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On the Impact of Better Targeted Transfers on Poverty in Tunisia[1]

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Abstract : This paper describes the effects of general food subsidies on poverty in Tunisia, as revealed by household survey data for 1990. The analysis indicates that the poorest certainly take advantage of this system, but at the price of considerable leakages to non-poor people and at a sizeable economic efficiency loss resulting from relative price distortions. Further, non-parametric estimations suggest that there are no commodities predominantly consumed by the poor. This implies that targeting by commodities is not an effective way to fight against poverty and so, it is unlikely that restructuring the current scheme would improve significantly the living standards of the less well-off members of society. We then investigate the impact on poverty of a more targeted transfer scheme, based on proxy means-tests, using an appropriate econometric technique to model it. Simulations show that this design would be more effective in reducing poverty than the use of general food subsidies. Finally, dominance tests show that this design would first-order-dominate food subsidies scheme within a range of poverty lines including all those estimated and generally used for Tunisia.

Key Words: Poverty; Targeting; Subsidies; Transfers.

JEL classification: D12; D63; H53; I32; I38.

1. Introduction

The living standards of the less well-off members of a society affect public policy and are also of ethical interest. Because governments have limited resources, and it is important to use them efficiently, the question of how to design policies to lessen poverty is likely one of the most important concerns of policymakers. Among available tools to enhance the lot of the poor, targeting by commodities, that is, by subsidizing food staples mainly consumed by the poorest, has been very popular in developing countries. Yet targeting by commodities fails to promote efficiency, by creating economic distortions. Further, the leakage of food subsidies to the non-poor people is generally considerable while failure to improve substantially the well-being of the poorest is well known.

The objective of this work is then twofold. First, we aim to analyze the effects of one of the most important tools for alleviating poverty in Tunisia, that is the food subsidies program. This analysis requires that we have econometric estimates of the relevant demand system. Given this information, it is possible to assess the impact on poverty of this scheme; using a wide range of poverty lines and poverty measures for robustness analysis. It will be also instructive to test whether reforming this system to increase the poorest share of food subsidies benefits is feasible. If the presence of some commodities that are largely consumed by the poorest is proved, increasing food subsidies to these commodities should be an effective way to lessen poverty. Otherwise, designing an alternative means to achieve this goal becomes appealing.

Unfortunately, estimation results suggest that there are no commodities predominantly consumed by the poor. Hence, the second part of this work illustrates how proxy means tests, using an appropriate econometric technique to model them, could be used to reach a better outcome on poverty, revenue-neutral.[1] Household characteristics are used as explanatory variables to compute the income transfer to be awarded to each household; as deduced from a model designed to minimize the severity of poverty given an anti-poverty budget.

The approach developed in this paper has been applied using a Tunisian data set. Expending the same anti-poverty budget currently devoted to food subsidies, simulations reveal large potentialities in alleviating poverty, if targeting by commodities is replaced by the transfer scheme resulting from our proxy means-tests methodology. For instance, using robustness analysis to avoid critical choices of poverty lines and/or poverty measures, the results show that

[1] With revenue-neutral reforms, the problem of the optimal size of the government is ignored. An alternative assumption requires information on the households' willingness to pay for public goods. See King (1983).

the simulated design would dominate targeting by commodities scheme within a wide range of poverty lines, which includes all those estimated and generally used for Tunisia.

This paper is structured as follows. Section 2 provides a broad characterization of the food subsidies effects on poverty, as well as an evaluation of the leakages and deadweight loss resulting from this scheme. Section 3 illustrates how targeting by indicators, when it is derived from an adequate framework, can be used to achieve a better outcome on poverty. Section 4 offers some concluding observations.

2. Targeting by commodities: effects on the welfare of the poor population

Searching for a poverty-alleviating reform presupposes agreement on a measure of the standard of living. This is an important and controversial subject and would require a separate study on its own. In line with most studies, we use the total expenditure *per capita* as a basis for measuring the (permanent) income.[2]

We assume that before implementing the food subsidies scheme, each household h has an exogenous income y^h and faces the price system $\mathbf{p}^o$. After implementing the targeting by commodities program, by expanding the compensation fund B available to finance this policy, each household has the same nominal income, y^h, but faces a new price system $\mathbf{p}^p$. We aim to compare the levels of a household's welfare when it faces different price systems. To achieve this goal, we choose a benchmark price system, denoted by $\mathbf{p}^r$, and we define as in King (1983) the concept of equivalent income: for a given budget constraint ($\mathbf{p}$, y), equivalent income is defined as that income level which allows, at the benchmark price system, the same utility level as can be reached under the given budget constraint. Formally, we have:

$$v(\mathbf{p}^r, y_e)=v(\mathbf{p}, y), \tag{1}$$

where $v(.)$ is the indirect utility function, $\mathbf{p}$ is a vector of price system, and y is a vector of a household's income *per capita*. Notice that since $\mathbf{p}^r$ is fixed across all households, y_e is an exact monetary metric of actual utility $v(\mathbf{p}, y)$ because y_e is an increasing monotonic transformation of $v(.)$. Thus, inverting the indirect utility function, we obtain the equivalent income in terms of the expenditure function:

$$\begin{aligned} y_e &= e\left(\mathbf{p}^r; v(\mathbf{p}, y)\right) \\ &= y_e(\mathbf{p}^r, \mathbf{p}, y), \end{aligned} \tag{2}$$

[2] Obviously, this is not the best option, although there are good reasons to use this indicator in practice. Deaton (1997) provides an exhaustive discussion about this subject.

where $e(.)$ is the expenditure function, that is the minimal amount of income necessary to reach utility v at prices $\mathbf{p}$, and $y_e(.)$ is the equivalent income function.[3]

If $\mathbf{p}^r$ is set to be equal to the non food subsidies price system, that is $\mathbf{p}^r = \mathbf{p}^o$, the move from the original situation to the current one, when some food items are subsidized, could be considered as a first means to fight against poverty by enhancing the purchasing power of households. The maximum gain *per capita* for each household, M^h, resulting from this policy could be computed using the next formula:

$$\mathrm{M}^h = (\mathbf{p}^p - \mathbf{p}^o)x^h, \tag{3}$$

where x^h is the consumption basket *per capita* of household h purchased following this policy. Because it does not require any hypothesis on the consumption behavior of households, M^h is easy to compute. Yet considering the deadweight loss (DL) resulting from distortionary subsidies, this measure overestimates the welfare improvement. A satisfactory measure of the households' value of this program is the change in their equivalent income. This measure is known as the equivalent gain *per capita*, E^h, and it is given by:

$$\begin{aligned} \mathrm{E}^h &= y_e(\mathbf{p}^o, \mathbf{p}^p, y^h) - y_e(\mathbf{p}^o, \mathbf{p}^o, y^h) \\ &= y_e^h - y^h. \end{aligned} \tag{4}$$

The DL resulting from distortionary subsidies let the equivalent gain always less important than the maximum gain. Hence, a natural definition of the excess burden arising from this distortionary transfer is:

$$\mathrm{DL} = \overline{\mathrm{M}} - \overline{\mathrm{E}}, \tag{5}$$

where $\overline{\mathrm{M}}$ and $\overline{\mathrm{E}}$ are respectively the average of the maximum and equivalent gain.

Along with information about the distribution of welfare gains among households, it is worthy to assess the social impact of the scheme under consideration. Since the main objective of the current program is to improve the welfare of the poor, a natural measure of its social impact could be given by the decline of a pre-specified poverty index. Many poverty measures can be expressed in terms of poverty gaps g for income y and poverty line z as:

$$g^h = \max\{z - y^h, 0\}.$$

Following Jenkins and Lambert (1997), poverty measures which are defined in terms of g and which are in line with the aforementioned axioms belong to the class of Generalized

[3] It is obvious that $y_e(\mathbf{p}^r, \mathbf{p}^r, y) = y$.

Poverty Gap (GPG) indices. An important subset of GPG is the FGT set of additively decomposable indices suggested by Foster et al. (1984), which can be written as:[4]

$$\mathrm{P}_{\alpha}(z,y)=\frac{1}{H}\sum_{h=1}^{H}\frac{n^{h}}{\overline{n}}(g^{h})^{\alpha}, \tag{6}$$

where H is the total number of households in the survey, n^h is the size of household h, $\overline{n}$ is the average size of households, and α may be deemed as a measure of poverty aversion: a larger α gives greater emphasis to the poorest of the poor. When α becomes very large, $\mathrm{P}_{\alpha}(.)$ approaches a Rawlsian measure, which considers only the poorest households' welfare. The FGT class involves many commonly used poverty measures as special cases. For instance, when $\alpha = 0$, $\mathrm{P}_0(.)$ is the headcount ratio which is insensitive to variations of the poor's income; while for $\alpha = 1$, $\mathrm{P}_1(.)$ is the (non-normalized) poverty deficit.[5] Finally, for $\alpha > 1$, $\mathrm{P}_{\alpha}(.)$ is sensitive to inequality within the poor.

Considering we wish to assess the effects of the food subsidy program, poverty measures should be sensitive to price system variations. For this purpose, we present them in terms of values of the equivalent income function. Hence, the social impact of this anti-poverty program could be captured using the next formula:

$$\Delta\mathrm{P}_{\alpha}=\frac{1}{H}\sum_{h=1}^{H}\frac{n^{h}}{\overline{n}}\left(z_{e}-y_{e}(\mathbf{p}^{o},\mathbf{p}^{o},y^{h})\right)_{+}^{\alpha}-\frac{1}{H}\sum_{h=1}^{H}\frac{n^{h}}{\overline{n}}\left(z_{e}-y_{e}(\mathbf{p}^{o},\mathbf{p}^{p},y^{h})\right)_{+}^{\alpha}, \tag{7}$$

where z_e is the equivalent poverty line, that is the minimum expenditure level required at $\mathbf{p}^o$ to reach the indifference curve corresponding to the minimum standard of living one.

Furthermore, since the poverty measures are estimated on the basis of sample observations, we need to test whether the predicted magnitude and direction of change in poverty following this anti-poverty scheme is statistically significant, which is possible using the test of Kakwani (1993):

$$\kappa=\frac{\Delta\mathrm{P}_{\alpha}}{\sigma(\Delta\mathrm{P}_{\alpha})}, \tag{8}$$

where $\sigma(.)$ is the standard error of $\Delta\mathrm{P}_{\alpha}$:[6]

$$\sigma(\Delta\mathrm{P}_{\alpha})=\sqrt{\frac{\mathrm{P}_{2\alpha}(z_{e},y)-[\mathrm{P}_{\alpha}(z_{e},y)]^{2}}{\overline{n}H}+\frac{\mathrm{P}_{2\alpha}(z_{e},y+\mathrm{E})-[\mathrm{P}_{\alpha}(z,y+\mathrm{E})]^{2}}{\overline{n}H}}.$$

[4] In reality, this is a non-normalized version of the FGT poverty measures class, adopted also by Chakravarty and Mukherjee (1998). The normalized version is given by φ, where: $\varphi^h = \max\{1 - y^h/z, 0\}$.
[5] This is a good measure only if all the poor have the same living standards. See the Axiom N of Sen (1976).
[6] It is evident from equation (4) that $y_e(\mathbf{p}^o, \mathbf{p}^p, y^h) = y^h + \mathrm{E}^h$.

The methodology presented above is applied to data set from the 1990 Tunisian survey. This is a multipurpose household survey which provides information on expenditures and quantities for food items and expenditures for non-food items, as well as on many other dimensions of 7734 households behavior; education, housing, region of residence, demographic information, and economic activities. The application of this methodology requires to compute foremost the equivalent income function, $y_e(.)$, the construction of which calls for the estimation of an appropriate demand system.[7]

Arguably, a general equilibrium model is required to elicit the sharing out of food subsidy benefits between firms and households. Most computable general equilibrium models broadly assume that all production functions are homogeneous of degree one and that there is perfect competition. Under these assumptions, the supply curve of each commodity is horizontal so that consumers reaped the entire benefits of the indirect transfers. For simplicity, we assume such framework, although there is nothing in the followed approach that prevents the introduction of alternative hypotheses. Hence, through this scheme, consumer price is lowered below marginal cost by 37 percent for hard wheat, 35 percent for tender wheat, 9 percent for other wheat, 14 percent for poultry and eggs, 18 percent for milk, 24 percent for sugar, and 34 percent for grain oil. The outcomes of this program, for different poverty lines and poverty measures, are summarized in the following table.[8]

[7] Bibi (1998) has estimated the parameters of *IQAIDS* demand system according Deaton's (1988) methodology, who assumes spatial price variation in the survey and makes use of unit values as indicators of market prices. We use the estimation results of this demand system to compute the equivalent income.

[8] The identification problem is beyond the aim of this study. So we use a wide range of poverty lines to avoid an arbitrary choice. Note that the official poverty line estimated (under the vector $\mathbf{p}^0$) by the National Statistic Institute (see the World Bank (1995)) is between 196 and 252 DT. Ayadi and Matoussi (1999) found that z is rather between 213 and 262 DT.

Table 1: Impact of targeting by commodities program on poverty[9]

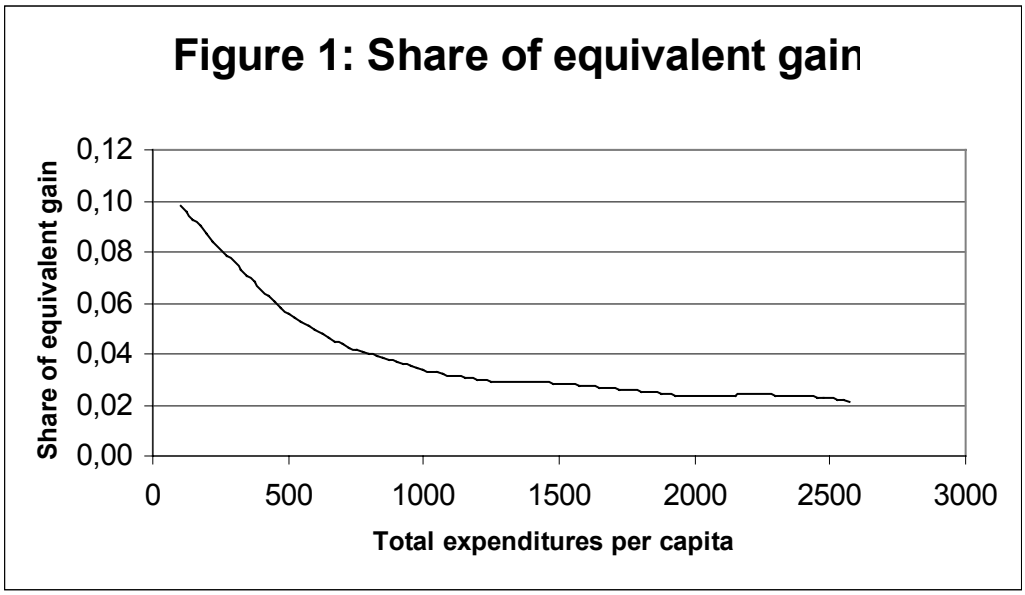
α	z_e	$P_\alpha(z_e, y)$	$P_\alpha(z_e, y + E)$	ΔP_α (%)	κ
0	265	0.173	0.144	-17.02	-12.1
0	290	0.209	0.176	-15.65	-12.4
0	320	0.255	0.219	-13.98	-12.5
0	345	0.290	0.255	-11.99	-11.6
0	360	0.312	0.278	-11.03	-11.3
1	265	12.561	9.725	-22.58	-13.1
1	290	17.313	13.688	-20.90	-13.5
1	320	24.288	19.616	-19.26	-14.1
1	345	31.119	25.565	-17.85	-14.3
1	360	35.640	29.556	-17.08	-14.3
2	265	36.624	31.467	-14.08	-11.9
2	290	45.577	39.657	-12.98	-12.5
2	320	57.689	50.596	-12.29	-13.1
2	345	68.567	60.743	-11.41	-13.6
2	360	75.514	67.157	-11.07	-13.8

The presence of targeting by commodities scheme is a meaningful source of welfare improvement for the poor, as the decline of all poverty measures proved. In addition, table 1 shows that the subsidies on foodstuffs benefited more the poorest of the poor than the richest in relative terms, that is targeting by commodities program is progressive in relative terms. For instance, we note that poverty reduction is less important as the equivalent poverty line rise for a given poverty index. This result would be strengthened if it could be shown that the contribution of equivalent gain to total expenditure, (E^h/y^h), declined monotonically with increases in income. In figure 1, we display the results of the link between these two variables obtained using a non-parametric estimation, with Gaussian kernel and bandwidth selected to minimize the mean integrated square error.[10] The results are revealing, since they confirm the progressive feature of the current program. Also, as the slope of figure 1 is always

[9] For convenience, we report $[P_\alpha(.)]^{(1/\alpha)}$ instead of $P_\alpha(.)$ for $\alpha \geq 1$. So, if $\alpha = 2$, we have a quadratic average of poverty deficit. Another attraction of this increasing monotonic transformation is that, since the inequality among the poor let $[P_\alpha(.)]^{(1/\alpha)} > P_1(.)$, the difference between $[P_\alpha(.)]^{(1/\alpha)}$ and $P_1(.)$ could be interpreted as an overall cost of inequality.

[10] See Silverman (1986).

negative, regardless of the (equivalent) poverty line chosen, we can argue that the post-subsidy distribution of expenditures dominate the (hypothetical) pre-subsidy one within all the range of income variations.[11]



Performances of targeting by commodities in reducing poverty do not indicate, however, that it is an optimal transfer design. Indeed, the magnitude of the income transfer to the non-poor, that is the leakages of the program benefits, is very important. The distribution of the absolute benefits between the different quintile groups, arranged in ascending order from the poorest quintile to the richest, is reported in the following table.

Table 2: Distribution of equivalent and maximum gain from food subsidies program[12]

Q_s	$\bar{y}_s$	$\overline{\mathrm{E}}_s$	$\overline{\mathrm{M}}_s$	$\sum_{Q_s} n^h \mathrm{E}^h / B$	$\sum_{Q_s} n^h \mathrm{M}^h / B$
Q_1	222.54	18.75	22.79	10.78 (10.78)	13.10 (13.10)
Q_2	378.51	25.34	30.56	14.57 (25.35)	17.57 (30.67)
Q_3	541.02	28.29	34.52	16.26 (41.61)	19.84 (50.51)
Q_4	771.08	31.22	38.75	17.94 (59.55)	22.27 (72.78)
Q_5	1590.64	41.25	47.33	23.72 (83.27)	27.22 (100.0)

[11] In the stochastic dominance literature, this result is known as "first-order dominance."
[12] Values between parentheses indicate the cumulative distribution of the variable under consideration.

Table 2 shows that the anti-poverty program in hand benefited the rich more than the poor in absolute terms. The richest quintile group of the population received 2.2 times more of the equivalent gains from food subsidies than the poorest, with an average equivalent gain *per capita* ($\overline{E}_s$) of 41.25 DT and 18.75 DT respectively.[13] This mistaken awarding of transfers to the non-targeted group reduces the vertical efficiency of this scheme and leads to the leakage of program benefits. It is obtained by adding the transfers that are given to those who are ineligible in perfect targeting and the total cost of the deadweight loss. Indeed, the excess burden cost represents another source of leakage, which is specific to the distortionary transfers, and should also be added to the traditional leakage cost. The leakage ratio, which is obtained by dividing the leakages by the available budget, approximates at least 75 percent of the anti-poverty funds even if we should admit that 40 percent of the population is poor.[14] Further, 16.7 points of percentage of the leakage ratio are related to the excess burden cost. In the absence of this distortionary cost, the equivalent gains would equalize the maximum gain and the impact on poverty would be more important.[15] Regarding the weight of the deadweight loss and, especially, the weak benefits targeted to the poorest group, the restructuring of this scheme must be a pressing priority. Thus, it is worthy to investigate first, reform possibilities within the existing framework of targeting by commodities over those requiring a new institutional structure to avoid the transition costs of such a moving.[16]

The previous analysis raises the question of how to improve targeting by commodities so as to reduce as much as possible the leakage of its benefits to the non-poor. For this purpose, we need an estimate of the expected expenditure on each commodity conditional upon individuals' income, which could be obtained consistently by non-parametric regressions. If the estimation results reveal the presence of some commodities predominantly consumed by the poorest, increasing food subsidy to these commodities should be an effective way to raise the poorest share of food subsidies benefits; and so to lessen more poverty. Estimation results of the income-expenditure relationship for different commodities (the Engel curves) are displayed graphically in figure 2.

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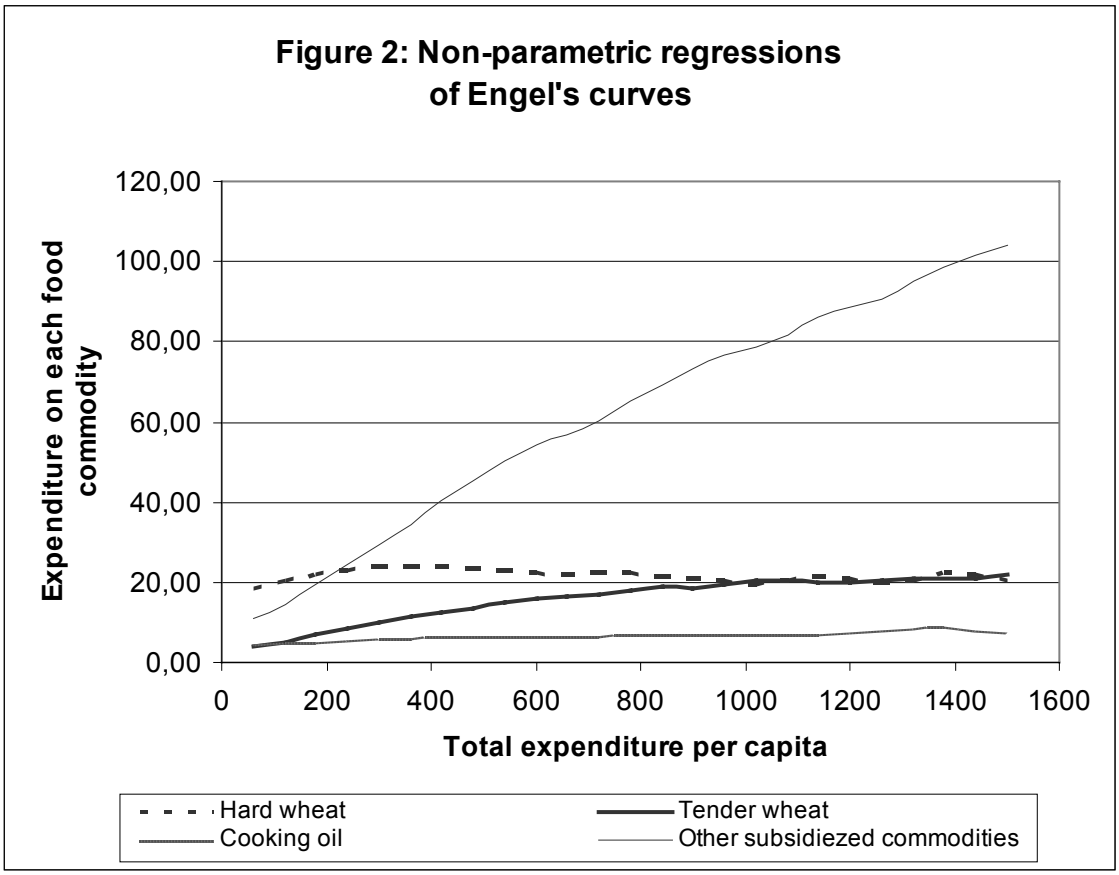
[13] In 1990, 1 DT is close to 1 US dollar.

[14] Creedy (1996) has distinguished between the vertical expenditure inefficiency, that is equal to the leakage ratio as defined here, and the poverty reduction efficiency which includes also the total transfers which, although received by the pre-transfer poor, are in a sense unnecessary since these individuals are raised above the poverty line. Because the cost of unnecessary transfers is really insignificant when anti-poverty design is based on targeting by commodities, we ignore its computation in this section.

[15] Simulations show that the opportunity cost of the excess burden in terms of poverty reduction is between 2 and 3 percent according to the poverty line and poverty measure selected. See table A-3 in annex for more details.

[16] These costs are related to the political, economic, and administrative constraints of implementing a more targeted program excluding powerful groups of the population. On this issue, see Besley and Kanbur (1993).



It is worthwhile to give another interpretation of this figure. Consider a policymaker who aims to decrease the incidence of poverty but does not know who is really poor. To be on the safe side, it is best to lessen the headcount ratio regardless of the poverty line chosen.[17] This requires the presence of some commodities whose expenditures are downward sloping across different income groups (at least from a threshold level of income) and even fall down at higher income groups. Unfortunately, the main feature of the regressions shown in figure 2 is that there is no commodity fulfilling this requirement. Restructuring the current scheme, by reducing subsidies on other subsidized items and raising them on wheat and cooking oil, could probably decrease to some extent leakages. Given that the non-poor purchase all commodities, this is not an effective means to increase targeting accuracy and so, it is unlikely to improve significantly the living standard of the poorest without looking for an alternative targeting procedure.

[17] This is necessary to have a post-reform income distribution which first-order-dominates the pre-reform income distribution, regardless of the poverty lines and poverty measures chosen.

3. An alternative means to fight against poverty: proxy means tests

The previous findings chiefly reveal that leakages from food subsidies to non-poor people are very large while a failure to improve substantially the living standards of the poorest is manifest. Because governments have limited resources, and given that it is important to use them efficiently, looking for an alternative targeting tool to achieve more poverty reduction is an appealing goal. However, it is not usually easy to identify the poor directly. Whilst such identification is required to curb poverty given an available budget, it is unlikely to be administratively feasible cheaply [Besley and Kanbur (1993)]. It is for this reason that among targeting options, awarding benefits to the poorest based on targeting by indicators could be an attractive alternative to targeting by commodities.[18]

There is plenty of theoretical modeling and empirical estimation concerned with the question of how to provide assistance to poor people when it is possible to observe some individuals' characteristics, but not their income. For instance, Ravallion and Chao (1989) have modeled the targeting problem as one of minimizing some particular poverty measures subject to an anti-poverty budget. They have constructed an algorithm allowing an optimal use of limited number of dummy variables by explicitly minimizing a selected poverty index given an available budget. The main issue with this method is that it cannot be applied without losing some information, especially when some available variables are continuous.

To avoid this limit, Glewwe and Kanaan (1989) as Baker and Grosh (1995) have followed a two-step procedure leading to a least predicted poverty. In a first step, the expectation of households' income *per capita* conditional on some indicators was estimated by ordinary least square (OLS) regression. In the second step, they have simulated the impact of awarding a transfer to each household predicted poor.

Whilst poverty measures are not sensitive to welfare variations of the non-poor, the predictive power of OLS methods is increased when the errors between true and predicted income at the top of the welfare distribution decrease. Because a higher predictive power does not necessarily lead to a better targeting accuracy, the OLS technique is therefore not a suitable choice. To overcome drawbacks of the previous approaches, Glewwe (1992) has developed a framework allowing the use of dummy and continuous variables. Although his approach is theoretically as plausible as Ravallion and Chao's (1989) one, it is much more

[18] On the advantages and drawbacks of the main imperfect targeting options, see for instance Baker and Grosh (1995), Bigman and Fofack (2000), Glewwe (1992), and Ravallion (1992).

difficult to compute, and does not produce results really different from those based on OLS regression [Baker and Grosh (1995)].

The approach suggested here attempts to go over the basic difficulties of the previous ones while preserving their main advantages. Thus, it is theoretically plausible, easier to compute, and enables to use a large set of discrete and continuous variables.

Assume that $P_\alpha(.)$ is unaffected by the vector of transfers T.[19] Assume equally that each household is a representative one of a given subgroup of the population with $P_{h,\alpha}(.)$ is the $P_\alpha(.)$ measure for the h^{th} subgroup. When the objective is to minimize poverty given the anti-poverty budget B, the optimal awarding of benefits is the one leading to the least poverty, as defined by a pre-selected FGT measure. Formally, we have to resolve the program below:

$$\begin{aligned} &\text{Min. } P_\alpha[z_e, y_e(\mathbf{p}^o, \mathbf{p}^o, T)] = \sum_h w^h P_{h,\alpha}[z_e, y_e(\mathbf{p}^o, \mathbf{p}^o, T^h)] \\ &\text{subject to } \sum_{h=1}^{H} n^h T^h = B, \end{aligned} \tag{9}$$

where w^h is the proportion of the population having the same characteristics of household h, and T^h is the *per capita* transfer to be awarded to subgroup h in perfect targeting so as to maximize the fall in poverty. It is required to be non-negative for all subgroups, since we have not to consider how the available budget B is financed.

From Kanbur (1987), we know that if the population is divided into mutually exclusive subgroups, when the objective is to minimize the α^{th} order measure $P_\alpha(.)$, the budget should be allocated so as to equalize the $(\alpha - 1)^{th}$ order measures $P_{h,\alpha-1}(.)$ in the different subgroups. In reality, the available budget could not permit to reach all the subgroups. For $\alpha > 1$, some richest subgroups of the poor should then be excluded from the benefits of this program since it is optimal to transfer the entire anti-poverty budget to the poorest subgroups of the poor.[20] The available budget will be spent so as to decrease as many of the poorest subgroups measures $P_{h,\alpha-1}(.)$ as possible up to a common measure $\overline{P}_{h,\alpha-1}(.)$ below their initial one.

Obviously, $P_{h,\alpha-1}(.)$ is often costly to observe directly, so that perfect targeting is not feasible. Yet these poverty measures are likely to be correlated with observable variables, denoted by the vector x. If x contains regional characteristics, it is possible to make use of the

[19] Besley and Kunbur (1993) provide a discussion about the incentive effects of a transfer scheme targeted to poor population.

[20] Using the terminology of Bourguignon and Fields (1997), this corresponds to a 'p-type' transfer scheme. On the other hand, for $\alpha < 1$, they show that it is optimal to spend the available so as to lift as many of the richest subgroups of the poor out of poverty as possible. This corresponds to a 'r-type' transfer scheme.

regional targeting approach to study to what extent their outcomes could be better than those of targeting by commodities.[21] But if x includes other variables that are not continuous, targeting accuracy of transfers to the poorest could be enhanced, and Ravallion and Chao's (1989) algorithm becomes the best means to get an optimal allocation of the available budget. As discrete and continuous variables are often found in x, this algorithm cannot be used without losing some information; especially because continuous variables should be beforehand transformed into discrete ones.

A suitable technique is available, however, if the problem could be addressed as a censored model, in which case Tobit regression becomes a relevant tool to avoid many drawbacks of previous methods:

$$\begin{aligned} &\mathrm{P}_{h,\alpha-1}(z, y^h)=\Phi(x^h)+\hat{\vartheta}^i \qquad \text{if} \qquad y^h < z \\ &\mathrm{P}_{h,\alpha-1}(z, y^h)=0 \qquad\qquad\quad \text{otherwise.} \end{aligned} \tag{10}$$

The estimation of $\Phi(.)$ is then theoretically very plausible. The transfer scheme that would result from the estimation of equation (10), noted $\hat{\mathrm{T}}$, is explicitly computed with regard to the functional form of the pre-selected poverty measure. Furthermore, for a large value of α, estimation of equation (10) takes into account the fact that the corresponding poverty measures are more sensitive to errors of exclusion among poorer households. Finally, the probability that a higher predictive power of $\Phi(.)$ leads to a better targeting accuracy is more important than that of a higher predictive power of the usual OLS estimation.

When it is possible to alleviate poverty greater within the new design, it is then possible to reach the pre-reform poverty level while reducing public spending. This reduction, which is equal to the marginal benefit (*per capita*) of imperfect targeting design, is given by:[22]

$$\begin{aligned} &\mathrm{MB}=Max\frac{1}{\bar{n}H}\sum_h [B-n^h\hat{\mathrm{T}}^h)] \\ &\text{subject to} \\ &\mathrm{P}_\alpha(z_e, y+\hat{\mathrm{T}})=\mathrm{P}_\alpha(z_e, y+\mathrm{M}). \end{aligned} \tag{11}$$

This evaluation is particularly interesting since, in the wake of structural adjustments, the reduction of public deficit without impairing the welfare of a targeted group is one of the most sought-after objectives.

In general, the imperfect-targeting ability to lessen poverty has to increase with the number of correlated characteristics with the welfare distribution included in x. Let x_j a vector

[21] On the regional targeting approach, see Kanbur (1987), Bigman and Fofack (2000), and Park et al. (2002).

of characteristics which contains more information than x_i. We can capture this improved targeting from additional information by computing the marginal benefit of the new information, noted MB($x_j|x_i$). Formally, it can be expressed as follows:

$$\begin{aligned} &\mathrm{MB}(x_j|x_i)=Max\frac{1}{\bar{n}H}\sum_h n^h[\hat{\mathrm{T}}(x_i^h)-\hat{\mathrm{T}}(x_j^h)] \\ &\text{subject to} \\ &\mathrm{P}_\alpha[(z_e, y+\hat{\mathrm{T}})|x_j]=\mathrm{P}_\alpha[(z_e, y+\hat{\mathrm{T}})|x_i]. \end{aligned} \tag{12}$$

The knowledge of the marginal benefit of each observable characteristic is very useful especially because this observation is not costless. The solution to problem (12) is thus the best means to assess the maximum cost which the policymakers are willing to support without reappraisal of imperfect targeting relief. The optimal set of variables should be fixed so that the marginal benefit from the last indicator equates its marginal administrative cost.[23] Hence, the more important is the marginal benefit of some characteristics, the better are the possibilities to cover the cost of observing them while alleviating poverty. The strategy followed by the households attempting to become eligible or to get more transfer, by providing false information, could end in failure.[24]

The methodology presented above can be implemented for different values of poverty aversion, α. For instance, if the objective is to minimize $P_2(.)$, the equation (10) must be estimated using as dependent variable the deficit of poverty, g^h.[25] An equivalent poverty line of 360 DT *per capita* per year is used. Many of the explanatory variables used to estimate the model should not be costly to identify and should not be manipulated cheaply. These variables are reported and defined in table A-1 in annex. The variables can be clustered in two sets. In set I, we find the vector x^{I} which includes only regional characteristics of the households.[26] Set II (vector x^{II}) includes in addition to regional indicators, demographic information of each household and some characteristics of the household's dwelling. Whereas it is technically easy to add other information, like the occupation of the households' head and his education level, we avoid doing this since some people attempting to become

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[22] Cost reduction calculated by Glewwe and Kanaan (1989) as well as by Glewwe (1992) are identical to the marginal benefit.

[23] Rai (2002) shows that targeting costs can be substantially reduced by asking recipients to make reports about each other.

[24] Also, according to Besley (1990), it is not excluded that some non-poor households will avoid masquerading as poor because of the psychic costs of the social stigma resulting from the participation in programs meant specifically for the poor.

[25] The squared poverty deficit, $(g^h)^2$, is the dependent variable when the aim is to minimize $P_3(.)$. Such an extension is let for a future research.

[26] The use of this set enables us to compare performances of model (10) with regard to performances of regional targeting model in lessening poverty.

eligible or to get more benefits may effortlessly conceal these variables. Table A-2 in annex presents Tobit estimators of the equation (10).

Using estimation results of the equation (10), table 3 gives the effects on the poor population welfare of the two estimated models (reported in the two last columns) to be compared with targeting by commodities (reported in second column).[27] Besides, this table reports (in the third column) the outcomes of regional targeting model when the objective is to minimize $P_2(.)$.

Table 3: Impact on poverty of alternative schemes

α	$P_\alpha(z_e, y+M)$	$P_\alpha(z_e, y+RT)$	$P_\alpha(z_e, y+T^I)$	$P_\alpha(z_e, y+T^{II})$
0	0.271	0.255^*	0.257^+	0.228^*
1	28.38	23.28^*	23.50^+	17.86^*
2	65.5	55.42^*	55.87^+	45.42^*
Marginal Benefit	-	19.38	19.10	26.98
Leakages (%)	79.1	64.5	65.1	48.9

* Poverty difference between current and precedent simulation is significant at 1 percent level.
$^+$ Poverty difference between current and precedent simulation is not significant, yet poverty difference between current simulation and targeting by commodities is significant at 1 percent level.

For the purpose of comparing this methodology to previous ones, table 3 shows that the Tobit regression performs as better as the geographic targeting model when we use only regional variables. This evidence supports the fact that our procedure could be at least as useful as the previous ones that are theoretically plausible.[28] Broadly, using only regional characteristics lowers leakages by 14 points of percentage. This decline entails a significant reduction of poverty from the original level - given by the food subsidies scheme - when the aim is to minimize the severity of poverty, $P_2(.)$. This decline is between 6 and 15 percent according to whether the poverty measure retained is $P_0(.)$ or $P_2(.)$. Furthermore, one way to look at the gains from targeting is to see by how much money can be saved while attaining the same poverty alleviation achieved by food subsidies. So, when the aim is to minimize $P_2(.)$, regional targeting allows the alleviation of poverty as much as targeting by commodities,

[27] The DL costs resulting from food subsidies are ignored in the following comparison. Indeed, if the simulated reforms decrease more poverty under this hypothesis, these results would be at least maintained under an alternative hypothesis.
[28] For instance, when only regional characteristics are included for OLS regression, the outcomes produced by Baker and Groch's (1995) procedure are far from being in compliance with those obtained from geographic targeting model. We have also checked that the outcomes produced using our methodology are always better.

while providing a substantial budgetary saving, equal to 19.10 Tunisian dinars (TD) *per capita*.[29]

Performances of regional targeting do not indicate, nevertheless, that it is the optimal transfer scheme. Adding demographic and dwelling information on households to provide assistance to the poor, simulation II reveals an additional decline in leakages, which allows for more poverty alleviation than regional targeting does. Poverty could be reduced further by 10 percent for $\alpha = 0$ up to 18 percent for $\alpha = 2.$. Moreover, considering both demographic and dwelling characteristics make possible to increase the budgetary saving by 7.88 TD *per capita*, bringing it from 19.10 to 26.98 TD *per capita*, without altering poverty from its original level. Yet, if the observation cost of this last information set exceeds 7.88 TD *per capita* (which corresponds to 22.6 percent of the available budget), the imperfect targeting becomes irrelevant and the regional targeting scheme is likely to be the only alternative to the current system.[30]

The analysis that we have just led is based on the choice of a poverty line z and a poverty measure $P_\alpha(.)$ whose specification is essentially arbitrary. The literature on poverty dominance provides methods for addressing these two problems. For instance, Atkinson (1987) has defined criteria of dominance corresponding to levels of stochastic dominance. He has also underlined that lower degree dominance usually entails higher degree dominance, but that the converse does not necessary hold.

Suppose that it is possible to have an agreement neither about the choice of the poverty line, that is on the position of the poverty line in the resource space, nor on the choice of the poverty measure. Then, it can be shown that poverty will certainly fall following the simulated design based on indicators included in x^{II}, regardless of the poverty line and the poverty measure chosen, if we have:

$$\Delta P_0(.) = P_0(z_e, y + M) - P_0(z_e, y + T^{II}) \geq 0, \qquad (13)$$

for all z_e with at least one strict inequality. In the dominance literature, this finding is known as "first-order dominance" (FOD). Figure 3 illustrates the relationship of universal food subsidies and direct transfers based on proxy means tests to FOD and the headcount ratio variation.

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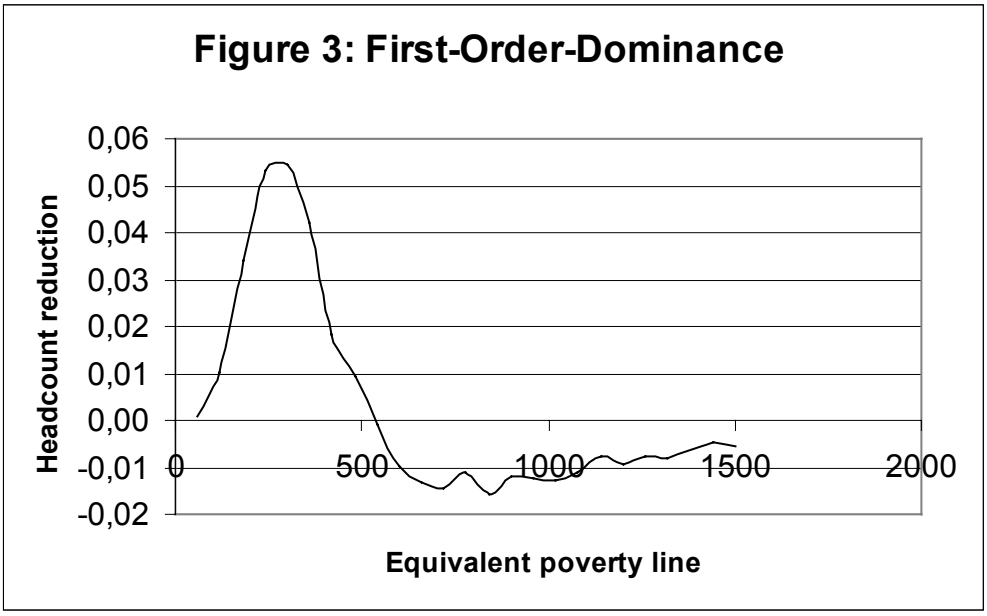
[29] In 1990, one Tunisian dinar is approximately one US dollar.

[30] The marginal benefit of these variables per household is 45.41 TD (22.6 percent of the available budget). So it is hard to believe that the administrative cost of this program could exceed this amount. For instance, Baker and Grosh (1995) report that the cost of the Chile' s program, based on proxy means tests, is approximately 5 US dollars per assessment. Also, Kesselman (1982) finds that administrative costs as a percentage of benefits ranged from 5.2 percent to 15.4 percent for the tested programs in U.K.



Hence, by plotting the cumulative difference in percentages of the population below various equivalent poverty lines, we find that $\Delta P_0(.)$ could be negative. The impact of providing assistance to the poor based on targeting by indicators with regard to targeting by commodities is therefore ambiguous. Some equivalent poverty lines and some poverty measures will show a better effect on poverty following the p-type transfers' scheme, but some others will show a contrasting outcome. Yet, if it is admitted that the equivalent poverty line could never exceed 540 DT, then it is possible to argue that targeting by indicators of transfers is unambiguously more effective in serving the poorest than universal food subsidies scheme, no matter which FGT poverty measure is chosen. It is perhaps useful here to note that this range includes all the poverty lines estimated for Tunisia. Nonetheless, if it is relevant to set the cut-off poverty beyond the limit of 540 DT, the outcome becomes equivocal and FOD is unable to rank the relative effectiveness of p-type direct transfer in alleviating poverty.

Considering that these two schemes cannot be ranked by FOD, it is possible to order them by second-order dominance (SOD). A fall in poverty with p-type transfers requires that the poverty deficit measure for the post-reform distribution is not higher than that for the status quo everywhere among the range variation of z_e, that is:

$$\Delta P_1(.) = P_1(z_e, y + M) - P_1(z_e, y + T^{II}) \geq 0, \qquad (14)$$

for all z_e with at least one strict inequality. As we are simulating a revenue-neutral reform, this difference is equal to the cost reduction of awarding the non-targeted group, that is the decrease of leakages. Figure 2 illustrates the relationship of universal food subsidies and p-type transfers to SOD and the cumulative poverty deficit variation.

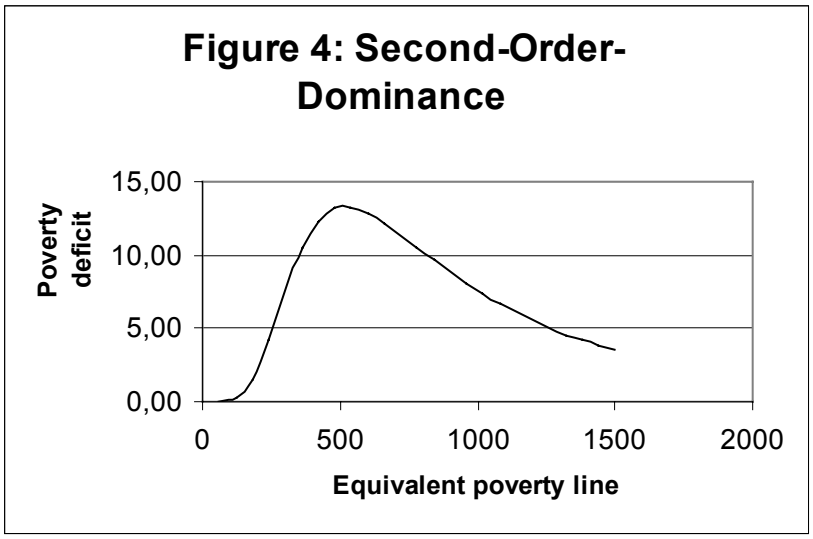


Figure 4 shows that direct transfers based on targeting by indicators second-order-dominates indirect transfers based on targeting by commodities, even up to an equivalent poverty line equalizing 1500 DT. Since the cumulative benefits with targeting by indicators are positive at each equivalent poverty line up to 1500 DT, we can argue that the proposed design is more effective in decreasing the poverty deficit; and this holds for all poverty measures with $\alpha \geq 1$. The need to test higher orders of dominance becomes really thin since the hypothesis of an equivalent poverty line exceeding the limit of 1500 DT is arguably far from being plausible.

4. Conclusion

The food subsidies program is one of the most important tools for alleviating poverty in Tunisia, but its effects are not well understood. The presence of this scheme makes the poverty problem less serious than it should appear in official statistics. This paper is partly concerned by this subject. Notwithstanding, even if the food subsidies scheme lessens poverty, looking for alternative design to improve targeting accuracy of limited resources is always one of the most important objectives of policymakers.

To achieve these goals, the second section presents a methodology, which enables the evaluation of the food subsidy effects on the poor population's welfare. It consists in computing the King's (1983) equivalent income gain for each household, in the available sample, which results from the current program. The distribution of these gains could be so aggregated to capture the poverty reduction achieved under the current scheme. This analysis reveals that the food subsidies program is certainly a meaningful source of welfare improvement for the poor. Yet it entails an important excess burden and benefits the rich more than the poor in absolute terms. For instance, the richest quintile group of the population receives 2.2 times more of the equivalent gains from food subsidies than the poorest quintile. Moreover, non-parametric estimations suggest that there are no commodities predominantly consumed by the poor. This limits the targeting-by-commodities option to further significantly the goal of poverty reduction and so, it becomes appealing to look for an alternative option, like the targeting-by-indicators one, to reach this objective.

For the purpose of assessing to what extent proxy means tests could raise the poorest share of the available budget, the third section suggests a new approach to target p-type direct transfers. Whereas it overcomes some drawbacks of the main previous methods, this approach is also theoretically plausible. More precisely, since it is optimal to award the available budget so as to equalize the $(\alpha - 1)^{th}$ order poverty measures of the poorest subgroups, when the objective is to minimize the α^{th} order poverty measure, we suggest estimating straightly the $(\alpha - 1)^{th}$ order poverty deficit of each household, conditional upon some of its characteristics. The results are encouraging. For instance, when only easily observed indicators are included to look for a p-type transfer design, results show that poverty could be

reduced – from the original level given by the food subsidies scheme – at least by 15.8 percent for $\alpha = 0$ and up to 30.6 percent for $\alpha = 2$.[31]

In order to avoid diverse and conflicting views on how to select the poverty line and poverty measure, dominance tests are also used to assess the likely effects of direct transfers derived from targeting by indicators on a wide range of poverty lines and poverty measures. The main result is that such transfers design would first-order-dominate the current food subsidies scheme within a range of poverty lines including more a larger set that all those estimated for and used in Tunisia. Thus, it is possible to conclude that providing assistance to the poor based on targeting by indicators should be more effective in alleviating poverty than targeting by commodities, regardless of the poverty measure chosen.

The methodology followed in this paper does not include the possibility for households to change the characteristics by which they could be targeted. For instance, by some effort or with some loss of utility, some characteristics could be altered or concealed by households attempting to receive a (greater) transfer. While it is feasible that the marginal benefit of doing so will outweigh the marginal effort required, it is unlikely that the net benefit of such behavior will always be non-negative. It is also not excluded that some non-poor households would avoid masquerading as poor, because of the psychic costs of the social stigma resulting from the participation in programs meant specifically for the poor [Besley and Kanbur (1993)]. The empirical analysis of this paper does not consider either the indirect effects on poverty, which would arise through the impact of the simulated reforms on conditions in other markets, such as those for labor. In reality, only applied general equilibrium models can allow to include all indirect and direct effects of the suggested reforms. All these issues raise interesting and useful avenues for further research.

[31] In reality, poverty would fall even more if we considered the excess burden costs resulting from food subsidies scheme.

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6. Annex

Table A-1: Nomenclature and definition of Explanatory variables

Area	
Great Tunis	1 if household lives in Great Tunis, 0 otherwise.
Northeast	1 if household lives in a region of the Northeast, 0 otherwise.
Northwest	1 if household lives in a region of the Northwest, 0 otherwise.
Middle east	1 if household lives in a region of the Middle east, 0 otherwise.
Middle west	1 if household lives in a region of the Middle west, 0 otherwise.
Sfax	1 if household lives in Sfax, 0 otherwise.
Southeast	1 if household lives in a region of the Southeast, 0 otherwise.
Southwest	1 if household lives in a region of the Southwest, 0 otherwise.
Demographic information	
Nc2	Number of children in household old less than 2 years old.
Nc3-6	Number of children aged between 3 and 6 years.
Nc7-11	Number of children aged between 7 and 11 years.
Na12-18	Number of adults aged between 12 and 18 years.
Na19p	Number of adults old more than 19 years.
Age	Age of the household head (HH).
Age2	Squared age of the HH.
Type of house	
Nbroompc	Number of rooms *per capita*
Det. House	1 if household lives in a detached house, 0 otherwise.
Flat	1 if household lives in a flat, 0 otherwise.
Arab house	1 if household lives in an Arab house, 0 otherwise.
Hovel	1 if household lives in a hovel, 0 otherwise.

Variables which are in *italic* have been omitted during estimations.

Table A-2: Regression results

Variables	Set I	Set II
Constant	-0.897	-0.541
	(-30)	(-2.5)
Northeast	0.410	0.275
	(8.3)	(5.1)
Northwest	0.849	0.748
	(19)	(16)
Middle West	0.768	0.509
	(17)	(10)
Sfax	0.469	0.566
	(7.2)	(8.1)
Southeast	0.743	0.618
	(14)	(11)
Southwest	0.494	0.354
	(9.8)	(6.4)
Age	-	-0.016
		(-2)
Age2	-	0.0002
		(2.7)
Nc2	-	0.106
		(4.3)
Nc3-6	-	0.166
		(9.6)
Nc7-11	-	0.139
		(8.6)
Na12-18	-	0.061
		(4.6)
Na19p	-	-0.103
		(-9.9)
Nbroompc	-	-1.909
		(-20)
Flat	-	-0.741
		(-2.7)
Arab house	-	0.795
		(13)
Hovel	-	1.434
		(15)

t-ratios in parentheses.

Table A-3: The opportunity cost of the deadweight loss in terms of poverty reduction

α	z_e	$P_\alpha(z_e, y+E)$	$P_\alpha(z_e, y+M)$	ΔP_α (%)	κ
0	265	0.144	0.138	-4.12	-2.5
0	290	0.176	0.169	-4.12	-2.9
0	320	0.219	0.211	-3.51	-2.8
0	345	0.255	0.250	-2.29	-2
0	360	0.278	0.271	-2.59	-2.4
1	265	9.725	9.169	-5.71	-2.7
1	290	13.688	13.021	-4.87	-2.8
1	320	19.616	18.720	-4.57	-2.8
1	345	25.565	24.495	-4.18	-2.9
1	360	29.556	28.378	-4.02	-2.9
2	265	31.467	30.446	-3.24	-2.5
2	290	39.657	38.363	-3.26	-2.6
2	320	50.596	49.159	-284	-2.7
2	345	60.743	59.155	-2.61	-2.8
2	360	67.157	65.496	-2.47	-2.8