HOUSEHOLD TARGETING IN PRACTICE: THE NICARAGUAN RED DE PROTECCIÓN SOCIAL

by

Jon Maluccio

Middlebury College

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HOUSEHOLD TARGETING IN PRACTICE: THE NICARAGUAN *RED DE PROTECCIÓN SOCIAL*

John A. Maluccio*

Department of Economics
Middlebury College
Middlebury VT 05753, USA
john.maluccio@middlebury.edu
Phone: (802) 443-5941 Fax: (802) 443-2084

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Abstract: This article describes the details underlying the targeting of a Nicaraguan anti-poverty program, emphasizing the rationale for how it was designed and implemented. It offers, by way of example, a guide for targeting in an anti-poverty program, and highlights some of the potential tradeoffs. It then goes on to present a quantitative assessment of how well the program was able to target poor households. A combination of ad hoc and statistical procedures led to targeting that was effective, with undercoverage rates of 10 percent or below and leakage rates of 15 percent or below. This was in spite of the fact that the targeting methodologies used were imprecise at both the household and geographic levels.

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1. INTRODUCTION

With rising competition for development financing the world over, the cost-effectiveness of poverty alleviation programs has become increasingly important. As a result, targeting, one potential mechanism for improving cost-effectiveness, is commonly employed. A recent review of poverty reduction programs in developing countries that involved targeting, however, found that out of over a hundred programs examined, more than one-quarter of them were actually regressive, and many others only favored the poor minimally (Coady *et al.*, 2004). The authors concluded that to be effective in reaching the poor, targeting must be designed *as well as* implemented carefully.

In the past decade, several Latin American countries have introduced an innovative poverty reduction program, known as the conditional cash transfer program (CCT). CCTs integrate investing in human capital with access to a social safety net (in the form of current transfers) and typically incorporate targeting as an important aspect of their design, often exploiting household-level information collected to administer the program. One of the first, and largest, programs was the *Programa Nacional de Educación, Salud y Alimentación* (PROGRESA, now called Oportunidades) in Mexico, begun in 1997. Another large program is *Bolsa Alimentação*, a nutrition-oriented cash transfer program in Brazil. Similar programs have been implemented in Colombia, Ecuador, El Salvador, Honduras, and Jamaica.

In this article, I examine the targeting mechanism of another such CCT program in Nicaragua, the *Red de Protección Social* (RPS) or "Social Safety Net." I review the development and experience of targeting in RPS, highlighting the reasoning for the various decisions undertaken, and then assess the program's targeting performance. The experience is particularly relevant for the design and implementation of CCT programs like RPS, but is also relevant to a variety of anti-poverty programs that have built-in informational requirements which can be exploited for targeting purposes at low marginal cost. The results indicate that targeting in RPS was effective, with

undercoverage rates of 10 percent or below in program areas and leakage rates of 15 percent or below. This was in spite of the fact that the household-level targeting methodologies used were imprecise at the household level.

2. THE *RED DE PROTECCIÓN SOCIAL*[1]

Modeled after PROGRESA, RPS was designed to address both current and future poverty via cash transfers targeted to poor households in rural Nicaragua. The transfers were conditional, and households were monitored to ensure that, among other things, their children were attending school and scheduled preventive visits to health-care providers. When households failed to fulfill those obligations, they lost their eligibility. By targeting the transfers to poor households, the program alleviated short-term poverty. By linking the transfers to investments in human capital, the program addressed long-term poverty.

RPS's specific objectives included:

- Supplementing household income for up to 3 years to increase expenditure on food,
- Reducing dropout rates during the first 4 years of primary school, and
- Increasing the health and nutritional status of children under age 5.

RPS comprised two phases over five years, starting in 2000. In this article, I examine targeting in the pilot phase, or Phase I, which lasted three years and had a budget of $11 million, representing approximately 0.2 percent of GDP or 2 percent of annual recurring government spending on health and education (World Bank, 2001, annex 21).

2.1 Program design and implementation

Phase I of RPS was implemented in two stages between late 1999 and 2002. In the first stage, the program incorporated approximately 6,000 households in 21 census-"*comarcas*"[2] (hereafter

[1] This section draws from Maluccio and Flores (2005).

[2] Census-*comarcas* are administrative areas within municipalities that include between one and five small communities

localities) from rural areas in six municipalities in the northern part of the Central Region of Nicaragua, using geographic-level targeting—I will refer to these as the geographic-level targeted localities. In the second stage of Phase I, approximately 4,000 additional beneficiary households from 17 different rural localities, but the same six municipalities, were selected using household-level targeting methods—I will refer to these as the household-level targeted localities.

RPS had two core components:

Food security, health, and nutrition: Each eligible household[3] received a fixed cash transfer known as the *food security transfer*, every other month, contingent on attendance at educational workshops held every other month and on bringing their children under age 5 for scheduled preventive (i.e., well child) appointments with health-care providers. To ensure adequate supply in these poor, rural communities, RPS trained and paid private providers to deliver the specific health-care services required by the program. These services, provided free of charge to beneficiary households, included growth and development monitoring, vaccination, and provision of antiparasites, vitamins, and iron supplements. Children under age 2 were seen monthly and those ages 2–5, every other month.

Education: Each eligible household also received a cash transfer known as the *school attendance transfer* every other month, contingent on enrollment and regular school attendance of children ages 7–13 who had not completed fourth grade of primary school. Additionally, for each eligible child, the household received an annual cash transfer intended for school supplies

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of about 100 households each. The census *comarcas* were constructed using the most recent Nicaraguan National Population and Housing Census carried out in 1995. They are not everywhere identical, however, to the geographical areas known as *comarcas* and used by municipality governments for political and administrative purposes. The advantage of census *comarcas* is that unlike the administratively defined *comarcas*, they wholly contain census segments. Both types of *comarcas* can include one or more (whole or partial) communities and at times are divided by natural or man-made boundaries such as rivers and roads, which can be problematic for geographic-level targeting if they form the dividing line between beneficiary and non-beneficiary groups, as they did in a small number of areas receiving the program.

[3] RPS defined a household as a group of persons habitually living, eating, and cooking together. The same definition was used in all the survey work.

(including uniforms and shoes) known as the *school supplies transfer*, which was contingent on enrollment. Unlike the school attendance transfer, which was a fixed amount per household regardless of the number of children in school, the school supplies transfer was for each child. To provide incentives to the teachers, who had some additional reporting duties and were likely to have larger classes after the introduction of RPS, and to increase resources available to the schools, there was also a small cash transfer, known as the *teacher transfer*. This was given to each beneficiary child, who in turn delivered it to the teacher. The teacher was to keep one-half, while the other half was earmarked for the school.

In Table 1, I summarize the eligibility requirements and demand- and supply-side benefits of RPS. In principle, all households in geographic-level targeted localities were eligible for the food security transfer. Households with children ages 7–13 who had not yet completed the fourth grade of primary school were also eligible for the education component of the program. In household-level targeted localities, only households with predicted per capita expenditure below the Nicaraguan poverty line were included—about 80 percent of the households. The details of this prediction model, as well as some exclusions that were made in geographic-level targeted localities, are described in Section 4.3.

[TABLE 1 ABOUT HERE]

The amounts for each transfer were initially determined in U.S. dollars and then converted into Nicaraguan Córdobas (C$) in September 2000, just before RPS began distributing transfers. Table 1 shows the original U.S. dollar annual amounts (using the September 2000 average exchange rate of C$12.85 to US$1). The food security transfer was $224 a year and the school attendance transfer $112. On its own, the food security transfer represented about 13 percent of total annual household expenditure in beneficiary households before the program. A household with one child benefiting from the education component would have received additional transfers of about 8

percent, yielding an average total potential transfer of 21 percent of total annual household expenditure. Over the two years, the actual average monetary transfer (excluding the teacher transfer) was approximately $272 or 17 percent of total annual household expenditure. The value of the supply-side benefits shown in the table, as measured by how much RPS paid to the providers, was also substantial—approximately $50 for the education workshops and $110 for the health-care services for children under age five, per beneficiary household. To enforce compliance with program requirements, beneficiaries did not receive the food or education component(s) of the transfer if they failed to carry out any of the conditions or co-responsibilities.

2.2 Program effectiveness

Research evaluating the program (e.g., Maluccio and Flores, 2005) has shown that on the whole, Phase I of RPS had positive and significant double-difference estimated average effects on a broad range of indicators and outcomes from 2000 to 2002, including expenditure, school enrollment and attainment, health-care inputs, and nutritional status of children under age five. Where it did not, it was often due to similar, though smaller, improvements in the control areas. Nearly all estimated effects were larger for the extremely poor, reflecting their lower starting points (for example, lower percentages of children enrolled in primary school before the program). As a result, the program reduced inequality across expenditure classes for these outcomes.

3. METHODOLOGY FOR HOUSEHOLD TARGETING IN RPS

Before turning to a description and assessment of both geographic- and household-level targeting in RPS, I first describe the ultimate objectives of that targeting and the principal methodology used to implement and assess it.

3.1 Targeting the (extremely) poor

The stated objective of RPS was to target extremely poor households in rural Nicaragua—it therefore targeted households based on their poverty status. Given the multiple objectives of the

program (both current poverty alleviation and future poverty alleviation via increased investment in child human capital), this approach was substantially justified. It is unlikely, however, that targeting on the basis of "current" poverty yields the exact same beneficiaries as targeting approaches based on one of the other program objectives, such as schooling, would. For example, it is clear that not all nonpoor children attend school. Such children, then, would be missed under a pure "poverty-based" targeting scheme, but possibly not under a targeting scheme which focused on enrollment. Conversely, many poor children already attend school. Indeed, if school attendance were the *only* objective, then it might be possible to target more finely and save substantial resources in the process (De Janvry and Sadoulet, 2006). For similar reasons, targeting instead nutritionally at-risk children also might yield a different group of beneficiaries.[4] While there certainly would be overlap among the beneficiary households selected under various possible approaches (focus on poverty, schooling, or health and nutrition), they almost certainly would not yield identical groups of beneficiaries.[5]

A second issue related to poverty-based targeting is operationalizing what is meant by "poverty." The conventional approach in economics is to approximate economic welfare by measuring household expenditure (as from a comprehensive household survey such as a World Bank Living Standards Measurement Survey or LSMS [Grosh and Glewwe, 2000]) and then compare per capita annual expenditure (perhaps adjusted for adult equivalents) to an estimated poverty line. This approach is generally preferred to using income, for example, since expenditures are likely to better represent a measure of long-term resource availability as they are less subject to seasonal fluctuations (in part due to consumption smoothing) and often more reliably reported

[4] Programs using targeting based on nutritional indicators are described in Gilligan and Veiga (2003) and MNPTSG (2002).

[5] This observation is related to the concept of multidimensional measurements of poverty that go beyond expenditure or income measures, see for example Bourguignon and Chakravarty (2003). See Besley and Kanbur (1993) for a general introduction to the principles of targeting.

(Deaton and Zaidi, 2002). Of course, even when done carefully, implementing a household expenditure survey and constructing an aggregate expenditure measure from such a survey suffers from a variety of sources of measurement error (Boozer and Goldstein, 2003; Hentschel and Lanjouw, 1995). Recent work using panel data, moreover, has highlighted the fact that the incidence of what is called transitory poverty, where in one period a household is under the poverty line while in another it is not, can be large relative to chronic poverty, in which the household is poor in all the periods (Baulch and Hoddinott, 2000).

These complexities suggest that the typical reliance on expenditure as the "gold standard" measure of economic well-being when measuring poverty or when evaluating targeting, may be misplaced. In this article, I instead use *predicted* expenditure to assess targeting. While this is in part due to data limitations (i.e., not having complete expenditure information for households in the household-level targeted localities), it has the benefit of avoiding to some extent the above concerns. It is plausible that predicted expenditure, based on many semi-permanent characteristics of households and their situations, better measures the permanent income capacity, or poverty status, of the household.

3.2 Proxy means analysis and poverty mapping

The primary household targeting method used in the RPS targeting was a proxy means test.[6] Starting with a comprehensive household survey, the logarithm of per capita expenditure, the indicator of welfare, is modeled as the dependent variable, considering a large number of possible explanatory variables (Grosh and Baker, 1995). This is essentially a weighted index of household characteristics. The idea behind selecting key factors that predict per capita expenditure is that with the model in hand, rather than collect detailed expenditure information for potential beneficiary

[6] Proxy means testing is an extension of means testing, where one asks directly about income. The latter method rarely makes sense in developing countries. For example, typically it is not feasible in rural areas with substantial own-production, such as those where RPS operated.

households, one only needs to collect the limited set of explanatory variables (which almost certainly is less expensive to do) and then apply the relevant coefficients to obtain a prediction. Similar approaches have been applied in a variety of settings (Ahmed and Bouis, 2002; Vélez *et al*., 1999; Castañeda, 2005; Orozco and Huber, 2005). The criteria for selecting potential predictors include that to the extent possible they should be factors such as location, size, and composition of the household that are easily collected and at the same time easily verified. The model is developed for prediction purposes only, and underlying behavioral or causal interpretations are not identified. Using step-wise elimination of regressors with replacement, an iterative process removes insignificant regressors keeping only those that are significant at a predetermined cut-off significance level (StataCorp, 2007). The methodology is sensitive to non-normality and heteroskedasticity—rejection of either the null hypothesis of normality or homoskedasticity leads to biased predictions, a problem usually resolved by removing a small number of observations (Grosh and Baker, 1995).

In addition to this household-level use for the proxy means model, there is another important application related to targeting—poverty maps (Elbers *et al*., 2003; Hentschel *et al*., 2000). These prediction models are applied to census data enabling estimation of various measures of poverty (head count, gap, severity), and their standard errors, for groups of households and therefore regions within countries. This application has obvious uses in geographic-level targeting, and these are exploited in the analysis below, mainly to assess the effectiveness of such targeting.

4. TARGETING IN RPS

4.1 RPS Geographic-level Targeting: Department and Municipality Levels

In the design phase of RPS, rural areas in all 17 departments of Nicaragua were eligible for the program. The focus on rural areas reflects the distribution of poverty in Nicaragua—of the 48 percent of Nicaraguans designated as poor in 1998, 75 percent resided in rural areas (World Bank,

2001). On the basis of information from the health and education ministries, as well as correlates of poverty, such as the percentage of rural population, the Government of Nicaragua selected municipalities in two departments from the northern part of the Central Region of Nicaragua of RPS (Arcia, 1999). The criteria informally applied in that selection are presented in Table 2.

[TABLE 2 ABOUT HERE]

According to the Nicaraguan poverty map (World Bank, 2001, Annex 19), which was unavailable during the design period of RPS so could not itself be used for geographic-level targeting, poverty in the Central Rural Region was 80 percent in 1998, the highest among the country's seven regions. In addition, the Central Region was the only one that showed worsening poverty between 1998 and 2001, a period during which both urban and rural poverty rates were declining nationally (World Bank, 2003). The departments selected within the Central Rural Region, Matagalpa and Madriz, also exhibited substantial poverty. In 1998, according to estimates based on the Nicaraguan poverty map, 78 and 81 percent of the rural population of Matagalpa and Madriz, were poor, and just over half of those were extremely poor. This compares with 48 percent poor and 17 percent extremely poor for Nicaragua as a whole and 69 and 29 percent, respectively, for rural Nicaragua.[7]

While I do not evaluate formally the selection of departments (or of municipalities and localities described below), it is informative to place the chosen departments within the context of rural Nicaragua. Extreme poverty in the rural areas of the chosen two departments was 40 percent or

[7] These figures differ slightly from the estimates based on the 1998 Nicaraguan LSMS in World Bank (2001), of 47.9 percent poor and 17.3 percent extremely poor nationally, and 68.5 and 28.9 percent in rural areas. The figures also differ slightly from results reported for the Nicaraguan poverty map (World Bank, 2001, annex 19). For internal consistency in this article, I report estimates based on my calculations using the Nicaraguan poverty map data. Using the database developed for the poverty map, I re-estimated area poverty rates for all regions of Nicaragua, including estimates for more disaggregated levels than were publicly available (e.g., to the locality level). My estimates are quite close to, but not exactly the same, as those reported in World Bank (2001). I did not have access to the original proxy means estimation data from the 1998 EMNV and therefore could not calculate standard errors for these estimates. Given the concern about estimating poverty rates for small areas (Elbers *et al*., 2003), in most of the analysis I focus on estimates from the other prediction models for which I can estimate standard errors.

higher, compared to a national average of 37 percent. Madriz had the second highest rural poverty rate and the third highest rural extreme poverty rate. Rural areas in Matagalpa were slightly less poor on average, but still in the worse half of the national distribution for both measures.[8]

In the next stage of geographic-level targeting, all six (out of 20) municipalities that had the small-scale participatory development program *Microplanificación Participativa* (MP) run by the national Emergency Social Investment Fund (FISE), the institutional home of RPS, were chosen, after again applying the same set of criteria described for departmental-level selection. The goal of MP, which operated in 43 municipalities across the country, was to develop the capacity of municipal governments to select, implement, and monitor social infrastructure projects such as school and health post construction, with an emphasis on local participation.

According to estimates based on the Nicaraguan poverty map, 36–54 percent of the rural population in each of the chosen municipalities was extremely poor and 75–90 percent poor in 1998. In Madriz, the municipality of Totogalpa was the poorest in the department, but Yalagüina among the least poor (Table 3a). In Matagalpa, the selected municipalities were also among the least poor, except for Esquipulas (Table 3b). While not the poorest municipalities in the country, or in the chosen departments for that matter, the proportion of impoverished people living in these areas was still well above the national average.

[TABLES 3A & 3B ABOUT HERE]

Estimates using more recent information collected as part of the program confirm this assessment, indicating similar rates of poverty for rural areas in the six municipalities as a whole, but some minor (and largely offsetting) differences at the municipality level (Table 4). For example, estimated poverty in El Tuma-La Dalia was higher in 2000 than in 1998, whereas in Ciudad Darío it

[8] Many of the departments exhibited similarly high (extreme) poverty rates; therefore it is inappropriate to treat departments with similar rankings as being substantially different.

was lower. The differences tend to be larger for estimates of extreme poverty. These differences are the result of imprecision in the estimates, as well as possible changes in poverty over time in these areas, though with the information at hand it is not possible to ascertain how much of the difference is due to each of these two possible causes.

[TABLE 4 ABOUT HERE]

Of course, poverty was not the only criteria considered for selection (Table 2). Although they exhibited severe poverty, the selected municipalities also had by design relatively easy physical access and communication (including being less than a one-day drive from the capital, Managua, where RPS was headquartered), relatively strong institutional capacity and local coordination, and reasonably good coverage of schools (Arcia, 1999). The six municipalities, like the two chosen departments, appear to have been reasonably well targeted in terms of poverty.

Even if RPS had not been in its pilot stage, geographic-level targeting on poverty levels alone might have been ill advised, given the multiple objectives of the program. By purposively targeting, RPS possibly avoided both offering educational transfers to households with no access to schools and devoting a disproportionate share of its resources to increasing the supply of schools. Indirect evidence that this approach was justified is provided by the effectiveness of the program in increasing enrollment rates (Maluccio and Flores, 2005). Thus, in judging the targeting, it is important to recognize that RPS was in its pilot phase—targeting decisions made during the pilot were part of a learning process and also may have reflected different criteria than those that would be used during an expansion of the program.

4.2 RPS Geographic-level Targeting: Locality Level

In the last stage of geographic-level targeting, a marginality index was constructed, based on information from the 1995 National Population and Housing Census (hereafter, the 1995 National Census), and an index score was calculated for all 59 rural localities in the selected municipalities.

The index was the weighted average of a set of locality-level indicators (with respective weights in parentheses) known to be highly associated with poverty (World Bank, 1995):

1) Average family size (10 percent)

2) Percent without piped water in the home or yard (50 percent)

3) Percent without a latrine (10 percent), and

4) Percent of persons over age 5 who are illiterate (30 percent)

Higher index scores were associated with more impoverished areas. Since the index did not reliably distinguish between localities with similar scores, the 59 rural localities were grouped into four priority levels after renormalizing the highest index score to 100: a score of above 85 was given highest priority (priority 1); 70–85, priority 2; 60–70, priority 3; and below 60, lowest priority, 4. The 42 localities with priority scores 1 and 2 were eligible for the first stage, i.e., they were geographic-level targeted localities where there was no finer-level targeting originally planned; in the remaining 17 rural localities with priority scores of 3 and 4, targeting continued down to the household level, i.e., the household-level targeted localities (Arcia, 1999). For the purposes of evaluation, 21 of the geographic-level targeted localities were randomly selected for inclusion in the program in 2000, leaving the remaining 21 as controls for the evaluation. A baseline survey similar in content to the 1998 Nicaraguan LSMS was implemented in these 42 localities before the program began as part of the impact evaluation, allowing direct calculation of expenditure and estimates of poverty for a representative sample of households in those localities.

I now assess how well the marginality index distinguished among poor localities. In doing so, I make use of estimates of poverty in each of the 59 localities based on a proxy means model that I will refer to as the LSMS 1998 model, which was developed during this research and is described in section 4.3.[9] A simple way to examine the performance of the marginality index is to

[9] The results are similar if instead I use the Nicaraguan poverty map or Baseline 2000 model estimates (also described

consider the spearman rank correlation between it and estimated (extreme) poverty rates. The correlations between the marginality index and the poverty rate and extreme poverty rate were both 0.64, indicating a high degree of concordance. A second way to explore the performance is presented in Figure 1, which shows the marginality index on the horizontal axis graphed against predicted poverty levels for each locality on the vertical axis, based on the LSMS 1998 model. The straight line shows the estimated linear relationship between the two. As with the spearman rank correlation, there is an apparent relationship; once one takes into account the estimated 95 percent confidence intervals around the poverty estimates, however, even some localities categorized as priority 4, or least poor (to the left of 60), are not significantly lower than the majority of localities categorized as priority 1 (to the right of 85). This holds for both poverty (Figure 1a) and extreme poverty (Figure 1b), though the marginality index seems to do a better job with the latter, possibly because there is more variation in extreme poverty levels.[10] So while the marginality index has an association with poverty levels in the localities, once one takes into consideration the confidence intervals it has relatively weak predictive power.

[FIGURE 1 ABOUT HERE]

4.3 RPS Household Targeting

4.3.1 Ad hoc household targeting within "geographic-level targeted" localities

The initial program documents (in particular the Inter-American Development Bank loan contract) for Phase I of RPS called for 5,000 beneficiary households targeted using geographic-level targeting only (i.e., at the locality-level as described Section 2.1), and an additional 5,000 households targeted

in section 4.3) for locality-level poverty. They are also similar to results based on reported expenditure for a representative sample of households from the geographic-level targeted localities.

[10] One possibility is that the relative arbitrariness of the weighting system for the marginality index could have been improved upon. To assess this, a national rural model was estimated at the locality level in which the dependent variable was the poverty level and the four components of the index were the covariates. Although the estimated coefficients for poverty and extreme poverty suggest very different weights than those used by Arcia (1999), the improvement in ranking localities by poverty level is slight—spearman correlation coefficients improve only by about five percentage points.

via a combination of geographic- and household-level targeting methodologies. After implementing a registry census in May 2000 in the 42 localities slated for geographic-level targeting only, and randomly selecting 21 of them for the intervention, RPS discovered that there were close to 6,000 potential beneficiaries. Therefore to better approximate the target number of beneficiaries in the loan contract, RPS deviated from the original plan and excluded a percentage of households who appeared not to be extremely poor. The need for some adjustment was even more pronounced when an additional 949 households that had been missed in the initial census were discovered during program incorporation assemblies. These were integrated into the registry during a second RPS population census carried out in September 2000, two months before the first transfers were distributed.

Missing households in the first-round census fieldwork, particularly more isolated ones, was a common operational problem for the program as indicated by a third wave of entrants in these areas in 2001 and similar patterns when the program later entered different municipalities. In the first census, it appears the undercounting may have been due in part to contracting out the census activities. After that round, RPS internalized these activities. RPS showed appropriate flexibility in allowing most households not interviewed initially to enter the program.[11] An important lesson for RPS (and for other programs) was to strengthen the initial census activities to avoid missing households to the extent possible, as well as to provide a mechanism for correcting errors.

To refine the geographic-level targeting, then, RPS first excluded a small number of households *ex ante*, those that satisfied one or both of the following conditions:

- Owned a vehicle, truck, pickup truck, or jeep
- Owned more than 20 manzanas (14.1 hectares) of land.

[11] There is no evidence that the additional households were new to the areas (e.g., in-migrants) but rather they seem to have been isolated households or those that were temporarily absent during the initial census periods.

Using these criteria, 171 or 2.6 percent of households surveyed in the intervention areas were not invited to participate in the program. Then, after the incorporation assemblies, RPS excluded over 250 households for further investigation. An additional questionnaire that included questions about permanent employment, cattle holdings, small businesses, agricultural machinery, and domestic appliances was administered to these households, after which a small number were reinstated. In the end, 265 (4.0 percent) censused households were excluded for one or more of the following reasons:

- household comprising a single man or woman, or childless couple who were not disabled
- household with significant economic resources or a business
- household omitted or falsified information during the RPS population census.

A similar number of households did not attend the orientation assembly or chose not to participate in the program (259 or 3.9 percent). Thus in the first stage, the program excluded a total of 436 (6.6 percent) households and 259 (3.9 percent) households self-excluded, leaving 5,995 (89.6 percent) beneficiaries among the 6,690 rural households interviewed in the RPS population censuses of May and September 2000 in these 21 geographic-level targeted localities. A separate qualitative study also indicated that despite the repeated census activities there continued to be some households that were never included in a census, though it is not possible to judge how many. It seems likely that these comprised a small percentage of households, though the effects of their exclusion from the program may have been disproportionately important, particularly in terms of the perception of fairness (Adato and Roopnaraine, 2004).[12] RPS had provisions for appealing such exclusions, but it seems they were not well understood and it is unclear how well the functioned.

[12] Also of note from the qualitative assessment is that there was no mention of political influence in the targeting, likely a reflection of the centralized nature of the system.

In Table 5, I consider where the RPS censused households were located in the national distribution.[13] The first thing to notice is that consistent with the high rates of poverty calculated above, RPS beneficiary households were relatively poor—93 percent of the beneficiary households were in the bottom half of the national expenditure distribution.[14] Only a small percentage of households chose not to participate in RPS when given the opportunity. As in PROGRESA, there appears to have been a positive association between wealth and the probability of self-exclusion (Coady 2006; Álvarez *et al*., 2006). Both the pre- and post- household targeting carried out in these geographic-level targeted localities were slightly progressive, excluding proportionately more households from the upper expenditure deciles. Nevertheless, a significant number of households in the lower deciles also were denied the program.

[TABLE 5 ABOUT HERE]

4.3.2 Household targeting within household-level targeted localities

a. Development of the proxy means model

Even though there was substantial information available in the program areas—and plans to collect more—there was still not enough to be able to determine with *certainty* which households were and were not (extremely) poor. In areas where household-level targeting was to be implemented, the program design called for a proxy means model to be estimated and applied to potential beneficiaries.[15] Coady *et al*. (2004) found proxy means models to be among the most effective of those that they evaluated in their cross-country assessment, though the variation in performance was substantial.

[13] Each household's per capita expenditure is predicted using the LSMS 1998 model and then it is categorized in a decile of the national population where national deciles are drawn from the distribution of predicted expenditure in the national population for 1998. Predicted rather than actual expenditure are used in constructing deciles to put the two measures on a similar basis. See also MNPTSG (2002).

[14] Since households in the lower half of the national distribution are also on average larger, more than 95 percent of the individual beneficiaries (i.e., persons) were from the bottom half of the national distribution.

[15] The original program design also called for local input into decisions about who would be excluded. While this may have occurred on an informal basis, it was not widely or systematically implemented (Adato and Roopnaraine, 2004).

The purpose of the proxy means model was to identify extremely poor households for inclusion in the program. During development of the household targeting system, two different prediction models were estimated, in addition to the model already available from the Nicaraguan poverty map. There were two reasons why RPS did not simply implement the poverty mapping prediction model from the Nicaraguan poverty map. The first was that, as a pilot, it was important to explore new options for targeting. The second was that the poverty map model only included explanatory variables appearing in both the 1995 National Census and the 1998 Nicaraguan LSMS, which were used to estimate it. The 1995 National Census, like most national censuses, did not include a number of factors that have proven to be good predictors of expenditures. As such, estimating a new prediction model allowed the possibility that new explanatory factors could be included in the proxy means prediction, improving precision (Grosh and Baker, 1995). For example, variables measuring durable goods and access and use of credit were incorporated. This was particularly important given Hentschel *et al.*'s (2000) warnings against using such models to target down to the household level because of their imprecision.

The first proxy means model was estimated in April 2000 using the 1998 Nicaraguan LSMS. Modeling the logarithm of per capita expenditure as the dependent variable,[16] over one hundred variables were constructed as potential regressors. These included factors such as location, size and composition of the household, levels of education of household members, and characteristics of the living environment. All households from rural areas of the Central Region were selected. Stepwise estimation yielded a model with 21 explanatory variables (StataCorp, 2007). With this subset of variables, the model was able to explain approximately half of the variation in logarithmic per

[16] The measure of per capita expenditure constructed by the World Bank and available in the publicly released data was used, to ensure comparability with other work including the poverty map (World Bank 2001, Annex 1). If one instead assumes that infants and children consume less, using per capita measures has the effect of underestimating adult equivalent per capita expenditure for households with children; since they are central to the objectives of the program using per capita expenditure without adjusting for adult equivalence scales tends to bias the predictions toward including households with more children.

capita expenditure in the sample. These “proxy” variables had many potential advantages. For example, they were less costly to collect than complete expenditure information and they were selected in a fashion to make them less susceptible to falsification (or alteration) by respondents. IFPRI (2002) presents the details.

It is important to emphasize that it is inappropriate to interpret these estimated relationships as causal; instead, they represent associations among a set of factors that is highly correlated with per capita expenditure. For example, the association between family size and per capita expenditure, in part due to the construction of the indicator that has the same variable on both sides of the equation, cannot be interpreted as causal. A similar concern arises from the use of durable goods as explanatory factors since the dependent variable includes imputed use values for these same goods. As a final example, it would be inappropriate to interpret the use of credit as a causal factor in per capita expenditure since it may be that the fact the household has credit allows it to spend more or it may be that the fact that the household has access to a lot of resources it is able to spend more, as well as gain access to (formal) credit.

With the completion of this proxy means model, which I refer to as the LSMS 1998 model, the RPS population census questionnaire was designed to 1) collect information necessary to register beneficiaries in the programs and 2) collect all the explanatory factors from the above model to allow prediction of per capita expenditure during the RPS census of the program areas begun in May 2000.

In August and September 2000, a baseline survey was implemented for the evaluation in all the geographic-level targeted localities. This survey included, among other things, an expenditure module based on the 1998 LSMS questionnaire. As a result, upon collecting that information it became possible to estimate a second proxy means model using the Baseline 2000 data. This model had two advantages over the LSMS 1998 model. First, it was based only on information from the

six program municipalities. Second, it was measured in 2000, rather than in 1998, so it more accurately reflected the relationship between proxy variables and expenditure in 2000—this relationship may have changed over time for a variety of reasons, including the effects of Hurricane Mitch in late 1998, which devastated some areas of the country. A disadvantage of the Baseline 2000 model, however, was that it could be estimated only for households living in geographic-level targeted localities with priority levels 1 and 2, and therefore may be less accurate for prediction in the other (household-level targeted) localities. This might occur if the relationship between per capita expenditure and its correlates differs for the on average poorer households in geographic-level targeted localities compared to the households in household-level targeted localities. Weighing these tradeoffs and recognizing that the marginality index was unable to distinguish sharply between localities so even those selected for household-level targeting may not have been very different, the Baseline 2000 model was used in selecting households in household-level targeted localities.

b. Precision of the proxy means model

It is well known that proxy means predictions, regression-based predictions, are imprecise. Indeed, the poverty mapping literature cautions us against using those techniques for small area samples (e.g., below several hundred households)—proxy means approaches essentially take the prediction to the extreme, down to a single household observation. To demonstrate the imprecision, I graph the predictions of per capita expenditure for all households in household-level targeted localities, as well as their associated 95 percent confidence intervals, based on the Baseline 2000 model that was used for targeting (Figure 2). Also included in the chart are the estimated extreme (C$ 2,809) and moderate (C$ 5,326) poverty lines. This graph makes clear that the level of imprecision when trying to predict per capita household expenditure at the household level is enormous (and increases with expenditure). For example, a household at the 50^{th} percentile of the

predicted distribution in Figure 2 has an estimated per capita expenditure of just under C$ 4,000 but a 95 percent confidence interval that ranges from C$ 1,400 to C$ 11,000, making it difficult to determine whether the household is extremely poor, poor, or nonpoor.

[FIGURE 2 ABOUT HERE]

An alternative way to view these predictions is to convert them into estimates of the probability of whether each household is extremely poor (or poor). Figure 3 presents estimates for the same households shown in Figure 2. The height of the bottom curve represents the probability that a household is extremely poor given its predicted level of per capita expenditure. For example, a household with a predicted per capita expenditure of C$ 2,809, the extreme poverty line, has a fifty-fifty chance of being extremely poor (below the line). In similar fashion, the upper curve shows the probability that a household is poor, given its predicted expenditure per capita.

Since the RPS mandate was to target extremely poor households, the proxy means model was employed for targeting in a fashion to ensure a relatively small probability of excluding extremely poor households, i.e., of committing exclusion errors. From Figure 3, it is clear that in this sample if households with predicted per capita expenditure above the poverty line were excluded, this would result in a probability of approximately 8 percent or less of excluding a household that was, in fact, extremely poor. As a result, the decision was taken to exclude all such households. This rule has two interpretations. First, one can think of it as a rule excluding households with predicted permanent expenditure above the poverty line. While simple to understand, this is unsatisfactory in the sense that because the predictions are imprecise, households with predictions near (but below) the cut-off have a approximately 50 percent probability of being incorrectly excluded. Of course, given the sharp cut-off point represented by a poverty line, this is unavoidable. The second interpretation is that households are excluded that have an approximately 8 percent (or less) probability of being extremely poor—the target population for RPS.

[FIGURE 3 ABOUT HERE]

c. Assessment of targeting using the proxy means model

I turn now to an assessment of the effectiveness of this targeting, placing beneficiary and nonbeneficiary households in the national distribution (as was done in the previous subsection in Table 5), in Table 6. I caution that these results may overstate the success of the methodology because I use the same information to assess targeting that was used to carry out the targeting (therefore there are no "errors" in those eliminated pre-assembly). The table, then, is meant to be indicative and the extent to which errors crept into the targeting will be captured when I consider leakage and coverage rates (that account for estimation errors) below.

[TABLE 6 ABOUT HERE]

Subject to these caveats, the table shows that targeting was effective in terms of benefiting households in the lower portion of the national distribution. Very few households self-excluded at the start of the program in these areas. The small amount of targeting carried out by RPS post-assembly (in a manner similar to the ad hoc methods used in the localities discussed in the previous subsection), however, does not appear to have been very effective.

4.4 Undercoverage and leakage in the program areas

The final assessment of targeting in RPS that I provide is undercoverage and leakage rates. Since RPS was a pilot program operating in only six of 151 municipalities in Nicaragua, it is not informative to calculate undercoverage for the program on a national scale. Therefore, I do so only for the areas in which the program was operating. Undercoverage is defined as the percentage of poor households excluded from the program of all poor households in the program areas. Leakage, on the other hand, is the percentage of nonpoor households included in the program of all households included in the program.

In areas originally slated for geographic-level targeting, the undercoverage rate is predictably low whereas leakage is somewhat higher. If pure geographic-level targeting had been implemented, that is if all households had been included, then the undercoverage rate would have been zero and the leakage to the nonpoor would have been the percentage of nonpoor in the areas. Because of the small amount of *ex post* household targeting, as well as self-exclusion by some households, however, undercoverage necessarily will increase though the effect on leakage is ambiguous. Undercoverage for the poor was 3 percent in these areas and leakage to the nonpoor, 14 percent (the estimates are based on the same information underlying Table 5). Most of this leakage, however, was to households that were not in the upper three deciles of the national income distribution.[17]

The implementation of the proxy means test and household-level targeting was expected to improve (i.e., reduce) leakage, but at the same time possibly increase undercoverage as a result of making a greater number of errors. To calculate undercoverage and leakage for areas that had household targeting, however, it is not possible to use the information underlying Table 6 but instead they must be based on probabilities underlying the prediction model.[18] As expected, leakage to the nonpoor improved (i.e., was reduced), to 6 percent, in these areas while undercoverage increased, to 10 percent. These rates compare favorably with PROGRESA, which implemented a similar household-level targeting strategy, where undercoverage and leakage rates for the poor were both 16 percent (Skoufias *et al*., 2001). Because PROGRESA covered a much larger proportion of

[17] These estimates do not adjust for households that apparently were never included in a census, as indicated by Adato and Roopnaraine (2004). Such an exclusion is likely to bias downward slightly my estimate of the undercoverage rate.

[18] Undercoverage = [(Probability of being poor | household was excluded) × Number of excluded households] / Total number of poor households. Leakage = [(Probability of being nonpoor | household was included) × Number of included households] / Total number of included households.

the country, which likely included more heterogeneous areas making targeting more difficult, however, it is not surprising that RPS might have done better.

Finally, a comparison of the targeting effectiveness of RPS against a wider array of programs can be made if instead we consider the percentage of program resources going to the bottom two quintiles of the population. Coady, Grosh, and Hoddinott (2004) develop an indicator of this which is the percent received by the bottom two quintiles divided by 40 percent, representing a uniform distribution of benefits. A so-called CGH indicator score of 1 suggests targeting is approximately uniform and neither regressive nor progressive, scores higher than 1 are progressive. For RPS in geographic-level targeted localities, the score is nearly 2 and in household-level localities it is approximately 1.5. These compare favorably with other proxy means targeted programs (which ranged from 0.50 to 2.08, Castañeda *et al*. 2005) and were among the top third of all programs considered by Coady et al. (2004).

5. CONCLUSIONS

This article describes the details underlying the Nicaraguan RPS targeting, emphasizing the rationale for how it was designed and implemented, based on available information. It offers, by way of example, a guide for targeting in an anti-poverty program, and highlights some of the potential tradeoffs. In judging the targeting, it is important to recognize that RPS was in its pilot phase—targeting decisions made during the pilot were part of a learning process and also may have reflected different criteria than those that would be used during an expansion of the program.

At the broad geographic-level, targeting was based on a set of criteria that included, but were not limited to, poverty. This strategy was appropriate given both the pilot nature of the program, as well as its design, since it would have been self-defeating, for example, to target the program to areas without schools. As a result, program areas, though not the poorest areas in the country, had poverty rates well above national rural levels.

For targeting at the household level, RPS used locally collected information to develop a proxy means prediction model for household-level logarithmic per capita expenditures (considered more stable than income) that required easily obtainable and verifiable predictor variables. The latter were collected as part of the census information gathering activities necessary for the program. One area for continued diligence in RPS and related programs is ensuring comprehensive coverage during census activities. Targeting on expenditures favored the objective of targeting poor households rather than explicitly incorporating the other RPS program objectives of improved child health and education, though the loss in accuracy to using this approach was likely small. Due to the nature of regression analysis, the confidence intervals associated with these household-level per capita expenditure predictions were relatively large. As a result, a decision rule aimed at mitigating the effects of this uncertainty was implemented—households with predicted probability of approximately 10 percent or less of being *extremely* poor were deemed eligible for the program. In this fashion, few extremely poor households were expected to be excluded, though the probability of excluding a poor household whose predicted per capita expenditures was near the poverty line, was about 50 percent.

Despite their imprecision, these statistical techniques, in conjunction with the prior geographic-level targeting and subsequent self-selection of households out of the program, led to targeting that was on average effective, exhibiting relatively low leakage and undercoverage rates in the areas of operation. Even in areas where leakage was its highest (15 percent), however, it was important to recognize that the nonpoor in this beneficiary population was relatively poor in the overall national income distribution. It is fair to say that much of the success of the household targeting rests on the geographic targeting that came before it.

A key aspect of RPS that facilitated the development of a proxy means targeting model was the substantial informational requirements of the program. As in PROGRESA (Skoufias *et al*.

2001), this design feature minimized the marginal costs of collecting additional information necessary for application of the targeting models, so that they represented only a tiny percentage of total administrative costs. Programs without similar information requirements would need to consider more carefully the costs involved in mounting such a targeting system (Coady *et al*., 2004).

Despite using the most relevant possible data, up-to-date and from the very same municipalities where the program was operating, the methods used for household-level targeting in RPS remain imprecise. While the number of exclusion errors appears to be small this does not readily translate into their being unimportant. Related research for PROGRESA in Mexico shows that even small (quantitative) errors in targeting may have other important ramifications that can affect the success of the targeting and the overall effectiveness of the program (Adato, 2000). Moreover, in Nicaragua, Adato and Roopnaraine (2004) found that the RPS targeting mechanisms were not well understood at the local level. Community members offered a variety reasons for why or why not households were included: luck, God, or location on the map—which referred to the fact that the census maps used by program officials were not always coincident with communities. These findings, combined with the known prediction imprecision, serve as a reminder that statistical targeting can never be perfect, and point to the importance of developing complementary processes (such as appeals) to go along with the statistical models.

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Table 1—Nicaraguan RPS eligibility and benefits

	PROGRAM COMPONENTS	
	Food Security, Health, and Nutrition	**Education**
ELIGIBILITY		
Geographic-level targeting	All households[a]	All households[a] with children ages 7–13 who have not yet completed fourth grade of primary school
Household-level targeting	Households with predicted expenditure below poverty line	Households with predicted expenditure below poverty line with children ages 7–13 who have not yet completed fourth grade of primary school
DEMAND-SIDE BENEFITS		
Monetary transfers	**Food security transfer** $224 per household per year	**School attendance transfer** $112 per household per year **School supplies transfer** $21 per child beginning of school year
SUPPLY-SIDE BENEFITS		
Services provided and monetary transfers	Health education workshops every two months Child growth and monitoring -Monthly: 0–2 year olds -Every two months: 2–5 year olds Provision of anti-parasites, vitamins, and iron supplements Vaccinations (0–5 year olds)	**Teacher transfer** US $6 per child per year given to teacher/school

a. As described in section 4.3, a small percentage of households were excluded.

Table 2—Nicaraguan RPS targeting criteria and data sources

Level of targeting	Criteria / Methodologies	Data sources
Department	• High levels of poverty, especially of extreme poverty • Good access to schools and health posts • Easy access and communication • Strong institutional capacity and local coordination	• 1995 National Census • Various government administrative data
Municipality	• *Criteria for department level* • FISE participatory development program in municipality	• 1995 National Census • Various government administrative data
Locality	• Marginality index score (Arcia, 1999)	• 1995 National Census
Household	• Proxy means test	• 1995 National Census • 1998 Nicaraguan LSMS • 2000 RPS population census • 2000 RPS baseline survey

Table 3a—Estimated poverty in department of Madriz, Nicaragua: By municipality				
Municipality	Rural poverty rate 1998 (%)	Rural poverty rank 1998	Rural extreme poverty rate 1998 (%)	Rural extreme poverty rank 1998
Las Sabanas	82.2	5	45.3	3
Palacagüina	74.3	9	34.3	9
San Jose de Cusmapa	86.5	2	50.3	2
San Juan de Rio Coco	76.9	8	38.5	8
San Lucas	82.8	3	44.8	4
Somoto	79.8	7	42.0	6
Telpaneca	82.7	4	44.5	5
Totogalpa	**90.0**	**1**	**54.4**	**1**
Yalagüina	**80.2**	**6**	**40.6**	**7**
Department of Madriz	80.9	n.a.	43.1	n.a.

Source: Author's calculations based on Nicaraguan poverty map and 1995 National Census.
Municipalities in bold were those selected for RPS.

Table 3b—Estimated poverty in department of Matagalpa, Nicaragua: By municipality

Municipality	Rural poverty rate 1998 (%)	Rural poverty rank 1998	Rural extreme poverty rate 1998 (%)	Rural extreme poverty rank 1998
Ciudad Darío	**75.2**	**10**	**36.4**	**11**
El Tuma-La Dalia	**77.3**	**9**	**39.7**	**8**
Esquipulas	**79.8**	**4/5**	**40.9**	**5**
Terrabona	**78.5**	**7**	**38.4**	**9**
Matagalpa	74.5	11	36.2	12
Matiguas	80.8	3	44.0	1
Muy Muy	80.9	2	43.4	2
Rancho Grande	79.8	4/5	42.4	4
Río Blanco	81.0	1	43.2	3
San Dionisio	79.0	6	40.1	6
San Isidro	74.4	12/13	37.0	10
San Ramón	77.6	8	40.0	7
Sebaco	74.4	12/13	35.5	13
Department of Matalpa	77.6	n.a.	39.6	n.a.

Source: Author's calculations based on Nicaraguan poverty map and 1995 National Census.
Municipalities in bold were those selected for RPS.

Table 4—Estimated poverty in Rural areas of RPS municipalities: Sensitivity to estimation approach

	1998		2000			
	Nicaragua poverty map model		LSMS 1998 model		Baseline 2000 model	
Municipality	Rural poverty rate	Rural extreme poverty rate	Rural poverty rate	Rural extreme poverty rate	Rural poverty rate	Rural extreme poverty rate
Totogalpa, Madriz	90.0	54.4	87.4 (1.2)	53.1 (1.9)	95.7 (0.8)	75.1 (1.9)
Yalagüina, Madriz	80.2	40.6	77.3 (1.4)	39.0 (1.5)	68.5 (2.8)	28.4 (2.6)
Ciudad Darío, Matagalpa	75.2	36.4	72.3 (1.3)	34.4 (1.4)	70.1 (2.2)	30.9 (1.8)
El Tuma-La Dalia, Matagalpa	77.3	39.7	82.2 (1.0)	46.0 (1.4)	80.9 (1.2)	45.2 (1.5)
Esquipulas, Matagalpa	79.8	40.9	79.5 (1.4)	40.9 (1.7)	73.7 (1.7)	35.6 (1.7)
Terrabona, Matagalpa	78.5	38.4	76.3 (1.6)	35.9 (1.7)	74.4 (1.9)	33.2 (1.9)
Total (all six municipalities)	78.2	41.1	79.2 (1.1)	41.9 (1.4)	77.3 (1.0)	40.8 (1.1)

Source: Author's calculations based on Nicaraguan poverty map and 1995 National Census in first two columns and based on prediction models and RPS data in the remainder of the table. As described in the text, data were not available to permit calculation of standard errors for estimates based on the Nicaraguan poverty map.

Table 5—RPS beneficiary and nonbeneficiary households in the Nicaraguan national expenditure distribution: Geographic-level targeted localities

	Expenditure Decile										
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Total
Beneficiary	2036 (95.1)	1479 (94.1)	861 (91.4)	721 (88.8)	456 (85.4)	251 (77.7)	121 (61.7)	58 (52.3)	8 (21.1)	4 (17.4)	5995 (89.6)
Self-excluded	76 (3.6)	58 (3.7)	38 (4.0)	26 (3.2)	27 (5.1)	14 (4.3)	16 (8.2)	2 (1.8)	2 (5.3)	0 (0.0)	259 (3.9)
Eliminated pre-assembly	10 (0.5)	19 (1.2)	22 (2.3)	19 (2.3)	17 (3.2)	25 (7.7)	18 (9.2)	13 (11.7)	10 (25.3)	18 (78.3)	171 (2.6)
Eliminated post-assembly	18 (0.8)	15 (1.0)	21 (2.2)	46 (5.7)	34 (6.4)	33 (10.2)	41 (20.9)	38 (34.2)	18 (47.4)	1 (4.4)	265 (4.0)
Total	2140 (32.0)	1571 (23.5)	942 (14.1)	812 (12.1)	534 (8.0)	323 (4.8)	196 (2.9)	111 (1.7)	38 (0.6)	23 (0.3)	6690 (100.0)

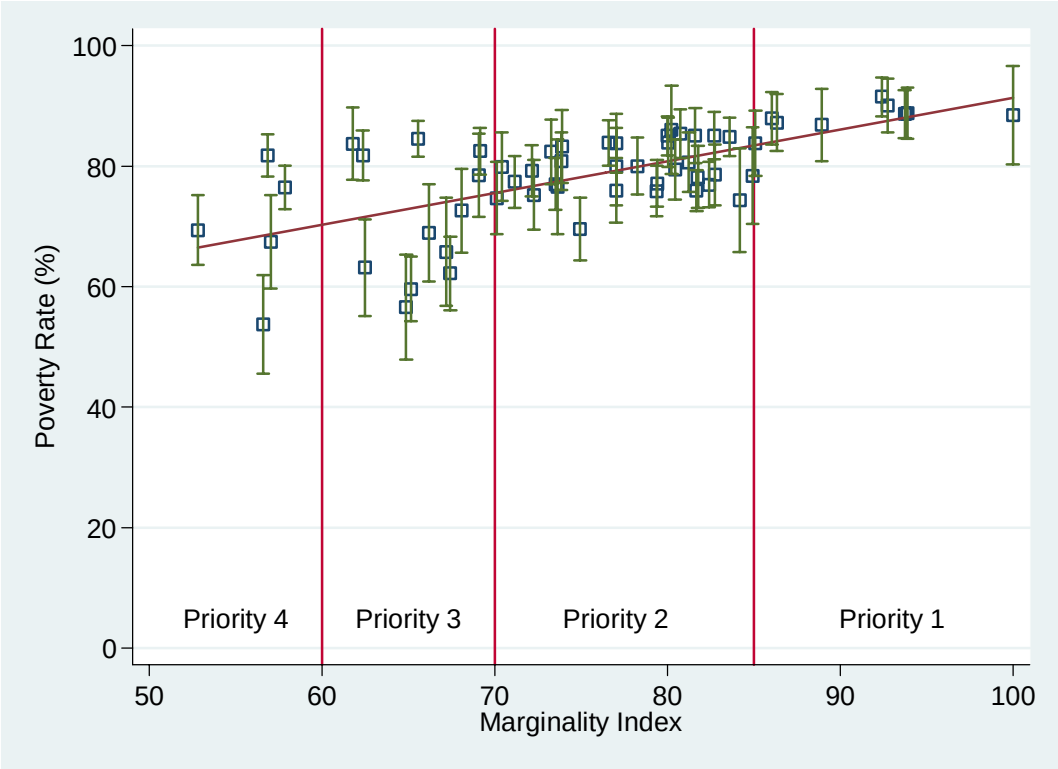
Source: Author's calculations based on LSMS 1998 model. Row percentages in parentheses, except for Total row which presents the column percentages.

Table 6—RPS beneficiary and nonbeneficiary households in the Nicaraguan national expenditure distribution: Household-level targeted localities

	Expenditure Decile										
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Total
Beneficiary	560 (98.4)	599 (98.5)	505 (99.2)	519 (97.2)	474 (98.1)	142 (33.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2799 (74.9)
Self-excluded	2 (0.4)	2 (0.3)	2 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (0.2)
Eliminated pre-assembly	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	277 (65.2)	271 (100.0)	177 (100.0)	99 (100.0)	60 (100.0)	884 (23.0)
Eliminated post-assembly	7 (1.2)	7 (1.2)	2 (0.4)	15 (2.8)	9 (1.9)	6 (1.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	46 (1.2)
Total	569 (15.2)	608 (16.3)	509 (13.6)	534 (14.3)	483 (12.9)	425 (11.4)	271 (7.3)	177 (4.7)	99 (2.7)	60 (1.6)	3735 (100.0)

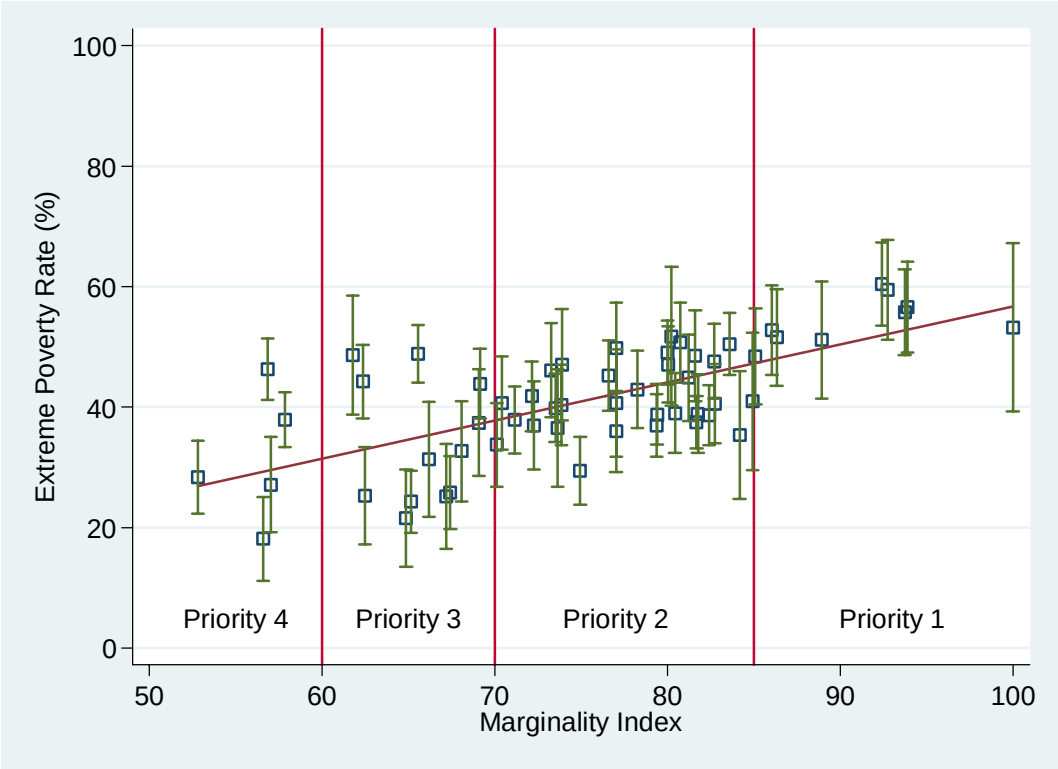
Source: Author's calculations based on Baseline 2000 model. Row percentages in parentheses, except for Total row which presents the column percentages.

Figure 1a—Locality-level poverty rates (and 95% confidence intervals) and the marginality index



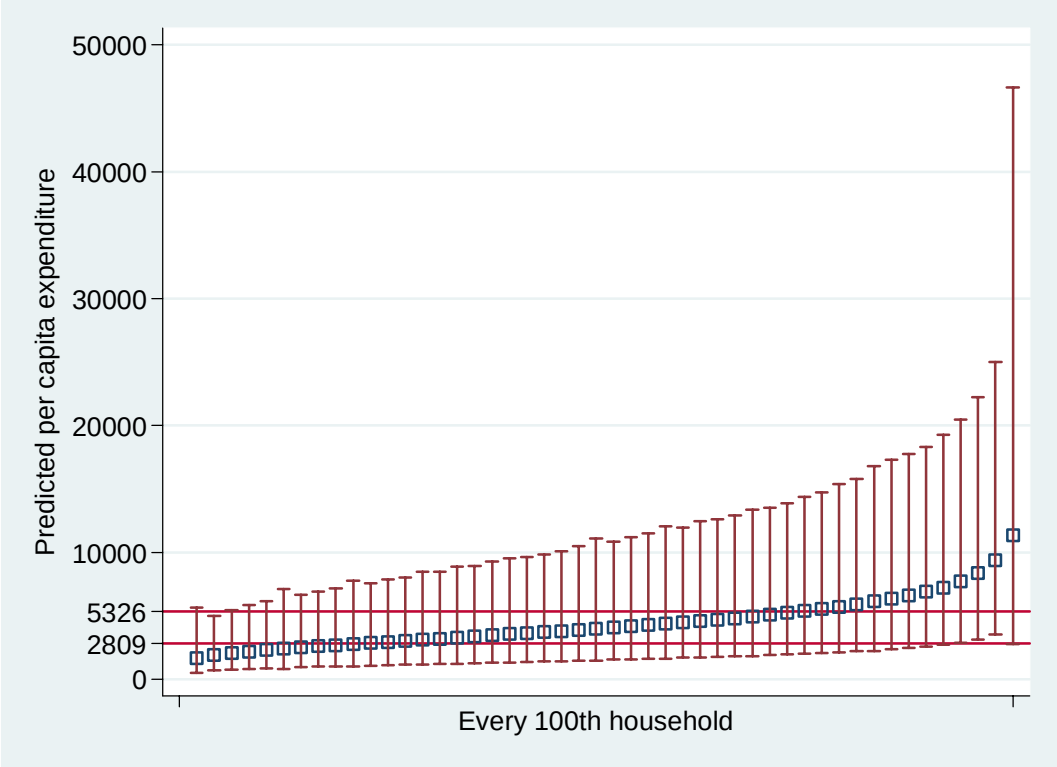
Source: Author's calculations based on LSMS 1998 model.

Figure 1b—Locality-level extreme poverty rates (and 95% confidence intervals) and the marginality index



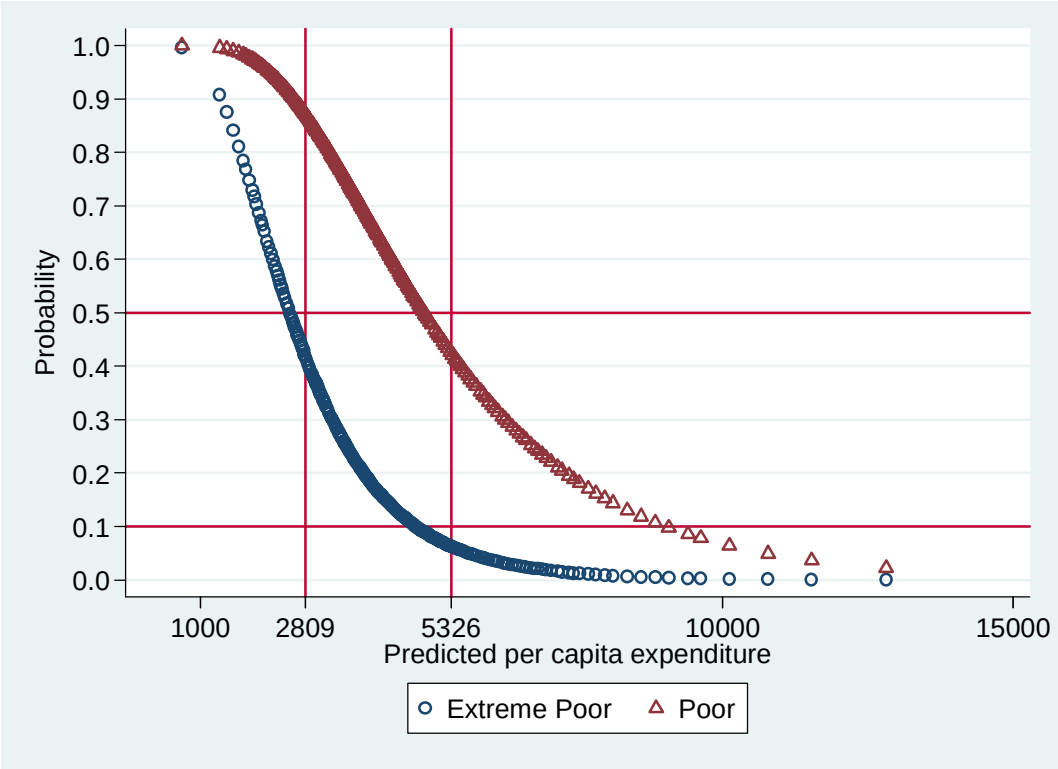
Source: Author's calculations based on LSMS 1998 model.

Figure 2—Predicted poverty at the household level (and 95% confidence intervals)



Source: Author's calculations based on Baseline 2000 model.

Figure 3—Predicted probability of being (extremely) poor at the household level



Source: Author's calculations based on Baseline 2000 model.