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Revealed Community Equivalence Scales*

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ABSTRACT

This paper estimates the equivalence scale revealed by discretionary community allocations of welfare benefits to poor households. I apply the proposed approach to a subsidized rice program in Indonesia in which villages designated program beneficiaries, and estimate the equivalence scale implicit in the beneficiaries they selected. I find that the "revealed community equivalence scale" for this program lies much closer to per-capita expenditure than traditional demand-based equivalence scales, particularly in the poorest communities. This suggests that per-capita expenditure may be closer to how poor communities actually compare the households when allocating aid than previously thought.

JEL Codes: D12, I32, O12.
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1. Introduction

A fundamental issue in welfare economics, dating back at least to Engel (1895), is how to compare the welfare of households of different sizes and compositions. Economies of scale within the household and the differential resource needs of children and adults suggest that comparisons based on either per capita household expenditure or total household expenditure may substantially misrepresent the actual welfare of households. This suggests that a more sophisticated way of comparing households may better capture actual welfare differences.

Several principal methods have been used to address this issue. Each begins by postulating that some aspect of a household's demand decisions, such as the food share of expenditure (Engel 1895) or the total expenditure on adult goods (Rothbarth 1943), is indicative of either the average welfare of all household members or the welfare of the adults in the household. One can then use this measure of welfare to infer how much additional expenditure would be required to compensate a household with a different composition so that it had the same welfare as some reference household.[1]

In this paper, I examine a different approach to comparing households, based on discretionary community allocations of welfare benefits among households. While economists may be unsure how to make inter-household comparisons, communities are forced to do so whenever they are faced with decisions about how to allocate a finite amount of benefits across households. Implicit in the communities' choices is an

[1] Other methods, such as the commonly-used Prais-Houthakker (1955) method, attempt to avoid having to make such an assumption by separately identifying for each good the substitution effects caused by changing household characteristics. However, as pointed out by Muelbauer (1980), these methods are under-identified without the addition of a Rothbarth-like exclusion restriction that some goods are consumed only by adults, and so at heart also rely on the same type of *a priori* assumption for identification.

equivalence scale, which is revealed by the allocation the community makes. I discuss how to back out the equivalence scale from the allocations, and then compare the resulting "revealed community equivalence scale" to equivalence scales calculated using traditional methods. I also show how this method can be used to create monetary equivalents of other aspects of poverty not traditionally included in poverty analysis, such as illness or illiteracy.

I apply this method to data from a particular community-based aid program, the OPK (for *Operasi Pasar Khusus*, or Special Market Operation) rice program in Indonesia. Under the program, villages received a monthly block grant of subsidized rice from the central government and chose which households would receive the rice. I compute the equivalence scale implied by the probability that a household with a given set of demographic characteristics received the rice, and compare this equivalence scale to demand-based equivalence scales estimated using traditional methods for the same group of households.

Using this community-based approach, I find that Indonesian communities allocated aid as if adding an additional child requires expenditure equal to 75% of the amount spent of each of first two adults, and as if adding a third adult requires expenditure equal to approximately 85% of the amount spent on each of first two adults. These estimates are somewhat higher than the current consensus estimates, based on traditional demand-based equivalence scales, that maintaining the same level of welfare after adding an additional child requires only 40-50% the cost of each of the first two adults (Deaton 1997).

These results suggest that in actually allocating aid, communities place substantially more weight on children and on large households than traditional estimates based on expenditures would suggest. In fact, in actually allocating aid, communities seem to use an equivalence scale about halfway between per-capita expenditure and traditional estimates of equivalence scales. Given the sensitivity of poverty lines and inequality measures to the equivalence scale used, adopting these community-based equivalence scales as the basis for policy analysis in place of more traditional demand-based estimates could have substantial impacts on the measurement of poverty and on the allocation of welfare benefits.[2]

The results also suggest that, in allocating aid, communities give substantial additional weight to other aspects of poverty, such as widowhood, illiteracy, poor health, and employment status. These results underscore the difference between calculating poverty levels based only on consumption levels and the based on community-based approach used here.

It is important to recognize that the equivalence scales I estimate here include not only the actual costs of children and additional adults, but also how communities weight the relative welfare levels of these different types of households in making allocation decisions. For example, the cost of children may be substantially less than that of adults, but if children are more vulnerable than adults, communities may give children a higher weight than that implied by costs alone. These total welfare costs, rather than the consumption-only costs, are often what are desired for policy purposes, such as designing

[2] A number of papers have investigated the sensitivity of poverty lines, composition of the poor, and inequality to the choice of equivalence scale and found that the choice of equivalence scale can substantially affect the results. See, for example, Buhmann 1988, Jenkins and Cowell 1994, Deaton and Paxson 1998, and Lanjouw et. al 1998.

aid programs or assessing poverty. However, to the extent that community allocation rules vary more than direct expenditures across different types of communities, these equivalence scales may be more context dependent than traditional cost-based equivalence scales. As I discuss below, however, this method can be applied in a wide variety of other contexts.

Though the approach taken in this paper differs from the demand-based equivalence scales that dominate the literature, it does build on several existing bodies of work. Several authors, such as Ruggles (1990) and Cutler and Katz (1992), have calculated the equivalence scales implicit in program rules, such as the U.S. poverty line. Since program rules are often designed using estimates of demand-based equivalence scales, however, this exercise reveals only whatever estimate of equivalence scales was used to construct the program rules. The approach used in this paper does not suffer from this problem, however, because the allocations I use to estimate equivalence scales are based on discretionary decisions made by community leaders rather than on an econometric estimate of equivalence scales.

Another approach taken by several authors has been to estimate equivalence scales based on individual self-assessments of welfare. (See, for example, Kapteyn and Van Praag (1976) and Van Praag and Van der Sar (1988)). While the subjective approach also does not require the *a priori* assumptions about what indicators proxy for household welfare required by the Rothbarth or Engel methods, it suffers from the problem that each household is evaluating its own, and only its own, welfare rather than comparing the welfare across many households. As discussed by Deaton and Zaidi (1999), this can substantially bias the results.

The remainder of the paper is organized as follows. Section 2 discusses how to estimate the equivalence scales revealed by discretionary community allocations of aid to poor households. Section 3 presents estimates of equivalence scales derived by applying this method to data from the Indonesian OPK program. Section 4 compares these estimates to estimates generated using traditional methods of estimating equivalence scales on the same set of households. Section 5 concludes.

2. Estimating equivalence scales revealed by community allocations

2.1. Conceptual approach

This section discusses conceptually how I recover the equivalence scales implicitly used in community allocations of aid. To begin, define each household's indirect utility function, as evaluated by the community, as:

$$v(y, n, k, x, p, a),$$

where y represents total household expenditure, n represents the total number of people in the household, k represents the number of children in the household, x represents other household characteristics, p represents a vector of prices, and a represents the amount of aid received by the household.[3] I assume that v is concave in y.

In making the decision as to which household members should receive the assistance, I assume that the community maximizes a social welfare function of the form:

$$\max \sum_{i=1}^{i} \beta(y_i, n_i, k_i, x_i, p) v(y_i, n_i, k_i, x_i, p, a_i) \quad \text{s.t. } \sum_{i=1}^{I} a_i = A,$$

[3] The issue of precisely whose utility within the household is being measured has received considerable discussion in the literature (see Nelson 1993). Since we do not know how communities aggregate individual utilities to make household-level allocations, it is not possible to specify with certainty how this community-assessed household utility function maps to the utility functions of individual household members.

where β represents the welfare weights on each household and A represents the total amount of aid available to be distributed. Conceptually, the difference between β and v is subtle, but important. Many aspects of a household's welfare that might affect the community's decision, such as the vulnerability of children to malnutrition, habit formation for the unemployed, and increased medical expenditures for the sick, can be captured by v. However, it is possible that other factors besides pure welfare maximization may also affect a village's decision rule, such as political connectedness or a desire to provide social insurance, which might manifest itself as a decision to compensate those who experienced a shock, even if their marginal utility of receiving aid was still lower than that of the very poorest households. These factors would be captured by β.

Since these weights β may also be related to household composition (i.e., n and k), we cannot separately identify the community welfare weights β and the indirect utility function v in this context, at least without strong identification assumptions. What we can identify, however, is the product of the two, which I call the overall community benefit function and denote by:

$$B(y_i, n_i, k_i, x_i, p, a_i) = \beta(y_i, n_i, k_i, x_i, p)v(y_i, n_i, k_i, x_i, p, a_i).$$

The community maximization function is therefore

$$\max \sum_{i=1}^{i} B(y_i, n_i, k_i, x_i, p, a_i) \quad \text{s.t. } \sum_{i=1}^{I} a_i = A.$$

To introduce household economies of scale and the differential cost of children relative to adults, I parameterize these effects using the standard parameterization in the literature (see Deaton 1997). For a given set of prices, define α to be the cost of children

relative to adults, so that each child costs as much as α adults. In this section, for notational simplicity I assume that there is a single α that applies to all children; in the empirical application, I also allow for different values of α for different child age groups. Once again holding prices fixed, define the total number of effective household members to be $(n\text{-}(1\text{-}\alpha)k)^{\theta}$, where θ captures household economies of scale.[4] As θ increases from 0, economies of scale within the household decline; constant returns to scale in household size correspond to θ = 1.

To incorporate this parameterization into the community benefit function *B*, I rewrite *B* so that it depends on household composition only through the effect of household composition on household expenditure per effective adult. Define expenditure per equivalent adult, $\tilde{y}$, to be:

$$\tilde{y} = \frac{y}{\left(n - (1-\alpha)k\right)^{\theta}}$$

and then re-write *B* so that it depends on *n* and *k* only through $\tilde{y}$, i.e.

$$B(\tilde{y}, x, a).$$

Given that prices are now assumed to be held constant, from this point on I suppress the price vector *p* in the indirect utility function.

I make three assumptions about this function *B*. First, I assume that *B* is concave in income per equivalent adult $\tilde{y}$. Second, I assume that I assume that

$$\frac{\partial^2 B}{\partial \tilde{y} \partial a_i} < 0, \qquad (1)$$

[4] The parameters θ and α depend on the price vector, *p*, because different relative prices result in different relative child and adult costs. For example, if the relative price of child-specific goods rises compared to that of adult-goods, the value of α will increase.

so that conditional on all other household characteristics x, the marginal utility of aid is higher for those households with lower effective consumption; the marginal utility of aid is higher for the poor. Third, I assume that

$$\frac{\partial^3 B}{\partial \tilde{y} \partial a \partial x} = 0. \tag{2}$$

This assumption ensures that household characteristics x have only a level effect on the probability that a household receives aid—i.e., there is no interaction between other characteristics x and $\frac{\partial^2 B}{\partial \tilde{y} \partial a_i}$. For example, if this condition holds, communities could still have a preference to deny aid to minorities; however, the condition implies that, within both the majority and the minority, the communities trade off between rich and poor in the same way.

Given the social welfare function and these three assumptions, it is clear that conditional on x, households with the lowest consumption per equivalent adult receive the aid. If this process were carried out exactly, there would be a threshold level of consumption per equivalent adult below which all households receive aid and above which no households receive aid.[5] The threshold level for each community may vary depending on how much aid the community has to distribute, denoted by A, the distribution of household utilities in the community, and how strong is the community's preference for targeting aid among the very poor, captured by the magnitude of $\frac{\partial^2 B}{\partial \tilde{y}_i \partial a_i}$.

[5] Note that in some cases the threshold may be above the utility level of the wealthiest household, so that all households receive some of the aid. The identification will come from those communities where the threshold excludes at least one household. Also, note that when the aid is divisible, under the optimal distribution different households will receive different amounts of aid, with poorer households receiving more than wealthier households.

If we introduce an error term into the model, then the probability that a household receives aid is equal to the probability that a household's consumption per effective adult, as evaluated by the community, is lower than some threshold level. Since the threshold may vary by community, this is equivalent to a binary choice model with community fixed effects, i.e. an equation of the form:

$$\Pr(\text{Receive aid}_{ij}) = F\left[\gamma_j + \gamma_2 B\left(\frac{y_{ij}}{\left(n_{ij} - (1-\alpha)k_{ij}\right)^{\theta}}, x_{ij}\right)\right], \qquad (3)$$

where γ_j is the community fixed effect that captures the different threshold in each community and where F represents the distribution function for the error term. I discuss how to use equation (3) to recover estimates of α and θ in the empirical application below.

The interpretation of the estimates of α and θ depends on the degree to which the community welfare weights β depend on household composition. Suppose, for example, that community leaders were asked to name the N poorest households on a survey. In such a case, it might be reasonable to assume that the list they produce would be based on their evaluation of the household indirect utilities v. The estimates of α and θ from such a list could then be interpreted as the equivalence scale implicit in the community's perception of household indirect utility v. On the other hand, in an actual aid program, such as the OPK program I discuss below, other factors besides pure welfare maximization may enter the decision rule through the welfare weights β. To the extent that these other factors are not controlled for and correlated with household composition (i.e., n and k), the estimates of α and θ will reflect the composite equivalence scale from the B function—i.e. the product of the welfare weights β and the household utilities v.

2.2. Empirical specification

Empirical estimation of equation (3) requires specifying a functional form for *B* and the distribution of the error term *F*. For ease of comparison with other estimates of equivalence scales in the literature, I assume a log indirect utility function. The probability a household *i* in a given community *j* receives the aid is therefore:

$$\Pr(\text{Receive aid}_{ij}) = F\left[\gamma_j + \gamma_2 Log(y_{ij}) - \gamma_2\theta Log(n_{ij} - (1-\alpha)k_{ij}) + \gamma_3 x_{ij}\right] \quad (4)$$

Since this equation is non-linear, I estimate a linear approximation to it:[6]

$$\Pr(\text{Receive aid}_{ij}) = F\left[\gamma_j + \gamma_2 Log(y_{ij}) - \gamma_2\theta Log(n_{ij}) + \gamma_2\theta(1-\alpha)\left(\frac{k_{ij}}{n_{ij}}\right) + \gamma_3 x_{ij}\right] \quad (5)$$

This equation is similar to the Working-Lesser functional form for demand systems used by Deaton and Muellbauer (1986) and others. In some of the empirical work below, I extend this framework in order to separately estimate equivalence scales for different child age categories by separately including the percentage of household members in each child age category rather than just the percentage of children.

In the empirical work, I assume that the error term takes the logistic form, which allows me to use the conditional fixed-effects logit model. Rewriting equation (5) incorporating this functional form requires some additional notation. Denote by r_{ij} a binary dependent variable equal to 1 if household *i* in village *j* received rice, and 0 otherwise. Denote by N_j the number of households in village *j* and by T_j the number of households in village *j* that received rice. Finally, denote d_{ij} to be a dummy variable equal

[6] Note that this linear approximation is best when the number of children in the family is small relative to the size of the family. To check the empirical validity of the approximation in the Indonesian setting, in results not presented here I estimate the equation (4) directly by non-linear least-squares and compare the results to estimating equation (5) by ordinary least squares (i.e. a linear probability model). The estimates for θ and α obtained from the linear approximation are virtually identical to those obtained from the non-linear estimation, suggesting that the approximation does not substantially affect the results. I use the linear approximation for comparability to the existing literature.

to 1 or 0, and denote by S_j the set of all possible vectors $\mathbf{d_j} = \{d_{1j}, \ldots, d_{Nj}\}$ such that $\sum_{i=1}^{N_j} d_{ij} = T_j$. Define $\lambda_1 = \gamma_2$, $\lambda_2 = -\gamma_2\theta$, $\lambda_3 = \gamma_2\theta(1-\alpha)$, and $\lambda_4 = \gamma_3$. Substituting the logistic CDF for F in equation (5) and conditioning out the fixed effects yields an empirical specification of the following form:

$$\Pr(r_{ij} = 1 | \sum_{i=1}^{N_j} y_{ij} = T_j) = \frac{\exp\left[\sum_{i=1}^{N_j} y_{ij}\left(\lambda_1 Log(y_{ij}) + \lambda_2 Log(n_{ij}) + \lambda_3\left(\frac{k_{ij}}{n_{ij}}\right) + \lambda_4 x_{ij}\right)\right]}{\sum_{\mathbf{d_j} \in S_j} \exp\left[\sum_{i=1}^{N_j} d_{ij}\left(\lambda_1 Log(y_{ij}) + \lambda_2 Log(n_{ij}) + \lambda_3\left(\frac{k_{ij}}{n_{ij}}\right) + \lambda_4 x_{ij}\right)\right]} \quad (6)$$

I estimate equation (6) using maximum likelihood. I use the estimated coefficients λ_1, λ_2, and λ_3 to recover estimates of θ and α. To compute the revealed community equivalence scale, defined as the ratio of the income of household with a given composition to that of a reference household, I set the welfare levels for the reference and comparison household equal, and solve. Define a reference household with income y^R, size n^R, and number of children k^R, and a comparison household with income y^C, size n^C, and number of children k^C. Setting equation (5) for the reference and comparison households equal yields

$$\lambda_1 Log\left(\frac{y_{ij}^C}{y_{ij}^R}\right) = \lambda_3\left(\frac{k_{ij}^R}{n_{ij}^R} - \frac{k_{ij}^C}{n_{ij}^C}\right) - \lambda_2 Log\left(\frac{n_{ij}^C}{n_{ij}^R}\right), \quad (7)$$

Dividing the right hand side by λ_1 and taking exponents yields the equivalence scale. Note that in this model, the equivalence scale is independent of the income of the

reference household. One can use a similar technique to recover the money equivalents of other household characteristics x.

3. Empirical application: OPK rice in Indonesia

I apply the method discussed in Section 2 to a large-scale community targeted poverty relief program in Indonesia known as *OPK*, or Special Market Operation. OPK was set up as a transfer program to poor families in the aftermath of the 1997-1998 Asian economic crisis, where the transfer came in the form of subsidized rice.[7] While there were official eligibility criteria that determined which households would be eligible for the subsidized rice, these criteria were based on a pre-existing survey designed for other purposes and were acknowledged by government officials to be unsatisfactory measures of poverty (Rahayu et. al, 1998). As a result, though these criteria were used by the central government to allocate rice to each village, village heads were free to make their own allocations of the rice rather than use the criteria set by the government (Pritchett et al., 2002).[8] In practice, villages appear to have exercised this discretion. More details about the OPK program can be found in Appendix A.[9]

To estimate the equivalence scales implied by community allocations of OPK rice, I estimate equation (6) using data from the 1999 SUSENAS, the Indonesian national

[7] According to conversations with those involved in designing the OPK program, the government chose to provide income support in the form of subsidized rice rather than through a direct cash transfer for several reasons. First, providing the income support in the form of rice was expected to reduce leakage due to corruption, as it is more difficult to abscond with several tons of rice than with money, though this was not completely successful—see Olken (2003) for more details. Second, rice was chosen because it was believed that it would end up in the hands of the women of the households, where it would be more likely to affect family welfare. However, local rice markets in Indonesia are liquid enough that households that wanted the cash value of the subsidy could sell their rice on the private market, although some fraction of the value of the subsidy might be lost due to transaction costs (Olken et. al 2001).

[8] To control for the possibility that, despite the *de facto* local autonomy, official eligibility rules may have influenced rice allocations, I include an estimate of household eligibility as a control variable. Doing so does qualitatively affect the results.

[9] Note that I use the term "village" to include both a rural *desa* (village administrative unit) and as well as an urban *kelurahan* (the equivalent administrative structure in most urban areas). Since the OPK program included both urban and rural areas, I include both in this analysis.

social welfare survey. (More details about the SUSENAS, including summary statistics, can be found in Appendix B.) The dependent variable is a binary variable of whether a household received OPK rice at any time during the six months prior to the survey. Table 1 presents the main results where equation (6) is estimated using maximum likelihood.[10] As shown in Table 1, the model includes village-level fixed effects and a number of household characteristics that might affect *v* as controls. In column (1), I present the results estimating a single value of α, the cost of children relative to adults. Based on these results, I estimate the economies of scale parameter, θ, to be 0.85 and the children parameter, α, to be 0.93. Both of these estimates are significantly different from both 0 and 1 at the 1% level.

The results in column (2), which disaggregate child costs α by age bracket, are consistent with these results. Using the same specification, I estimate that α ranges from 0.86 for the 0-4 age group to 0.95 for the 5-9 age group and 0.94 for the 10-14 age group. The estimate for the 0-4 age group is significantly different both from 1 and from the estimates for older age groups, while the estimates for older children are not significantly different from either each other or from 1. The estimate of θ remains unchanged at 0.85. This confirms the intuition that younger children might receive less aid than older children and that older children might be more similar to adults.

The omitted category in column (2) is the elderly, i.e. adults age 55 and over. As the estimate of $\alpha_{15\text{-}54}$ shows, though the point estimate is that the elderly receive more aid than working-age adults, these results are not statistically significant.

[10] In results not presented here, I find that when equation (5) is estimated using a linear probability model with fixed effects rather than the conditional fixed-effects logit model of equation (6), the results are qualitatively similar.

To facilitate interpretation of these estimates, they can be transformed into an equivalence scale, i.e., the ratio of expenditure between a given household and a reference household of two adults such that the two households had the same probability of receiving aid. In Table 2a and Table 2b, I present these estimates, based on the empirical results from Table 1. I find that to maintain the same probability of receiving the OPK rice after adding a child to a household of two adults requires an increase in expenditures of 38%. This implies that communities distribute aid as if adding an additional child requires an increase in household expenditure equal to 76% of that spent on each of the first two adults to maintain constant welfare. Similarly, Indonesian communities allocated aid as if adding a third adult to the reference household of two adults requires an increase in expenditures of 42%, implying that communities distribute aid as if adding an additional adult requires an increase in household expenditure equal to 84% of that spent on each of the first two adults.

As discussed in more detail in Section 4 below, these estimates are somewhat higher than the consensus estimates of demand-based equivalence scales, which is that adding a child to a household in a developing country requires between 40-50 percent of the amount spent on each of the first two adults to maintain constant adult welfare (Deaton 1997). Since setting θ and α equal to 1 is equivalent to comparing households using per-capita expenditure, and since these estimates are closer to 1 than traditional estimates, these estimates suggest that the actual allocation rule used by Indonesian communities in allocating aid is about halfway between per-capita expenditure and typical estimates of demand-based equivalence scales.

As discussed by Sen (1999), Narayan et. al (2000) and many others, poverty is multi-dimensional, and other household characteristics besides household size and the number of children may be relevant to capture poverty differences among different types of households. One advantage of the approach discussed in this paper is that it allows us to translate the differential preference communities give households with certain characteristics into a money metric. For example, we can compute how much more income a widow could have and still have the same probability of receiving aid as a non-widow.[11]

In Table 3, I present estimates of the equivalence scales implied by the estimates in Table 1 for various other household characteristics that may be associated with poverty, where once again the reference household is a household with two adults and none of these attributes. The results suggest that communities strongly favor both widows and the illiterate in allocating aid. For example, a household headed by a widow could have 51% more monthly expenditure than a household headed by a non-widow and still have an equal chance of receiving the rice. A household whose head was illiterate would require 19% greater expenditure in order to have an equivalent chance of receiving the rice as a household whose head could read. These results suggest that communities perceive several household characteristics as having large effects on welfare, even beyond their impact on consumption.[12]

[11] Traditional methods can also be used to calculate the consumption costs of other household characteristics, such as disability (Jones and O'Donnell 1995). However, Sen and others note that consumption-based measures may not fully capture the true extent of poverty, as there may be a welfare loss in addition to the consumption loss. Such approaches may therefore understate the welfare loss associated with other aspects of poverty compared to the community-assessed approach, which allows communities to incorporate these effects.

[12] Another interpretation for these findings is that communities have poor measures of consumption, and instead used these more easily observable attributes as proxies.

There is also evidence that villages compensated households for temporary shocks. For example, a household whose head was sick for all 30 days of the month prior to the survey would need to have 51% greater expenditure in order to be have an equivalent chance of receiving the rice as a household whose head was healthy. Along the same lines, a household head who was recently laid off from work could have had up to 20% greater expenditure than a household whose head was not laid off and still have the same probability of receiving rice.[13]

The revealed equivalence scales reported in Table 2a and Table 2b represent an average of community equivalence scales from villages across Indonesia. However, as discussed above, the weights that different communities place on different types of households may vary with the type of community. For example, if food is a larger share of expenditures in poor communities than in wealthier communities, there would be fewer economies of scale—i.e., a higher level of θ—in poor communities than in rich communities. To investigate this possibility, I interact a number of village characteristics, such an index of economic development, whether a village is urban or rural, the amount of rice available for distribution, characteristics of the village head, and measures of social capital with the variables used to estimate θ and α (i.e., log household expenditure, log household size, and percent children.) From these interactions, one can use equation (5) back out how θ and α vary with these village characteristics. I normalize all village characteristics to have a mean of zero and a standard deviation of one, so the reported

[13] In results not presented here, I find that the number of household members who report being "paralyzed"—the only measure of disability in the SUSENAS—appears to have no significant relationship to the probability of receiving rice.

coefficients represent the marginal effect on θ or α of a one standard deviation change in the village characteristic.

The results from this exercise are presented in Table 4. Several interesting findings emerge. First, villages distribute rice as if there are lower economies of scale—i.e., higher θ—in poorer communities than in wealthier communities. A one-standard deviation increase in the village's economic index, equivalent to approximately a 20% increase in mean household expenditure in the village, is associated with a reduction in θ of 0.041, or approximately 5%. This suggests that the allocation rule in poorer areas may be even better approximated by per-capita expenditure than that indicated by the mean for Indonesia. Along the same lines, urban areas appear to distribute rice as if there were substantially more economies of scale than in rural areas, though urban areas also place substantially more weight on children. In particular, the results imply that, holding constant other characteristics of the village, rural areas distributed the rice as if $\theta = 0.89$ and $\alpha = 0.88$, whereas urban areas distributed rice as if $\theta = 0.77$ and $\alpha = 1.06$, though the latter coefficient on α is not statistically significantly different from 1. Furthermore, once I control for the village economic index, the amount of rice available for distribution in the district does not seem to affect the estimated economies of scale.[14] This suggests that the same allocation rule seems to be used at different income levels within a given village.

There is also some evidence that other, more political factors may have influenced how villages distributed the rice. As can be seen in Table 4, villages with more social

[14] The reason that the coefficient on rice interacted with θ is significant when I do not control for the overall level of village development is that OPK rice tended to be distributed in poorer areas, so not controlling for economic level could result in omitted variable bias.

groups appear to have distributed the rice as if θ was higher, and villages where the village head has been in office longer appear to distribute the rice as if θ was lower. Furthermore, the results from Table 1 imply that there was a substantial bias against religious minorities. I classify a household as a religious minority if they live in a village that contains religious institutions (i.e., mosques, churches, or temples), but does not contain a religious institution of their religion. Based on this definition, a minority would have to have 40% lower expenditure than an equivalent non-minority household to have the same probability of receiving rice. Excluding these political variables from the analysis, however, does not change the main estimates. However, they do suggest that understanding how local political factors influence the distribution of aid in decentralized redistribution programs may be an important area for future work.

4. Comparison to traditional based equivalence scales

In order to gauge the differences between the equivalence scales implicit in communities allocations and traditional estimates of equivalence scales, I estimate equivalence scales using traditional methods with the same data and functional form. First, I estimate the Engel equivalence scale, where a household's welfare is presumed to be measured by the share of its expenditures devoted to food. As noted by Nicholson (1976), however, estimates based on Engel's method tend to overstate the cost of children. The reason is that, particularly in developing countries, food constitutes a much higher percentage of consumption for children than for adults. As a result, a household with the same utility level as a reference household but with an additional child would have a higher food share. Compensating such a household to the point where their food

share was equal to that of the reference household overcompensates such a household, and estimating equivalence scales on this basis overstates the cost of children.

Second, I estimate the Rothbarth equivalence scale. Rothbarth (1943) assumes that the welfare of the adults in the household can be found by the level (not the share) of their expenditure on adult goods. The definition of adult goods has varied in the literature—I present results from both a very broad definition, all non-food expenditure, and a very narrow definition, household expenditure on tobacco products.[15] However, as pointed out by Barten (1964), it is possible that children create substitution effects towards adult goods, so that the Rothbarth method may undercompensate households with children. For example, if all goods consumed by both adults and children must be shared with all adults and children, the effective cost of a unit of such a good for an adult increases, which may lead adults to substitute towards adult goods. This may lead to underestimation of child costs.

To address the potential biases in the Rothbarth method, the response of the literature has been to estimate a more complex demand system that includes Barten-style substitution effects. Based on such calculations, Deaton (1997), for example, suggests that one should use a rule of thumb estimate that a child aged 0-4 adds 20% to the total expenditure of a household with two adults and that an additional child aged 5-14 adds 25% to total expenditure. This rule of thumb implies that each child costs 40% and 50%, respectively, of the cost of each of the first two adults. This rule of thumb is consistent with other estimates that use more complex demand systems to try to capture substitution effects (see, for example, Deaton and Muellbauer 1986).

[15] A more traditional choice in the literature would be household expenditure on both alcohol and tobacco. However, as Indonesia is a Muslim country, the vast majority of households have zero reported alcohol consumption, whereas smoking is much more widespread.

In order to facilitate comparisons between these demand-based methods of estimating equivalence scales and the community-based method used in this paper, I estimate both Engel and Rothbarth equivalence scales using the same specifications on the same data. Specifically, I re-estimate equation (5) using OLS, replacing the left-hand side of the equation with the household's food share, log non-food expenditure, and tobacco expenditure. For comparability to the existing literature, I do not include village fixed-effects or household level controls, though doing so does not qualitatively change the results.[16] I then repeat the same process to generate child equivalence scales using equation (7). It is important to note that the Rothbarth method cannot separately identify economies of scale (θ) and the lower cost of children relative to adults (α), so I make all comparisons between methods on the basis of the total additional cost of a child. (Deaton 1997) The empirical results are presented in Table 5a, and the resulting equivalence scales, which are comparable to results using similar Indonesian data presented in Deaton and Muellbauer (1986), are presented in Table 5b.[17]

Comparing the results, I find that community-based assessments lie slightly below the Engel-based estimates and substantially above the Rothbarth-based estimates. Even when Deaton and Muellbauer correct for substitution effects in the Rothbarth method using the Barten (1964) correction, they still estimate the cost of a third child at only 30-40 percent of the cost of each of the first two adults. My estimates, by contrast, suggest that even this correction, and the "rule of thumb" of 40-50 percent, are substantially

[16] The only substantial difference when I include village fixed-effects is that the estimate of the Engel equivalence scale is somewhat lower, though still above the community-based estimates.

[17] Since the detailed consumption data required to estimate the Rothbarth equivalence scale and to accurately estimate the Engel equivalence scale is only available for a randomly selected one third of the sample, in column (1) of Table 5a and Table 5b I present for comparability the community-based equivalence scale re-estimated using this subsample of households. These results are qualitatively similar to the results in Table 1. As discussed in Appendix B, any difference between the two samples may be due to the methodology used to collect expenditure data.

lower than the values communities actually use in allocating aid, which are closer to 75 percent.

There are several potential reasons why the estimates based on community allocations of aid may be different from traditional measures. One reason may be that community assessments of household welfare are different than the measure of welfare implied by food share or the share of consumption spent on adult goods. However, this is by no means the only possibility. As discussed in Section (2.1), the estimates here include not just the effect of n and k on the indirect utility function v, but also the effect on the welfare weights β. For example, a society might have preferences for aiding the sick or widows, for insurance reasons rather than for pure welfare-maximization reasons.

Another possible alternative explanation for the relatively high child-equivalents estimated using this method may that while the OPK program was intended as a transfer program, that transfer came in the form of subsidized rice. Since village rice markets are relatively liquid, this should be equivalent to distributing a cash transfer. Nevertheless, it is possible that villages targeted the rice to those households that were particularly in need of food rather than overall in need of income. As with the estimation of equivalence scales from Engel curves, since children consume a greater percentage of their total consumption as food, if villages targeted OPK rice to those in need of food this would increase the implied estimate of child costs. Comparing these community-based estimates of child costs to those from a cash transfer program, such as the Albanian *NE* program discussed in Alderman (2002), would be an interesting area for further research.

5. Conclusion

This paper has proposed a way to estimate the equivalence scales revealed by a community's allocation of aid, and has applied this approach to data from one such community-allocated welfare program, the OPK rice program in Indonesia.

Using this approach, I find that Indonesian communities allocated aid as if adding a child to a household of two adults required additional expenditure equal to 75 percent that spend on each of the adults to maintain similar probabilities of receiving aid. I also find that that adding an extra adult to a household of two adults requires additional expenditure equal to approximately 84 percent of the amount spend on each of the first two adults to maintain the same probability of receiving aid. I also found that, in allocating aid, Indonesian communities placed a substantial premium on windows, illiterates, and those who recently suffered a negative shock.

I then show that the estimated equivalence scales actually used by Indonesian communities are substantially closer to per-capita expenditure than conventional estimates of equivalence scales, even when estimated using the same data. This suggests that using traditional equivalence scale estimates understates the poverty of large households and households with many children, relative to the views the communities in which they live actually use when allocating aid among households.

Similar estimates could be obtained for the many settings in which communities are given discretion over allocating benefits. Programs of this type can be traced back to at least seventeenth and eighteenth century England (Conning and Kevane 2002), and are common throughout the world today. In particular, with the current emphasis on community participation in economic development, these types of community-based

welfare programs are ubiquitous throughout the developing world, from the transition economies of Albania (Alderman 2002) and Uzbekistan (Coudouel et al. 1998) to Asian countries such as Bangladesh (Galasso and Ravallion 2002), India (Drèze 2002), and Indonesia (Pritchett et al. 2002). The distribution of aid by religious and other charities provides yet another potential setting in both the developed and developing world where this method can be applied.

For settings without such a discretionary welfare program, or to conduct cross-country studies, an alternative approach would be to expand surveys that investigate perceptions of poverty, such the World Bank's Voices of the Poor project (Narayan et. al 2000), to include a section asking community leaders to identify the poorest N households in the community. One could then use this information to back out the equivalence scale used by these community leaders in comparing households, though this would be based on hypothetical questions rather than actual allocations. Extending this approach along these lines may be a promising direction for future work.

Appendix A: Indonesia and the OPK program

The community-based evaluations of welfare used in this paper are based on village allocations in the Indonesian *Operasi Pasar Khusus* (subsequently renamed *Raskin*) subsidized rice program. This Appendix details some of the relevant features of the program.

In 1997-1998, Indonesia experienced a severe economic collapse. In one year, the value of the local currency fell by as much as 80% and real GDP fell by 13%. As a result, the percentage of people living below the poverty line increased from 15 percent before the crisis to 27 percent in 1999. (World Bank, 2000) The OPK program was introduced as a response to the crisis, and was the main form of direct income support provided by the Indonesian government.

Under the program, beginning in August 1998 each eligible household was allowed to purchase first 10kg, and starting in December, 1998, 20kg of rice per month at Rp.1,000/kg ($0.10), a subsidy of about Rp. 1,750/kg from the average market price of Rp. 2,750/kg. The median family eligible for the program had reported a monthly expenditure of Rp. 357,000; the program thus represented a subsidy equal to 9.8% of monthly expenditure for a typical family that received it. The program was quite substantial in scope—in January 1999, the program was delivering a total of 200,000 tons of rice per month, enough for 10 million households to receive a monthly allotment of 20kg of rice.

The government of Indonesia decided to target the OPK program at the poorest households. However, the only data on every Indonesian household that could be used for targeting purposes was a family welfare survey conducted by the Indonesian family planning agency, BKKBN, which had been in place long before the crisis, primarily as a means to target reduced-cost birth control. The BKKBN data was updated annually by local staff at the sub-district and village level, and in principle covered every household in the nation headed by a married couple. The survey had a list of minimum standards for each of three welfare levels—the Prosperous Family Levels 1-3. A household not meeting even the lowest of these standards was classified as “Pre-Prosperous.” These minimum standards were meant to capture a broad definition of poverty, and as such ranged from the easily observable, such as having a dirt floor, to the more subjective,

such as being able to perform one's religious obligations. Households were officially eligible for the OPK program if they were considered either "Pre-Prosperous" or "Prosperous Level 1."

It is important to note that the government chose the BKKBN criteria as the basis of OPK targeting not because they explicitly represented the government's objectives, but rather because they were the only nationally standardized criteria the government had at the time they decided to introduce OPK. Given the time urgency created by the economic crisis, the government did not have time to institute a new nationwide survey of poverty. As a result, the central government allows local officials substantial leeway in determining to whom the rice should be distributed.

The delivery of the rice was managed by the central government but implemented by local officials. To implement the OPK program, the government logistics agency, BULOG, using the official number of eligible people in each village derived from the BKKBN lists, sent the requisite amount of rice to the district level logistics depots, which brought the rice to distribution points closer to the villages. Village officials picked up the rice at the distribution point, brought it back to their village, and returned one week later to deliver the Rp. 1,000/kg co-payment to BULOG. Once the rice was in the village, however, there was essentially no central government monitoring of which households actually received the rice—so long as the Rp 1,000/kg co-payment was remitted back to BULOG, villages were largely left alone to deliver the rice. Village officials, in particular, the village head, therefore had almost complete autonomy to decide which households in the village should receive the rice.

Appendix B: Data

This study draws on the 1999 National Welfare Survey (SUSENAS), a large household survey conducted by the Indonesian Central Statistics Bureau. The SUSENAS is cross-sectional survey conducted annually and representative of the country at the district (i.e., sub-province) level. The 1999 wave of the SUSENAS was fielded in January, 1999 and consists of approximately 206,000 households spread over 11,131 villages across the country. Due to the vast political, cultural, and economic differences separating Irian Jaya (the western half of New Guinea) and East Timor from the rest of Indonesia, I exclude those two provinces from the analysis. Summary statistics from the SUSENAS are presented in Table 6 for the main variables used in the analysis.

The SUSENAS asked respondents if the household had ever received help from the government Social Safety Net programs (JPS) in the form of "*sembako* / cheap *sembako*", where *sembako* refers to the government-defined basket of nine basic commodities (including rice). If so, they then asked if the food assistance was free, at reduced price, or some combination. They then asked how many times a household had received the *sembako* in the past six months, and whether the *sembako* came from the government or private sources. Since OPK was the main source of subsidized rice, following Pritchett et. al (2002) and others, I code a household as receiving OPK if they received subsidized or part-subsidized, part-free *sembako* from the government. Using these definitions, approximately 80 percent of those households reporting receiving any type of food assistance received it from the OPK program. No data was collected as to the amount of rice received by the household or the price paid for it.

In the regressions discussed above, I control for a household's predicted eligibility for the program, as some villages may have at least in part targeted the program based on official program eligibility. A household was officially eligible for the program if it failed any of the 14 BKKBN criteria for being a Prosperous Level II household (and was therefore Prosperous Level I or Pre-Prosperous.) I consider a household eligible if they failed any of the 11 of the 14 criteria that are available from the SUSENAS. Estimated eligibility seems to slightly overstate actual eligibility—overall, in 1999 actual eligibility was 49% of all households in Indonesia; my estimate of eligibility is 55% of all households. At the district level, the correlation of actual and predicted eligibility is 0.76.

In addition to a core household questionnaire administered to all households, in 1999 the SUSENAS fielded several additional modules—a module on the social safety net, including OPK, administered to all households, and a detailed consumption module, administered to one-third of the households in the sample. Pradhan and Sparrow (2000) note that overall expenditure measures appear to be different in the sample where detailed consumption data was collected. To account for this, I re-normalize the total expenditure levels for the set of households that received the detailed questionnaire so that they have the same mean and standard deviation as the set of households that did not receive the detailed questionnaire.

I obtain community-level characteristics from the 1999 Village Potential Census, or PODES, which I match with the SUSENAS. To construct an overall index of economic development, I use principle-components analysis, aggregating factors including the central government's rating of a village's development, the types of toilet facilities generally used by residents, presence of roads, telecommunications facilities, and housing levels. Regressing this index of economic development on log household expenditure from the SUSENAS suggests that, on average, a one standard deviation increase in this index is associated with an 18.5% increase in mean household consumption. The variable on the number of social groups is equal to the number of different types of social activities present in the village, where the list of possible activities includes scouts, houses for orphans, the elderly, or the handicapped, religious study groups, youth clubs, women's groups, rotating credit associations, and several types of organized sporting groups. To facilitate interpretation, I normalize all village level variables to have a mean of zero and a standard deviation of one.

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Table 1: Probability of receiving rice

	(1)	(2)
Model	FE Logit	FE Logit
Log total expenditure	-1.707***	-1.701***
	(0.026)	(0.026)
Log household size	1.454***	1.449***
	(0.027)	(0.027)
Percent children 0-14	-0.106***	
	(0.042)	
Percent children 0-4		-0.197***
		(0.066)
Percent children 5 – 9		-0.071
		(0.064)
Percent children 10 –14		-0.092
		(0.065)
Percent adults 15 – 54		-0.053
		(0.034)
Household controls:		
Woman head of household	0.025	0.024
	(0.042)	(0.042)
Widow head of household	0.422***	0.415***
	(0.047)	(0.047)
Number of days hh head sick	0.014***	0.014***
	(0.002)	(0.002)
Illiterate household head	0.174***	0.173***
	(0.024)	(0.024)
Religious minority	-0.495***	-0.494***
	(0.090)	(0.090)
Recently laid off from work	0.180***	0.183***
	(0.050)	(0.050)
Rice fields in rural areas	-0.231***	-0.233***
	(0.020)	(0.020)
Other fields in rural areas	-0.060***	-0.061***
	(0.013)	(0.013)
Rice fields in urban areas	0.260***	0.261***
	(0.025)	(0.025)
Other fields in urban areas	0.020	0.020
	(0.030)	(0.031)
Household eligible for program	0.345***	0.342***
	(0.019)	(0.019)
Village fixed effects	YES	YES
Observations	188,435	188,435
Implied θ	0.852°°°	0.852°°°
	(0.012)	(0.012)
Implied $\alpha_{0\text{-}14}$	0.927°°°	
	(0.029)	
Implied $\alpha_{0\text{-}4}$		0.864°°°
		(0.045)
Implied $\alpha_{5\text{-}9}$		0.951
		(0.044)
Implied $\alpha_{10\text{-}14}$		0.937
		(0.044)
Implied $\alpha_{15\text{-}54}$		0.964
		(0.023)

Estimates of the probability of receiving OPK rice from equation (5). The implied value of α_x is the value of α for age group x. Robust standard errors in parentheses, where standard errors for θ and α are calculated using the delta method. Note that the number of observations includes the 63,387 observations for which all households in a village either did or did not receive the rice even though those villages do not affect the estimates.

* significant at 10%; ** significant at 5%; *** significant at 1%

° sig. different from 1 at 10%; °° sig. different from 1 at 5%; °°° sig. different from 1 at 1%

Table 2a: Equivalence scales calculated from probability of receiving rice for overall number of children

H.H. Size	Number Children	Equivalence Scale:
2	0	1.000
3	1	1.384
3	0	1.412
4	2	1.750
4	1	1.777
4	0	1.805

Estimates derived from empirical results presented in column (1) of Table 1.

Table 2b: Equivalence scales calculated from probability of receiving rice for number of children in each age bracket

H.H. Size	Number Age 0-4	Number Age 5-9	Number Age 10-14	Number Age 15-54	Equivalence Scale:
2	0	0	0	2	1.000
3	1	0	0	2	1.373
3	0	1	0	2	1.407
3	0	0	1	2	1.402
3	0	0	0	3	1.413
4	2	0	0	2	1.730
4	0	2	0	2	1.795
4	0	0	2	2	1.784
4	0	0	0	4	1.805

Estimates derived from empirical results presented in column (2) of Table 1.

Table 3: Other aspects of poverty

Household characteristics	Equivalence Scale (Spec. 1 of Table 1)
Two adults	1.000
Widow as head of household	1.514
Household sick and unable to work for 1 day in last month	1.014
Household sick and unable to work for 30 days in last	1.511
Household head is illiterate	1.189
Household head recently laid off from work	1.201

Estimates are based on results from column (1) of Table 1. Each estimate is the effective cost, as judged by the community, of having with two adults and the characteristic listed., relative to a household with 2 adults and none of these characteristics

Table 4: Heterogeneity in revealed equivalence scales across villages

	(1)	(2)	(3)	(4)	(5)
Baseline estimates					
θ	0.844°°°	0.838°°°	0.860°°°	0.858°°°	0.852°°°
	(0.012)	(0.012)	(0.013)	(0.013)	(0.014)
α	0.943°°°	0.951°°°	0.923°°°	0.919°°°	0.949°°°
	(0.030)	(0.030)	(0.030)	(0.029)	(0.033)
Heterogeneity in θ					
Village economic index * θ	-0.055***				-0.041**
	(0.012)				(0.018)
Urban area * θ		-0.056***			-0.057***
		(0.011)			(0.016)
Amount of OPK rice distributed in district * θ			0.029**		0.007
			(0.013)		(0.014)
Age of village head * θ				0.003	0.007
				(0.012)	(0.013)
Village head years in office * θ				-0.038***	-0.045***
				(0.012)	(0.013)
Number of social groups * θ				0.011	0.046***
				(0.013)	(0.015)
Community self-help * θ				0.023*	0.025*
				(0.013)	(0.014)
Religious heterogeneity * θ				-0.011	0.015
				(0.011)	(0.013)
Heterogeneity in α					
Village economic index * α	0.052				-0.001
	(0.031)				(0.047)
Urban area * α		0.083***			0.101**
		(0.029)			(0.041)
Amount of OPK rice distributed in district * α			-0.043		-0.006
			(0.031)		(0.035)
Age of village head * α				0.033	0.022
				(0.030)	(0.033)
Village head years in office * α				0.030	0.028
				(0.031)	(0.034)
Number of social groups * α				-0.015	-0.042
				(0.032)	(0.038)
Community self-help * α				-0.082**	-0.084**
				(0.033)	(0.037)
Religious heterogeneity * α				0.039	0.013
				(0.029)	(0.033)
Household controls	YES	YES	YES	YES	YES
Village fixed effects	YES	YES	YES	YES	YES
Number of observations	188,324	188,324	179,886	179,886	179,886

See notes to Table 1. Results are derived from conditional fixed-effects logit regressions as described in equation (6), in which all of the variables listed above are interacted with log total expenditure, log household size, and percent children. The coefficients reported above are derived from the estimated coefficients as described in the text. Robust standard-errors are computed using the delta method. All variables listed are normalized to have mean of zero and standard deviation of one, so reported coefficients represent the marginal effect of a one standard deviation change in the village characteristic. The description of the village-level characteristics can be found in Appendix B.

* significant at 10%; ** significant at 5%; *** significant at 1%

° sig. different from 1 at 10%; °° sig. different from 1 at 5%; °°° sig. different from 1 at 1%

Table 5a: Estimates from different equivalence scales

	(1) Community Assessment	(2) Engel (Food Share)	(3) Rothbarth (Nonfood Exp)	(4) Rothbarth (Tobacco Exp)
Model	FE Logit	FE	FE	FE
Log total expenditure	-1.829***	-0.136	1.382	23,602.65
	(0.046)	(0.003)***	(0.010)***	(1,124.730)***
Log household size	1.508***	0.099	-0.288	3,781.33
	(0.049)	(0.003)***	(0.009)***	(950.950)***
Percent children	-0.170**	0.028	-0.09	-8,457.02
	(0.075)	(0.004)***	(0.014)***	(1,408.357)***
Household controls	YES	NO	NO	NO
Village fixed effects	YES	NO	NO	NO
Observations	58,427	55,610	55,610	55,610

Column (1) presents estimates of the probability of receiving OPK rice based on equation (5) for the subset of the sample for which detailed consumption data is available. Columns (2) – (4) present OLS results using the functional form of equation (5) without village-level fixed effects or household controls using the dependent variable indicated in each column. Household controls include all household controls listed in Table 1. Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5b: Comparison of cost of children using different equivalence scales

		Equivalency Scale Using the Following Specification:			
H.H. Size	Number Children	Community Assessment	Engel (Food Share)	Rothbarth (Nonfood Exp)	Rothbarth (Tobacco Exp)
2	0	1.000	1.000	1.000	1.000
3	1	1.354	1.439	1.112	1.056
4	2	1.690	1.836	1.194	1.070

Estimates derived from empirical results in Table 5a.

Table 6: Summary Statistics

Household received OPK rice	0.358
	(0.479)
Log total household expenditure	13.087
	(0.610)
Log household size	1.307
	(0.501)
Percent children age 0-14	0.282
	(0.224)
Percent children age 0-4	0.081
	(0.130)
Percent children age 5 – 9	0.090
	(0.135)
Percent children age 10 –14	0.092
	(0.138)
Percent adults age 15 – 54	0.588
	(0.260)
Woman head of household	0.131
	(0.337)
Widow head of household	0.091
	(0.288)
Number of days hh head sick	1.249
	(4.016)
Illiterate household head	0.179
	(0.383)
Religious minority	0.014
	(0.118)
Recently laid off from work	0.022
	(0.148)
Rice fields in rural areas	0.154
	(0.922)
Other fields in rural areas	0.331
	(1.393)
Rice fields in urban areas	0.017
	(0.423)
Other fields in urban areas	0.026
	(0.427)
Household eligible for program	0.503
	(0.500)
Urban area	0.326
	(0.469)

Means and standard deviations of household variables used in regressions, computed from SUSENAS data.