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Poverty Alleviation Policies: The Problem of Targeting when Income is not Directly Observed.

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Summary

This paper aims to propose an indicator to evaluate the degree of targeting of programs to alleviate poverty, which weights success of reaching (families correctly included) and leakage (families wrongly included) in a social program. A *proxy means-tested* criterion is also proposed, based on estimation of the *propensity score* (the probability of a family being poor, conditional on covariates). This criterion consists of choosing a cut-off value for the *propensity score* in such a way as to maximize the proposed indicator. An application of the indicator to the metropolitan regions of Brazil is carried out. It is shown that even when there is a social consensus that policies should be directed toward the truly needy families, a significant degree of mistargeting can persist.

Key words

Poverty, targeting, policy, proxy means-tested, Brazil.

1. Introduction

Many governments have spent a lot of money on social policies; but even so, a significant proportion of the poorer population continues to be badly served, while at the same time people with relatively higher incomes become the beneficiaries of such programs. Several analysts argue that the inability of many governments to eliminate or substantially reduce poverty is due to social policy being inadequately targeted. For example, according to Lustig and Deutsch (1998), if policies were perfectly targeted, the volume of transfers necessary to eliminate extreme poverty in the countries of Latin America and the Caribbean is in a range between approximately 0.5% and 1% of GDP. In other words, the elimination of poverty problem is not a lack of funds, but the structure of the transfer policies.

Although widely defended by economists, targeting of social policies can present both economic and political problems. The economic problems are concerned with the negative incentives to work. One of the most common forms of targeting is to reduce benefits as income rises, imposing a high marginal income tax, discouraging work. From the point of view of welfare, it can be argued that a targeted social policy is preferable to a policy of universalized benefits.

A reduction in distortive taxes on the richer (more productive) taxpayers equal to the amount of transfers which they receive, associated with elimination of these benefits, would tend to reduce the distortions in the price system and increase the income of this group. They would thus finish up paying a higher net amount of taxes (after discounting the benefits received). If this increase in taxes were transferred to those people who continue to be

recipients of the social benefits (the less productive ones), all would have a better situation at the end of the process. Thus this latter situation is superior to the system of universalized benefits.

The second problem in targeting social programs is the possible lack of political support. It is possible that, in a democracy, political equilibrium occurs when a significant proportion of the population, much larger than the proportion of those truly in need, is included in a benefit program. On the other hand, when only the poorest are included, there is a possibility of the funding destined for the program falling far short of the necessary volume: programs for the poor would be poor programs. In this case, targeting only for the most needy finishes up being worse for the poor themselves.[1].

Assuming there is a social consensus on the need to target only the poorest, there is a possibility that governments may not know how to do this in a precise form, or that the cost of this may be extremely high. Thus an additional aspect of the difficulties of targeting social policies, dealt with in this paper, relates to questions of a technological nature[2]. In the case of policies aiming to alleviate poverty, this problem can arise when the income of the potential beneficiaries is not directly observed by the executors of the program. This problem can be especially marked in developing countries, where a significant proportion of the population is in the informal sector of the economy, making the task of observing income much more difficult.

In general, analyses of targeting have tended to consider one of two aspects: (i) distribution of spending, or (ii) access. In the case of poverty alleviation policies, the first of these aspects is concerned with evaluating the relationship between the distribution of benefits among poor families and the intensity of their poverty. One criterion suggested for targeting is to distribute a fixed amount of funds between families, in such a way as to minimize a certain given measure of aggregate poverty [Ravallion and Chao (1989)]. The second, which is dealt with in this paper, assumes a fixed benefit per family, and a target public to be assisted – in this case, all the poor families. The use of targeting involves some mechanism which discriminates between the poor and the non-poor and a criterion for inclusion which maximizes some welfare function, which involves a weighting of the two types of possible errors: exclusion of the poor, and inclusion of the non-poor [Wodon (1997)].

The usual procedure for classification of the poor is to define a "poverty line" and consider as poor all those who live in families whose per capita income is equal or lower than this amount. Thus, a perfectly-targeted poverty alleviation program would include only the families with *per capita* income below the poverty line (*means-tested*) [3].

When income is not directly observed, an alternative is to use personal and family characteristics which are easier to observe, and are correlated to income (*proxy means-tested*). However, since the correlation between income and the variables used is not perfect, the use of a *proxy means-tested* criterion is subject to the two types of divergence from perfect targeting: exclusion of families which ought to be included in the program, and inclusion of those which ought to excluded. That is to say, when income is not directly observed, there is some degree of "mistargeting" implicit in poverty alleviation policies[4]. The question is how significant the proportion of the erroneous allocations tend to be.

This paper has two tasks. The first is to offer a criterion of *proxy means-tested* for targeting poverty alleviation policies, which seeks to optimize the use of information contained in directly observed variables. The criterion for inclusion is based on estimated *propensity score* (the probability of a family being poor, conditional on covariates). The second purpose is to evaluate the degree of expected "mistargeting", even when the executors of social programs use the *proxy means-tested* mechanism in an efficient way.

The paper has four sections, other than this introduction. The first (Section II) briefly discusses the dilemmas involved in determining the degree of targeting desired, and proposes an indicator of the degree of targeting. Section III takes into account a criterion for inclusion in a program, in which *propensity score* cut-off is chosen to maximize the proposed targeting indicator. In Section IV, an empirical illustration of the mechanism is presented using real data for the metropolitan regions of Brazil. The closing section contains final comments.

2. A Targeting Indicator

There are several mechanisms involved in reaching the target population in social programs[5]. The choice of one or other mechanism, or even a combination of mechanisms at different stages of the program, has to be made on the basis of three criteria: (i) reaching efficiency (number of poor people included); (ii) the degree of leakage (number of the non-poor included); and iii) administrative costs[6].

Along programs which aim to combat poverty, the targeting effort should, simultaneously, minimize the exclusion of poor people (type I error) and the inclusion of non-poor people (type II error). However, a trade-off tends to exist between these two types of error. As a program expands, there is a tendency for type I errors to diminish and type II errors to increase. The opposite occurs when there is a reduction in a program. An initial problem is to decide on an ideal combination of these two types of error.

For a program of given scale, it is possible simultaneously to reduce both types of error, if the capacity to discriminate between the poor and the non-poor is improved. Improvement of this capacity to discriminate, in turn, tends to increase the administrative costs of the program, thus imposing another trade-off for policymakers.

Taking these into account, the indicator proposed in this paper is[7]:

$$T = a\left[P_I - P_E\right] + (1-a)\left[NP_E - NP_I\right] \qquad (1)$$

where,

T = the targeting indicator;
P_I = proportion of poor families correctly included in the program;
P_E = proportion of poor families wrongly excluded from the program;
NP_E = proportion of non-poor families correctly excluded from the program;
NP_I = proportion of non-poor families wrongly included in the program; and
a = the weighting factor, where $0 \leq a \leq 1$.

As can be seen $T \in [-1,1]$, and the closer it is to one, the better the degree of targeting. When T = 1, targeting is perfect. The term $\left[P_I - P_E\right]$ represents the efficiency in the reach of the policy. A value of 1 indicates that all the poor families have been included, while a value of –1 indicates they have all been excluded. The term $\left[NP_E - NP_I\right]$ is a measure of the inaccuracy of the program. A value of 1 indicates that all the non-poor families have been duly excluded, while a value of –1 indicates they have all been wrongly included. Lastly, α is the weighting factor which specifies the relative weighting between these two evaluation criteria.

For a better understanding of the indicator, we can initially assume that α is 0.5, thus $T = [P_I - NP_I]$. That is to say, the indicator evaluates only the difference in the probabilities of inclusion in the program, for poor and non-poor families. Note that if the choice of the families to be benefited is made randomly, then $E[T]=0$. Thus, if $T > 0$, the selection method adopted has a capacity to discriminate between the poor and the non-poor better than a simple lottery.

Note that in the above situation, the capacity for discrimination is the only relevant criterion. Thus, the level of targeting would be the same if $P_I = 1$ and $NP_I = 0{,}6$, or if $P_I = 0{,}5$ and $NP_I = 0{,}1$. However, it is possible to argue that the first situation would be preferable, since it provides for all the poor people to be reached. It is a value judgement that gives more weight to the inclusion of the poor than to the exclusion of the non-poor. This can be made explicit in (1) by the term α. Note that when $\alpha = 1$, then $T = [P_I - P_E]$, that is to say only the criterion of inclusion of the poor is considered. In this case, a trivial solution which maximizes T would be universalization of benefits. Thus, when $0 < a < 1$ there is a combination of these two criteria: discrimination and inclusion of the poor.

The targeting index defined in (1) does not take into account the degree of poverty. A poor family which is excluded from the program and has income close to the poverty line produces the same impact on the index as the exclusion of a family whose poverty is more pronounced. Similarly, the inclusion of a non-poor family with income close to the poverty line results in the same impact as the inclusion of a richer family. However, it is possible to take into account the intensity of poverty (wealth) by using a system of (re)weighting based on the distance between a family's per capita income and the poverty line. The greater this distance, the greater the weight attributed.

A possible (re)weighting factor, used in Section IV below, is $\frac{g_i}{E(g_i \mid D_i = 0,1)}$, where $g_i = |L - Y_i|$; L is the poverty line; Y_i is per capita family income; and D_i is a qualitative variable which takes the value of 1 when the family is poor and 0 when it is non-poor. Thus, the weight attributed to the poor (non-poor) family is determined by the ratio between its distance from the poverty line and the average distance of poor (non-poor) families from the poverty line.

3. A Targeting Criterion

Let us assume that the executors of a poverty alleviation program are unable to observe per capita family income directly, but do know the *propensity score* $P(X_i) = \Pr(D_i = 1 | X_i)$, where X_i is the vector of the observed characteristics of family "i". Let us also assume that they wish to obtain the highest possible degree of targeting, based on the T defined in (1) above. Their task would thus be to choose a cut-off value of $P(X_i)$ which results in all the families with equal or higher values being included in the program. This must be done in such a way to maximize T.

Proposition 1: T is maximized when all the families with $P(X_i) \geq \frac{(1-a)PO}{a\ NPO + (1-a)PO}$ are included in the program, where PO is the number of poor families and NPO is the number of non-poor families.

Proof: see appendix.

Note that when $\alpha = 0.5$, the targeting indicator is maximized by the inclusion of all the families for which the probability of being poor is equal to or greater than the proportion of poor families in the population, that is to say the condition for inclusion becomes $P(X_i) \geq \Pr(D_i = 1)$ [8].

Proposition 2: For any criterion of inclusion in a social program based on a cut-off value of $P(X_i)$, there is an $a \in [0,1]$ for which the criterion adopted maximizes T.

Proof: follows directly from proposition 1.

Proposition 2 states that to the extent that the inclusion criterion adopted in *proxy means-tested* mechanisms can be related to a *propensity score* cut-off value, another form of evaluating the degree of targeting of a program is to find its implicit α.

The use of the criterion presented in this section requires – only – an estimate of the *propensity score*. It is, thus, fully viable for countries which have household surveys which include reliable income information.

4. An Application of the Targeting Criterion to the Brazilian Metropolitan Regions

The information source used in this section was Brazil's National Household Sample Survey (PNAD) carried out by the IBGE, the Brazilian government statistics institute, for the year of 1998. For poverty lines we adopted the estimates of Rocha (1997)[9], among the most used in literature on poverty in Brazil.

An initial question which arises in this type of study is the treatment to be given to the unemployed. The PNAD, for example, has only information on the current income of the individual in the month of the survey (September). If zero income is attributed to the unemployed, families with their heads in this situation would have a high chance of being classified as poor. This creates some difficulties: (a) this situation is, usually, transitory; (b) families with a high standard of living may be classified as poor; and (c) monitoring unemployment can be as difficult as monitoring income itself, especially in countries with a large informal sector. At the same time, it can be argued that the problem of unemployment should be dealt with by other programs, while poverty alleviation programs should remain focused on structurally poor families.

In this study, it was decided to impute earnings to all the unemployed and, based on this, to recalculate per capita family income. The following procedure was adopted:

(1) For each of the regions, a Mincearian regression of earnings was estimated, for which the covariates were: sex, color or race, level of education, age, square of age, and status in the family (head or non-head). The error of estimate (difference between observed earnings and estimated earnings) was also computed.

(2) Based on the coefficients obtained in the regression, an expected earning was imputed for each unemployed person. A measure for the error of estimate was also imputed. For this, a random variable was generated with average of zero, and variance determined on the basis of the estimated errors.

For the estimate of the *propensity score*, a logit model was used, although it is also possible to use other models[10]. As discussed above, the choice of the potentially correlated variables is a key point in this type of study, since it relates to the cost of data collection and monitoring by the executors of the program. Solely for the purposes of illustration, the following variables were used:

- Characteristics of the family: type of family (head and spouse present, male head without spouse, and female head without spouse); and the number of children younger than 14 (0, 1, 2, 3, 4 or more).
- Characteristics of the head: years of education (0-3, 4, 5-7, 8, 9-10, 11, 12 or more); and age (below 25, 25-34, 35-44, 45-54, 55 and over).
- Characteristics of the household: access to the sewer network, access to garbage collection, access to the telephone network, and residents per room (a continuous variable).

The targeting indicator was calculated for two values of α: 0.5 and 0.7. The respective results are in Tables 1 and 2. In the case where $\alpha = 0.5$, the targeting index was around 0.53. When the families were re-weighted in accordance to their distance from the poverty line, the targeting indicator rose, to around 0.75. This improvement was predictable, since the poor families excluded tend to be closer to the poverty line than the poor families included. Similarly, the non-poor families included tend to be closer to the poverty line than the non-poor families excluded

Table 1

The criterion adopted includes a significant proportion of the poor, around 77%, while leakage is around 24%. In all cases the proportion of families included exceeded the proportion of poor families in the region. This difference increased as the proportion of poor families in the region falls. For example, in Porto Alegre, where only 9.28% of the families are poor, the proportion of families included was some 3 times higher than the proportion of poor families, while for the average of all regions this value was 1.4.

A point that should be noted is that, on average, only half of the families included are poor. The proportion of poor families among those included tended to grow with the proportion of poor families in the region. The correlation between these two proportions was 0.96. An interesting case is, again, Porto Alegre, where only 26.3% of those included are poor. Note that this is the best that the executors of the program could do, given the criteria adopted.

When a higher weighting factor is used, both the coverage of the program and its leakage increase, though there is a reduction of the type I error. Analyzing the case of $\alpha = 0.7$, we note that the proportion of poor families included comes close to 90%. At the same time, the proportion of non-poor families included is, on average, 45%. With the exception of Porto Alegre, all the other regions included more than half of the population in the program.

And, with the exception of the regions of the Northeast (Fortaleza, Recife and Salvador), all the others showed a larger proportion of non-poor among those included.

Table 2

The results obtained here are, clearly, sensitive to the characteristics vector used. It is possible that inclusion of other variables may improve the degree of targeting of the program, although the administrative costs tend to increase. For example, in local programs, and in regions where poverty is spatially concentrated, a better characterization of the territory can increase the efficiency of targeting[11]. However, the geographical criterion is difficult to apply in nationwide programs. In any event, the results presented in this section give an idea of the magnitude of the "mistargeting" which can still persist, even if the planners of programs are efficient in using the information available in their efforts for better targeting.

5. Concluding Remarks

This paper analyzes the problems of targeting in policies to combat poverty under imperfect income information. An indicator to evaluate the degree of targeting is proposed. It expresses the degree of success (families correctly included in the program) and leakage (families wrongly included) in a social program. A *proxy means-tested* criterion is also proposed, based on estimation of the *propensity score* (the probability of a family being poor, conditional on covariates). This criterion consists of choosing a cut-off value for the *propensity score* in such a way as to maximize the proposed indicator. An application of the indicator to the metropolitan regions of Brazil is carried out.

The recent literature has put forward absence of political support as one of the main explanations for the mistargeting of social programs. This paper seeks to show that even when there is a social consensus that policies should be directed toward the truly needy families, a significant degree of mistargeting can persist, even if the formulators of programs act efficiently in their efforts to reach this objective.

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Appendix

Proof of Proposition 1: Rearranging the terms of (1) we obtain:

$$T = 2a\frac{PO_I}{INC}\frac{INC}{PO} - a + (1-a)\left[1 - 2\frac{INC}{NPO} + 2\frac{PO_I}{INC}\frac{INC}{NPO}\right] \qquad (2)$$

where

PO_I = number of poor families included in the program

INC = number of families included in the program

Assuming that inclusion goes from the families with a higher probability of being poor to the families with a lower probability of being poor, and that there is a continuum of families of size N, then

$$\frac{PO_I}{INC} = \Pr(D_i = 1 \mid I = 1) = \Pi(INC) \quad \text{and} \quad \Pi'(INC) < 0$$

I = qualitative variable that assumes the value 1 when the family is included in the program and 0 when it is not included.

The first-order condition for maximization of T, with relation to INC, is:

$$\Pi(INC) + INC\,\Pi'(INC) = \frac{(1-a)PO}{a\ NPO + (1-a)PO} \qquad (3)$$

The second-order condition is: $2\Pi'(INC) + INC\,\Pi''(INC) < 0$

Since $\Pi(INC) = \frac{1}{INC}\int_0^{INC} g(z)\,dINC$, where $g(z)$ is the probability of the z-th family included being poor, then $\Pi'(INC) = \frac{g(INC) - \Pi(INC)}{INC}$. Thus, we can rewrite (3) as:

$$g(INC) = \frac{(1-a)PO}{a\ NPO + (1-a)PO} \qquad (4)$$

Since $g'(INC) < 0$, then (4) is a maximum condition. ÿ

Table 1: Targeting indicator ($a = 0.5$)

Region	Poverty line (in 1998 R$)	Proportion of poor families	Proportion of families included in the program	Proportion of poor families within those included	Proportion of poor families included	Proportion of non-poor families included	Targeting indicator	Targeting indicator, re-weighted
Belém	72.67	25.17%	38.08%	50.64%	76.57%	25.12%	0.514481	0.766539
Fortaleza	78.38	33.62%	41.16%	62.16%	76.05%	23.47%	0.525793	0.750981
Recife	104.84	45.77%	49.32%	71.65%	77.18%	25.79%	0.5139	0.773341
Salvador	119.79	40.16%	45.53%	67.87%	77.06%	24.42%	0.526309	0.755672
Belo Horizonte	103.09	26.98%	38.75%	54.08%	77.64%	24.37%	0.532627	0.760791
Rio de Janeiro	125.44	22.98%	37.64%	46.92%	76.91%	25.93%	0.509775	0.735088
São Paulo	133.66	21.33%	36.30%	42.91%	73.16%	26.33%	0.468316	0.683795
Curitiba	107.44	18.77%	33.97%	43.31%	78.35%	23.71%	0.546323	0.742139
Porto Alegre	74.59	9.28%	27.01%	26.27%	76.36%	21.95%	0.544051	0.738025
Brasília	128.24	25.76%	35.21%	59.19%	81.27%	19.32%	0.619485	0.791314

Table 2: Targeting indicator (a = 0.7)

Region	Poverty line (in 1998 R$)	Proportion of poor families	Proportion of families included in the program	Proportion of poor families within those included	Proportion of poor families included	Proportion of non-poor families included	Targeting indicator	Targeting indicator, reweighted
Belém	72.67	25.17%	55.9%	40.7%	90.34%	44.31%	0.598881	0.820466
Fortaleza	78.38	33.62%	60.61%	50.35%	90.71%	45.36%	0.59775	0.822618
Recife	104.84	45.77%	66.79%	62.85%	91.67%	45.77%	0.608699	0.839488
Salvador	119.79	40.16%	65.14%	57.06%	92.68%	46.70%	0.617279	0.837172
Belo Horizonte	103.09	26.98%	56.23%	43.81%	91.25%	43.28%	0.617861	0.821124
Rio de Janeiro	125.44	22.98%	59.07%	35.71%	91.87%	49.3%	0.590396	0.798157
São Paulo	133.66	21.33%	60.25%	32.06%	90.72%	52.01%	0.557953	0.752069
Curitiba	107.44	18.77%	51.16%	33.16%	90.35%	42.1%	0.612343	0.786907
Porto Alegre	74.59	9.28%	46.86%	17.76%	89.59%	42.48%	0.599353	0.766412
Brasília	128.24	25.76%	50.22%	46.84%	91.75%	35.91%	0.669009	0.81656

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[1] For a discussion on the political economics of targeting see, for example, Gelbach and Pritchett (1997), De Donder and Hindriks (1998), and Ravallion (1999).

[2] For a discussion of the administrative, economic and political costs involved in targeting of social policies – and also the benefits – see Van de Walle (1998).

[3] Whether or not it is appropriate to base the poverty line on current income when defining the most needy is beyond the scope of this paper. On this subject, see, for example, Lipton and Ravallion (1995), and Ravallion (1996).

[4] On the other hand, by classifying families or people by their more permanent characteristics, instead of current income, this procedure tends to reduce the problem of disincentives to work.

[5] As well as the means-tested and *proxy means-tested* methods presented in the introduction, other methods widely discussed are (i) self-selection and (ii) geographical targeting. In the first of these, all are regarded as having the right to benefits, but the high transaction costs imposed for entry into the program tend to select only the most needy. The second method, is, in fact, a *proxy means-tested* method in which the only variable taken into account is the location of the place of residence.

[6] See Legovini (1999) for more details.

[7] This indicator can be seen as a specific function or form of the class of social objective functions of the type $W(P_I, 1-NP_E)$, analyzed in Wodon (1997).

[8] It should be noted that, in contrast to Wodon (1997), the *propensity score* cut-off is independent of the characteristics vector X, depending only on α and on the distribution of poor and non-poor in the population. Wodon estimates, firstly, the ROC (Relative Operating Characteristics) curve, which generates all the possible combinations of the two types of error for a continuum of *propensity score* cut-off levels. He then maximizes $W(P_I, 1-NP_E)$, subject to this curve. Thus, the optimum cut-off value may vary with the forecast method used. Here the optimization of the targeting indicator was carried out on the basis of the true *propensity score*,

leaving estimation for a second stage. Thus, a better model for estimating the poor would only increase the value of the indicator, without changing the optimum cut-off value. The procedure adopted here has an operational advantage, since the specific functional form of the ROC curve can be difficult to find, creating difficulties for the maximization exercise.

[9] The values for poverty lines, available for 1990, were adjusted using the Amplified Consumer Price Index (IPCA), published by the IBGE.

[10] A criticism of use of these models can be found in Pudney (1999).

[11] See, for example, Bardhan (1996).