypothesis that the difference in pre-transfer *per capita* expenditure has a mean value of zero. Thus, simple comparison of means based on Table 3 represents an incomplete picture of the relationship between household income and program enrollment.

The data from Table 3 indicate that, relative to the non-participant group, households in the participant group invest more in their children's education, both in absolute and relative terms. Also, relative to the non-participant group, the participant cohort is characterized by larger overall household size, number of eligible school-age children and dependency ratio, as well as a lower

number of out-of-school children.[28] The average number of recipients of *Seguro Popular*, a social protection program that provides low-cost health services to those families without formal social security, is almost twice that of households not participating in the *Oportunidades* program. The beneficiary group also has, on average, more educated parents.

Table 4 presents descriptive statistics for community, school- and teacher-quality variables. At the community level, the marginality index may explain the relationship between participation and regional poverty. This index was used to do the geographic targeting of villages, and according to Table 4, households that participate in the program tend to belong to poorer villages.

With respect to non-participant families, beneficiary families tend to live in communities closer to primary and lower secondary schools but farther away from upper secondary schools and health providers. Among the health centers available in the communities, there are two main providers in the areas covered by *Oportunidades*: the IMSS *Oportunidades* health centers managed by the Institute for Social Security of Mexico (IMSS), and the SSA health centers operated by the Ministry of Public Health of Mexico (SSA) which serve the rural poor in areas not covered by social security. The general belief is that the overall service in health centers operated by IMSS is better, and in the data there are not large differences in health care providers available for the participant and non-participant groups. Finally, those households in the participant group live in communities that have been exposed to *Oportunidades* on average 5 months more than the communities of the non-participant group.

Taken together, these data suggest that variation in pre-transfer household expenditure cannot entirely explain differences in observed program enrollment, since we also observe significant differences in household characteristics, such as dependency ratio and household size, and community characteristics, such as marginality index, school quality, and year of availability of *Oportunidades.* Thus, it is my hypothesis that differences in household pre-transfer expenditure play a

[28] Dependency ratio is defined as the sum of household members aged 0 to 14 and those older than 65 years, divided by the number of members aged 15 to 64.

decisive role in program participation, controlling for household, community, school- and teacher-quality variables.

3.3 Estimation method

The linearization of the participation decision model described in equation (8) can be represented by

$$V_i^* = \alpha y_i + \beta t_i + p_i\theta + X_i\delta + \varepsilon_i \qquad (10)$$

where the parameters α and β, and the vectors of parameters θ and δ represent coefficients to be estimated; ε_i is assumed to be a normally distributed error term, and

$$V_i = \begin{cases} 1 & \text{if} \quad \Delta V_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \qquad (11)$$

where V_i^* is not directly observed; and household income, y_i, the expected cash transfer, t_i, and the proxy variables for the relative price of schooling p_i, and economic status and parents' preferences, X_i, are all observed and listed in Tables 3 and 4.

Thus, the probability of participating in *Oportunidades* can be written as

$$P_i = \Pr(V_i = 1 \mid y_i, t_i, p_i, X_i) = \Pr(\Delta V_i^* > 0) = \Pr(\alpha y_i + \beta t_i + p_i\theta + X_i\delta + \varepsilon_i > 0)$$

$$\Leftrightarrow \Phi(\alpha y_i + \beta t_i + p_i\theta + X_i\delta) = \int_{-\infty}^{\alpha y_i + \beta t_i + p_i\theta + X_i\delta} \phi(s)ds \qquad (12)$$

where the errors are independently distributed according to the unit-normal distribution, i.e. $\varepsilon_i \sim N(0,1)$; and $\phi(s)$ is the probability density associated to the normal distribution function Φ.

The parameter estimates α and β, and the vector of parameters θ and δ are those coefficients that maximize the log-likelihood function:

$$\ln L = \sum_{Y_i=0} \ln\left[1 - \Phi\left(\alpha y_i + \beta t_i + p_i\theta + X_i\delta\right)\right] + \sum_{Y_i=1} \ln \Phi\left(\alpha y_i + \beta t_i + p_i\theta + X_i\delta\right), \qquad (13)$$

and to estimate standard errors, I use the robust asymptotic covariance matrix estimator.[29]

The model in (10) has enough structure to capture the differences in responsiveness to household income, expected cash transfer, and associated costs of participation across households. Later, I investigate non-linear effects of household income on program participation by including higher degree polynomials of income ($\sum_{j=1}^{n} \alpha_j y_i^j$) in this model.

3.4 Discussion of estimation results

Table 5 reports the average marginal effect of each variable on the probability of participating in *Oportunidades*, and whether the variable was statistically significant in the probit model (with robust standard errors in parentheses). I start with a baseline specification that includes both a linear measure of pre-transfer household expenditure and the calculated expected cash transfer. This model is presented in column (1) which controls for a number of standard household and community characteristics that may independently affect participation. Those variables are household size, the dependency ratio, and whether the household head is a single mother; also, years of availability of *Oportunidades* at the community level, and the population and marginality index of the community. The main results in column (1) are comparable to those of previous studies which find that participation is inversely related to household wealth.

The subsequent columns in Table 5 report results for different specifications that include additional independent variables, which according to the participation model described in (10), are key determinants of the households' decision to enroll in CCT programs. In addition, columns (2)-(4) incorporate a second degree polynomial of household expenditure to study a possible non-linear

[29] See McFadden and Train (2000).

relation between participation and household income.[30] Thus, departing from the baseline specification, column (2) includes an additional set of variables which are indicators of economic status. These variables are ownership of a car, having a dwelling with dirt floor, and the *per capita* expenditure to poverty line ratio. Column (3) incorporates additional variables that may account to some extent for parents' preferences for schooling, such as parents' years of schooling, the percentage of investment in education, an indicator for access to particular types of public health providers, and school- and teacher-quality variables.[31]

Column (4) in Table 5 includes proxies for both direct and opportunity costs of participation. I include distances from the center of the community to the closest schools and health care providers as a proxy for direct costs. In addition, I consider dummy variables for child work and migration as measures which might point out (or explain) the effects of opportunity costs. Finally, column (5) is different in that it does not include the squared term of household expenditure to compare its results with those of previous studies which use only a linear term of wealth. In particular, the specification in column (4) is the one that better reproduces and predicts the equation described in (10).[32]

According to column (4), the results show that pre-transfer household's expenditure has a non-monotonic effect on the probability of enrolling in *Oportunidades*. To describe this effect more clearly, Figure 3 plots the predicted probability of participating in *Oportunidades* as a function of expected household income (i.e. pre-transfer income plus the calculated expected cash transfer). This graph shows that the probability of participating in *Oportunidades* increases as income rises until a

[30] The effects of a third degree polynomial of income were tested and were not statistically significant.
[31] Columns (3)-(5) only include lower secondary school- and teacher-quality variables for two reasons: first, because not much precision is gained by incorporating the set of school- and teacher-quality variables for primary school education, and second, because I was unable to match all communities with their closest primary school, and therefore the model loses a quarter of the total observations.
[32] Interactions between the second degree polynomial of household income and other independent variables were tested. In particular, I obtained significant results for interactions between household income and parents' years of education, and household income and a threshold of availability of high-quality schools (and health provider). On one hand, a positive coefficient on the linear income-education interaction supports the common belief that for households with observationally similar levels of poverty, those with higher education are more likely to participate in *Oportunidades*. On the other hand, a positive coefficient on the linear income-availability of high-quality schools (and health provider) suggests that households living in communities with higher-than-average quality schools (and health provider) are more likely to participate in *Oportunidades*.

certain point, and then it declines. The confidence interval becomes more volatile for higher values of expected household expenditure, which may be explained by the fact that those households closer to the poverty line have a higher uncertainty about their eligibility status and so are less likely to participate.

There are several reasons why we might observe a lower probability of participation towards the boundaries of the income distribution of poor households. One explanation is that the targeting mechanism of *Oportunidades* excludes an important number of households which have an asset index close to the *puntaje* cutoff (the rule to determine eligibility status). In addition, according to the formal rules of placement of *Oportunidades*, the subsidy was granted to communities within geographical zones with higher density of marginalization and with some level of availability of schools and health clinics, which may in turn have excluded very poor households from the program. However, this should not be the case in this study since my analysis focuses only on communities where *Oportunidades* was available.

Another explanation for differences in the participation rates for those households closer and further away from the poverty line has to do with both direct and opportunity costs of participating. In deciding whether or not to enroll in the program, families need to compare the total costs of fulfilling the conditions of the program with the overall benefits of receiving the transfer. For those households closer to the poverty line, the opportunity cost of enrolling in *Oportunidades* requires periodic visits to the health center and attendance at public lectures, which may take valuable time away from their productive activity. By contrast, the cost of enrolling in the program for the very poorest families (those farthest from the poverty line) involves less help from their children in the running of the household. Furthermore, there are important direct costs associated with meeting the conditions of the program (both education and health conditions). One important example is transport costs, given that there is limited access to roads and public transportation in rural areas of Mexico.

What appears to be the most important reason why the very poorest households do not enroll in CCT programs is that the conditionality is imposed on the consumption of normal goods — richer

households are more likely to avail themselves of education and health care than poorer households. Accordingly, very poor families with a significantly lower level of income and/or weak preferences for the schooling level of their children will have very few incentives to participate in the program, even though they are certain about their eligibility status.

The results in column (4) also confirm the hypothesis that a higher expected amount of the cash transfer entitled to each household increases the probability of participating in *Oportunidades*. The coefficient for household size is negative, while the coefficient for dependency ratio is positive and statistically significant, implying that families with more dependants have a higher probability to enroll in *Oportunidades.* Measures of a relative better economic status, such as ownership of a car, and the ratio of income to poverty line have a negative effect on program enrollment. Households in less populated communities with a larger period of exposure to the *Oportunidades* program are more likely to participate. The coefficients for distances measured in kilometers from the center of the community are mixed and not statistically significant. Finally, those households which are beneficiaries of *Seguro Popular* have a greater probability of enrolling in the program. This may occur because the government often requires those families enrolled in *Oportunidades* to participate in other social protection programs.

Similar results to those in column (4) are obtained when estimating the model with only the linear term of household income, however the coefficient for pre-transfer household expenditure has a small positive magnitude, and it is not statistically significant.

3.5 Robustness tests

The main results from the participation model are robust to household expenditure when studying solely the subsample of extremely poor families. Appendix A summarizes and discusses these results in more detail.

Since the determination of poverty status and the calculation of the expected CCT designated for each household were based on a number of assumptions and were calculated on the accuracy of

reported households' characteristics and income, this classification is likely to contain a non-trivial amount of error. Thus, to confirm the finding that participation rates are significantly lower for the very poorest households, I must deal with the existence of measurement error. This potential source of bias is addressed by using variables that are directly related to the determination of the subsidy (according to the official program rules) as instruments for the calculated actual CCT. These variables, which must be uncorrelated with current error, include number of children, their age and gender, and the exact school grade they were attending.

Using a first-stage OLS regression, I predict the value of the actual CCT. I use this value to calculate pre-transfer *per capita* expenditure in order to determine predicted poverty status. The group of families predicted as poor in the first-stage regression agree well with the group of households originally calculated as poor. Particularly, 1,453 households reported as predicted poor where originally calculated as poor households, while 84 households reported as predicted poor are not matched in the group of originally calculated poor households. In addition, there are 25 households originally calculated as poor who were not identified as poor households. Departing from this predicted classification of poor households and using the predicted value of pre-transfer household expenditure, I estimate a two-stage probit model of equation (10) and present its results in Table 6. Since the estimated coefficients of the second-stage regression in Table 6 have the same signs as the coefficients in column (4) of Table 5, the main finding of a non-monotonic (and concave) relationship between household income and CCT program participation holds, and therefore it is not explained by measurement error.

3.6 Comparison with previous studies

This subsection highlights the main differences of my findings with respect to the previous literature concerning the effects of household wealth on participation in anti-poverty programs for developing countries. My econometric analysis suggests that it is important to model the relationship between household wealth and program participation non-linearly, and to include controls for the costs and

benefits of meeting the conditions imposed by CCT programs, particularly the explicit inclusion of cost of schooling and school- and teacher-quality variables when estimating the model in (10).

Earlier studies on the determinants of participation in anti-poverty programs have focused on public-works programs. There is strong empirical evidence confirming a negative relationship between household wealth and participation in these programs (see for example, Gaiha, 1996; Jalan and Ravallion, 1999; Chirwa *et al.*, 2002). But this negative association is driven by the design of the workfare programs which were are aimed to self-select unemployed workers from poor families.

More recently, a number of studies have argued that poverty is associated with a higher probability of participating in CCTs. Heinrich (2007) presents evidence of the positive effects of the Argentina's *Becas Estudiantiles* CCT program on students' outcomes. In her first-stage regression she finds that those students from families with a *per capita* income below a threshold of 45 pesos per month were significantly more likely to participate. However, after controlling for an index of need, she finds that students from families with lower *per capita* incomes were less likely to participate in the CCT program, a result which is in line with my main finding.[33] In a related study, Oosterbeek *et al.* (2008) analyze the impact of Ecuador's *Bono de Desarrolo Humano* CCT program on school enrollment. They report the results of a regression of actual treatment status on background characteristics, finding that poorer people are more likely to receive the transfer. Interestingly, they incorporate a third degree polynomial of the poverty index in the children's outcomes estimation, but they only use the linear poverty index in the regression of actual treatment.

Two recent studies using the Urban Evaluation Survey of *Oportunidades* (Encelurb) investigate the extent to which the urban component of *Oportunidades* affects children's outcomes and household consumption. Angelucci and Attanasio (2009) estimate a linear probability model of program participation for eligible households in treatment areas which incorporates second degree

[33] Heinrich (2007) constructed an index of need using 20 measures from base data that include: dependents; household head occupation; household head pregnant; type of home/tenancy/living conditions; distance to school; years of education of all household members; student hours worked outside/inside home; student age-grade difference; illness or disability; and family income.

polynomials for the poverty level as well as household income and consumption variables. They find that a household in the 75th percentile of the poverty distribution is 69% more likely to be a program participant than a household in the 25th percentile. They also conclude that participation is inversely related to both consumption and income. In addition to data on household income, consumption, and poverty level, their model includes information on transitory shocks and local availability of schools and health centers. However, their model has some data limitations since it does not include key determinants of the household's decision to participate in *Oportunidades,* such as proxies for the relative price of schooling, parents' preferences, and opportunity costs of participating. Although their results are contrary to the findings presented in this paper, they conclude that the observed low participation rate in the urban component of *Oportunidades* may be due to self-selection caused by both insufficient information and inadequate financial incentives, and that "further research to estimate the relative importance of these determinants is needed." Finally, it is unclear why their participation model includes in the same regression measures of poverty level, food and nonfood consumption and income, instead of estimating different models using each of these measures of household well-being.

In the other study that uses the urban component of *Oportunidades*, Behrman *et al.* (2010) estimate a first-stage discrete choice model of participation. Their results show that key correlates of poverty, such as dirt floor, walls or ceilings made of provisional materials, and the need for certain assets, increase the probability of participation in *Oportunidades*. However, besides having access to a rich set of household and community characteristics, their model neither concentrates the information into one sole poverty index nor incorporates any second or third degree polynomials of household wealth. In addition, their participation model does not control for costs of schooling and school- and teacher quality variables.

Closer to my analysis are Alvarez *et al.* (2008) and González-Flores *et al.* (2010) who, using discrete duration models, show a u-shaped relationship between the probability of dropping out of *Oportunidades* and a poverty index score (*puntaje*). Alvarez *et al.* (2008) find that the likelihood of a

household's leaving the *Oportunidades* program in rural areas is the highest for relatively wealthier recipients; it declines at diminishing rates as wealth decreases, and it increases again at the poorer end of the distribution. Correspondingly, González-Flores *et al.* (2010) study the determinants of the probability of dropping out from the *Oportunidades* program in urban areas. In line with my main finding, they show that the very poorest recipients, those below the 70th percentile of the poverty index score distribution, are more likely to dropout. Although their studies assess the determinants of dropouts in *Oportunidades* as a function of an asset-based measure instead of the determinants of participation as a function of an expenditure-based measure, my findings are consistent with those of Alvarez *et al.* (2008) and González-Flores *et al.* (2010).

The analysis in this paper adds to the existing literature in a number of ways. Explicit inclusion of higher degree polynomials of household income in the current paper allows me to identify a non-monotonic (and concave) relationship between participation in the *Oportunidades* program and household income. In particular, when income for eligible families is either too small or too close to the poverty line, the probability of participation in the CCT program is lower than for intermediate levels of income. This study takes advantage of comprehensive data from the ENIGH Survey from Mexico, a nationally representative sample for rural communities, which enhance the external validity and economic relevance of my findings. In addition, the ENIGH data is enhanced by information which includes distances from the center of the community to the closest schools, and school- and teacher-quality variables. I am able then to estimate a discrete choice model of program participation while controlling for a set of covariates that are key determinants of program enrollment decisions. This contrasts with previous studies that model the participation decision of the poor in CCT programs unable to control adequately for proxies for the relative price of schooling, parent's preferences, and opportunity costs of participating. As a result, they may suffer from omitted variable bias.

4 Policy implications

To investigate the broader policy implications of the above empirical findings, I develop a model representing household decision-making in order to identify conditions under which CCTs dominate Unconditional Cash Transfers (UCTs), and vice-versa, for several commonly used poverty measures that take into account the intensity and severity of poverty.

4.1 Household decision making

Assume the utility of the parents in household i discussed in Section 3 is represented by a log-linear utility function. Then, the expenditure in schooling when the household demands an amount of education that is greater, or equal to, the CCT schooling condition $\bar{x}_1$ is $x_{i1}^* = (a_1 y_i)/p_1$, i.e. a constant fraction of wealth given any cost of schooling. The expenditure in schooling when the condition is met becomes $x_{i1}^* = a_1 \cdot (y_i + t)/p_1$, i.e. a constant proportion of the income plus the flat transfer for any cost of schooling.

Following King (1983), I calculate the equivalent income function of the CCT scheme to identify the threshold value that defines whether or not parents' demand for schooling exceeds the CCT schooling condition, and then receives the cash transfer. First, I normalize to one the cost of schooling, and then the price of good x_2 is defined as p. Then, I compare the indirect utility functions of the expenditure minimizing commodity bundle that provides the same level of utility as the utility received from the subsidized commodity bundle

$$v_i(p, y_i^E) = \left(a_1 y_i^E\right)^{a_1} \left(\frac{a_2 y_i^E}{p}\right)^{a_2} \tag{14}$$

$$v_i(p, y_i) = \left(\bar{x}_1\right)^{a_1} \left(\frac{y_i + t - \bar{x}_1}{p}\right)^{a_2} \tag{15}$$

where y_i^E denotes equivalent income. Equalizing (14) and (15) gives the equivalent income function of household i, which is the value of income that at the CCT schooling condition gives the same utility as the actual income level

$$y_i^E = \frac{1}{a_1^{a_1} \cdot a_2^{a_2}} (\bar{x}_1)^{a_1} (y_i + t - \bar{x}_1)^{a_2}. \quad (16)$$

4.1.1 Threshold value of income that determines the participation decision of the poor

Consider the non-participating choice as the reference point to define the threshold value of wealth, $\hat{y}$, in terms of equivalent income

$$v_i(x_{i1}^* = a_1 \hat{y}) = v_i(x_{i1}^* = \bar{x}_1 = a_1(y_i^E - t)) \Leftrightarrow \hat{y} = y_i^E - t. \quad (17)$$

Since the demand for schooling at the critical value of income is precisely the demand for schooling at the CCT schooling condition, plugging $\bar{x}_1 = a_1 y_i^E$ into (16) produces the threshold level of income that represents the cutoff point between participation and non-participation in the CCTs

$$\hat{y} = \frac{\bar{x}_1}{a_1} - t > 0, \quad 0 > a_1 > 1. \quad (18)$$

Then, household i's demand of schooling in terms of the threshold level of income is

$$x_{i1}^* = \begin{cases} a_1 y_i & if \quad y_i < \dfrac{\bar{x}_1}{a_1} - t \\ a_1(y_i + t_i) & if \quad y_i \geq \dfrac{\bar{x}_1}{a_1} - t. \end{cases} \quad (19)$$

Figure 4 depicts the Engel curve of schooling (x_1) for all households eligible to enroll in a CCT program. The relevant eligibility line is assumed to be equivalent to the poverty line z_y, so the

Engel curve is restricted to the interval of the income distribution $F(y)$ that lies between $\lfloor 0, z_y \rfloor$.[34] Also, Figure 4 portrays both the pre-transfer income associated with the CCT schooling condition, $\tilde{y}$, and the threshold level of income, $\hat{y}$. In particular, a poor household i with an income level greater or equal to the critical value of income will participate in the CCT program and will move from its original Engel curve to a greater Engel curve.

From (18) and (19) it is possible to define the equivalent income distribution in terms of the income distribution, the expected cash transfer, the CCT schooling condition and the parents' preferences for schooling (Figure 5)

$$y^E = \begin{cases} y & if \quad y_i < \dfrac{\bar{x}_1}{a_1} - t \\ \\ y + t & if \quad y_i < \dfrac{\bar{x}_1}{a_1} - t. \end{cases} \tag{20}$$

4.1.2 Participation rate of the eligible poorest households

Assume a continuous income distribution that lies between $[0, \infty)$ with an associated density function $f(y)$ and a poverty line defined by z_y. The poverty ratio in the economy is defined as

$$P_0 = \int_0^{z_y} f(y)dy = \frac{q}{I} \tag{21}$$

where is q the number of poor households and I is the total number of households in the economy. Moreover, using the threshold condition from (18), the participation rate in the CCT program for the eligible poor households in the economy is defined as

[34]The eligibility line z_y defined over the income space is induced from an implicit eligibility line z_A defined in the asset distribution. Recall that most of the screening mechanisms of CCT programs give an important weight to their eligibility criteria to indices derived by factor analysis on household assets. According to Sahn and Stifel (2003), such asset-based indices are considered valid predictors of poverty, and represent an alternative to the standard use of expenditures in defining well-being. This is particularly applicable to poor regions where there is limited capacity to collect consumption, expenditure and price data.

$$Q_0 = \int_{\hat{y}}^{z_y} f(y)dy = \frac{r}{q} \qquad (22)$$

where r is the number of poor households with income greater to the critical value of income, $\hat{y}$.

Since both Q_0 and $\partial f(y)/\partial \bar{x}_1$ are continuous in y and $\bar{x}_1$, and since both $\hat{y} = (x_1/a_1) - t$ and z_y are continuous in $\bar{x}_1$ and both have continuous derivatives for $0 \leq \bar{x}_1 \leq a_1 t$. The, using the Leibniz Integral rule for $0 \leq \bar{x}_1 \leq a_1 t$

$$\frac{dQ_0}{d\bar{x}_1} = \left(\frac{\partial Q_0}{\partial z_y}\right)\frac{dz_y}{d\bar{x}_1} + \left(\frac{\partial Q_0}{\partial \hat{y}}\right)\frac{d\hat{y}}{d\bar{x}_1} + \int_{\hat{y}}^{z_y} \frac{\partial}{\partial \bar{x}_1} f(y)dy = \left(\frac{\partial Q_0}{\partial \hat{y}}\right)\frac{1}{a_1} < 0 \qquad (23)$$

since $\partial Q_0/\partial \hat{y} < 0$ and $a_1 > 0$. This result implies that given a condition over the consumption of a normal good (education) and assuming a fixed budget, the government has to impose a sufficiently low CCT schooling condition to grant the transfer in order to increase the participation rates of the very poorest households.

4.2 Distributional effects of cash transfers

To assess and compare the distributional effects of CCT programs with respect to an alternative transfer scheme, I first address the issue of endogenous transfer, and then I select a metric to make meaningful comparisons in terms of poverty reduction and attainment of a CCT schooling condition.

4.2.1 The equilibrium transfer size

To this point, I have treated the size of the transfer as exogenous. However, given a fixed budget, the equilibrium transfer size depends upon the total number of beneficiary families. So it is a function of the threshold value of income which in turn is a function of the transfer size.

Before implementing a standard CCT scheme, the policymaker must choose a poverty line, z_y, a CCT schooling condition, $\bar{x}_1$, and a fixed budget to operate the program, B, which is

characterized by the triple $(z_y, \bar{x}_1, \mathrm{B})$ that uniquely determines the threshold value of income and the participation rate in the CCT program.[35]

Let a cash transfer $t(z_y, \hat{y}, \mathrm{B})$ be a function of the critical value of income defined in (18); and conversely, define the threshold level of income, $\hat{y}(\bar{x}_1, t)$, as a function of the cash transfer of size t. Then $t(z_y, \hat{y}, \mathrm{B})$ should be treated as a fixed amount equal to τ, such that (18) becomes

$$\hat{y}(\tau, \bar{x}_1) = \frac{\bar{x}_1}{a_1} - \tau. \qquad (24)$$

For tractability, consider a uniform income distribution for all eligible poor households on the interval $[0, z_y]$ with $F(\hat{y}) = (\hat{y} / z_y)$ and $F(z_y) = 1$. Combining both $F(\hat{y})$ and $F(z_y)$ with a fixed budget B, the number of poor households q, and the threshold value of income defined in (24), I solve for τ:

$$\tau = \frac{\mathrm{B}}{q[F(z_y) - F(\hat{y})]} = \frac{\mathrm{B} \cdot z_y}{q\left(z_y - \frac{\bar{x}_1}{a_1} + \tau\right)}$$

$$\Leftrightarrow \tau^2 + \tau \cdot \left(z_y - \frac{\bar{x}_1}{a_1}\right) - \left(\frac{\mathrm{B} \cdot z_y}{q}\right) = 0. \qquad (25)$$

Thus, the equilibrium threshold value of income, $\hat{y}$, is obtained from substituting the τ that solves (25) into (24); and subsequently, the equilibrium transfer size is

$$\hat{t}(z_y, \bar{x}_1, \mathrm{B}) = -\frac{1}{2}\left(z_y - \frac{\bar{x}_1}{a_1}\right) + \frac{1}{2}\left[\left(z_y - \frac{\bar{x}_1}{a_1}\right)^2 + 4\left(\frac{\mathrm{B} \cdot z_y}{q}\right)\right]^{\frac{1}{2}}. \qquad (26)$$

From (26), I calculate the following comparative static results

[35] It is assumed that the government's budget B has an upper-bound in $(\bar{x}_1 \cdot z_y) / a_1$ and a lower-bound on zero, otherwise the problem becomes trivial. This implies that the cash transfer cannot exceed an amount $\bar{x}_1 / a_1$, otherwise all poor households will participate in the program and would no longer be under the poverty line.

$$\frac{\partial \hat{t}}{\partial z_y} < 0, \tag{27}$$

$$\frac{\partial \hat{t}}{\partial \overline{x}_1} > 0, \tag{28}$$

$$\frac{\partial \hat{t}}{\partial \mathrm{B}} > 0. \tag{29}$$

Holding everything else constant, the relationship in (27) predicts a decline in the equilibrium size of the transfer as the government expands the eligibility criteria for the program. The thought behind this result is that a larger pool of potential recipients will reduce the average size of the subsidy given a fixed budget. The result from (28) implies an increase in the equilibrium transfer size as the government chooses a higher CCT schooling condition to grant the subsidy. It is reasonable to assume that, given a fixed budget, a greater number of eligible poor households would fall short of the mandatory education requirement if the policymaker raises the CCT schooling. Since schooling is a normal good, the average transfer size will be larger for those poor families still demanding a quantity of schooling greater than the CCT schooling condition. Finally, as expected, the association in (29) shows that the equilibrium transfer size is an increasing function of government spending.

4.2.2 Measuring poverty

I choose the Foster-Greer-Thorbecke (FGT) Index that consists of a class of poverty measures which satisfy both the monotonicity and transfer axioms proposed by Sen (1976) and the decomposability property, to conduct meaningful comparisons between a CCT program and an unconditional cash transfer (UCT) scheme. In general, the FGT Index (also known as the P_α measure) can aggregate information on poor households below certain income threshold conditions. It also can represent several commonly used poverty metrics that take into account the intensity and severity of poverty, and it has the property of subgroup decomposability.

The FGT Index estimates the weighted sum of the poverty gap ratios of a group of observations under an arbitrary poverty line, and includes a parameter α that measures the sensitivity of the income distribution within those observations. Assuming a continuous income distribution that lies between $[0,\infty)$, the FGT Index can be represented as

$$P_\alpha = \int_0^{z_y} \left(\frac{z_y - y_i}{z_y} \right)^\alpha f(y)dy\,,\ \alpha \geq 0. \qquad (30)$$

The FGT Index represented in (30) groups several commonly used poverty indices as special cases. In particular, when $\alpha = 0$, this index becomes the head count ratio. This metric represents the number of households under the poverty line but fails to capture the extent to which each household income fails below the poverty line. When $\alpha = 1$, this index becomes the income-gap ratio for the mean poor income. This ratio measures the total shortfall of the poor households with respect to the poverty line. However, the income-gap ratio is not sensitive to the distribution of income among the poor. When $\alpha = 2$, the FGT Index becomes the square income-gap ratio. This index computes the severity of poverty more accurately, since it represents the square income-gap ratio for the mean poor income. In this form, the index incorporates information on both poverty and income inequality among the poor households. Higher order classes of poverty indices can be derived as α becomes larger. Finally, as $\alpha \to \infty$ the FGT family of poverty measures tends to a Rawlsian social welfare function, i.e. the index depends only on the welfare of the poorest household in the population.

4.2.3 Conditional versus unconditional cash transfers

To conduct the comparison of the distributional effects for different levels of poverty aversion of a CCT program with respect to an unconditional cash transfers (UCT) intervention, I continue to focus on schooling as the conditioned-on good. Particularly, I am interested in calculating the optimal conditioning of schooling, $\bar{x}_1^*$, that minimizes the P_α measure subject to a fixed budget of size B and the equilibrium transfer size defined in (26). In particular, I address the question: could unconditional

cash transfers (UCTs) be superior to CCTs if the objective of the government is to minimize income poverty for different measures of aversion to the severity of poverty? (i.e. for different values of parameter $\alpha \geq 0$).

Consider the problem

$$\min_{\{\bar{x}_1 \geq 0\}} \left[P_\alpha = \int_0^{z_y} \left(\frac{z^E - y^E}{z^E} \right)^\alpha f(y) dy \right] \tag{31}$$

$$s.t. \quad \hat{t}\left(z_y, \bar{x}_1, \mathrm{B}\right) = -\frac{1}{2}\left(z_y - \frac{\bar{x}_1}{a_1} \right) + \frac{1}{2}\left[\left(z_y - \frac{\bar{x}_1}{a_1} \right)^2 + 4\left(\frac{\mathrm{B} \cdot z_y}{q} \right) \right]^{\frac{1}{2}}$$

where z^E is the poverty line in the equivalent income space.

When $\alpha = 0$ and there is a uniform distribution of income for all eligible poor households on the interval $[0, z_y]$, such that $F(z_y - \hat{t}) = \left(z_y - \hat{t} / z_y\right)$, the problem (31) becomes

$$\min_{\{\bar{x}_1 \geq 0\}} \left[P_0 = \int_0^{z_y - \hat{t}} f(y) dy \right] \Leftrightarrow \min_{\{\bar{x}_1 \geq 0\}} \left[P_0 = \frac{z_y - \hat{t}}{z_y} \right]. \tag{32}$$

Taking the derivative of poverty headcount ratio with respect to the CCT schooling condition yields

$$\frac{\partial P_0}{\partial \bar{x}_1} = -\frac{1}{z_y} \cdot \frac{\partial \hat{t}}{\partial \bar{x}_1} = 0. \tag{33}$$

and partial differentiating the equilibrium transfer size with respect to the CCT schooling condition yields

$$\frac{\partial \hat{t}}{\partial \bar{x}_1} = 1 - \frac{\left(z_y - \frac{\bar{x}_1}{a_1} \right)}{\left[\left(z_y - \frac{\bar{x}_1}{a_1} \right)^2 + 4\left(\frac{\mathrm{B} \cdot z_y}{q} \right) \right]^{\frac{1}{2}}} > 0. \tag{34}$$

Combining (33) and (34), the optimal CCT schooling condition that minimizes poverty headcount ratio, P_0, is

$$\bar{x}_1^* = a_1 z_y. \tag{35}$$

For comparison, consider a UCTs scheme that transfers a cash benefit of size m to all eligible poor households. Given (35), we can compare the effect on poverty headcount ratio of CCTs with respect to UCTs

$$\int_0^{z_y-\hat{t}} f(y)dy \gtreqless \int_0^{z_{y-m}} f(y)dy \Leftrightarrow \; -t \gtreqless -m. \tag{36}$$

A UCT is a special case of a CCT when the threshold value of income that determines participation is equal to zero. However, in the current example the critical value of income is strictly positive (i.e. $\hat{y} = z_y - \hat{t} > 0$), and so the conditional monetary benefit, $\hat{t}$, is strictly greater than the unconditional subsidy, m, which implies that poverty headcount ratio under a CCT program ($P_{0,CCT}$) will be strictly less than the corresponding poverty headcount ratio under a UCTs intervention ($P_{0,UCT}$). In other words, if the objective of the government is to minimize poverty headcount ratio (i.e. $\alpha = 0$), then CCTs are superior to UCTs. This result is illustrated in Figure 6.

For the case of $\alpha = 1$ (poverty income-gap ratio, P_1), problem (31) becomes

$$\min_{\{\bar{x}_1 \geq 0\}} \left[P_1 = \int_0^{z_y-\hat{t}} \left(\frac{z^E - y^E}{z^E} \right) f(y)dy \right]. \tag{37}$$

Taking the derivative of poverty income-gap ratio with respect to the CCT schooling condition yields

$$\frac{\partial P_1}{\partial \bar{x}_1} = \left[-\frac{1}{z_y} \frac{\partial \hat{t}}{\partial \bar{x}_1} \right] \left[1 - \frac{1}{z^E} \left(\frac{\bar{x}_1}{a_1} - \hat{t} \right) \right]. \tag{38}$$

From substituting the equilibrium transfer described in (26) and the partial derivative of the equilibrium transfer with respect to the CCT condition of schooling in (34) into expression (38), the optimal CCT schooling condition that minimizes P_1 is

$$\bar{x}_1^* = a_1\hat{t}. \tag{39}$$

From (39), the threshold value of income that determines participation is equal to zero at the optimal education condition, which implies that a CCT program is equivalent to a UCT scheme, and thus their corresponding transfer sizes are equivalent (i.e. $t = m$). Moreover, the condition $\bar{x}_1^* < a_1\hat{t}$ is not binding because public schooling is assumed to be a normal good and all eligible poor families receiving the transfer attain or exceed such condition (i.e. poor families allocate a fraction $0 < a_1 < 1$ to spending in education). In terms of the poverty income-gap ratio, if the policymaker sets a condition of schooling strictly greater than the proportion a_1 of the cash transfer, the reduction of the poverty income-gap ratio is always larger under a UCT scheme ($P_{1,UCT}$) relative to a CCT intervention ($P_{1,CCT}$). In general, if the government's objective is to minimize the poverty income-gap ratio (i.e. $\alpha = 1$), then UCTs would dominate CCTs.

According to Figure 7, the government's budget not used effectively to achieve the schooling condition under CCTs is defined by the area of the triangle $(\hat{t}/2)\left[z_y - (\bar{x}_1/a_1) + \hat{t}\right]$, and correspondingly, under a UCT scheme it is characterized by the area $(m/2)\left[z_y - (\bar{x}_1/a_1) + m\right]$; then, since $t > m$, in this particular setting it is better to transfer cash unconditionally.

In general, the result for $\alpha = 1$ holds true for any $\alpha \geq 1$. That is, UCTs could be preferred over CCTs when a government's poverty aversion is high enough.

Moreover, in Appendix B it is shown that these basic arguments carry over from income poverty to "education poverty." In particular, it is shown that UCTs could also be preferable with a sufficiently high degree of "education poverty" aversion (P_α for $\alpha \geq 1$). That is, if the policymaker's

objective is to minimize more distributionally sensitive measures of education expenditure (and schooling) poverty than the headcount ratio, a UCT program should be implemented.

5 Conclusions

Many empirical papers have highlighted the positive effects of CCT programs on education and health outcomes which in turn have raised the popularity of these schemes to the extent that at this point, "there has been a tendency to treat CCT programmes as magic bullets. Once a country has a CCT scheme, it thinks it has dealt with the problem of poverty."[36] However, only a few studies have focused on how the conditioning of the transfer on the consumption of normal goods (typically education and health) imposed by CCTs impacts the participation decision of the poor.

Using detailed cross-sectional data from rural Mexico, I estimate an econometric model of the participation decision of the poorest households in the *Oportunidades* CCT program. Departing from previous studies, I identify a non-monotonic (and concave) relationship between participation in the *Oportunidades* program and household income. I find that the probability of participating in the program is significantly lower for the very poorest households, after controlling for a rich set of variables which might independently affect participation.

Based on these empirical findings, I develop a model representing household decision-making to conduct policy analysis comparing CCTs with Unconditional Cash Transfers (UCTs). In particular, it is shown that UCTs could be preferable with a sufficiently high degree of poverty aversion. It is also shown that these basic arguments carry over from income poverty to "education poverty."

The findings of this paper call for a more nuanced assessment of CCTs than is generally found in the policy literature. Their efficacy in improving health and education outcomes for those who participate is well established. But lower participation among the very poorest, which is

[36] The Economist, July 29, 2010.

predicted by the fact of conditioning on normal goods, should raise concerns, and should raise the question of whether the resources could be alternatively deployed to have a greater impact on poverty.

References

1. Alvarez, C., F. Devoto, and P. Winters (2008). "Why Do Beneficiaries Leave the Safety Net in Mexico? A Study of the Effects of Conditionality on Dropouts," *World Development*, vol. 36(4), pp. 641-658.
2. Angelucci, M. and O. Attanasio (2009). "*Oportunidades* : Program Effects on Consumption, Low Participation, and Methodological Issues," *Economic Development and Cultural Change*, vol. 57(3), pp. 479-506.
3. Attanasio, O., E. Battistin, E. Fitzsimons, A. Mesnard and M. Vera-Hernandez (2005). "How Effective Are Conditional Cash Transfers? Evidence from Colombia." Briefing Note No. 54, London: Institute for Fiscal Studies.
4. Behrman J., P. Sengupta and P. Todd (2005). "Progressing through *Progresa*: An Impact Assessment of a School Subsidy Experiment in Mexico," *Economic Development and Cultural Change*, vol. 54(1), pp. 237-75.
5. Behrman J., S. Parker and P. Todd (2009). "Schooling Impacts of Conditional Cash Transfers on Young Children: Evidence from Mexico," *Economic Development and Cultural Change*, vol. 57(3), pp. 439-477.
6. Behrman J., J. Gallardo-Garcia, S. Parker, P. Todd and V. Velez-Grajales (2010). "How Conditional Cash Transfers Impact Schooling and Work for Children and Youth in Urban Mexico." Unpublished manuscript. University of Pennsylvania.
7. Besley, T. and S. Coate (1992). "Workfare versus Welfare: Incentive Arguments for Work Requirements in Poverty-Alleviation Programs," *American Economic Review*, vol. 82(1), pp. 249-261.
8. Besley, T. and R. Kanbur (1988). "Food Subsidies and Poverty Alleviation," *The Economic Journal*, vol. 98, issue 392, pp. 701-719.

9. Besley, T. and R. Kanbur (1993). "The Principles of Targeting," in (M. Lipton and J. van der Gaag eds.) *Including the Poor. Proceedings of a Symposium Organized by the World Bank and IFPRI*. Washington, D.C.: The World Bank.
10. Blackorby C. and D. Donaldson (1988). "Cash versus Kind, Self-Selection, and Efficient Transfers," *American Economic Review*, vol. 78(4), pp. 691-700.
11. Bourguignon, F., F. Ferreira, and P. Leite (2003). "Conditional Cash Transfers, Schooling, and Child Labor: Micro-Simulating Brazil's *Bolsa Escola*," *World Bank Economic Review*, vol. 17(2), pp. 229-254.
12. Cardoso, E. and A. Souza (2003). "The Impact of Cash Transfers on Child labor and School Attendance in Brazil." Unpublished manuscript. Rio de Janeiro: Instituto de Estudos do Trabalho e Sociedade.
13. Chirwa, E., E. Zgovu and P. Mvula (2002). Participation and Impact of Poverty-Oriented Public Works Projects in Rural Malawi," *Development Policy Review*, vol. 20(2), pp. 159-176.
14. Cronin, F. (1982). "The Household's Decision to Accept or Reject a Conditional Transfer Offer," *Southern Economic Journal*, vol. 49(1), pp. 218-234.
15. Cuhna, J. (2010). "Testing Paternalism: Cash versus In-kind Transfers in Rural Mexico." Unpublished manuscript.
16. Currie, J. (2006). "The Take-Up of Social Benefits," in (Auerbach A., Card, D. and J. Quigley eds.) *Public Policy and the Income Distribution*. New York,: The Russell Sage Foundation.
17. Currie, J and F. Gahvari (2008). "Transfers in Cash and In-Kind: Theory Meets the Data," *Journal of Economic Literature*, vol. 46(2), pp. 333-383.
18. De Janvry, A., and E. Sadoulet (2006). "Making Conditional Cash Transfer Programs More Efficient: Designing for Maximum Effect of the Conditionality," *World Bank Economic Review*, vol. 20(1), pp. 1-29.
19. Fiszbein, A. and N. Schady (2009). "Conditional Cash Transfers: Reducing Present and Future Poverty." Washington, D.C.: The World Bank.

20. Foster, J., J. Greer, and E. Thorbecke (1984). "A Class of Decomposable Poverty Measures," *Econometrica,* vol. 52(3), pp. 761-766.

21. Gaiha, R. (1996). "Wages, Participation and Targeting – The Case of the Employment Guarantee Scheme in India," *Journal of International Development,* vol. 8(6), pp. 785-803.

22. Glewwe, P. and P. Olinto (2004). "Evaluating the Impact of Conditional Cash Transfers on Schooling in Honduras: An Experimental Approach." Unpublished manuscript, University of Minnesota.

23. González-Flores M, M. Heracleous and P. Winters (2010). "Retargeting of Conditional Cash Transfer Programs." Unpublished manuscript. American University.

24. Heinrich, C. (2007). "Demand and Supply-Side Determinants of Conditional Cash Transfer Program Effectiveness," *World Development,* vol. 35(91), pp. 121-143.

25. Jalan, J. and M. Ravallion (1999). "Income Gains to the Poor from Workfare: Estimates for Argentina's *Trabajar* Program." Working Paper No. 2149. Washington, D.C.: The World Bank.

26. King, M. (1983). "Welfare Analysis of Tax Reforms Using Household Data," *Journal of Public Economics,* vol. 21(2), pp. 183-214.

27. León, M. and S. Younger (2007). "Transfer Payments, Mother's Income, and Child Health in Ecuador," *Journal of Development Studies,* vol. 43(6), pp. 1126-143.

28. Maluccio, J. and R. Flores (2005). "Impact Evaluation of a Conditional Cash Transfer Program: The Nicaraguan *Red de Protección Social*." Research Report 141. Washington D.C.: International Food Policy Research Institute.

29. McFadden D. and K. Train (2000). "Mixed MNL Models for Discrete Response," *Journal of Applied Econometrics,* vol. 15(5), pp. 447-470.

30. McGarry, K. (1996). "Determining Participation of the Elderly in Supplemental Security Income," *The Journal of Human Resources,* vol. 31(2), pp.331-358.

31. Moffitt, R. (1983). "An Economic Model of Welfare Stigma," *American Economic Review,* vol. 73(5), pp. 1023-1035.

32. Oosterbeek, H., J. Ponce, and N. Schady (2008). "The Impact of Cash Transfers on School Enrollment: Evidence from Ecuador," Policy Research Working Paper 4645. Washington, D.C.: The World Bank.

33. Riccio, J., N. Dechausay, D. Greenberg, C. Miller, Z. Rucks, and N. Verma (2010). *Toward Reducing Poverty across Generations: Early Findings from New York City's Conditional Cash Transfer program.* Retrieved on March 30, 2010, from www.mdrc.org/publications/549/full.pdf

34. Sahn, D. and D. Stifel (2003). "Exploring Alternative Measures of Welfare in the Absence of Expenditure Data," *Review of Income and Wealth*, vol. 49(4), pp. 463-489.

35. Salanié, B. (2002). *The Economics of Taxation.* Chapter 8. Cambridge, MA: The MIT Press.

36. Schady, N. and M. Araujo (2008). "Cash Transfers, Conditions, and School Enrollment in Ecuador," *Economía*, vol. 8(2), pp. 43-70.

37. Schultz, P. (2004). "School Subsidies for the Poor: Evaluating the Mexican Progresa Poverty Program," *Journal of Development Economics*, vol. 74(1), pp. 199-250.

38. Sen, A. (1976). "Poverty: An Ordinal Approach to Measurement," *Econometrica*, vol. 44(2), pp. 219-231.

39. Todd, P. and K. Wolpin (2006). "Using Experimental Data to Validate a Dynamic Behavioral Model of Child Schooling: Assessing the Impact of a School Subsidy Program in Mexico," *American Economic Review*, vol. 96(5), pp. 1384-417.

Appendix

A Empirical analysis of the participation decision of the extremely poor

Instead of using the capacity poverty line as in the previous analysis, now I use the nutritional poverty line defined by CONEVAL to determine 'extremely' poor status. The nutritional poverty line represents the disposable income necessary to acquire a basic food basket and, as of August of 2006, it was MX$598.70 per month for a single individual in rural areas (about US$54 or PPP$83). Under the nutritional poverty line, the sample for the extremely poor consists of 1,183 households, of which 839 were receiving the *Oportunidades* transfer.[37]

Table A.1 reports the average marginal effect of household expenditure on the probability of enrolling in the CCT program only for the subset of extremely poor families. As in the full sample of poor families, I found a non-linear effect of household income on the probability of enrolling for the extremely poor. Figure A.1 plots the predicted probability of participating in *Oportunidades* as a function of expected household income. This graph illustrates precisely this non-monotonic (and concave) relationship between income and participation in the CCT program. All other reported coefficients are very similar as in the full sample.

B The effect of CCTs on education expenditure (and schooling): conditional versus unconditional cash

In this Appendix I address the question: could UCTs be superior to CCTs if the objective of the government is to minimize education expenditure (and schooling) poverty for different measures of the severity of poverty (represented by the parameter $\alpha \geq 0$ in the FGT Index)? Since the relative price of schooling was normalized to one, in the subsequent analysis, the value and distribution of education expenditure is equivalent to the value and distribution of education for all poor families.

[37] Since the determination program eligibility and poverty is based on a number of assumptions and relies on the accuracy of reported expenditure, this classification is subject to error. Explanations of the sources of this error are provided later on.

This implies that the results of the comparison between UCTs and CCTs for the distributional effects of education expenditure will hold true for the distributional effects of the demand of schooling.

To compare the distributional effects of CCTs with respect to UCTs, I use the definition of the threshold value of income described in (18) and the income distribution in terms of equivalent income from (20) to define the equivalent education expenditure function of poor families

$$x_1^E = \begin{cases} x_1, & x_1 < \bar{x}_1 - a_1 t \\ x_1 + t, & x_1 \geq \bar{x}_1 - a_1 t \end{cases} \qquad (B.1)$$

where x^E denotes equivalent education expenditure, which is the value of spending in education that at the CCT schooling condition gives the same utility as the actual education expenditure level, x; and where $\bar{x}_1$ is the CCT schooling condition, the parameter a_1 denotes the parents' preferences for schooling, and t is the cash transfer. Figure B.1 plots the correspondence in (B.1).

Next, I solve for the optimal condition of schooling $\bar{x}_1^*$ that minimizes the P_{α,x_1} measure for education expenditure subject to a fixed budget of size B and the equilibrium transfer defined in (26). Consider the problem

$$\min_{\{\bar{x}_1 \geq 0\}} \left[P_{\alpha,x_1} = \int_0^{a_1 z_y} \left(\frac{a_1 z_{x_1}^E - x^E}{a_1 z_{x_1}^E} \right)^{\alpha} f(x_1) dx_1 \right] \qquad (B.2)$$

$$s.t. \quad \hat{t}\left(z_y, \bar{x}_1, \mathrm{B}\right) = -\frac{1}{2}\left(z_y - \frac{\bar{x}_1}{a_1} \right) + \frac{1}{2}\left[\left(z_y - \frac{\bar{x}_1}{a_1} \right)^2 + 4\left(\frac{\mathrm{B} \cdot z_y}{q} \right) \right]^{\frac{1}{2}}$$

where $z_{x_1}^E$ is the poverty line in the equivalent education expenditure space.

For $\alpha = 0$, the optimal schooling condition that minimizes education expenditure poverty headcount ratio (the number of households that fall short of the education expenditure poverty line, $a_1 z_y$) P_{0,x_1} is

$$\bar{x}_1^* = a_1 z_y \qquad (B.3)$$

Since the CCT of size $\hat{t}$, is greater than the UCT of size m, then CCTs are superior to UCTs when the objective is to minimize education expenditure poverty headcount ratio (Figure B.2).

For $\alpha = 1$, the optimal condition of schooling that minimizes the education expenditure-gap ratio, P_{0,x_1} is

$$\bar{x}_1^* = a_1 \hat{t} \qquad (B.4)$$

So, if the policymaker sets a condition of schooling strictly greater than the fraction of the transfer that is used to demand schooling ($\bar{x}_1^* > a_1 \cdot \hat{t}$), the reduction of poverty in terms of the education expenditure-gap is superior under UCTs relative to CCTs. As for the case of income poverty, the result for $\alpha = 1$ can be generalized for any $\alpha \geq 1$. Therefore, UCTs are preferred with a sufficiently high degree of poverty aversion to "education poverty."

Figures and tables

Figure 1: Kernel distributions of monthly pre-transfer household expenditure for poor households

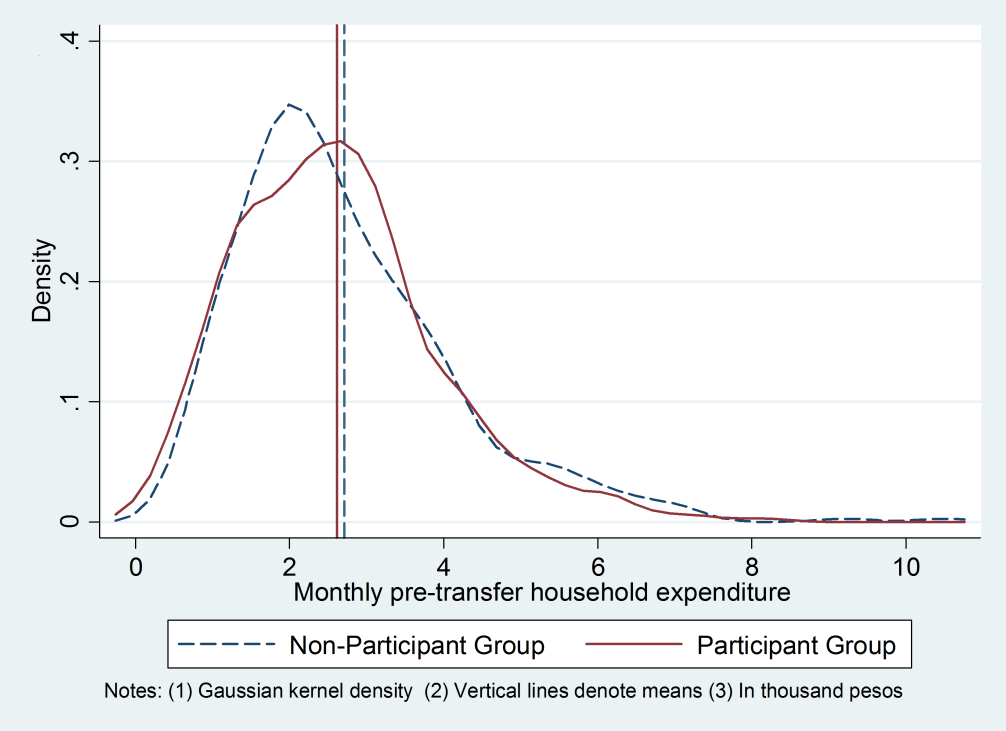

Figure 2: Kernel distributions of monthly pre-transfer *per capita* expenditure for poor households

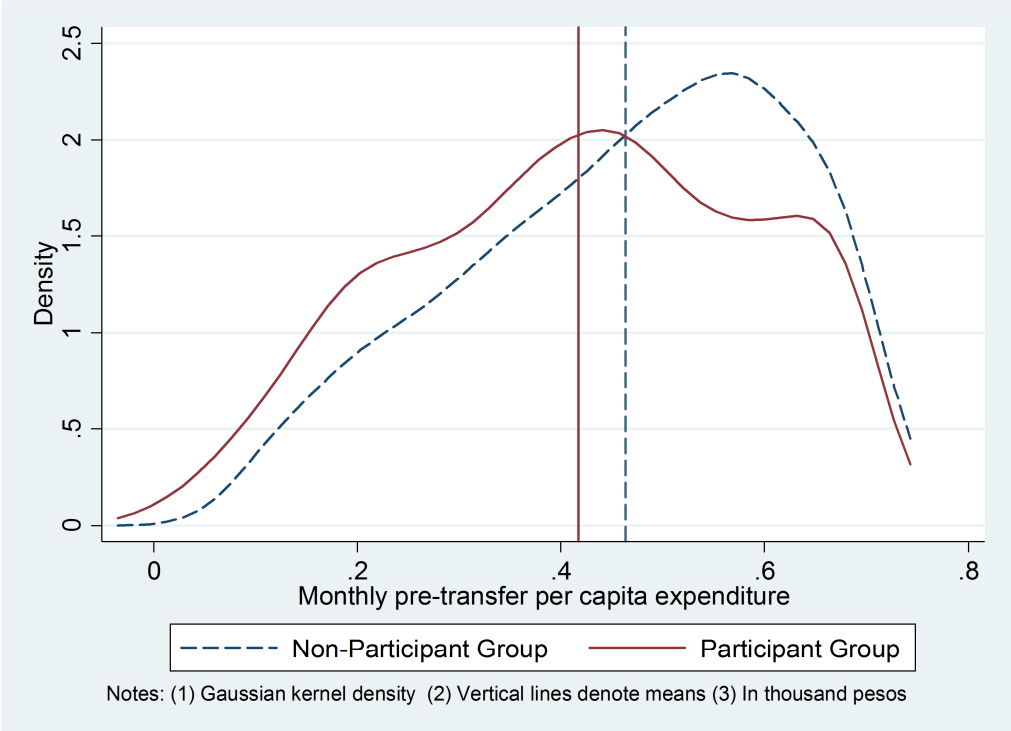

Figure 3: Predicted probability of participation in *Oportunidades* as a function of expected household expenditure

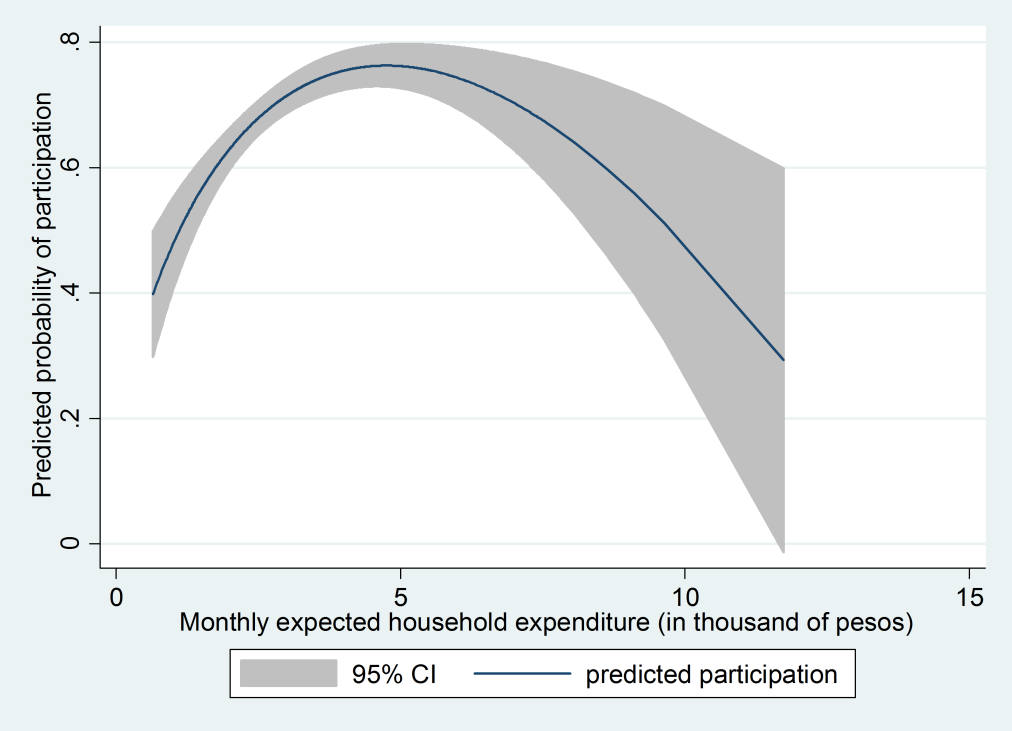

Figure 4: Engel curves of schooling before and after the introduction of CCTs

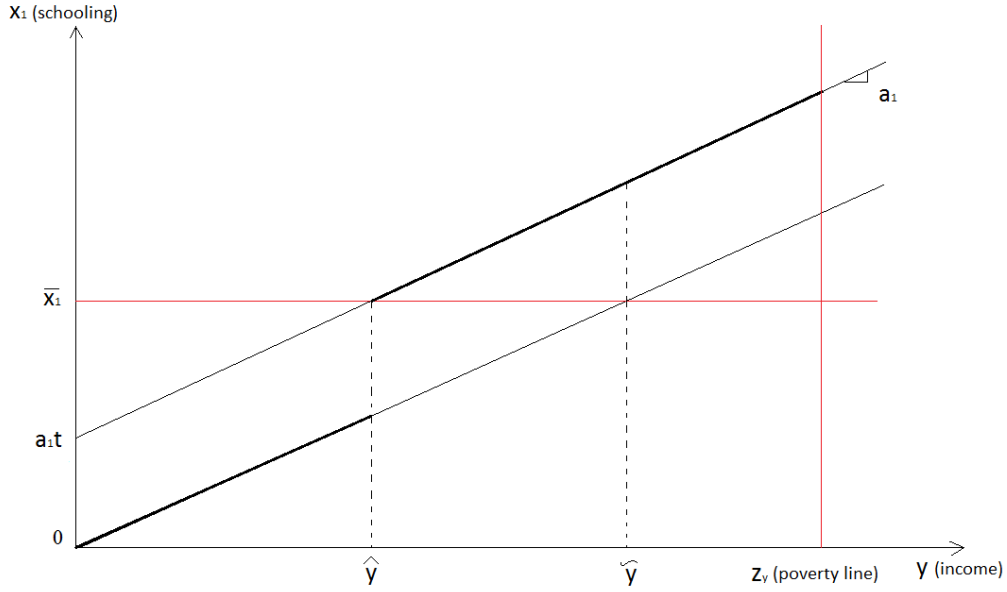

Figure 5: Equivalent income function before and after the introduction of CCTs

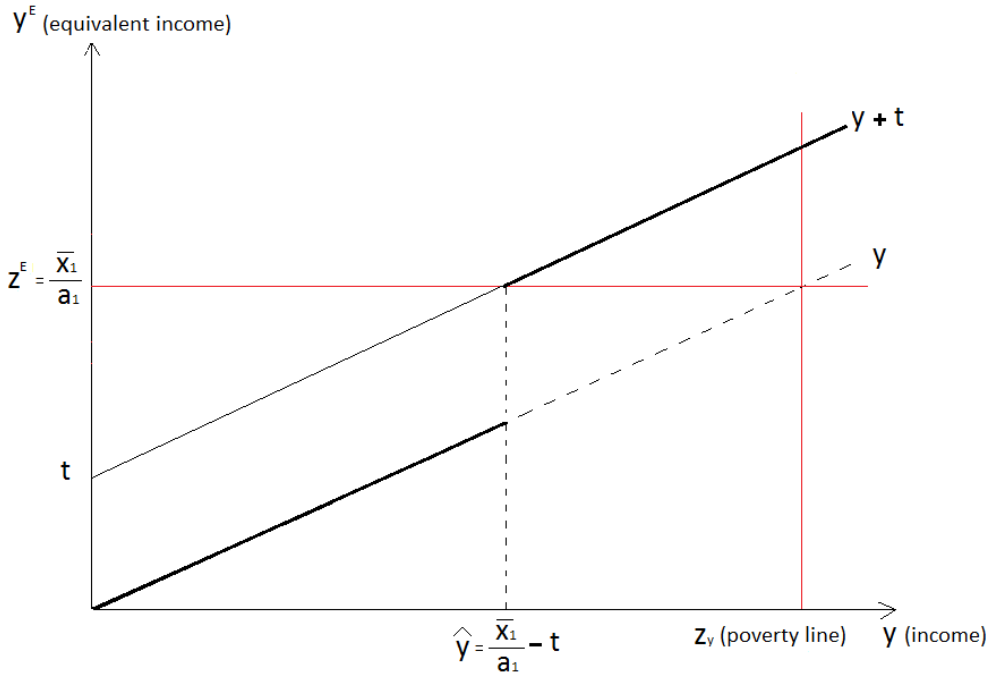

Figure 6: CCTs versus UCTs (income poverty headcount ratio)

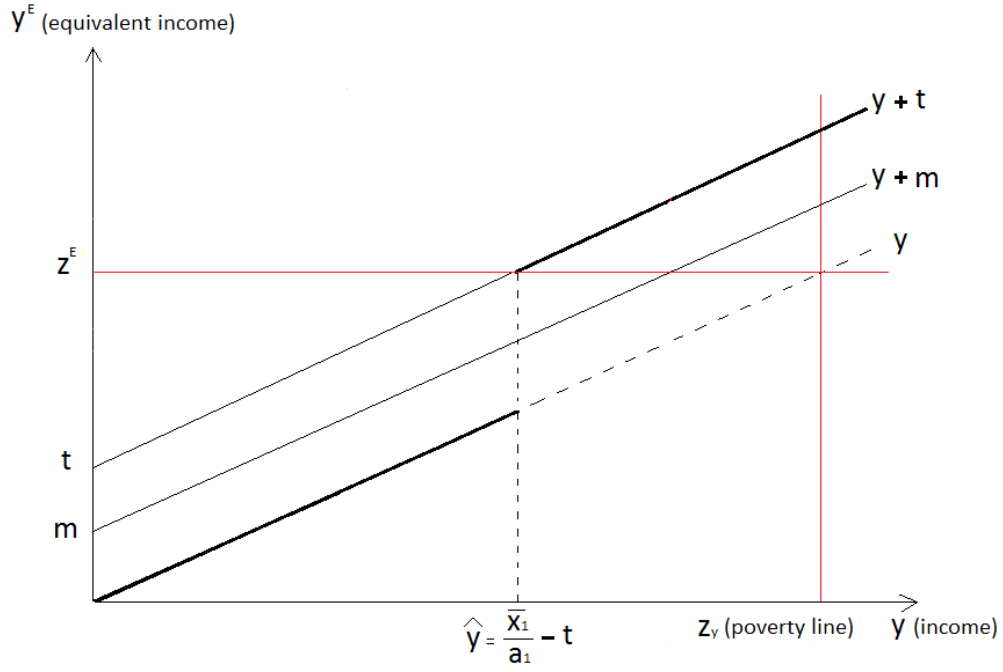

Figure 7: CCTs versus UCTs (poverty income-gap ratio)

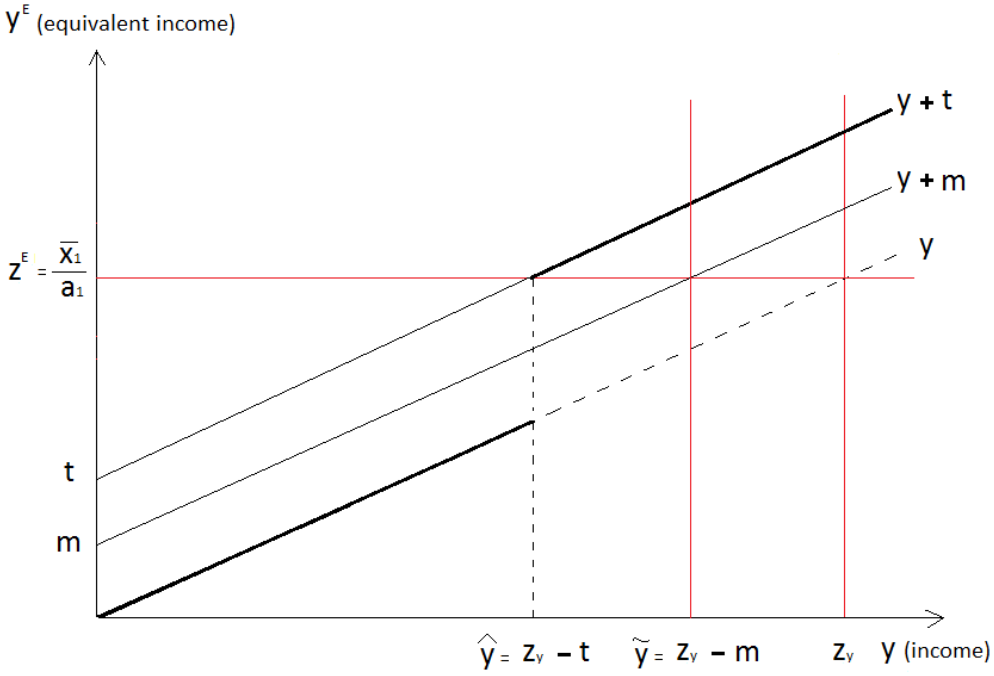

Table 1: Monthly amount of the schooling transfer in *Oportunidades* (MX$)
Semester July-December 2006

Level/Grade	Boys	Girls
Primary		
3rd grade	120	120
4th grade	140	140
5th grade	180	180
6th grade	240	240
Lower secondary		
1st grade	350	370
2nd grade	370	410
3rd grade	390	450
Upper secondary		
1st grade	585	675
2nd grade	630	715
3rd grade	665	760

Source: SEDESOL, 2007 *Oportunidades* program operating rules
Exchange rate for August 3, 2006, US$1=MX$11.02

Table 2: Maximum monthly transfer in *Oportunidades* per household (MX$)
Semester July-December 2006

	With children enrolled in primary education	With children enrolled in upper secondary education
Food transfer	180	180
Maximum amount of schooling transfer	915	1,675
Maximum amount of total transfer	1,095	1,855

Source: SEDESOL, 2007 *Oportunidades* program operating rules
Exchange rate for August 3, 2006, US$1=MX$11.02

Table 3: Summary statistics of household characteristics

	Full Sample		Participant Group		Non-Participant Group		Test of differences
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	t-value
Household Characteristics							
Demographics							
Household size	6.3	2.2	6.4	2.1	6.0	2.5	-3.52
Female members	3.2	1.5	3.2	1.5	3.1	1.6	-1.53
Dependency ratio	1.2	1.0	1.3	1.0	0.9	0.9	-6.10
Young members (<19 years)	3.7	1.8	3.9	1.7	3.1	1.7	-7.99
Out of school children	0.7	0.9	0.5	0.8	1.0	1.0	9.32
Working children	0.5	0.8	0.5	0.8	0.5	0.7	-1.89
Children in eligible school age	2.4	1.3	2.6	1.2	1.9	1.1	-10.76
Oportunidades scholarship recipients	1.3	1.1	1.9	0.9	0.0	0.0	-43.68
Seguro Popular recipients	1.9	2.8	2.2	3.0	1.2	2.2	-6.18
% with single mom	11.8%	0.3	12.0%	0.3	11.5%	0.3	-0.29
Mother years of education	3.2	3.0	3.3	2.9	2.9	3.2	-2.00
Father years of education	3.1	3.1	3.2	3.0	3.0	3.3	-1.02
% with members that have migrated	48.8%	0.5	47.6%	0.5	51.7%	0.5	1.43
Economic Status[1]							
% with dirt floor	37.3%	0.48	37.3%	0.48	37.3%	0.48	0.01
% owns a car	11.9%	0.32	11.6%	0.32	12.6%	0.33	0.53
% receive income from agriculture	52.8%	0.50	54.7%	0.50	48.3%	0.50	-2.27
Expected *Oportunidades* transfer	729.3	432.34	857.4	404.98	439.4	343.22	-19.14
Actual *Oportunidades* transfer	551.1	491.87	794.7	393.98	0.0	0.00	-42.92
Expenditure before *Oportunidades*	2,644.0	1,352.1	2,614.2	1,320.6	2,711.3	1,420.0	1.27
Expenditure after *Oportunidades*	3,194.6	1,447.9	3,408.2	1,408.8	2,711.3	1,420.0	-8.75
Per capita exp before *Oportunidades*	431.5	169.39	417.3	172.00	463.5	158.93	4.87
Per capita exp after *Oportunidades*	523.7	187.00	550.2	192.31	463.5	158.93	-8.41
Per capita expenditure/Poverty line	60.9%	0.24	58.9%	0.24	65.5%	0.22	4.87
Expenditure in education	235.8	348.40	282.8	372.92	129.4	255.42	-7.96
% of total expenditures in education	6.74%	0.08	7.79%	0.09	4.4%	0.07	-7.26
Income before *Oportunidades*	3,228.1	2,322.3	3,109.8	2,117.1	3,495.7	2,713.8	2.95
Income after *Oportunidades*	3,778.8	2,350.6	3,903.9	2,160.5	3,495.7	2,713.8	-3.09
Per capita income before *Oportunidades*	526.1	335.23	497.4	315.49	591.2	368.25	5.00
Per capita income after *Oportunidades*	618.3	338.97	630.3	324.65	591.2	368.25	-2.05
Observations	1,478		1,025		453		

[1] Income and expenditure variables in 2006 Mexican Pesos (MX$), Exchange rate US$1=MX$11.02 (August 3, 2006), PPP US$1=MX$7.21 (2006).

Table 4: Summary statistics of community and school characteristics

	Full Sample		Participant Group		Non-Participant Group		Test of differences
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	t-value
Community Characteristics							
Marginality							
Population	1,939.06	2,824.05	1,753.43	2,612.46	2,359.73	3,216.72	3.82
% of the population illiterate	25.5%	14.88	25.7%	14.41	25.1%	15.90	-0.78
% without complete primary	49.5%	15.00	49.8%	14.35	48.8%	16.40	-1.10
% of hhs without sewage	20.8%	25.43	21.2%	25.43	20.0%	25.43	-0.83
% of hhs without electricity	12.0%	20.45	12.0%	19.92	11.8%	21.63	-0.22
% of hhs without water	35.3%	38.36	36.7%	39.04	32.1%	36.60	-2.13
% of hhs with overcrowding	54.4%	17.48	55.6%	17.00	51.6%	18.23	-4.13
% of hhs with dirt floor	42.0%	29.86	43.0%	29.58	39.7%	30.40	-1.97
% of hhs without fridge	62.8%	28.21	64.2%	27.27	59.6%	30.01	-2.89
Index of Marginality	0.00	0.80	0.03	0.76	-0.08	0.87	-2.46
Years of availability of *Oportunidades*	6.88	1.77	7.00	1.68	6.61	1.94	-3.97
Health care provider							
Distance to health center[1]	1.66	2.53	1.68	2.58	1.61	2.43	-0.53
IMSS *Oportunidades*	0.37	0.48	0.35	0.48	0.40	0.49	1.60
SSA health center	0.59	0.49	0.61	0.49	0.54	0.50	-2.58
Other health care provider	0.05	0.21	0.04	0.19	0.07	0.25	2.37
School Characteristics							
Distances [1]							
Distance to primary school	0.22	0.65	0.20	0.60	0.27	0.75	1.83
Distance to lower secondary school	1.09	1.63	1.06	1.56	1.16	1.76	1.07
Distance to upper secondary school	5.41	7.38	5.54	7.56	5.11	6.97	-1.04
Primary School Quality [2]							
Class size	17.93	9.26	17.61	9.28	18.67	9.16	1.96
Repetition rate	5.6%	0.05	5.6%	0.05	5.4%	0.05	-0.72
Director with BA or higher	95.0%	0.22	94.6%	0.23	95.9%	0.20	1.01
% of teachers with BA or higher	87.5%	0.25	88.1%	0.24	86.1%	0.27	-1.33
Pupil-teacher ratio	31.05	15.36	31.14	15.85	30.83	14.21	-0.34
Pupil-classroom ratio	7.04	4.64	6.86	4.61	7.45	4.69	2.19
Lower Secondary School Quality [2]							
Class size	22.10	9.46	21.85	9.21	22.66	9.98	1.50
Repetition rate	0.7%	0.02	0.6%	0.01	0.8%	0.02	1.53
Failure rate	5.6%	0.08	5.1%	0.07	6.8%	0.09	3.64
Director with BA or higher	72.1%	0.44	70.9%	0.44	74.7%	0.42	1.45
% of teachers with BA or higher	60.4%	0.37	60.2%	0.38	60.9%	0.36	0.29
Pupil-teacher ratio	26.56	9.83	26.82	10.11	25.99	9.14	-1.43
Pupil-classroom ratio	22.55	9.43	22.10	9.26	23.58	9.74	2.75

Notes:

[1] Distances in kilometers from the center of the community

[2] Characteristics of those schools closer to the community center.

Table 5: Main estimation results: Effects of household expenditure on participation in *Oportunidades*

Dependent variable: Participating in *Oportunidades*

	(1)	(2)	(3)	(4)	(5)
Household expenditure before *Oportunidades* [1]	-0.026**	0.080	0.128**	0.138**	0.006
	(0.012)	(0.059)	(0.064)	(0.064)	(0.035)
Household expenditure squared[1]		-0.007	-0.012**	-0.012**	
		(0.005)	(0.005)	(0.005)	
Expected Oportunidades transfer[1]	0.653***	0.654***	0.645***	0.627***	0.632***
	(0.044)	(0.044)	(0.047)	(0.048)	(0.048)
Household size	-0.009	-0.031*	-0.040**	-0.045**	-0.027
	(0.007)	(0.017)	(0.018)	(0.018)	(0.017)
Dependency ratio	0.075***	0.072***	0.065***	0.067***	0.071***
	(0.015)	(0.016)	(0.017)	(0.018)	(0.018)
Single mom	-0.070	-0.067	-0.061	-0.054	-0.062
	(0.046)	(0.047)	(0.055)	(0.052)	(0.052)
Dirt floor (1 if household has dirt floor)		-0.001	0.015	0.013	0.013
		(0.026)	(0.029)	(0.029)	(0.029)
Car (1 if family own a car)		-0.078*	-0.101**	-0.118**	-0.117**
		(0.046)	(0.050)	(0.052)	(0.051)
Farm (1 if agriculture activity)		0.021	0.021	0.014	0.013
		(0.027)	(0.030)	(0.030)	(0.030)
Per capita expenditure/Poverty line		-0.274	-0.409**	-0.425**	-0.164
		(0.180)	(0.197)	(0.196)	(0.167)
Mother years of education			0.001	0.001	0.001
			(0.005)	(0.005)	(0.005)
Father years of education			-0.003	-0.002	-0.002
			(0.005)	(0.005)	(0.005)
% of total expenditures in education			0.373**	0.353**	0.354**
			(0.177)	(0.180)	(0.179)
Population[2]	-0.013***	-0.014***	-0.014**	-0.015**	-0.015**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Community index of marginality	0.021	0.010	0.017	0.035	0.033
	(0.018)	(0.020)	(0.025)	(0.025)	(0.025)
Years of exposure to *Oportunidades* [3]	0.028***	0.027***	0.020**	0.022**	0.022**
	(0.008)	(0.008)	(0.009)	(0.010)	(0.010)
IMSS *Oportunidades* health center			0.028	0.052	0.051
			(0.064)	(0.062)	(0.062)
SSA health center			0.099	0.092	0.093
			(0.065)	(0.065)	(0.064)
Distance to health center[4]				-0.008	-0.007
				(0.008)	(0.008)
Distance to primary school[4]				0.013	0.013
				(0.026)	(0.026)
Distance to secondary school[4]				-0.008	-0.008
				(0.011)	(0.011)
Distance to high school[4]				0.001	0.001
				(0.003)	(0.003)
Seguro Popular (1 if enrolled)				0.026***	0.026***
				(0.006)	(0.006)
Child work[5]				0.03	0.04
				(0.020)	(0.020)
Migration[6]				-0.026	-0.021
				(0.032)	(0.032)
School-quality controls[7]	No	No	Yes	Yes	Yes
Teacher-quality controls[8]	No	No	Yes	Yes	Yes
Pseudo R-squared	0.248	0.251	0.280	0.298	0.294
Observations	1,460	1,460	1,224	1,224	1,224

Marginal effects from Maximum Likelihood Probit model with robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] In thousand Mexican Pesos (MX$) of 2006. Exchange rate US$1=MX$11.02 (August 3, 2006), PPP US$1=MX$7.21 (2006).

[2] In thousands of inhabitants.

[3] Years of program availability at the community level.

[4] Distances in kilometers from the center of the community

[5] Dummy variable equal to 1 if at least one child of less than 15 years old in the household works.

[6] Dummy variable equal to1 if at least one of the adults in the household has migrated within the last 5 years.

[7] Include class size, repetition rate, failure rate, pupil-teacher ratio and pupil-classroom ratio.

[8] Include the ratio of teachers with a BA degree or higher and whether or not the director has a professional degree.

Table 6: Two-stage probit results: Effects of household expenditure on participation

Dependent variable: Participating in *Oportunidades*	
	(1)
Predicted household expenditure before *Oportunidades* [1]	0.579***
	(0.069)
Predicted household expenditure squared[1]	-0.032***
	(0.005)
Expected Oportunidades transfer[1]	0.397***
	(0.050)
Household size	-0.176***
	(0.020)
Dependency ratio	0.056***
	(0.017)
Single mom	-0.002
	(0.044)
Dirt floor (1 if household has dirt floor)	0.033
	(0.026)
Car (1 if family own a car)	-0.142***
	(0.051)
Farm (1 if agriculture activity)	0.035
	(0.027)
Per capita expenditure/Poverty line	-1.592***
	(0.200)
Mother years of education	0.005
	(0.005)
Father years of education	-0.002
	(0.005)
% of total expenditures in education	0.349**
	(0.163)
Population[2]	-0.013**
	(0.006)
Community index of marginality	0.020
	(0.022)
Years of exposure to *Oportunidades* [3]	0.021**
	(0.009)
IMSS *Oportunidades* health center	0.073
	(0.055)
SSA health center	0.094
	(0.059)
Distance to health center[4]	-0.007
	(0.007)
Distance to primary school[4]	-0.004
	(0.022)
Distance to secondary school[4]	-0.003
	(0.010)
Distance to high school[4]	0.002
	(0.002)
Seguro Popular (1 if enrolled)	0.023***
	(0.005)
Child work[5]	0.017
	(0.018)
Migration[6]	-0.050*
	(0.029)
School-quality controls[7]	Yes
Teacher-quality controls[8]	Yes
Pseudo R-squared	0.298
Observations	1,224

Second-stage marginal effects from a ML probit model with robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] In thousand Mexican Pesos (MX$) of 2006.

[2] In thousands of inhabitants.

[3] Years of program availability at the community level.

[4] Distances in kilometers from the center of the community

[5] Dummy variable equal to 1 if at least one child of less than 15 years old in the household works.

[6] Dummy variable equal to1 if at least one of the adults in the household has migrated within the last 5 years.

[7] Include class size, repetition rate, failure rate, pupil-teacher ratio and pupil-classroom ratio.

[8] Include the ratio of teachers with a BA degree or higher and a dummy for director with at least a BA degree.

Appendix figures and tables

Figure A.1: Predicted probability of participation in *Oportunidades* as a function of expected household expenditure for the sample of extremely poor families

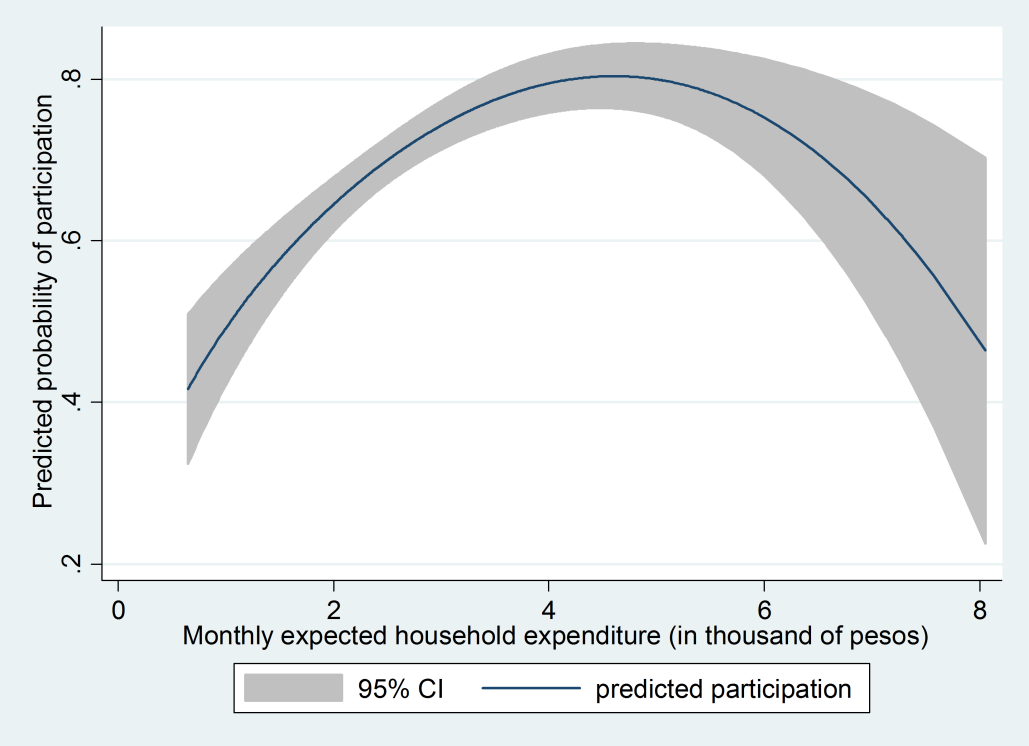

Figure B.1: Equivalent education-expenditure function before and after the introduction of CCTs

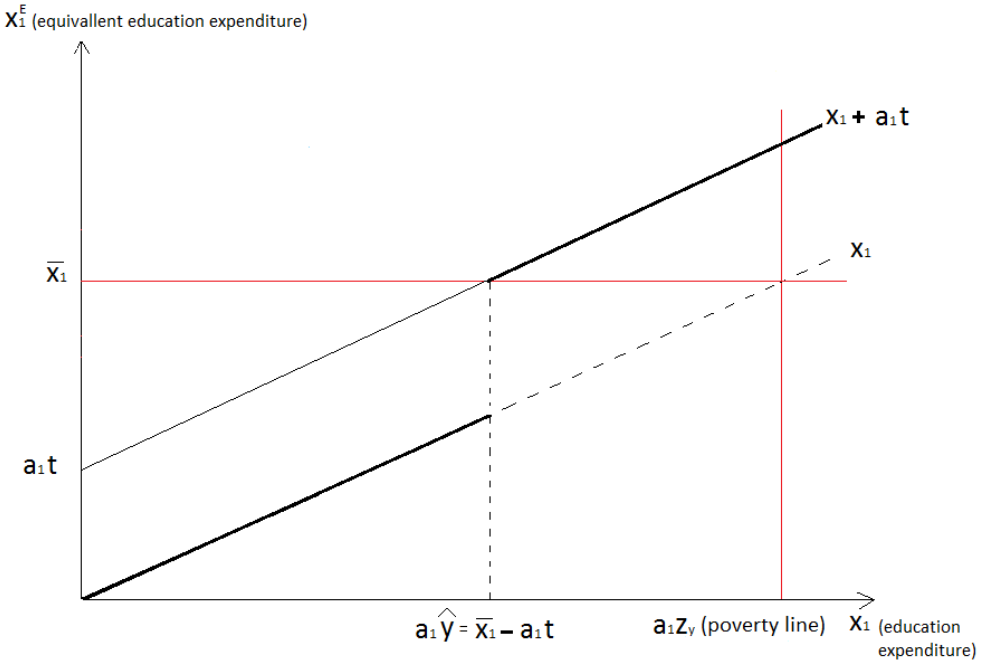

Figure B.2: CCTs versus UCTs (poverty headcount ratio for education expenditure)

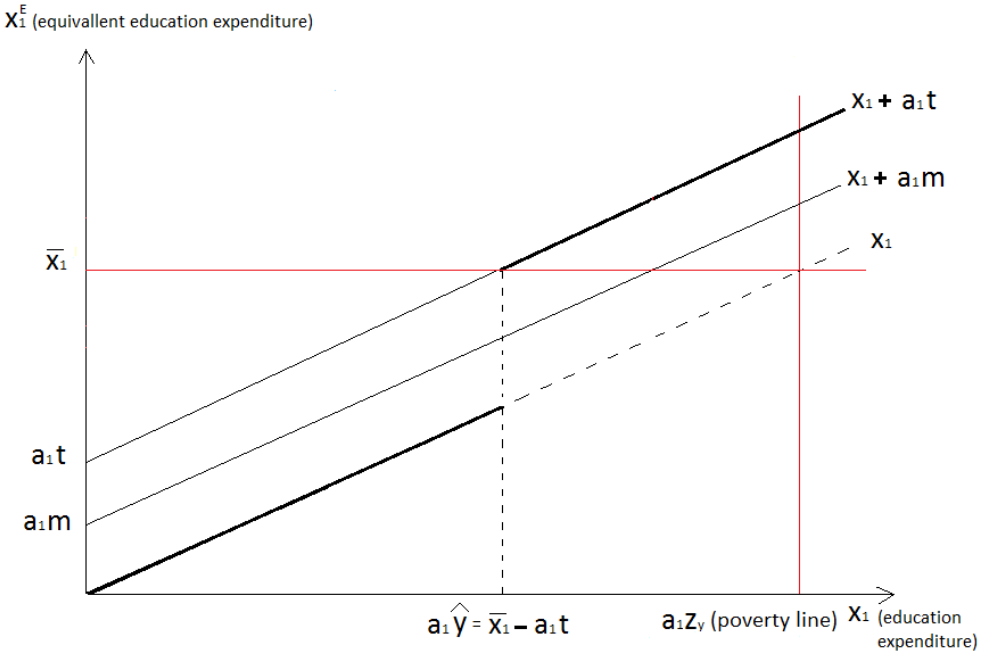

Table A.1: Robustness test results: Effects of household expenditure on participation of the extremely poor

Dependent variable: Participating in *Oportunidades*

	(1)	(2)	(3)	(4)	(5)
Household expenditure before *Oportunidades*[1]	-0.023	0.104	0.167**	0.169**	0.023
	(0.015)	(0.079)	(0.082)	(0.080)	(0.044)
Household expenditure squared[1]		-0.009	-0.016**	-0.016**	
		(0.008)	(0.008)	(0.007)	
Expected Oportunidades transfer[1]	0.663***	0.656***	0.663***	0.637***	0.642***
	(0.048)	(0.048)	(0.048)	(0.050)	(0.050)
Household size	-0.011	-0.038**	-0.046**	-0.049**	-0.033*
	(0.008)	(0.019)	(0.020)	(0.019)	(0.018)
Dependency ratio	0.060***	0.059***	0.046***	0.049***	0.054***
	(0.016)	(0.016)	(0.018)	(0.018)	(0.018)
Single mom	-0.095*	-0.088	-0.071	-0.069	-0.080
	(0.054)	(0.054)	(0.063)	(0.060)	(0.060)
Dirt floor (1 if household has dirt floor)		-0.008	0.008	0.007	0.007
		(0.028)	(0.030)	(0.030)	(0.030)
Car (1 if family own a car)		-0.036	-0.042	-0.050	-0.052
		(0.049)	(0.049)	(0.051)	(0.051)
Farm (1 if agriculture activity)		0.042	0.031	0.029	0.031
		(0.029)	(0.031)	(0.031)	(0.031)
Per capita expenditure/Poverty line		-0.387*	-0.492**	-0.485**	-0.193
		(0.235)	(0.248)	(0.242)	(0.208)
Mother years of education			-0.003	-0.002	-0.003
			(0.006)	(0.006)	(0.006)
Father years of education			-0.000	-0.001	-0.000
			(0.005)	(0.005)	(0.005)
% of total expenditures in education			0.283	0.290	0.325
			(0.199)	(0.200)	(0.200)
Population[2]	-0.014**	-0.013**	-0.009	-0.011	-0.011
	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)
Community index of marginality	0.014	0.004	0.011	0.021	0.020
	(0.019)	(0.021)	(0.024)	(0.025)	(0.025)
Years of exposure to *Oportunidades*[3]	0.025***	0.024***	0.014	0.016	0.016
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
IMSS *Oportunidades* health center			0.113*	0.123*	0.122*
			(0.068)	(0.066)	(0.065)
SSA health center			0.171**	0.157**	0.157**
			(0.075)	(0.073)	(0.072)
Distance to health center[4]				-0.009	-0.008
				(0.008)	(0.008)
Distance to primary school[4]				0.006	0.003
				(0.027)	(0.027)
Distance to secondary school[4]				-0.004	-0.004
				(0.011)	(0.011)
Distance to high school[4]				-0.002	-0.002
				(0.003)	(0.003)
Seguro Popular (1 if enrolled)				0.021***	0.021***
				(0.006)	(0.006)
Child work[5]				0.024	0.026
				(0.021)	(0.021)
Migration[6]				-0.019	-0.015
				(0.034)	(0.034)
School-quality controls[7]	No	No	Yes	Yes	Yes
Teacher-quality controls[8]	No	No	Yes	Yes	Yes
Pseudo R-squared	0.259	0.263	0.305	0.318	0.315
Observations	1,167	1,167	974	974	974

Marginal effects from Maximum Likelihood Probit model with robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Notes:

[1] In thousand Mexican Pesos (MX$) of 2006. Exchange rate US$1=MX$11.02 (August 3, 2006), PPP US$1=MX$7.21 (2006).

[2] In thousands of inhabitants.

[3] Years of program availability at the community level.

[4] Distances in kilometers from the center of the community

[5] Dummy variable equal to 1 if at least one child of less than 15 years old in the household works.

[6] Dummy variable equal to1 if at least one of the adults in the household has migrated within the last 5 years.

[7] Include class size, repetition rate, failure rate, pupil-teacher ratio and pupil-classroom ratio.

[8] Include the ratio of teachers with a BA degree or higher and whether or not the director has a professional degree.