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Improving Food Aid:
What Reforms Would Yield The Highest Payoff?

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Improving Food Aid's Impact:
What Reforms Would Yield The Highest Payoff?

Abstract: Developing an integrated model of the food aid distribution chain, from donor appropriations through operational agency programming decisions to household consumption choices we simulate alternative policies and sensitivity analysis to establish how varying underlying conditions – e.g., delivery costs, the political additionality of food, targeting efficacy – affect the optimal policy for improving the well-being of food insecure households. We find that improved targeting by operational agencies is crucial to advancing food security objectives. At the donor level, the key policy variable under most model parameterizations is ocean freight costs associated with cargo preference restrictions on US food aid.

Keywords: cargo preference, local and regional purchases, monetization, targeting, tying

1. INTRODUCTION

The efficacy of food aid is currently attracting significant high-level attention. Food aid has been a key point of contention between American and European negotiators in the current World Trade Organization negotiations. Several international organizations have published major reports on the topic recently (ITAP 2005, OECD 2005, OXFAM 2005, FAO 2006). A key international nongovernmental organization (NGO) issued a major new white paper rethinking of its use of food aid (CARE 2005). The Canadian government made a major change to its food aid procurement policies in September 2005. And the Bush White House in both 2005 and 2006 proposed the most substantial changes to US food aid programs since the 1990 Farm Bill. This attention partly reflects dramatic change in patterns of food aid over the past decade, especially the shift from predominantly government-to-government flows of nonemergency aid (so-called "program" food aid) to mainly emergency shipments distributed through NGOs and the United Nations' World Food Programme (WFP) in response to humanitarian crises (Barrett and Maxwell 2005, Barrett 2006).[1]

Some of these changes are driven by the apparent growth in complex humanitarian emergencies associated with natural disasters and conflict. Others have been driven by critical programmatic assessments (e.g., Clay et al. 1996) and by increasing budget pressures. The US food aid budget –the world's primary source of food aid – has fallen by more than half in the past ten years, from nearly $3 billion in 1994 to $1.2 billion in 2004 (OECD 2005, p. 17). European and Canadian food aid – the other major donors, historically – have fallen by similar proportions. To offset the impact of declining food aid budgets and the rise of new challenges associated with complex emergencies,

operational agencies (OA)[2] and donors must become more effective with their available resources. This has ignited much discussion of prospective policy changes.

The complexities of food aid procurement and distribution, and the wide range of policy reforms being vetted – changing appropriations from commodities to cash, lifting restrictions on shipping, procuring more food in developing countries,[3] banning monetization,[4] improving OA targeting, etc. – make comparative assessment of various options difficult. While food aid is a heavily researched topic, few studies follow food aid from the donor's farm gate to the recipient household.[5] Furthermore, there exist few formal models that permit simulation analysis to compare among alternative policies that span such a wide range of actors and interventions and incorporate as rich as set of considerations.

The model developed here follows food aid from the budgetary appropriations by a donor government – where there may be political additionality[6] associated with the form (cash or commodity) of the transfers provided – through a stylized OA that makes local purchase, monetization and related decisions about programming details - subject to critical contextual details related to transport costs, prices and possible corruption - to a recipient household. Each recipient household makes consumption decisions conditional on the resulting pattern of transfers and prices, which might be affected by policy and programming decisions through secondary market effects.

All such models are necessarily oversimplifications of complex realities. And some results that such models generate are reasonably obvious to careful observers of the system. But in the absence of an explicit model that integrates these various decisions and effects, policy alternatives are implicitly evaluated using ill-defined mental models

that are neither transparent nor amenable to replication and sensitivity analysis. The value of this modeling tool thus lies in its ability to help donor and operational agency analysts think through the range of programming choices and how optimal aid programming aimed at improving household-level food security – as enshrined in U.S. law – shifts as external factors (e.g., transport costs, corruption, etc.) change.

The remainder of the paper is organized as follows. Section 2 develops the model, explaining the key parameters and choice variables at each level of analysis: the donor government, the intermediating operational agency, and households impacted by donor and OA choices. Section 3 reports results from simulations of alternative policy changes and explores how the relative ordering of alternative policies varies as one changes exogenous model parameters (e.g., shipping costs, corruption rates, the political additionality of food). Section 4 concludes, summarizing the core policy-relevant findings from our simulations. Detailed technical appendices present further background information.

2. MODEL

The model we introduce explores how best to allocate scarce donor resources to improve food insecure households' welfare. Given it is both the largest program in the world and the program commonly singled out for proposed policy reforms, our entry point is US food aid policy. We therefore focus on some specifics of US aid programs, rather than those of other donor agencies. While these results developed with program or project food aid in mind, with appropriate adjustment of parameter values, the broader patterns apply to emergency food aid as well, with the important caveat that the model

does not directly address the core humanitarian issues that motivate emergency food aid shipments. We further caution that emergency aid sometimes faces slightly different constraints and priorities.

Our model involves three main participants, as shown in Figure 1: the donor government, the operational agency, and a stylized household. For ease of exposition, we assume there is only one agent at each of these levels, although we vary households by type (transfer recipient or non-recipient, and food secure or food insecure). Starting at the bottom of figure 1, households determine how much food and non-food goods and services to consume subject to their budget constraints. A transfer recipient may convert some of her transfer (cash into food or vice versa). In the aggregate, such induced changes in demand and supply may impact local food prices (Basu 1996). These prospective market effects are of particular relevance because of inevitable OA targeting errors: it is exceedingly difficult to correctly identify and reach food insecure households and only food insecure intended beneficiaries. Given generally large targeting errors (Clay et al. 1999, Jayne et al. 2001, Barrett 2002a, Barrett and Maxwell 2005), the indirect effects of programming decisions on food prices in local markets can be very important for food insecure non-recipients and therefore should, ideally, be incorporated into any assessment of a policy's impact on overall food security, as opposed to focusing exclusively on the food security of recipients. We therefore study a representative food insecure household, comprised from recipients and non-recipients, weighted by targeting efficacy.

[INSERT FIGURE 1]

In the second tier, an OA[7] must target food insecure households and determine

whether to make cash transfers or food transfers to targeted households or to invest in public goods to benefit those households. The OA does not choose the form in which it receives cash or food resources. However, it decides whether to convert food aid into cash transfers[8] or into investment in non-food public goods projects (e.g., health care, infrastructure, etc.) or to convert cash resources into food transfers (through local or regional purchases of food commodities). Thus even if the donor provides an imperfect resource portfolio, the OA can make costly conversions of resource form to better match local needs.

This decision to convert aid forms depends on numerous exogenous factors, including local prices, transportation costs, and corruption levels. Food aid generally has higher transaction costs and less flexibility than cash aid (Tschirley and Howard 2003). However, because cash aid is more liquid, it may be more readily siphoned off by corrupt managers in both the donor and recipient countries, decreasing the amount of aid received by households relative to food aid, given the same aggregate budget (Sen 1986, Barraclough 1991). Both households and OAs typically prefer cash, with its greater flexibility, over food (Barrett and Clay 2003). But conversion of food to cash through monetization is not costless for OAs[9] and can affect local market prices, adversely impacting local producers. Operational agencies can use both monetized food aid and cash grants to finance the provision of public goods such as health care, infrastructure, shelter, or savings and credit schemes. Such public goods can improve a household's welfare through increasing access to non-food goods and services and/or by increasing household productivity and income generation while, in some cases, avoiding the difficult issue of targeting (Cekan et al. 1996).

Finally, at the top of figure 1, the donor government determines the mix of cash and food aid that the government makes available to the operational agency. Food aid distribution is perceived by some US policymakers as meeting both development assistance and other (domestic farm support, export promotion, foreign policy) objectives. Because of this perceived additionality, food aid might be more readily available than the equivalent value of cash for development assistance, implying imperfect substitutability among aid forms in the donor appropriations process (Schulthes 2000). The prospective political additionality of food is counterbalanced by food's relative inefficiency as a form of transfer. Studies consistently find that food shipped from a donor country is, on average, considerably more expensive than food purchased in the recipient country, due to legal restrictions on competition for ocean freight,[10] and bureaucratic procurement processes that lead to commodity purchases at prices above open market rates (Barrett and Maxwell 2005, OECD 2005). For example, using action-specific data on procurement and shipping costs in the United States and corresponding local market prices for the same commodity in east African destination ports at the time of food aid delivery, we find that the median 1998-2002 U.S. food aid shipment cost 21% more than the value of the food delivered, with 64% of shipments being inefficient in the sense of costing more than the value of the commodity at the destination port. See the Appendix for more details.[11]

The model we develop in the following subsections integrates all of these various considerations into a single, tractable form for analyzing optimal food security policy design. Factors at the donor level (shipping costs and political additionality), at the OA level (targeting efficacy, leakages associated with corruption, local transportation costs,

prices), and at the household level (preferences between food and non-food consumption) all impact food security. The optimal policy for transferring resources from a donor through an OA to benefit food insecure households turns fundamentally on the context in which these actors operate, as section 3 demonstrates.

(a) Household Behavior

We start with the intended beneficiary: a food insecure household. The household maximizes its welfare, W, defined over a composite food commodity, f, and a non-food numéraire good, nf, subject to a budget constraint:

$$W = W(f, nf)$$

$$\text{subject to } y(z) + t = p^{*}(f - f^{a}) + nf \qquad (1)$$

Household income, y, is an increasing function of local public goods, z, such as education, sanitation, etc. Households may receive cash transfers, t, and/or food aid, f^{a}. The difference between f and f^{a} is purchased food, valued at p^{*}, where p^{*} is the household's shadow price of food, bounded from below by the sales price, p^{s}, and from above by the purchase price, p^{b}, both of which differ from the open market price in the recipient country, p, by transactions costs, τ:

$$p^{*} \in [p^{b} = p + \tau \ , p^{s} = p - \tau] \qquad (2)$$

This price band around p discourages market participation. Households whose shadow prices, p^{*}, fall within the band will be autarkic, i.e., neither selling nor buying food. The marginal value of food aid is thus p^{*}. If $p^{*}>1$, the value of the numéraire non-food good, food aid is more valuable than cash. Conversely, if $p^{*}<1$, cash is more valuable.

Cash transfers, food aid receipts, income and prices are exogenous to the household,

although cash transfers, food aid receipts, and public goods are choice variables and income and prices are endogenous in the broader model, as we discuss later. Substituting the budget constraint into the objective function, the household problem reduces to welfare maximization over food consumption:

$$\underset{f}{\text{Max}}\, W(f, y(z)+t - p^{*}(f - f^{a})) \tag{3}$$

This yields, f^{*}, a household's optimal consumption of food, given the cash and food aid transfers it receives, the available local public goods, transactions costs and prices, all of which are endogenous to the broader system:

$$f^{*} = f(\tau, p, z, t, f^{a}) \tag{4}$$

We can establish the household's "food security gap" by computing the food consumption level from equation (4) when there are no transfers or public goods[12] provided by the OA:

$$f^{0} \equiv f(\tau, p, y(z=0), t=0, f^{a}=0) \tag{5}$$

and then comparing f^{0} to a nutritionally minimum intake level, f^{min}, to establish whether the household is or is not food insecure in the absence of transfers. We use an indicator variable to identify food insecure households, those whose food consumption without transfers is less than or equal to f^{min}:

$$\begin{aligned} I = 1 \quad & \text{if } f^{0} < f^{min}, \text{ indicating food insecurity} \\ I = 0 \quad & \text{if } f^{0} \geq f^{min}, \text{ indicating food security} \end{aligned} \tag{6}$$

We now turn to OA's decision of how best to promote the food security of households it aims to serve with the resources made available to it by a donor.

(b) Operational Agency Decisions

We assume the operational agency wishes to improve household food security among the food insecure (i.e., I=1). It is not concerned with the well-being of food secure households, those for whom I=0. The OA can improve food security by distributing any or all of three goods: cash, food, or public goods.

The total agency aid budget is A^*. The OA receives aid resources, A^*, from donors in two forms: cash, A^c, and food, A^f:

$$A^* = A^c + (A^f p^d) \tag{7}$$

where A^f is quantity of food distributed to OA and p^d is the donor country price of food. We consider the donor's allocation of cash and food to OA in the next subsection. OA can convert imperfectly between these two forms of aid by monetizing some or all A^f or by purchasing food locally with some or all A^c. Cash, whether received directly as A^c or generated through monetization, can be used to invest in local public goods, z.

OA can distribute the food aid it receives, A^f, directly to households, A^{FD}, or it can monetize the food, A^M. The value of monetized food aid, C^M, is:

$$C^M = (A^M)\beta p \tag{8}$$

where $A^M \leq A^f$, $\beta \in [0,1]$ is the proportion of the local price, p, fetched in monetization, and A^M is the volume of food aid monetized.

Operational agencies can distribute allocated cash, A^c, and monetization proceeds, C^M, directly to households, C^{CD}, or use cash either to make local purchases of food, A^{LP}, or to invest in public goods. Cash allocated for local purchases of food, A^{CLP}, is less than or equal to A^c. Local food aid purchase volumes by OA, A^{LP}, depend upon the cost of procuring the food and local market prices:

$$A^{LP} = A^{CLP}/p(1+ \theta^r) \tag{9}$$

where $A^{CLP} \leq A^c$ and the transactions costs associated with procuring food, $\theta^r \geq 0$, are proportional.[13]

Total local purchases of food aid, A^{CLP}, direct cash distribution to households, C^{CD}, and total purchases of public goods, Zp^z, where p^z is the price of a unit of the public good, sum to less than or equal to the amount of cash available to the operational agency:

$$C^{CD} + Zp^z + A^{CLP} \leq A^c + C^M \tag{10}$$

Note that because θ^r and β are always at least zero, an OA would never both monetize food for cash and make local purchases of food. Thus, at any optimum:

$$A^{LP}C^M = 0 \tag{11}$$

The operational agency chooses local purchases, A^{CLP}, monetization volumes, A^M, and public goods to provide, Z, given A^c, A^f, p, p^z, β, and θ^r. OA's choices determine the aggregate transfer volumes of cash, C, food, F, and public goods, Z, provided to recipient households:

$$C \equiv A^c + C^M - A^{CLP} - Zp^z \tag{12}$$

$$F \equiv A^f + A^{LP} - A^M \tag{13}$$

$$Z \equiv (A^c + C^M - A^{CLP} - C^{CD})/p^z \tag{14}$$

We assume that cash and in-kind transfers are equally effective at reaching the target population (Coate, 1987, p. 204), i.e., distributions of food and cash are subject to equivalent targeting errors.[14] The amount of food aid received by the food insecure recipient household, f^a – an element in the household-level optimal food consumption volume, per equation (4) – depends on the amount of food the operational agency has to distribute, F, the transactions costs associated with delivering the aid, ζ, and the efficacy of its targeting. Targeting that is too restrictive will exclude intended beneficiaries (I=1).

Errors of exclusion $\varphi^1 \in [0,1]$[15] reflect the proportion of the food insecure population that does not receive a transfer. Targeting that is too broad will result in unintended beneficiaries among the food secure (I=0). These errors of inclusion are captured by $\varphi^0 \in [0,1]$ reflecting the proportion of food secure households receiving transfers. We later explore the effect of reducing these targeting errors.

Assuming identical rations of food distributed to recipient households,[16] we can compute each household's food aid allocation:

$$f^a = F(1- \zeta)/NR \tag{15}$$

where NR is defined as the number of recipients and ζ is the transaction costs associated with direct food distribution delivery. The number of recipients, NR, is

$$NR \equiv N[(1- \varphi^1)\rho + \varphi^0(1-\rho)] \tag{16}$$

where ρ is the food insecure proportion of the population and N is the population. The first term on the right hand side of equation (16), $N(1- \varphi^1)\rho$, represents the number of food insecure recipient households. The second term is the number of food secure households who mistakenly receive food aid.

Cash transfers to households, t, similarly depend on targeting and the total cash resources the agency has to distribute, C, and are assumed identical across recipients:

$$t = C(1- \gamma)/NR \tag{17}$$

where there may be leakages, γ, due to corruption or other means by which resources may be lost en route to intended beneficiaries, as well as targeting errors, φ^0, and φ^1.

The level of public goods available to recipient households, z, depends on similar parameters. We assume that deliveries of food transfers and public goods to identical households have equivalent transactions costs, ζ, yielding household-level benefits

$$z = Zp^z(1- \zeta)/NR \quad (18)$$

Substituting expressions, yields expressions for food aid and cash transfers to households:

$$f^a = [A^f + A^{CLP}/p(1+ \theta^r) - A^M](1- \zeta)/NR \quad (19)$$

$$t = [A^c + \beta p A^M - A^{CLP} - Zp^z](1- \gamma)/NR \quad (20)$$

We can substitute these expressions directly into the optimal household consumption decision, equation (4), to reflect how OA choice of A^{CLP}, A^M, and Z affects food insecure households' welfare. We now introduce the last set of resource allocations: the donor's.

(c) Donor Decisions

The donor's total aid budget, A^*, depends on the donor's budget allocation between cash, A^c, and food commodities, B^f, with $A^* = A^c + B^f$, such that

$$A^c = B^c_{min} + \alpha(B^f_{max} - B^f) \quad (21)$$

where $\alpha \in [0, 1]$. Equation (21) captures the prospective political additionality of food, reflected in the parameter α that reflects the tradeoff between cash and commodities, with perfect substitutability between cash and food indicated by $\alpha=1$. Conversely, when food aid is wholly additional, i.e., reductions in food appropriations will not be replaced at all by cash, $\alpha=0$. We assume there exists a minimum amount of cash, B^c_{min}, the donor country legislature will budget for development assistance, irrespective of food aid volumes, and a maximum amount it will budget for commodity food aid, B^f_{max}.[17]

The optimal choice of A^c and B^f depends on α, on donor country food procurement costs, p^d, and on shipping costs as a share of total costs, SC. These costs impact the cash and food received by the operational agency and thus the cash, food, and public goods OA can provide to food insecure households. A^f can be computed as:

$$A^f = (B^f/p^d)(1\text{-}SC) \quad (22)$$

where the food aid budget is adjusted by donor country commodity procurement costs and shipping costs to destination ports. The amount of cash received by the operational agency, A^c, is

$$A^c = B^c_{min} + \alpha(B^f_{max} - B^f) \quad (23)$$

a function of the exogenously given minimum amount of cash allotted by the legislature, B^c_{min}, and the budgetary conversion rate of food to cash, α. Substituting equations (22) and (23) into the earlier expressions (19) and (20) and then back into the household-level optimization problem, (4), it becomes clear that the donor's decision simplifies to choosing the level of B^f that maximizes the welfare of food insecure households in recipient countries.

(d) Market Implications

Up to this point, we have focused exclusively on the impact of development assistance on food insecure recipient households. However, due to imperfect targeting, many food insecure households will not receive transfers, yet they may be indirectly affected through induced changes in food prices (Barrett 2002). Induced food price changes will depend, among other things, on targeting efficacy because food secure transfer recipients have a lower marginal propensity to consume food than do food insecure recipients, thus the demand and supply effects of food and cash distribution depend on the targeting performance of the OA

The aggregate additional supply of food to the recipient country food market, ΔS, is the sum of the food monetized by OA and household net sales of food aid. Food aid flows

into the recipient country that increase the consumption of recipient households are not treated as added market supply. Using recipient household's marginal propensities to consume food aid, the supply-side additionality of food aid is:

$$\Delta S = N[f^a \varphi^0(1-\rho)(1- MPC^0_f) + f^a \rho(1- \varphi^1)(1- MPC^1_f)] + A^M \quad (24)$$

where MPC^1_f is the marginal propensity to consume food out of in-kind transfers for households that are food insecure (I=1) and MPC^0_f is the equivalent parameter for food secure recipient households (I=0).[18]

Similarly, induced changes in market demand for food, ΔD, arise from induced increases in household food demand brought about by receipt of cash transfers and/or added income due to the provision of public goods, as well as local purchases by OA,

$$\Delta D = N[[t +y(z)]\varphi^0(1-\rho)(MPC^0_c) + [t+y(z)]\rho(1- \varphi^1)(MPC^1_c)] + A^{LP} \quad (25)$$

where MPC^1_c (MPC^0_c)is the marginal propensity to consume food out of cash for food insecure (secure) recipient households.

Given the inverse price elasticity of demand and supply in the recipient country market – i.e., how equilibrium market prices change given a shift in demand, supply, or both – we can compute the induced change in the market price of food as

$$\Delta \underline{p} = p(\Delta D, \Delta S) \quad (26)$$

These potential price changes have significant ramifications for food insecure nonrecipient households. For example, if the demand is price inelastic, as supply increases due food aid monetization or significant errors of inclusion of food secure households on beneficiary rolls, food prices will fall. If food insecure households are typically net purchasers of food, lower prices will help to offset any Type I targeting errors.[19] This quite general formulation allows for the special case in which the recipient

economy is a pure price taker on international markets – i.e., inverse price elasticities of demand and supply both equal zero – and thus there are no price effects from food aid whatsoever. This general framework allows exploration of the possible advantageous and adverse effects of transfer programs in local communities.

Substituting expressions from the preceding subsections yields a maximization problem that nests household decisions (f), OA decisions (Z, A^M, A^{CLP}), and donor decisions (B^f):

$$\max_{f,\, z,\, A^M,\, A^{CLP},\, B^f} \sum_{i=1}^{N} W(f, nf) = \{N(1-\varphi^1)\rho\}W(f, y(z) + [B^c_{min} + \alpha(B^f_{max} - B^f) + \beta p A^M - A^{CLP} - Zp^z](1-\gamma)/NR - p^* f + p^*[(B^f/p^d)(1-SC) + A^{CLP}/p(1+\theta^r) - A^M](1-\zeta)/NR) + \{N\varphi^1\rho\}W(f, y/p^{**})$$

$$\text{subject to } f, Z, A^M, A^{CLP}, B^f \geq 0 \qquad (27)$$

The simple explanation of the complex expression in (27) is that social welfare maximizing donors and operational agencies would choose to provide levels and forms of assistance so as to maximize the sum of recipients' and non-recipients' welfare, taking into consideration their predictable behavioral responses to different forms and levels of assistance, the environmental parameters that affect the efficiency of different forms of assistance, and the targeting errors inherent to aid distribution. Non-recipient households' welfare is subject to $t=z=f^a=0$, with the endogenous shadow food price, p^{**}, which accounts for market adjustments following (26). This single optimization problem thus nests within it the welfare effects on all food insecure households, both recipients and nonrecipients, and the decisions of all actors in the system: the donor, the operational agency, and households. This integrated model thus permits policy simulations to evaluate the conditions under which alternative policies are expected to generate better or

worse outcomes for the food insecure households that are the intended beneficiaries of development assistance programming.

(e) Parameterization and Simulation

We simulate how political additionality, transactions costs, cash leakages due to corruption, procurement prices in donor and in recipient countries, and targeting efficacy influence the impact of food aid on the welfare of food insecure household under four distinct policy scenarios currently debated in international discussions. The goal of these simulations is to clarify the programming tradeoffs faced by donors and operational agencies and to examine the impact of prospective donor policy changes.

Using a common welfare function and parameter values we compute the welfare under each scenario for a composite household, aggregated across food insecure households weighted by the probability of being either a recipient or not (i.e., $1-\varphi^1$ or φ^1, respectively). Then, we alter particular model parameters so as to examine how these changes impact the relative welfare ranking of each policy scenario. Although the model has been calibrated using the best available recent figures or approximations bolstered by sensitivity analyses, we emphasize that the purpose of the model is only to facilitate qualitative assessment of optimal aid policies for advancing food security objectives. The quantitative welfare result is inherently uninformative in its magnitude; only the ordering among scenarios is useful.

Our base scenario, denoted W1, reflects current US food aid policy under PL480. In W1, the donor budget is composed entirely of food. Our second policy scenario, W2, includes both cash and food in the donor ODA budget, approximating 2002 European

Union (EU) practices, with 45 percent of the donor aid allocation is in the form of cash. No food aid is monetized under scenario W2. Policy scenario W3 involves a donor budget composed entirely of food aid paired with a policy not allowing OAs to monetize food aid. W3 addresses concerns over potential local market disincentive effects due to monetized food aid and the policy option of ending monetization. The final policy scenario, W4, is identical to W1 except that it assumes relaxation of US cargo preference restrictions on food aid ocean freight decreases shipping costs by 50 percent.

We must make functional form assumptions before parameterizing the model. The household welfare function is assumed to follow a standard Cobb-Douglas form:

$$W(f, nf) = f^{\varepsilon} nf^{(1-\varepsilon)} = \{N(1-\varphi^{1})\rho\}(f^{\varepsilon}[(Zp^{z}(1-\zeta)/NR) + [B^{c}_{min} + \alpha(B^{f}_{max} - B^{f}) + \beta p A^{M} - A^{CLP} - Zp^{z}](1-\gamma)/NR - p^{*}f + p^{*}[(B^{f}/p^{z})(1-SC) + A^{CLP}/p(1+\theta^{r}) - A^{M}](1-\zeta)/NR)]^{(1-\varepsilon)}) + \{N\varphi^{1}\rho\}(f)^{\varepsilon}(y/p^{**})^{(1-\varepsilon)}$$

$$\text{subject to } f, Z, A^{M}, A^{CLP}, B^{f} \geq 0 \qquad (28)$$

We use a constant elasticity of substitution model to compute $\underline{p}$:

$$\ln \underline{p} = a \ln \Delta D + b \ln \Delta S \qquad (29)$$

The coefficients a and b are the inverse price elasticity of demand and the inverse price elasticity of supply, respectively.

We assume the donor budget, B^{f}_{max}, is the 2002 PL480 budget of $1.27 billion. The initial monetization efficiency rate, β is 0.85, approximating the mean percentage of local food price earned by operational agencies. We set the local food price equal to 1, and use 1.21 – the alpha value estimated in the Appendix – for the donor price inclusive of shipping costs. Shipping costs are approximately 40 percent of the total aid cost (Barrett and Maxwell, 2005), resulting in the donor cost of food, p^{d}, equal to 0.73.

We initialize the model with a monetization rate of 60 percent, roughly the average share of non-emergency food aid sold by operational agencies and recipient governments (Barrett and Maxwell 2005, OECD, 2005) for W1 and W3, with the monetization volume dependent on the food aid budget, shipping costs and donor prices. In W2, we assume that one-third of the total cash budget is used for local purchases (i.e., approximately 15 percent of the total aid budget in W2).[20] In all scenarios, 75 percent of the proceeds from monetizing food aid is used by OAs to invest in public goods. The remaining 25 percent of the proceeds is distributed as cash transfers (OECD, 2005; Barrett and Maxwell, 2005). These numbers are crude approximations of current realities, but they make no qualitative difference to the results on which we focus below.

In this one period, one economy setting, it is not efficient to both convert cash into food, $A^{CLP}>0$, and to simultaneously convert food into cash, $A^{M}>0$. Therefore, depending on the scenario, either A^{M} or A^{CLP} (or both) equal zero. In W1 and W4, food aid is monetized, so A^{CLP} is zero; in W2 cash is used to purchase food, thus A^{M} is zero. In W3, there is no resource conversion by OA, thus both equal zero. Table 1 summarizes the starting values of parameters, by scenario.[21]

[INSERT TABLE 1]

To determine how sensitive the simulation results are to changes in parameter values, we increase and decrease each parameter value by 50%, holding all the other parameters constant. If the parameter's new values result in a re-ranking of the scenarios, we report the results explicitly in what follows. This is the case for α, β, γ, ρ, ζ and SC, values of which fundamentally affect the relative impact of a given food aid policy regime. Even sharp change in the other model parameters does not affect the welfare ordering among

scenarios, so we omit discussion of those parameters drive the following discussion of results.

3. SIMULATION RESULTS

Which of the four food aid policy regimes we model yields the greatest welfare impact for food insecure households, the intended beneficiaries of such assistance? And how does the answer to that crucial question turn on the value of the parameters describing the context in which donors, operational agencies and households make their independent resource allocation decisions? We explore these questions in this section, sequentially looking at how welfare impacts change across scenarios as we vary key parameters. Some scenarios are not impacted by certain parameter changes. For example, changes in α only impact W2, and changes in β impact only W1 and W4. But changes in most parameters affect all scenarios, but not necessarily equally. With the notable exception of variation in the targeting parameters, which make by far the biggest difference to the welfare impact of food aid policy, irrespective of the scenario, the welfare indices – representing composite food insecure households' welfare – all range between 1 and 7 for all sensitivity analyses, allowing us to directly visually compare rates of change across the scenarios in the figures that follow.

The first striking result is that the hypothetical policies W3 and W4 tend to outperform the stylized versions of actual US and EU food aid policies, W1 and W2, under most parameter configurations. This underscores the room for improvement that remains in contemporary food aid policy.

For our initial model parameter values, welfare is highest for food insecure

households under scenario W4, which assumes intercontinental shipping costs are halved (Table 1). The reason is intuitive; relaxing cargo preference restrictions dramatically lowers food aid costs in W4, thereby improving the efficiency of food aid and of monetization.

The second highest welfare under the base case parameterization arises under W3, which eliminates monetization. None of the OA budget is lost to transactions costs associated with converting from one form of transfer to another, as occurs under W1 and W4, the scenarios where resources are only provided in the form of food and OAs monetize.

Donors budget cash for distribution to OAs in W2, the quasi-European scenario. Under the base case parameterization, W2 is less welfare improving for food insecure households, relative to the W1 scenario that approximates current US food aid policy, than the other two policy scenarios: W4 and W3. But that result turns fundamentally on the mix of cash and food in the budget the donor passes to the operational agency. If the percent of cash increases to 60 percent, then W2 improves food security more than W3. But even if the entire budget of W2 is in cash, it still does not outperform W4. This occurs because when food aid enters the market via monetization or sales by recipients, the local food supply increases, which decreases food prices and benefits food insecure non-recipients.[22] In scenario W2, the inflow of cash to recipients drives food prices up, harming food insecure non-recipient households, and lowering the overall welfare index relative to W4. If targeting were perfect, cash might be preferable. But given inevitable targeting errors of omission, reducing the costs associated with delivering resources to intended beneficiaries seems the key policy reform needed to improve poor households'

welfare.

The key cost involved in food aid arises from intercontinental shipping. To examine the role of shipping costs, we equate the SC parameter across scenarios (i.e., now W1 is the same as W4, which we drop for the moment) and then vary the shipping costs associated with food aid deliveries (figure 2). As shipping costs decrease (i.e., 1-SC increases), welfare under W1 and W3 rises faster than welfare under W2. W2's mixed portfolio of cash and in-kind transfers performs better in the face of high shipping costs, 50% or more in this parameterization, and worse when shipping costs are low, below 10%. The gains associated with deadweight losses to shipping costs are obviously greatest when more aid flows in the form of commodities rather than cash.

[INSERT FIGURE 2]

As α increases, the political additionality of food aid falls and cash and commodities become more substitutable (figure 3). Welfare under scenario W2 improves sharply as α increases. If food aid is not at all additional, as Clay et al. (1996) argue is becoming the case in Europe, then $\alpha=1$, and W2's mix of cash and food would yield welfare gains for food insecure households, relative to W3 or W1 (Figure 3), for the simple reason that a commodities-only donor budget still faces nontrivial shipping costs. Conversely, if food is completely additional in political terms, thus $\alpha=0$, then the EU approach of mixing cash and commodity appropriations actually reduces food insecure households' welfare.

[INSERT FIGURE 3]

The efficiency with which OAs monetize makes an enormous difference to the welfare outcomes under different policy scenarios. At low rates of β (0.7 and less), scenario W4 (lower shipping costs) is dominated by the EU approach (W2) because the

efficiency of shipping commodities later monetized is so low (Figure 4). However, as the returns to monetization climbs above 1 (i.e., the OA earns a profit relative to local market prices from monetizing food aid), household welfare under the current US policy, W1, outstrips both W2 (EU policy) and W3 (a ban on monetization), although it still does not perform as well as W4, which likewise benefits from improved monetization efficiency. Monetization makes the most sense when OAs compete well on local markets, with the proceeds at least covering the transactions costs associated with converting food into cash. At present, few OAs seem able to achieve such results (Barrett and Maxwell 2005).

[INSERT FIGURE 4]

The local costs of direct food distribution plainly matter to the relative performance of different policies. The welfare levels for all four scenarios climb rapidly as local delivery costs, ζ, fall (Figure 5). When delivery costs are high (i.e., low 1- ζ rates), W3, which only provides transfers in-kind, performs worst. However, the relative efficiency of W3 rises quickly as delivery costs fall. With low delivery costs (e.g., transfers made to food insecure populations in port cities), delivering in-kind transfers is more efficient than converting aid to cash through monetization or direct cash appropriations. However, in situations with relatively high transportation costs, all else equal, a portfolio of cash, in-kind transfers, and public goods yields higher welfare for food insecure households than does in-kind transfers only.

[INSERT FIGURE 5]

As transactions costs associated with cash transfers, γ, fall (i.e., 1- γ rises), W1, W2, and W4 improve relative to W3 (Figure 6). In areas where cash transfers may be depleted due to corruption or due to large expenses in keeping cash secure prior to distribution to

households, food aid delivered in-kind generates greater welfare gains. Yet, the differential between the scenarios is much smaller than under other parameter changes. Leakages at this level generally appear less important than other parameters (e.g., food aid delivery costs, targeting errors).

[INSERT FIGURE 6]

Jointly examining how optimal policy changes with variation in leakages associated with transfers in cash or in kind, γ and ζ, respectively, a decrease in physical delivery costs has greater impact on welfare for both W1 and W2 than does a decrease in cash transactions costs (Figures 5 and 6) because OAs provide more food transfers and public goods than they do cash. Therefore, cutting distribution costs yields greater gains than equiproportional reductions in the leakages associated with cash distribution.

We initially set the targeting errors of exclusion rate, φ^1, equal to $1 - \rho$, where ρ is the percent of the food insecure population.[23] As ρ increases, the percent of non-recipient food insecure households drop and targeting errors of exclusion fall (Figure 7). Across policy scenarios, a portion of each household's transfer is in-kind, some of which leaks back into the market, lowering the price of food for food insecure non-recipient households. When exclusion errors are common, food insecure households' welfare is greatest under scenario W3. As targeting improves, W4 begins to outperform W3, reflecting how lowered shipping costs and a mixed portfolio of transfers in W4 benefits households more than just in-kind transfers if the portfolio is reasonably well targeted. Further, as targeting improves, W2 also approaches W3, bolstering the argument that multiple forms of transfers are more beneficial when targeting is relatively good, or when a large percentage of the population is food insecure so that there are fewer errors of

inclusion of the food secure and omission of the food insecure.

[INSERT FIGURE 7]

Figure 7 also underscores the critical role targeting efficacy plays in determining the welfare outcomes associated with food aid programming. The magnitude of the welfare changes associated with variation in targeting efficacy are more than three times greater than the welfare response to the next most influential parameter: local delivery costs (compare Figures 6 and 7). Welfare is fifteen times higher when targeting efficacy goes from near zero to nearly perfect. By contrast, welfare levels increase by less than half due to decreases in shipping costs. Across all scenarios (and therefore across mixtures of transfers delivered), improved targeting is the single most important means to advance food security objectives through food aid programming, far more important than the form of the transfer (cash or food), the cost of shipping or internal transport, or leakage due to prospective corruption.

We can visualize the context-dependency of optimal food aid policy by exploring different combinations of parameter values and computing which of the four policy scenarios generates the highest welfare for food insecure households. Figures 8-10 depict some such combinations. While local prices are normalized to one in the preceding figures, in figure 8, we allow both prices to vary from 0.50-1.50, i.e., by 50 percent above and below the benchmark value. The scenario with the largest welfare index for each pair of domestic and local prices is displayed on the graph. Figure 8 demonstrates that the optimal policy design depends heavily on the food price levels prevailing in the donor and destination country. At low local and donor prices, welfare is highest when aid is provided in the form of food and is directly distributed, scenario W3. At high donor

prices and low local prices, the most efficient scenario is W2, because OAs can then take advantage of relatively low prices for local purchases. As both local and donor prices climb – with local prices greater than donor prices – retaining the option to monetize food aid shipped under lower shipping costs, scenario W4, becomes optimal. One reason for this is that monetization increases the local supply of food, driving down local prices, to the benefit of food insecure, net food buyer non-recipients.

[INSERT FIGURE 8]

When we explore how joint variation in the two parameters that seem to most affect household-level welfare – the delivery costs of food aid transfers, ζ, and targeting errors, φ^1, we find that as targeting improves and as delivery costs rise, the mixed portfolio of W4 is preferred to the in-kind portfolio of W3 (Figure 9). When targeting efficacy is very low, especially if delivery costs are likewise low, then eliminating monetization and purely delivering in-kind transfers becomes most effective. Banning monetization in favor of in-kind transfers is likewise desirable in the face of high rates of cash leakage (Figure 10). As the transactions costs associated with either purchasing or selling food or cash leakages increase, the no monetization policy scenario, W3, becomes more attractive, regardless of targeting outcomes. But as the costs associated with food aid distribution increase, a mixture of transfers – under the low ocean freight costs scenario, W4 – becomes preferable.

[INSERT FIGURE 9]

[INSERT FIGURE 10]

4. CONCLUSIONS

Given the complex interlinkages in contemporary food aid policy and operations, it is difficult to coherently analyze the prospective relative gains from alternative policy configurations without an explicit model that captures the interlinkages among donor, operational agency, and household choices and the resulting effects on destination country markets. This paper introduces an integrated, quantitative model that allows for policy simulations that incorporate such effects. Our model is necessarily a coarse approximation of the complex realities that underpin any given food aid action, only loosely capturing some of the many parameters that must guide donor and operational agency programming for food insecure households. But as a tool for establishing which variables matter most and for generating a first rough identification of which policies are likely best under particular conditions, this model appears potentially quite useful. One of the core results of the simulation exercises we report is the tremendous context-dependence of optimal food aid policy design. One size fits all approaches are unlikely to best serve food insecure households across the wide range of settings they presently inhabit.

All the necessary caveats with respect to the inevitable coarseness of the model notwithstanding, several other striking results bear repeating. First, among the policy alternatives we simulate, scenario W1, reflecting current US policy, routinely performs worst among the four scenarios, underscoring that reforms are most necessary in US food aid programs. Second, the scenario (W4) that involves a halving of ocean freight costs – implying a significant relaxation of cargo preference restrictions that drive up the costs of delivering US food aid to developing countries –generally outperforms the others. The greatest progress in advancing the welfare of food insecure households would seem to

come from rolling back or ending cargo preference restrictions, thereby lowering shipping costs and markedly increasing the efficiency of transfers abroad. This policy change appears more welfare enhancing than other cost-neutral donor policy changes, including adjusting the mixture of aid forms. Third, the benefits of cash over in-kind food aid depend heavily on the local context, in particular on food delivery and cash leakage rates, the efficiency of operational agency monetization of food aid, and the effectiveness of targeting. Fourth and finally, and perhaps our most important finding, is that the quality of targeting of food insecure households is the single most important determinant of how effectively development assistance serves food insecure peoples. While most of the current attention surrounding food aid concerns donor-level policy, the greatest gains will result from further improvements in the targeting practices of operational agencies.

Our model confirms what operational agencies and donors already know: allocating transfers is extremely complicated. But some useful rules of thumb – e.g., the criticality of good targeting, the damage done by artificially high ocean freight costs – are readily established and some potentially useful, context-dependent analyses can be derived from an integrated model of the sort we introduce here.

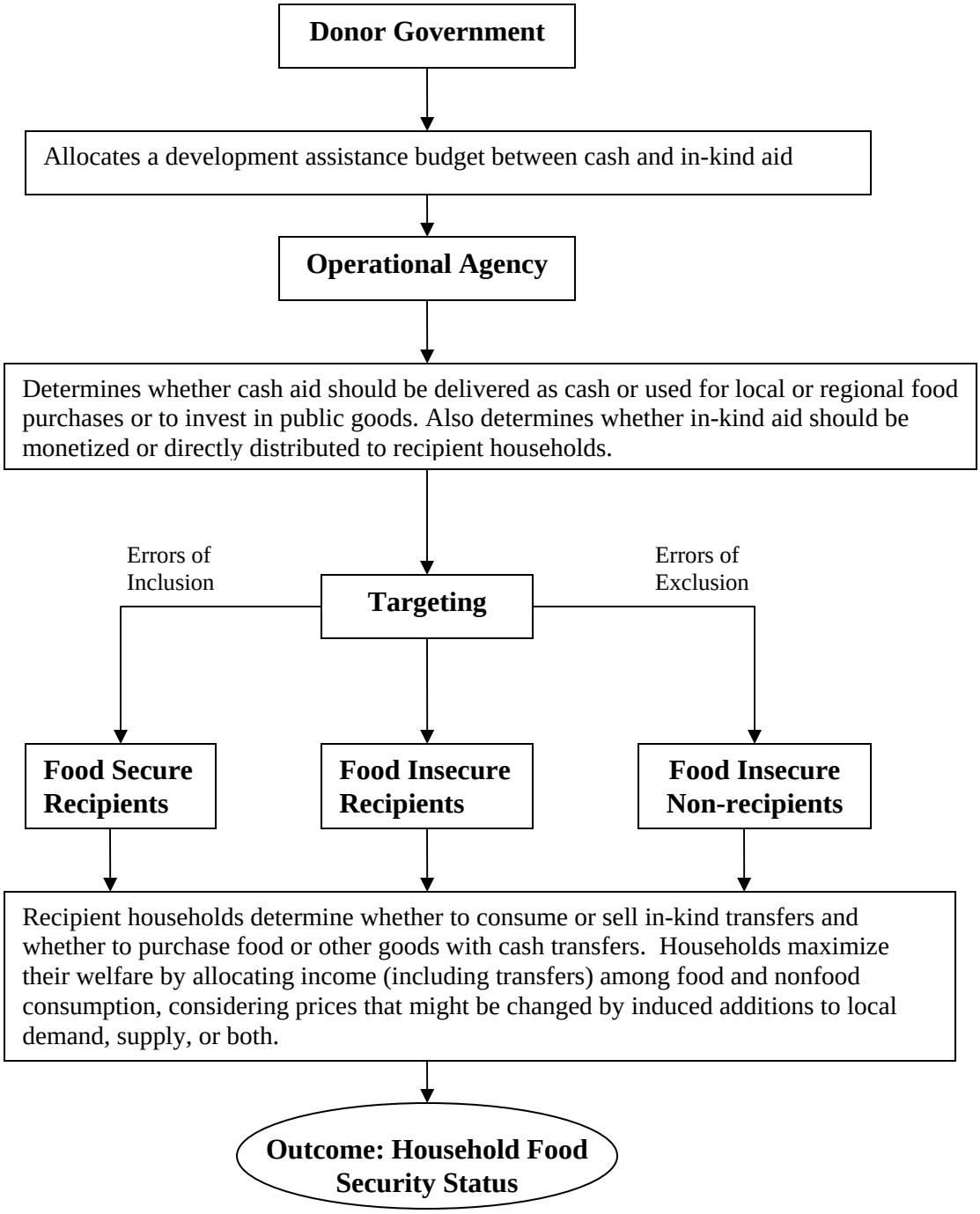

Figure 1: Actors and choices along the aid distribution channel

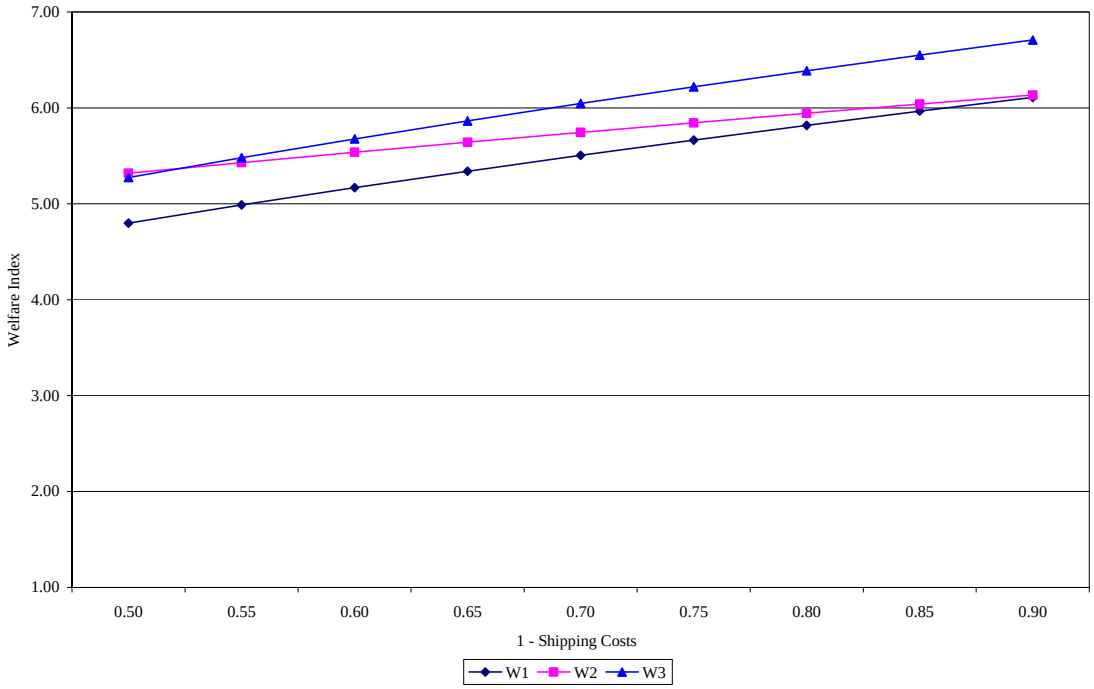

Figure 2: Changing intercontinental shipping costs

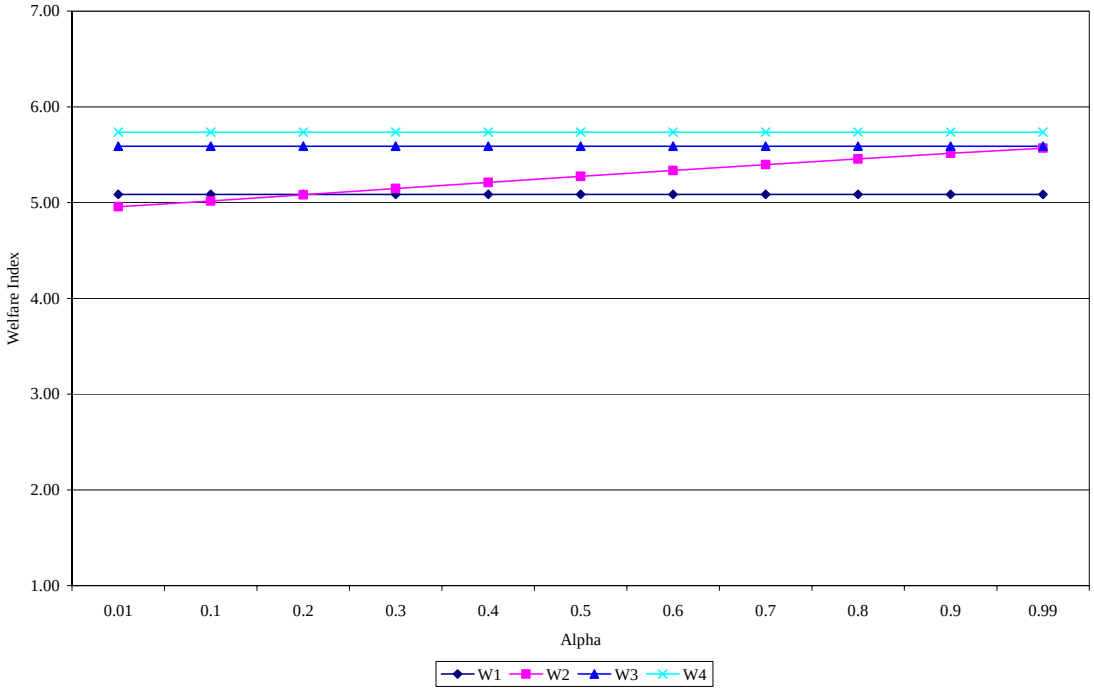

Figure 3: Changing the political additionality of food (Alpha = α)

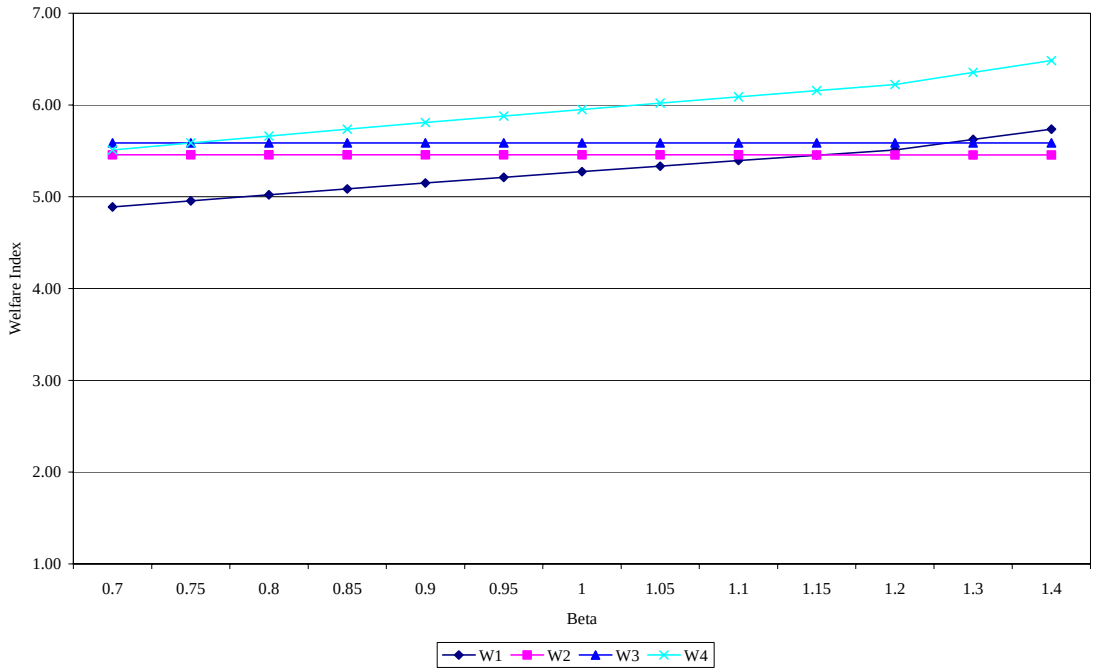

Figure 4: Changing the returns to monetization (Beta = β)

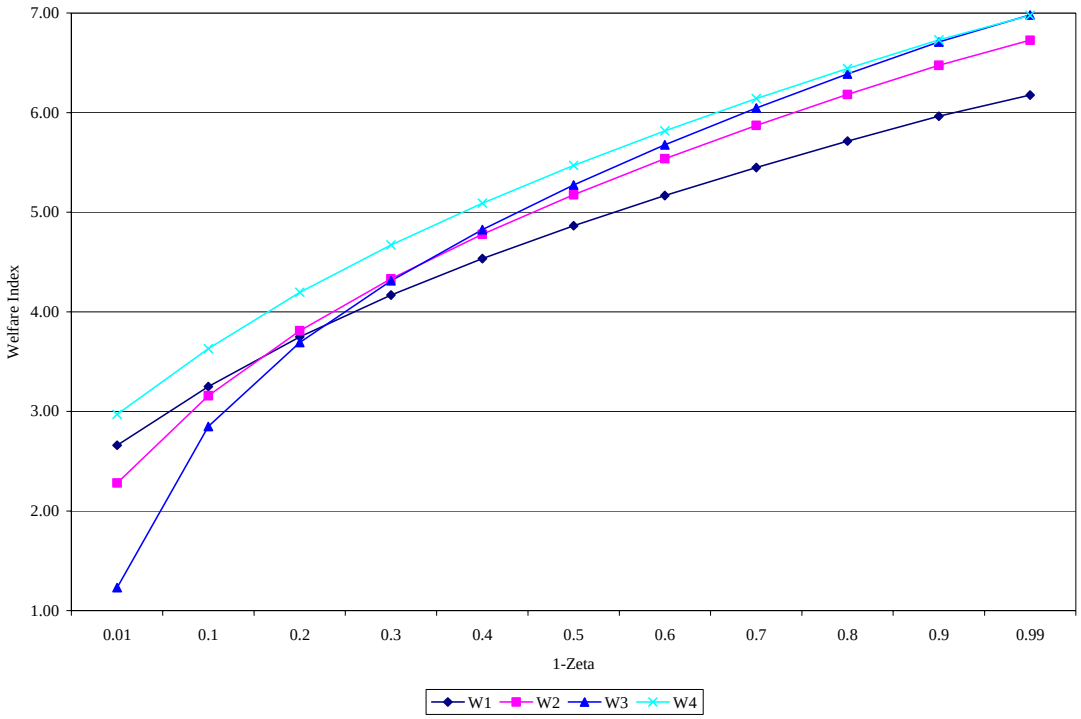

Figure 5: Changing the leakage and delivery costs associated with food (Zeta = ζ)

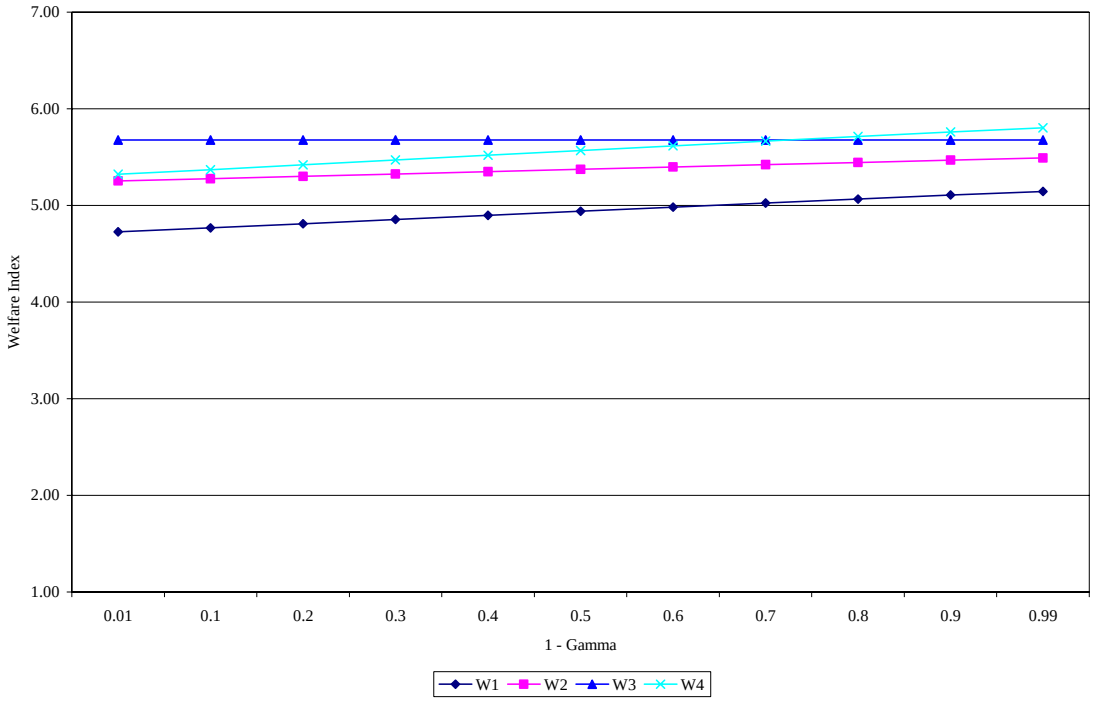

Figure 6: Changing the leakage and transactions costs associated with cash transfers (Gamma = γ)

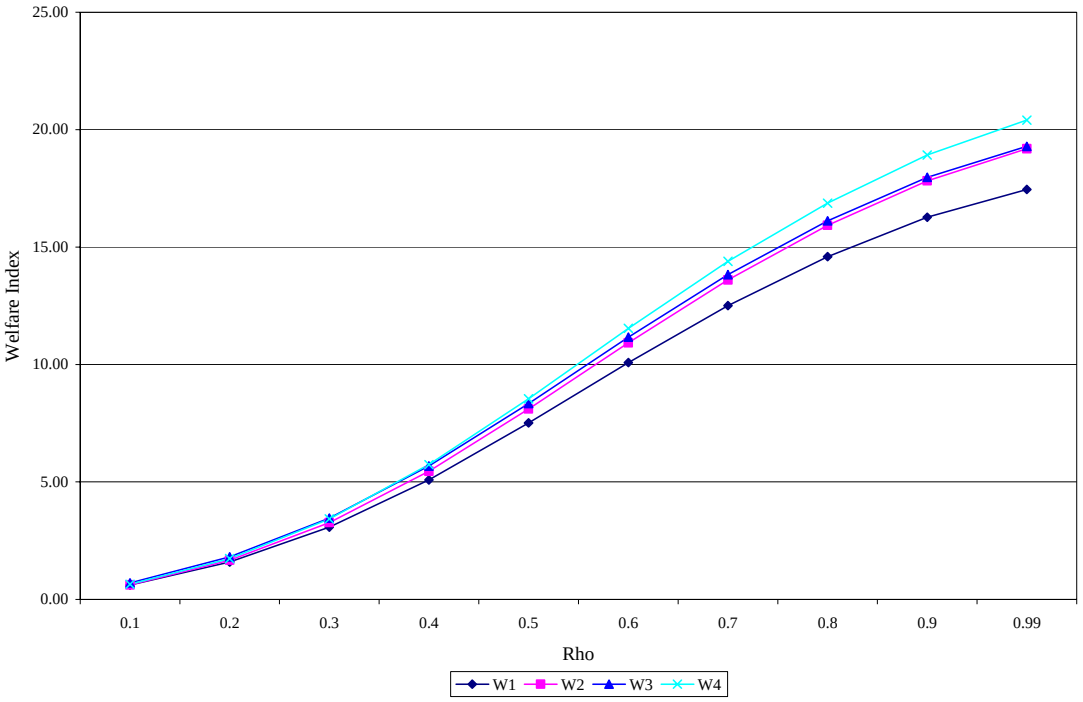

Figure 7: Changing the food insecure proportion of the population (Rho = ρ)

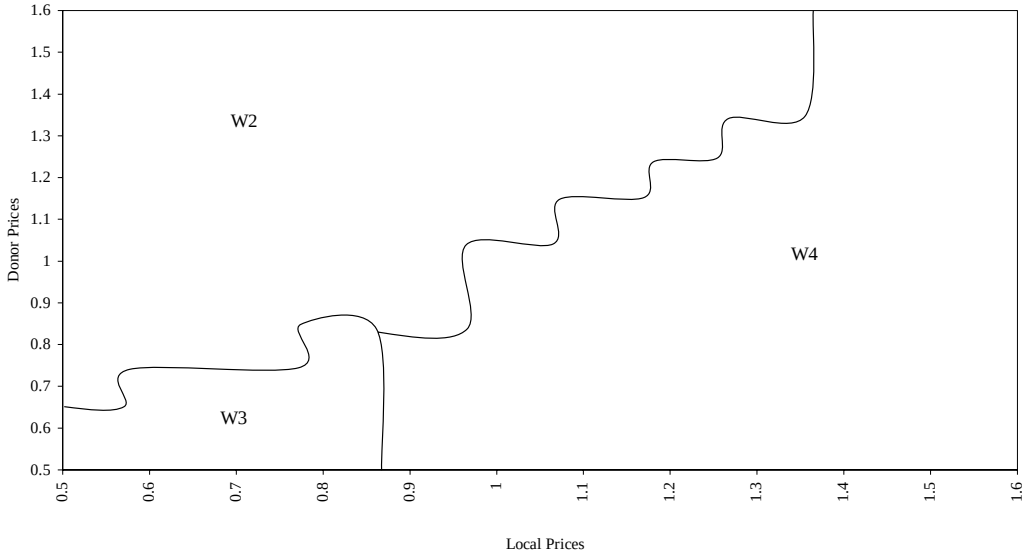

Figure 8: Optimal policy for different local and donor market price pairs

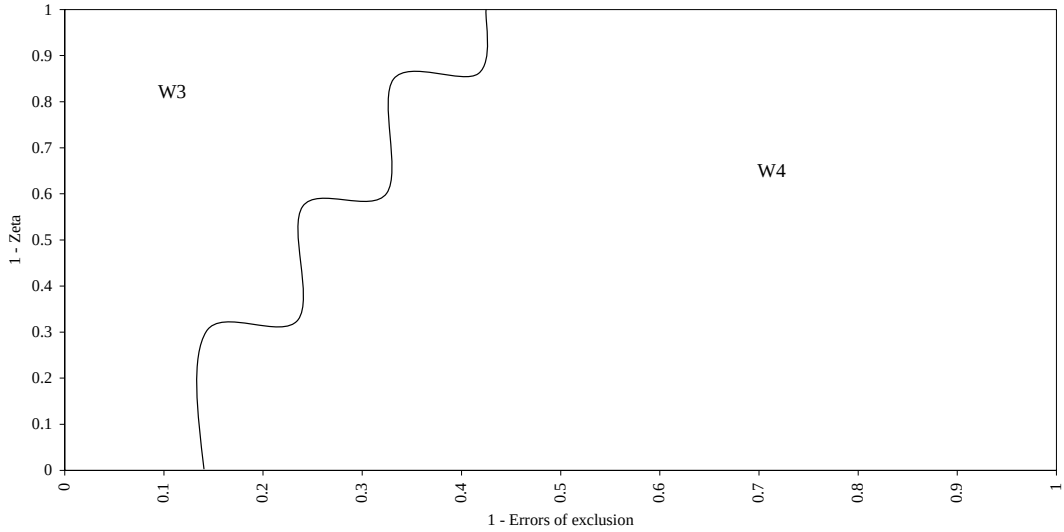

Figure 9: Optimal policy for different targeting efficacy and local delivery cost combinations

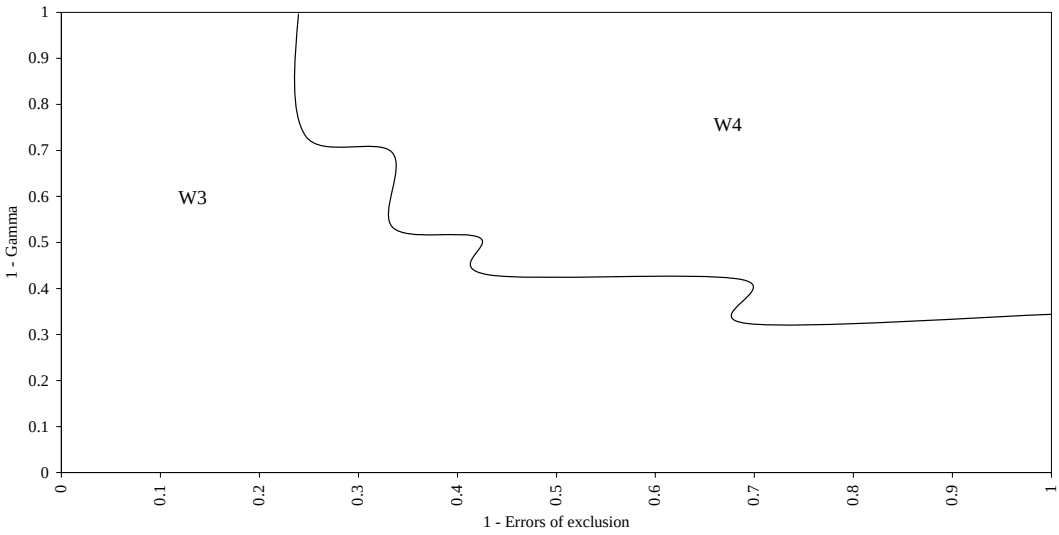

Figure 10: Optimal policy for different targeting efficacy and cash transactions costs combinations

TABLE 1: Parameter and Variable Start Values for the Welfare Scenarios

Name	Description	W1 No Cash	W2 No monetization	W3 No monetization and no cash	W4 Cut cargo preferences
f	Food endowment	5.00	5.00	5.00	5.00
y	Income endowment for non-recipients	5.00	5.00	5.00	5.00
B^{c}_{min}	Minimum cash allocation	0.00	270,000,000	0.00	0.00
B^{f}_{max}	Maximum allocation of food aid	1,270,000,000	1,000,000,000	1,270,000,000	1,270,000,000
Bf	Value distributed in 2000	1,270,000,000	698,500,000	1,270,000,000	1,270,000,000
α	Budgetary conversion rate	0.80	0.80	0.80	0.80
β	Monetization rate	0.85	0.85	0.85	0.85
p	Local price	1.00	0.88	1.00	1.00
$1 - \gamma$	Leakages associated with cash	0.85	0.85	0.85	0.85
p*	Shadow price	1.30	1.30	1.30	1.30
1-SC	Shipping cost	0.60	0.60	0.60	0.80
$1 + \theta$	OA's cost of procuring local food	1.10	1.10	1.10	1.10
$1 - \zeta$	Costs of local delivery	0.60	0.60	0.60	0.60
N	Population	10,000,000	10,000,000	10,000,000	10,000,000
φ^{1}	Errors of exclusion	0.60	0.60	0.60	0.60

φ^0	Errors of inclusion	0.60	0.60	0.60	0.60
ρ	% of pop which is food insecure	0.40	0.40	0.40	0.40
NR	Number of recipients	5,200,000	5,200,000	5,200,000	5,200,000
p^d	US government food aid prices	0.73	0.73	0.73	0.73
p^g	Global price	1.00	1.00	1.00	1.00
ε	Cobb-Douglas preference parameter	0.50	0.50	0.50	0.50
a	Inverse price elasticity of demand	0.01	0.01	0.01	0.01
b	Inverse price elasticity of supply	-0.02	-0.02	-0.02	-0.02
$1\text{-}MPC^{of}$	MPC secure HH in-kind	0.70	0.70	0.70	0.70
$1\text{-}MPC^{1f}$	MPC insecure HH in-kind	0.20	0.20	0.20	0.20
$1\text{-}MPC^{oc}$	MPC secure HH cash	0.8	0.8	0.8	0.8
$1\text{-}MPC^{1c}$	MPC insecure HH cash	0.40	0.40	0.40	0.40

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6. APPENDIX: EFFICIENCY OF US FOOD AID SHIPMENTS TO EAST AFRICA, 1998-2002

The ratio of the cost of food aid sourced in a donor country compared to the cost of procuring food in the recipient market – a measure of the efficiency of the transfer – is commonly referred to as an "alpha value" (Reutlinger and Katona-Apte 1984, Singer et al. 1987). A recent and influential OECD (2005) study finds average alpha values that significantly exceed one for all food aid grains: 1.42 for maize and wheat, and 1.28 for rice.[24] This implies considerable inefficiency in intercontinental food aid shipments. Such findings have long underpinned arguments for the conversion of "in-kind" food aid (i.e., commodities shipped from the donor country) to "cash-based" food aid (i.e., cash donations for local and regional purchases in developing countries).

Thanks to action-specific data generously made available by the U.S. Department of Agriculture and local price series kindly made available by other researchers, we were able to calculate similar efficiency measures using a different, arguably superior method. The OECD (2005) study uses a method that compares actual aid costs to the estimated cost of a hypothetical "alternative commercial transaction" (i.e., commercial imports), based on international market (e.g., US Gulf Port) prices, estimated freight costs, and a fixed markup rate to cover insurance and inspection. The denominator in this ratio may vary considerably, however, from actual prices in a destination country due to market imperfections, trade barriers, etc. We instead compute the ratio of actual aid costs (i.e., the same numerator) to actual destination market prices in the port to which the food aid was delivered. The benefit of our measure is that it does not use hypothetical alternative costs, but actual costs, thereby removing potentially significant measurement error. The main shortcoming of our approach is that analysis is necessarily limited by the

availability of reliable price data on comparable commodities within the same three-month span. Thus we cannot estimate the efficiency of more minor, less comparable products such as vegetable oil or nonfat dried milk powder, as one can with the OECD method. We therefore restrict our analysis to bulk hard red wheat and yellow maize U.S. food aid shipped to Tanzania (Dar Es Salaam), Kenya (Mombasa), and Ethiopia (Dire Dawa, Kombolcha, Mekele, and Nazareth)[25] during the years 1998-2002.

Our results generally corroborate the OECD (2005) findings, signaling that the qualitative point is quite robust to alternative methods of computing an alpha value. Only 36 percent of bulk food aid shipments from the US were as efficient as purchasing food locally, reflected by an efficiency ratio less than or equal to one (Figure A1).[26] The median action-by-action alpha value is 1.21, i.e., at the median transfer, food aid is 21 percent more expensive than local purchases of the same commodity in the same destination market in the same calendar quarter.

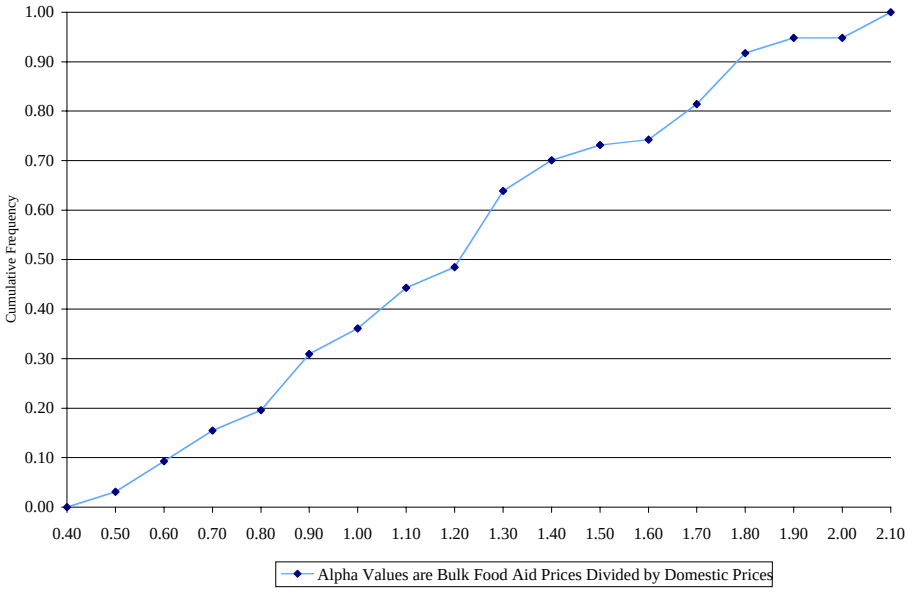

Figure A1: Cumulative Distribution of Action-by-Action Alpha Values (N=97)

7. NOTES

[1] In 2002, almost 60 percent of the United States' PL 480 Title II food aid – the world's largest program – was used for emergencies (USAID, 2004, p. ix, p. 35). Similarly, in 2003, WFP, the largest multilateral food aid agency, distributed 68 percent of its food aid for emergencies (WFP, 2004)

[2] We use the term "operational agencies," as is custom among field practitioners, to encompass both NGOs and United Nations agencies (e.g., UNICEF and WFP), or government entities that distribute food to individual recipients.

[3] Food procurement outside the donor country, closer to intended recipients, is commonly termed local or regional purchases, with the latter also termed "triangular transactions." Triangular transactions use cash from the donor country to purchase food in a third country which is then shipped to the recipient country.

[4] Monetization is a process whereby food aid is sold by an operational agency in the recipient country for cash for other food security-related programming.

[5] Notable exceptions include Barrett and Maxwell (2005) and Singer et al. (1987).

[6] Political additionality refers to the extent to which the donor government's distribution of food aid garners is politically more justifiable to its citizens than distribution of cash aid. (Colding and Pinstrup-Andersen, 2002, p. 196; Schulthes, 2000, p. 260).

[7] Both recipient country governments and operational agencies receive food aid. For simplicity, we assume an operational agency intermediates.

[8] In actuality, some donors may mandate distribution of cash transfers, restricting OA choice over this variable. We abstract from that constraint in this model.

[9] In order to monetize, an operational agency must acquire both specialized information on the local market where the monetization will occur, and technical capacity in commercial transactions, including auctions, negotiated sales, contracting, financing and storage (Ralyea and FAM, 1999, p. 9). This necessarily diverts resources away from OAs' target recipients, as compared to direct distribution of the food aid.

[10] US food aid transportation costs are particularly high because cargo preference laws stipulate that 75 percent of all US food aid must be shipped on US flagged vessels, subject to all US maritime and labor regulations. This results in sharply higher shipping costs than open market freight rates (GAO, 1994; Barrett and Maxwell, 2005).

[11] Readers interested in more detail about food aid in general or US food aid in particular – and especially the complex politics of food aid and its reform – are directed to Barrett and Maxwell (2005).

[12] The z=0 assumption implies some excludability, i.e., z reflects club goods such as education, sanitation or water services, etc. rather than pure public goods such as security or roads.

[13] We do not distinguish between local procurement and triangular transactions. Extending our research to include triangular transactions is a matter of adding an additional cost variable to allow for potential differences in procurement cost by source market. For one approach to modeling the welfare effects of triangular transactions, see Martens (1990).

[14] This is a simplification. Colding and Pinstrup-Andersen note, "Food transfers may sometimes be preferred to a cash transfer because experience shows that most food-for-work projects have been better able to target the most vulnerable groups... The reason is that deliveries of low-status grains… are less likely to leak to unintended beneficiaries than cash transfers" (2003, p. 206). Yet the observed increase in leakages associated with cash transfers may be due to self-targeting and stigma effects rather than the targeting mechanism. We have not found any empirical evidence which clarifies how targeting efficacy differs by resource form.

[15] The superscript "1" identifies food insecure households, while "0" identifies food secure households, following the earlier definition of the food insecurity indicator variable, I.

[16] A more realistic assumption would compute the total number of households targeted times a vector of food aid received per person multiplied by the number of household members. But since we work here with a representative household – and thus identical household composition – this refinement makes no difference to this analysis.

[17] There is a guaranteed minimum quantity of US food aid provided under law and in accordance with the Food Aid Convention. Our simulations do not approach the minimum value of food aid.

[18] We assume the marginal propensity to consume food out of transfers provided as food exceeds that for cash transfers (Breunig and Dasgupta, 2002; Barrett and Maxwell, 2005).

[19] Levinsohn and McMillan (2005) provide evidence from Ethiopia that most poor people are indeed net food purchasers (see also Barrett and Dorosh, 1996).

[20] Almost 15 percent of the EU's total 2002 food aid tonnage was local purchases (OECD, 2005, p.43).

[21] These parameters values are not derived from a specific data set – to the best of our knowledge, no data set encompasses all the parameters we need for this model – but rather captures standard stylized values from the broader literature.

[22] A substantial literature consistently finds that most poor households in Sub-Saharan Africa are net purchasers of food (Weber et al., 1988; Barrett and Dorosh, 1996; Levinsohn and McMillan, 2005).

[23] Put differently, we assume that targeting is no more successful than random draws at reaching food insecure households.

[24] Vegetable oil shipments, constituting a small percentage of donations, were less inefficient at 1.07.

[25] In the case of shipments to Ethiopia, our estimates are downwardly biased – i.e., they will understate the inefficiency of shipments – because we could not find reliable series for ground transportation costs from the delivery port to the final, interior destination (for example, from Djibouti to Dire Dawa). Muleta and Myers (2004) estimated average Ethiopian freight costs as a proportion of total marketing costs to be quite large: 68 percent.

[26] A not unsurprising pattern emerges in our USDA data. Our alpha values for donated US yellow corn are close to one. Yellow corn is not grown in Ethiopia, and therefore the local market price is essentially the import price. US alpha values for wheat were computed only for Kenya and Tanzania. Both countries grow wheat, and the price of wheat food aid (including delivery costs) is almost 50 percent higher. These examples suggest that US food aid prices are much closer to local prices for items which are not grown domestically (i.e., local traders and operational agencies face similar transport costs). US food aid is more inefficient in regions which can grow the particular aid commodity thereby avoiding expensive shipping costs.