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Decentralization of National Transfer Programs: compliance, local revealed equivalence scales, and efficacy of aid

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Abstract
Numerous national transfer programs around the world are designed with uniform benefit schedules imposed by central governments, but implemented by local governments. The Productive Safety Net Program (PSNP) in Ethiopia, the second largest safety net in Sub Saharan Africa, is one such program. First, using variance decomposition techniques, we document local government's noncompliance to the federally mandated uniform benefit schedule. Second, we find that local governments account for household economies of scale on the intensive margin (actual payouts to households) rather than the extensive margin (which households are selected into the PSNP). Younger children receive lower payments than older children or adults. Estimated equivalence scales on the intensive margin of participation suggest that communities distribute aid as if an additional young child (age 0-6) needs XX% of the payout that each of the first two adults received, and adding an older child (age 7-15) requires XX% of the payout that each of the first two adults received. Lastly, we examine whether noncompliance with federal mandates is more or less poverty reducing than the program would have been under the federally mandated uniform benefit schedule.

Keywords: decentralization, national transfer programs, equivalence scales, targeting, safety nets

1. Introduction

What are the consequences of local versus central control in national transfer programs? In this paper we examine Ethiopia's Productive Safety Net Program (PSNP), which has elements of both local and centralized control. The PSNP is a hybrid program with rules set by the federal government, but implemented by local governments.

National transfer programs provide an important mechanism for delivering targeted aid to those in need, often on a very large scale. Two of the world's largest programs are Mexico's *Progresa/Opportunidades*[1] and Brazil's *Bolsa Família,* which at times, have annual budgets that surpass USD$2 billion (Handa and Davis 2006). Mexico's *Progresa/Opportunidades* is an example of a highly centralized program in which the central government designs the program, chooses the recipients, and issues payments (Skoufias 2005) while Brazil's *Bolsa Família,* is an example of a decentralized program in which local municipalities select beneficiaries and execute payments (de Janvry et al. 2005).[2] There has been significant debate over how the locus of program control affects the effectiveness of programs.

[1] The program was initially called *Progresa* (1997-2002), but later the name was changed to *Opportunidades* (2002-present*)*.
[2] The *Bolsa Família* program shares the same decentralized features of one of its precedent programs, *Bolsa Escola,* which was a national transfer program focusing on education that was folded into *Bolsa Família* in 2003.

One side of the debate asserts that local governments should be able to acquire accurate and detailed information about the needs of a given household at a lower cost than central governments and therefore tailor programs more effectively. Notable examples include: social assistance programs of Albania being better targeted due to local information (Alderman 2002), decentralization increasing the responsiveness of public investment to local needs in Bolivia (Faguet 2004), and pro-poor program benefits increasing with decentralization in Bangladesh (Galasso and Ravallion 2000). Additionally, a local government knows best what is politically and socially feasible in the local context (Pritchett 2005). Huther and Shah (1998) find positive correlations between decentralization and indices of political participation, social development and an overall quality of government index in a broad study covering 80 countries.

However, despite these potential benefits, there is no guarantee that local governments are more accountable to their local constituents. Even if informational advantages exist for local governments, there may be high levels of political capture of local elites (Bardhan and Mookherjee 2000; Bardhan and Mookherjee 2005). Local rent seeking and the possibility that local preferences are not pro-poor are drawbacks of some decentralized social safety nets (Conning and Kevane 2002). Furthermore, ethnically heterogeneous and sparsely populated areas could be more prone to local corruption (Olken 2006).

Besley and Coate (2003) argue that if local governments allocate public goods with positive spatial spillovers outside their jurisdiction, the local government will not take into account the positive spillover effect (since it falls outside of its district) and the public goods will be underprovided in the presence of spatial spillovers. While this can be construed as an argument for centralization, the authors ultimately argue that the trade-off of centralized versus decentralized provision depends on the extent of heterogeneity in preferences and the degree of spatial spillovers (Besley and Coate 2003).

In this paper, we examine the consequence of decentralized control, whether it's intended (as with *Bolsa Família*) or not (as in the PSNP). In examining this hybrid program we use variance decomposition techniques to explore the degree of compliance with federal payment mandates with respect to constant returns to household scale (i.e., uniform per capita payments). We find widespread noncompliance with the federal directive of uniform per capita payments. Then we examine the determinants of inclusion in the program (the extensive margin of transfer payments) and determinants of payments once a household has been selected for the PSNP (the intensive margin). Does household composition influence decisions communities make on the extensive and/or intensive marginS of participation? Finally, we examine if this noncompliance with federal mandates is more or less poverty reducing than the program would have been under the federally mandated uniform benefit schedule.

The paper is structured as follows: section 2 discusses the genesis and design of the PSNP, section 3 describes methods for the variance decomposition of PSNP payments, estimating revealed community equivalence scales, and how to measure the degree of effectiveness of the program in its poverty reduction aims. Section 4 describes the data, section 5 presents results of the variance decomposition, the estimates of revealed community equivalence scales, and program effectiveness, and section 6 concludes.

2. Background and design of the Productive Safety Net Program

More than 80% of Ethiopia's population lives in rural areas and relies on rain fed agriculture as its main source of livelihood. Historically, insufficient and variable rainfall caused cycles of food shortage and famine and the government of Ethiopia requested international assistance, as and when needed. In the early 2000's the government and a consortium of international donors realized that Ethiopia's existing policy of issuing ad hoc emergency appeals had become an annual event and that Ethiopia's underlying issue was chronic food insecurity and not simply the acute food shortages caused by rainfall shocks. Therefore, beginning in January of 2005 the government of Ethiopia launched the Productive Safety Net Program (PSNP), which has the stated objective "to provide transfers to the food insecure population in chronically food insecure areas in a way that prevents asset depletion at the household level and creates assets at the community level" (Ethiopian Ministry of Agriculture and Rural Development 2004).

The PSNP is designed to assist approximately 7 to 8 million people per year and has an approximate annual budget of USD$500 million. The official administrative levels of the Ethiopian government moving from most central to most decentralized are: federal, region, zone, *woreda,* and *kebele.*[3] In 2005, 190 *woredas* were included in the PSNP; since then the PSNP has expanded to 262 *woredas* including pastoralist areas in Afar, Oromia, and Somali Region. The PSNP has two major parts: 1) a large public works (PW) program in which food insecure households provide daily labor to public works projects in exchange for food or cash, and 2) a smaller direct support (DS) component in which households without available labor (generally the elderly or disabled) receive a transfer with no work requirement. The PSNP adheres to the principle of "primacy of transfers," which states that transfers continue regardless of operational issues in the public works programs which might prevent participants from receiving their full quota of work days (Ethiopian Ministry of Agriculture and Rural Development 2004). This feature has been noted as rare when compared to public works programs in other countries, but also has been hailed as a critical element from a social protection perspective in that it ensures reliable and predictable transfers (Lieuw-Kie-Song 2011).

[3] A *woreda's* population generally ranges from 20,000 to 250,000, while a *kebele's* population generally ranges from 2,000 to 4,000 (Federal Democratic Republic of Ethiopia Population Census Commission 2008).

A family that qualifies for the PSNP is entitled to send someone to work five days per month for six months per year,[4] per family member. Often a family sends one person to work Nx5 days monthly, where N is the household headcount. This is known as full family targeting because each household member is entitled to receive the same level of payment. Based on the number of days of entitled work, the family will receive cash at the day labor rate, an equivalent amount of food aid, or a mixture of the two.[5] A direct support household receives a payout calculated in the same way without the work requirement; for example, a grandmother with four small children would receive the transfer payment equivalent to a family of five without any work requirement.

2.1 Targeting of program participants

A combined administrative and community targeting approach, as opposed to self-selection based on wage rate, is applied in the PSNP. Because the PSNP was designed as a response to repeated requests for emergency food aid, the regional and federal governments devise a list of the food insecure *woredas* in the country (based on historical food aid needs) and then individuals in rural *kebeles* within those *woredas* are selected based on household level criteria. The administrative and community targeting system to select program participants employs various local community level committees including: *woreda* food security task force, *kebele* council, *kebele* food security task force, and the community level food security task force. Numerous layers of administrative oversight, the public reading/posting of community beneficiary lists, and a community based mechanism to challenge inclusion and exclusion errors create the framework for a transparent beneficiary selection process. Retargeting is done twice a year to correct perceived targeting errors. The Program Implementation Manual (PIM) lists the key criteria for participant selection as having some combination of the following:

- Household is member of the community
- Chronically food insecure household which has faced continuous food shortages (3 months or more of food gaps per year) in the last three years
- Household suddenly becomes more vulnerable due to the result of a severe loss of assets, especially if linked to the onset of a severe chronic illness
- Households without adequate family support and other means of social protection

[4] The PSNP public works program generally runs from January to June to avoid conflict with peak farming times in the second half of the year. Common public works projects range from infrastructure projects (feeder roads, bridges, school buildings, health posts) to natural resource and environmental management projects such as terracing, reforesting hillsides, or erosion prevention activities. The daily wage rage is approximately USD$0.75-1.00 per day.

[5] One of the government of Ethiopia's initial stated goals of the PSNP was to move away from food aid and towards cash payments as aid. However, some donors, particularly the United States, would only give their contribution to the PSNP in the form of food aid, so the *woredas* supported by US government resources are generally chosen to be the most remote and those with the least market access where food aid is perhaps a better option than cash transfers.

Once a household is selected into the PSNP, each household member listed on the local government's administrative records is included when calculating the household's benefit level. From 2005-2009 polygamous households were considered one large household with all family members (all wives and all children) counted in the family. Starting in 2010, polygamous families were split into multiple families (the husband was counted with the first wife, and then each subsequent wife and her children were considered a separate female headed household).

These criteria are broad and potentially allow for significant local level discretion in determining who participates and who does not. While this allows variation in program participation as to which households are in or out of the PSNP (the extensive margin), the instructions are explicit that a uniform payment per household member is required conditional on PSNP participation (the intensive margin).

3. Estimation strategy

As previously mentioned a feature of the PSNP that will be of central importance for this study is the principle of full family targeting. The PIM states: "If a household is identified as being chronically food insecure and eligible for the PSNP, all household members will be listed as clients of the program. That is, the transfer that a household receives each month will be calculated using the prevailing wage rate multiplied by all family members, regardless of their age, even if some family members are only infants" (Ethiopian Ministry of Agriculture and Rural Development 2010). The prevailing wage rate for the PSNP public works program is set nationally by the central government and while the day rate periodically rose (6 Ethiopian birr (ETB)/day in 2005-2007, 8 ETB/day in 2008, 10 ETB/day in 2009-2010, 12 ETB/day in 2011 and 14 ETB/day in 2012),[6] the wage rate was uniform for all locations at any given date between 2005-2012.[7]

3.1. Construction of marginal payment variable

In any given year between 2005-2012 a uniform per capita benefit schedule was in place. The PSNP provides payments for six months of the year, for example, in 2009 the value of the annual PSNP payment was 300 ETB/person,[8] so a family of two should receive 600 ETB, a family of three 900 ETB, a family of four 1200 ETB, and so on. Therefore, conditional on household PSNP participation, there should be no variation in the marginal transfer for increasing household size by one. To test if this is the case, we construct a marginal payment variable for an additional household member. This is the difference in payment a household actually received compared to the mean payment (conditional on being in the PSNP) in that same *woreda* for a

[6] Source (Ahmed 2012; World Bank 2009).

[7] Starting in 2013 the wage rate will no longer be uniform across the country, but will vary by location based on local labor market conditions.

[8] The daily wage rate in 2009 was 10 ETB/day and the PSNP makes payments to beneficiaries for six months per year (10 ETB/day*5 days/month*6 months = 300 ETB/person/year).

household whose size is larger by one member. The probability density function of the incremental differences in marginal payouts for additional HH members is the distribution of:

$$MP_{ijw} = (\overline{T_{jw}} \mid H_{jw} = n+1) - (T_{ijw} \mid H_{ijw} = n) \tag{1}$$

Where $\overline{T_{jw}}$ is the mean transfer for households with size $H_{jw} = n + 1$ at year j at *woreda w* and T_{ijw} is the amount of transfer for household *i* at year *j* at *woreda w* and $H_{ijw} = n$ is household size for household *i* at year *j* at *woreda w*, and *n* represents the different household sizes found in the sample.[9] We symmetrically trim the 1% of outliers from each tail of the marginal payment sample to reduce the effect of outliers.[10]

3.2. Decomposing the variance of marginal payment

We adapt the nonparametric variance decomposition approach put forth in Barrett and Luseno (2004) to decompose the variance in marginal payments at differing levels of the government structure within the PSNP. Barrett and Luseno used this technique to locate the sources of producer price risk in livestock markets in northern Kenya, but it is easily adapted to understand how marginal payments vary at differing levels of government administration in the PSNP.

The decomposition works as follows. Let *i* index individual households, *k* is the *kebele* location, *w* is the *woreda* location, *z* is the zone location, *r* is the region location, and *f* is the federal level.[11] Simply begin with the obvious statement that marginal payment of a given household equals the marginal payment of that same household.

$$MP_{ikwzrf} = MP_{ikwzrf} \tag{2}$$

Then repeatedly add and subtract the same term to the right hand side of equation (2) and regroup with parentheses.

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[9] This is a one-step-ahead estimator. We also construct a one-step-behind estimator (i.e. $MP_{ijw} = (T_{ijw} | H_{ijw} = n) - (\overline{T_{jw}} | H_{jw} = n - 1)$. Results using the one-step-ahead estimator are presented in the main paper; results using the one-step-behind estimator do not materially change and are presented in Appendix A.

[10] We also calculate another marginal payment measure using the *kebele* rather than the *woreda* as the reference point. This would be advantageous if the *kebele* is the locus of determination in marginal payments; however, it has the disadvantage of data loss, as there are more boundary problems and more potential gaps in the data when creating the distribution of marginal payments. As an additional robustness check, the marginal payment variable is calculated with and without simple non-parametric smoothing to reduce the impact of any outliers in a given *woreda* or *kebele*. Irrespective of the way the marginal payment variable is generated, the variance decomposition results are largely the same, and these robustness checks are presented in Appendix A.

[11] The decomposition is executed only on data points from the same year; therefore the year subscript is dropped in the model specification.

$$MP_{ikwzrf} = (MP_{ikwzrf} - \overline{MP_k}) + (\overline{MP_k} - \overline{MP_w}) + (\overline{MP_w} - \overline{MP_z}) + (\overline{MP_z} - \overline{MP_r}) + (\overline{MP_r} - \overline{MP_f}) - \overline{MP_f} \quad (3)$$

Equivalently this can be rewritten as:

$$MP_{ikwzrf} = K + W + Z + R + F + \overline{MP_f} \quad (4)$$

where $K \equiv (MP_{ikwzrf} - \overline{MP_k})$ is the deviation of household marginal payment from the *kebele* mean marginal payment in the same *kebele*; $W \equiv (\overline{MP_k} - \overline{MP_w})$ is the deviation of *kebele* mean marginal payment from *woreda* mean marginal payment in the same *woreda*; $Z \equiv (\overline{MP_w} - \overline{MP_z})$ is the deviation of *woreda* mean marginal payment from zonal mean marginal payment in the same zone; $R \equiv (\overline{MP_z} - \overline{MP_r})$ is the deviation of zonal mean marginal payment from regional mean marginal payment in the same region; and, lastly, $F \equiv (\overline{MP_r} - \overline{MP_f})$ is the deviation of regional mean marginal payment from federal mean marginal payment. Taking the variance of equation (4) gives the following decomposition:

$$\begin{aligned} Var(MP_{ikwzrf}) &= Var(K) + Var(W) + Var(Z) + Var(R) + Var(F) + \\ &2[Cov(K,W) + Cov(K,Z) + Cov(K,R) + Cov(K,F) + Cov(W,Z) + \\ &Cov(W,R) + Cov(W,F) + Cov(Z,R) + Cov(Z,F) + Cov(R,F)] \end{aligned} \quad (5)$$

Simplification and splitting the covariance shares equally between the two components leads to the following five sources of variation in marginal payments:

$$KS \equiv Var(K) + Cov(K,W) + Cov(K,Z) + Cov(K,R) + Cov(K,F) \quad (6)$$

is the *kebele* source variation,

$$WS \equiv Var(W) + Cov(K,W) + Cov(W,Z) + Cov(W,R) + Cov(W,F) \quad (7)$$

is the *woreda* source variation,

$$ZS \equiv Var(Z) + Cov(K,Z) + Cov(W,Z) + Cov(Z,R) + Cov(Z,F) \quad (8)$$

is the zonal source variation,

$$RS \equiv Var(R) + Cov(K,R) + Cov(W,R) + Cov(Z,R) + Cov(R,F) \quad (9)$$

is the regional source variation, and

$$FS \equiv Var(F) + Cov(K,F) + Cov(W,F) + Cov(Z,F) + Cov(R,F) \quad (10)$$

is the federal source variation.

Substituting these five variables into equation (5) and dividing both sides by $Var(MP_{ikwzrf})$ gives a decomposition of the sources of variation of marginal payment:

$$1 = ks + ws + zs + rs + fs \tag{11}$$

where the lower case variables are source variation shares.

3.3. Conceptual approach to revealed community equivalence scales

As the size of a household expands, so do its needs. However, these needs do not expand proportionally for each additional household member. This concept is of central importance when making welfare comparisons between households of differing sizes and demographic composition, or in calibrating household benefit transfers in social programs. One way to address this challenge is to calculate an equivalence scale. An equivalence scale is a measure of the cost of living for a household of a given size and demographic composition, relative to the cost of living of a reference household, holding utility or standard of living constant (Deaton 1997; Lewbel and Pendakur 2008; OECD 2008). To recover revealed community equivalence scales in the PSNP, we follow the technique used in Olken (2005) which examines the allocations made by communities in a decentralized emergency relief program in Indonesia.

The conceptual setup of Olken's model is as follows. Each household's indirect utility function, as evaluated by the community is:

$$v(y, n, k, x, p, a) \tag{12}$$

where y represents total household expenditures, n represents 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. Assume that v is concave in y. Assume the community maximizes a social welfare function:

$$\max \sum_{i=1}^{I} \beta(y_i, n_i, k_i, x_i, p) v(y_i, n_i, k_i, x_i, p, a_i) \quad \text{s.t.} \sum_{i=1}^{I} a_i = A \tag{13}$$

where β represents welfare weights on each household, I is the total number of community residents, and A represents total amount of aid to be distributed. There are important distinctions between β and v. For example, many aspects of a household's welfare might affect the community's decisions such as vulnerability of children to shocks or increased medical expenditures for the sick. These are captured in v. However, it is possible that other factors besides pure welfare maximization affect a village's decision of how to allocate aid. For example, the

political connectedness of a household or a desire to provide social insurance to those suffering a recent unexpected shock even if their marginal utility of receiving the aid was lower than another statistically poorer household. These are captured by β. Because the weights of β may also be related to household composition (through n or k) we are unable to separately identify the community welfare weights β and the indirect utility function v in this context (Olken 2005). We can, however, identify the product of the two (called the overall community benefit function), which is denoted:

$$B(y_i, n_i, k_i, x_i, p, a_i) = \beta(y_i, n_i, k_i, x_i, p) v(y_i, n_i, k_i, x_i, p, a_i) \tag{14}$$

After doing so the community maximization problem becomes:

$$\max \sum_{i=1}^{I} B(y_i, n_i, k_i, x_i, p, a_i) \qquad \text{s.t.} \sum_{i=1}^{I} a_i = A \tag{15}$$

To differentiate the cost of children relative to adults and introduce household economies of scale, we parameterize these effects following Deaton (1997) and Olken (2005). For a given set of prices, let α be the cost of children relative to adults, so that each child costs as much as α adults. Initially assume a single value of α that applies to all children, however this can be further expanded (see empirical section) to allow different costs for different types of children (for example, younger vs. older children, or even to understand if there is a community based sex bias which favors children of a certain gender). Define total number of effective adults to be $(n - (1 - \alpha)k)^{\theta}$, where θ captures household economies of scale. As θ increases from 0, economies of scale within the household decline, constant returns to scale in household size (as the federal uniform benefit schedule of the PSNP suggests) corresponds to $\theta = 1$. Rewrite B so that it depends on household composition only through the effect of household composition on household expenditure per effective adult (Olken 2005). Expenditure per equivalent adult is defined as:

$$\tilde{y} = \frac{y}{(n - (1 - \alpha)k)^{\theta}} \tag{16}$$

and then rewrite B so that it depends on n and k, only through $\tilde{y}$:

$$B(\tilde{y}, x_i, a_i) \tag{17}$$

Following Olken (2005) assume that prices are held constant and remove the price vector p from the community benefit function.[12] There are two key assumptions

[12] In the estimation strategy constant spatiotemporal prices are captured in the year-*kebele* fixed effects. Essentially, communities assume that all households within the community face the same prices in a given location and time.

concerning the function B. First, assume B is concave in income per equivalent adult $\tilde{y}$. Second, assume that:

$$\frac{\partial^2 B}{\partial \tilde{y} \partial a_i} < 0 \tag{18}$$

meaning that conditional on all other household characteristics x, the marginal utility of aid is higher for households with lower effective consumption (i.e., the marginal utility of aid is higher for the poor).

Based on the community benefit function and the two assumptions presented, the households with the lowest consumption per equivalent adult (conditional on x) will receive aid. In theory, this means there is a threshold where all the households above the threshold do not receive aid and all the households below the threshold do receive aid. This threshold will vary by community based on the how much aid the community has to distribute 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 $(\partial^2 B / \partial \tilde{y} \partial a_i)$.

Next introduce an error into the model, and 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. This threshold varies by community, so it can be modeled as a binary choice model with community fixed effects. This is equivalent to an equation in the form:

$$\Pr(Receive_aid_{ij}) = F\left[\gamma_j + \gamma_2 B\left(\frac{y_{ij}}{n_{ij} - (1-a)k_{ij})^{\theta}}, x_{ij}\right)\right] \tag{19}$$

Where γ_j is the community fixed effect that captures different thresholds in each community and F is the distribution function for the error term.

3.4. Empirical specification of revealed community equivalence scales

To empirically estimate the community benefit function (equation (19)) requires a functional form for B and the distribution of the error term F. Following Olken we use the log indirect utility function. Therefore the probability a household i in community j receives aid is:

$$\Pr(Receive_aid_{ij}) = F\left[\gamma_j + \gamma_2 \log(y_{ij}) - \gamma_2 \theta \log(n_{ij} - (1-a)k_{ij}) + \gamma_3 x_{ij}\right] \tag{20}$$

Because this is nonlinear, estimate a linear approximation:[13]

[13] This is similar to the Working-Leser (Working 1943; Leser 1963) functional form used by Deaton and Muellbauer (1986).

$$\Pr(Receive_aid_{ij}) = F\left[\gamma_j + \gamma_2 \log(y_{ij}) - \gamma_2\theta \log(n_{ij}) + \gamma_2\theta(1-a)\left(\frac{k_{ij}}{n_{ij}}\right) + \gamma_3 x_{ij}\right] \quad (21)$$

In the empirical work this can be extended to include different child age categories to separately estimate equivalence scales for different groupings of children. To do that, include the percentage of household members in each child age grouping rather than just the overall percentage of children. A further extension includes the gender of those children to examine if community preferences in distributing aid are gender neutral or if there exists a sex bias.

Following Olken, we assume that the error term takes the logistic form, which allows us to use the conditional fixed-effects logit model. Rewriting equation (21) to incorporate this functional form requires additional notation. Let r_{ij} be a binary dependent variable equal to 1 if household i in village j received PSNP aid, and 0 otherwise. Let N_j be the number of households in village j and T_j be the number of households in village j that received PSNP aid. Denote d_{ij} to be a dummy variable equal to 1 if household i in village j received PSNP aid or 0 if the household did not receive aid, and denote by S_j the set of all possible vectors $d_j = \{d_{1j}, \dots, d_{Nj}\}$ such that $\sum_{i=1}^{N_j} d_{ij} = T_j$. Define $\lambda_1 \equiv \gamma_2$, $\lambda_2 \equiv -\gamma_2\theta$, $\lambda_3 \equiv \gamma_2\theta(1-\alpha)$, and $\lambda_4 \equiv \gamma_3$. Substituting the logistic CDF for F in equation (21) and conditioning out the fixed effects yields an empirical specification of the form:

$$\Pr(r_{ij} = 1 \mid \sum_{i=1}^{I} y_{ij} = T_j) = \frac{\exp\left[y_{ij}\left(\lambda_1 \log(y_{ij}) + \lambda_2 \log(n_{ij}) + \lambda_3\left(\frac{k_{ij}}{n_{ij}}\right) + \lambda_4 x_{ij}\right)\right]}{\sum_{d_j \in S_j} \exp\left[\sum_{i=1}^{N_j} d_{ij}\left(\lambda_1 \log(y_{ij}) + \lambda_2 \log(n_{ij}) + \lambda_3\left(\frac{k_{ij}}{n_{ij}}\right) + \lambda_4 x_{ij}\right)\right]} \quad (22)$$

Equation (22) is estimated with maximum likelihood. Then using the estimated coefficients λ_1, λ_2, and λ_3 we recover estimates of θ and α. To compute the revealed community equivalence scale, which is the ratio of the income of the household with a given composition to that of a reference household, set the welfare levels for the reference and comparison household equal, and solve. As per Olken (2005) define a reference household with income y^R, size n^R, and number of children k^R, and comparison household with income y^C, size n^C, and number of children k^C. Setting equation (21) for the reference and comparison households equal yields:

$$\lambda_1 \log\left(\frac{y_{ij}^C}{y_{ij}^R}\right) = \lambda_3\left(\frac{k_{ij}^R}{n_{ij}^R} - \frac{k_{ij}^C}{n_{ij}^C}\right) - \lambda_2 \log\left(\frac{n_{ij}^C}{n_{ij}^R}\right) \quad (23)$$

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

reference household (Olken 2005). This equivalence scale focuses on the extensive margin of participation of the aid program, for example, a statement like "to maintain the same probability of receiving aid after adding a child to a household of two adults requires an increase in expenditures of XX%." Further, similar techniques can be used to recover the money equivalents of other household characteristics x. For example, a statement like: "to maintain the same probability of receiving aid a widow headed household could have XX% more expenditures than a reference household of two adults." This technique, however, does not analyze how payment amounts vary once a household is selected into the aid program (i.e., the intensive margin of participation), but rather only the extensive margin of probability of participation.

A further extension of Olken's method is that his data only covers one point in time (as it is an emergency relief program), while the PSNP data is panel structure where the community selects households in or out of the PSNP repeatedly over time. To extend this to multi-year data we use the conditional fixed-effects logit model as well, but instead of conditioning out community level fixed effects, like Olken, we condition out community-year fixed effects. This however, assumes that the parameter coefficients are the same for a given community over time (i.e., $\lambda_1, \lambda_2, \lambda_3, \lambda_4$ do not change over time).

3.5. Calculating the intensive margin of participation
To be added…

3.6. Targeting as per Liu and Barrett (2013)
To be added…

3.7. Estimating the efficacy of targeting with the Coady, Grosh, and Hoddinott (2004) index
To be added…

4. Data and Descriptive Statistics[14]

The data came from the Ethiopian Food Security Survey (EFSS) a panel survey collected every two years in the four largest regions of Ethiopia (Amhara, Tigray, Oromia, and Southern Nations and Nationalities People's Region (SNNPR)) by the Central Statistical Agency (CSA) of Ethiopia and the International Food Policy Research Institute (IFPRI). The dataset focuses on PSNP implementation areas and comprises 3,689 households in 2006, after which it was expanded to 4,654 households in 2008 and beyond. The surveys took place in the traditional "hungry" season (June-August), which immediately precedes harvest time, which normally begins in September or October of each year.

[14] The sampling methodology is based on Gilligan, Hoddinott, and Taffesse (2009) and Gilligan et al. (2007), which can be referenced for a more detailed analysis.

Within each region, a sample was chosen of food insecure *woredas* proportional to the number of food insecure *woredas* in all four regions. Within each region, *woredas* were selected with probability proportional to size based on the estimated population of chronically food insecure population. In the 2006 round, 68 out of 190 *woredas* were selected for sampling. In 2008 and subsequent rounds this number increased to 79 total *woredas*. The sample includes both participant and non-participant households within selected PSNP *woredas*, however the sample was not originally designed to include non-PSNP *woredas* (though two of the *woredas* added in 2008 are non-PSNP *woredas*).[15]

Within *woredas*, enumeration areas (EAs) where the PSNP was active were identified. Then two EAs per *woreda* were chosen using probability proportional to size for Amhara, Oromia and SNNPR, three EAs were chosen per *woreda* in Tigray. Twenty-five households were interviewed in each EA; fifteen of these were randomly selected from the PNSP beneficiary list, while ten were randomly selected from non-beneficiary lists. For the 2006 survey round this resulted in approximately 900 households each in Tigray and Amhara, and 950 households each in Oromia and SNNPR. An EA essentially corresponds to a *kebele*; there are 192 *kebeles* (EA's) represented in the data.

The reason for the increase of more than 900 households into the survey in 2008 and subsequent rounds was USAID's financial support for the inclusion of twelve additional *woredas* in USAID supported areas of Amhara into the household panel dataset. Starting in 2008, these additional households[16] were given the same questionnaire as the rest of the sample. In subsequent rounds the same households were re-surveyed regardless of whether they had joined or left the PSNP.

4.1 Descriptive Statistics

Conditional on receiving a PSNP payment, the mean PSNP marginal payment in 2009 was 161 ETB/person/year (Table 1), about half the mandated federal level.[17] This level of payment varies considerably across regions, for example the Amhara-HVFB region had a marginal payment of 298 ETB/person/year while Oromia only paid about 35 ETB/person/year.

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[15] The data from non-PSNP *woredas* drops out of estimation equations since there is no variation on the extensive margin, nor any payment data to analyze on the intensive margin.

[16] For the analysis in this paper as in Berhane et al. (2011) the 1100 additional USAID supported households are treated as a different region called Amhara-HVFB. HVFB stands for high value food basket as these households always received a grain, cooking oil and lentils or peas (protein source) according to USAID procedures of providing a full food basket in food distribution projects. Food baskets in other areas generally consisted only of a staple grain. The monetary value of the food received is calculated for each food transfer and this common metric is used in calculations across regions to ensure comparability.

[17] The average exchange rate in 2009 was 11.4 ETB/USD meaning a marginal payment of 156 ETB/person would be approximately $13.68USD per additional household member.

Table 2 present the basic descriptive statistics of the variables used in the analysis that follows. The average non-participant household has about 20% more expenditures than a PSNP household (16,092 ETB vs. 13,457 ETB). A PSNP household is much more likely to be female headed (28.4% vs. 16.2%), less educated (1.3 vs. 1.1 years completed), and slightly smaller in size (5.6 vs. 5.2). PSNP households have about one third less hectare of land holdings (1.6 vs. 1.2), fewer livestock (5.0 vs. 3.3 tropical livestock units), and a lower value of productive equipment (388 ETB vs. 328 ETB). Other characteristics such as the likelihood of facing a shock in the past two years and age of the household head are not statistically different between the groups. While PSNP household have slightly more young children (18.4% vs. 17.2%) and slightly more elderly (8.5% vs. 6.8%), there is no statistical difference in the larger categories of household demographics, i.e., older children (26.2% vs. 25.9%) and working age adults (48.4% vs. 48.0%). According to these statistics, the hypothetical average PSNP family would have 5.2 members and therefore be entitled to an annual payout of 1,560 ETB (5.2 people * 300 ETB/person/year), which is approximately 11.6% of annual household expenditures.

5. Results

5.1 Variance decomposition of marginal payment

The federally mandated uniform benefit schedule implies zero variance across the sample because the marginal payment is uniform in a given year (180 ETB/person in 2007, and 300 ETB/person in 2009).[18] However, the variance decomposition (Table 3) shows that the largest share of variance in marginal payment is concentrated at the *kebele* (ks) level (73.5% and 71.7% in 2007 and 2009, respectively), followed by *woreda* (ws) (19.7% and 22.9% in 2007 and 2009, respectively), zonal (zs) source variation (4.0% and 2.9% in 2007 and 2009, respectively), regional (rs) source variation (0.9% and 1.7% in 2007 and 2009, respectively), and the federal (fs) level (2.0% and 0.9% in 2007 and 2009, respectively). In short, local governments account for most of the variation in marginal PSNP payments. Results are robust to the method in which the marginal payment variable is calculated (see Appendix Table A1).

It appears that the actual payment schedule is largely determined in a decentralized manner and does not follow the uniform payment schedule as stipulated by the federal government. This raises the important question: if the uniform payment structure is being violated and instead local levels of government determine payments, what factors determine actual benefit schedules, and what implications does this have for the effectiveness of targeting within the PSNP?

[18] Recall the daily wage rage in 2007 was 6 ETB/day (6 ETB/day*5 days/month*6 months = 180 ETB/person/year), and in 2009 was 10 ETB/day (10 ETB/day*5 days/month*6 months = 300 ETB/person/year).

5.2 Revealed community equivalence scales at the extensive margin of participation
In a similarly structured program in Indonesia, Olken (2005) finds that communities allocate aid taking into account the economies of scale of running a household. His analysis, done only on the extensive margin, finds that to maintain the same probability of being included in the aid program adding a child to a household of two adults requires an increase in expenditures of 38%, implying that communities distribute aid as if adding an additional child requires an increase of expenditures equal to 76% of that spent on each of the first two adults to maintain constant welfare (Olken 2005). In replicating Olken's method (Table 4) of revealed community equivalence scales on the PSNP data, we do not find statistically significant coefficient estimates for age grouping (or gender grouping) of children. This implies that unlike Indonesia, the community revealed equivalence scales (on the extensive margin) in Ethiopia does not adjust for children. All people are treated as equivalent.

The analysis does however show that households with additional adults are weakly significantly less likely to be included in the PSNP (Col. 1 and 2). However, when accounting for the gender of adults (Col. 3) households are less likely to be included in the PSNP as male working age members increase, while additional female adults or children do not affect the probability of inclusion into the PSNP. Other household characteristics with statistically significant negative coefficient estimates are household expenditures (the larger expenditures, the lower the likelihood of inclusion in the program), landholdings (more land associated with lower probability of program inclusion), and livestock (more livestock less likely to be included in the PSNP). Larger households, and single, divorced, or widowed households are strongly statistically significantly more likely to be included in the PSNP.

5.3 Intensive margin of participation
To be added…

5.4 Efficacy of targeting
To be added…

6. Conclusion
To be added…

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Table 1

Marginal payment, conditional on PSNP participation, for additional HH member (2009), countrywide and by region

Variable	Mean	Std. Dev.	N
Marginal Payment (2009) all Ethiopia	**161.4**	**872.7**	**1984**
Marginal Payment (2009) in Tigray	133.2	927.6	548
Marginal Payment (2009) in Amhara	119	636.7	351
Marginal Payment (2009) in Oromia	34.6	826.3	283
Marginal Payment (2009) in SNNPR	179.7	751.8	366
Marginal Payment (2009) in Amhara-HVFB	298.1	1055.7	436

Note: The step-ahead, *woreda* as reference point estimator is used to calculate marginal payment.

Table 2
Descriptive Statistics (2009)

	PSNP Status		
	Non-Participant	Participant	Difference
Total household expenditures, birr/year	16091.9	13456.5	2635.4***
	(11606.5)	(9678.3)	(342.0)
Age of household head	47.45	47.97	-0.521
	(14.81)	(14.88)	(0.472)
Female headed household	0.162	0.284	-0.122***
	(0.368)	(0.451)	(0.013)
Household head highest grade attained	1.316	1.117	0.199**
	(2.358)	(2.153)	(0.072)
Household size	5.578	5.215	0.363***
	(2.145)	(2.177)	(0.069)
Percent children aged 0-6	0.184	0.172	0.012*
	(0.180)	(0.176)	(0.006)
Percent children aged 7-15	0.262	0.259	0.003
	(0.182)	(0.188)	(0.006)
Percent adults aged 16-60	0.484	0.480	0.003
	(0.205)	(0.222)	(0.007)
Percent adults aged 61+	0.0679	0.0853	-0.017**
	(0.161)	(0.202)	(0.006)
Landholdings in hectares	1.559	1.226	0.332***
	(1.409)	(1.065)	(0.040)
Livestock in tropical livestock units	5.032	3.282	1.751***
	(5.046)	(3.179)	(0.136)
Value of productive equipment, birr	388.3	327.9	60.38***
	(349.2)	(357.2)	(11.22)
Drought mentioned as most important shock	0.636	0.637	-0.001
	(0.481)	(0.481)	(0.015)
Death of a spouse	0.0239	0.0304	-0.007
	(0.153)	(0.172)	(0.005)
Crops hurt from illness of household member	0.105	0.104	0.001
	(0.306)	(0.306)	(0.010)
Observations	2137	1842	

Note: The mean and standard deviation by participant status is presented in the first two columns, the difference between participants and non-participants and standard error is presented in the third column. Household expenditures and value of productive equipment have the top and bottom 1% of observations removed. Difference between non-participants and participants significant at *** p<0.01, ** p<0.05, * p<0.1

Table 3

Decomposition of Source Variation in Marginal Payments: Productive Safety Net Program (PSNP)

	kebele **source (ks)**	***woreda*** **source (ws)**	**zonal source (zs)**	**regional source (rs)**	**federal source (fs)**	**sample size (N)**
Source variation in marginal payments, 2007	0.7351	0.1967	0.0398	0.0086	0.0199	2205
Source variation in marginal payments, 2009	0.7167	0.2290	0.0284	0.0167	0.0092	1984

Note: Calculations based on PSNP payouts found in the Ethiopian Food Security Survey, the sample includes all payments to households for the tweleve month period (from Jan.-Dec. 2007 or Jan.-Dec. 2009) and removes outliers (the top 1% and bottom 1% of marginal payments).

Table 4

Extensive margin of PSNP participation (probability of inclusion into PSNP) replicating Olken (2005) method

	(1) FE logit	(2) FE logit	(3) FE logit
Log annual household expenditures	-0.25***	-0.25***	-0.24***
	(0.05)	(0.05)	(0.05)
Log household size	0.43***	0.43***	0.44***
	(0.09)	(0.09)	(0.09)
Percent children aged 0-15	-0.03		
	(0.21)		
Percent adults aged 16-60	-0.31*	-0.30*	
	(0.18)	(0.18)	
Percent children aged 0-6		-0.06	
		(0.23)	
Percent children aged 7-15		0.02	
		(0.23)	
Percent boys aged 0-6			-0.14
			(0.26)
Percent girls aged 0-6			-0.04
			(0.25)
Percent boys aged 7-15			-0.10
			(0.26)
Percent girls aged 7-15			0.10
			(0.26)
Percent men aged 16-60			-0.55**
			(0.22)
Percent women aged 16-60			-0.05
			(0.21)
Household controls:			
Sex of household head	0.17	0.17	0.11
	(0.11)	(0.11)	(0.11)
Single (not married)	0.68***	0.67***	0.68***
	(0.22)	(0.22)	(0.22)
Divorced	0.82***	0.82***	0.84***
	(0.16)	(0.16)	(0.16)
Widowed	0.59***	0.59***	0.62***
	(0.12)	(0.12)	(0.12)
Polygamous	0.04	0.03	0.03
	(0.12)	(0.12)	(0.12)
Household head highest grade attained	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)
Landholdings in hectares	-0.17***	-0.18***	-0.18***
	(0.04)	(0.04)	(0.04)
Livestock in tropical livestock units	-0.02***	-0.02***	-0.02***
	(0.00)	(0.00)	(0.00)
Value of productive equipment, birr	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Drought mentioned as most important shock	0.11	0.11	0.11
	(0.07)	(0.07)	(0.07)
Crops suffered from illness of household member	0.09	0.09	0.08
	(0.09)	(0.09)	(0.09)
Kebele-year fixed effects	Yes	Yes	Yes
Observations	9,261	9,261	9,261

Robust standard errors in parentheses

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

Note: The expenditures have the top and bottom 1% removed. Marital status is a categorical variable with married, one spouse as the omitted category.

Table A1

Decomposition of Source Variation in Marginal Payments: Productive Safety Net Program (PSNP)

	kebele **source (ks)**	***woreda*** **source (ws)**	**zonal source (zs)**	**regional source (rs)**	**federal source (fs)**	**sample size (N)**
Kebele as reference point, step ahead	0.8455	0.0631	0.0472	0.0241	0.0201	1791
Kebele as reference point, step behind	0.8429	0.0500	0.0613	0.0291	0.0166	1791
Kebele as reference point, step ahead, smoothed	0.7522	0.0928	0.0829	0.0367	0.0354	1682
Kebele as reference point, step behind, smoothed	0.6934	0.0869	0.1285	0.0575	0.0337	1688
Woreda as reference point, step ahead	0.7351	0.1967	0.0398	0.0086	0.0199	2205
Woreda as reference point, step behind	0.6709	0.2680	0.0344	0.0161	0.0105	2128
Woreda as reference point, step ahead, smoothed	0.6121	0.0594	0.2088	0.0448	0.0748	2201
Woreda as reference point, step behind, smoothed	0.6781	0.0579	0.1541	0.0630	0.0470	2125
Average Source Variation (2007)	**0.7288**	**0.1093**	**0.0946**	**0.0350**	**0.0323**	**1951**

	kebele **source (ks)**	***woreda*** **source (ws)**	**zonal source (zs)**	**regional source (rs)**	**federal source (fs)**	**sample size (N)**
Kebele as reference point, step ahead	0.8381	0.0683	0.0616	0.0230	0.0090	1562
Kebele as reference point, step behind	0.8825	0.0506	0.0401	0.0174	0.0095	1547
Kebele as reference point, step ahead, smoothed	0.7281	0.1017	0.1228	0.0352	0.0122	1446
Kebele as reference point, step behind, smoothed	0.7518	0.1126	0.0826	0.0351	0.0179	1422
Woreda as reference point, step ahead	0.7167	0.2290	0.0284	0.0167	0.0092	1984
Woreda as reference point, step behind	0.6975	0.2637	0.0204	0.0077	0.0106	1898
Woreda as reference point, step ahead, smoothed	0.6900	0.0551	0.1265	0.0766	0.0518	1976
Woreda as reference point, step behind, smoothed	0.7805	0.0697	0.0781	0.0311	0.0406	1889
Average Source Variation (2009)	**0.7607**	**0.1188**	**0.0701**	**0.0303**	**0.0201**	**1716**

Note: Calculations based on PSNP payouts found in the Ethiopian Food Security Survey. These tables represents eight ways to calculate the share of variation in marginal PSNP payments associated with each administative level of the Ethiopian government. Within the data for each year, rows 1,3,5,7 use a one-step-ahead estimator. Rows 2,4,6,8 use a one-step-behind estimator. The reference location is either the *kebele* (rows 1,2,3,4) or *woreda* (rows 5,6,7,8). Simple non-parametric local smoothing is used to reduce the effect of outliers (rows 3,4,7,8) while no smoothing is used in rows 1,2,5,6. The sample used includes all payments to households for the tweleve month period (from Jan.-Dec. 2007 or Jan.-Dec. 2009) and removes outliers (the top 1% and bottom 1% of marginal payments).