Food Aid and Biofuels: The Effects of Biofuel Policies on Procurement and Delivery

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Abstract

The food-aid community almost unanimously condemns policies that encourage crop production for fuel. Both food-aid donors and recipients are concerned that biofuels will increase foodgrain prices and leave donors unable to meet commitments. The effects of biofuel-induced higher cereal prices on food-aid recipients are complicated functions of several factors, each of which must be considered in an analysis of the effects of biofuel policies. These factors include the level of biofuel-induced price increases, changes in relative commodity prices, donor-recipient relationships and the sources from which food aid is procured. This article analyses the effects of biofuel policies on the food-aid supply chain and concludes that the more reliant a recipient is on emergency (vs. programme and project) food aid, the smaller will be biofuel-related decreases in shipments. Also, the larger is the share of maize (relative to wheat and rice) in a recipients' food-aid basket, the more detrimental will be the impact of higher foodgrain prices. Movements toward local and regional food-aid procurement are unlikely to significantly insulate food-aid shipments from biofuel-related price increases.

Keywords: food aid, biofuels, development economics
JEL classifications: O13, Q18, Q42

Introduction

The food-aid community almost unanimously condemns policies that encourage crop production for fuel. Both food-aid donors and recipients are concerned that biofuels will increase foodgrain prices and leave donors unable to meet commitments given fixed procurement budgets. Headline-grabbing statements such as "biofuelling poverty" (OXFAM, 2007), and "our cost to purchase grain for the world's hungry has risen an average of 50 percent" (WFP, 2007) have led to questions regarding the wisdom of biofuels incentives.

The central concern of food aid practitioners is that higher levels of biofuel production will increase demand for foodgrains (primarily maize in the case of the US) and therefore increase the prices of food-aid commodities. The effects for maize are expected to indirectly affect wheat and rice prices, the other two primary food-aid commodities. Most observers believe that biofuel policies will increase world prices for cereal grains, however the effects on food-aid deliveries is unclear. Food-aid donors that operate on fixed budgets will, *ceteris paribus*, be forced to reduce procurement levels. However, extrapolating that an increase in cereal prices of, say, 25% will decrease global food-aid shipments by an equivalent amount misrepresents the effects on specific food-aid recipients. Country- and region-specific effects of biofuel-induced higher cereal prices are complicated functions of several factors, each of which must be considered in an analysis of the effects of biofuel policies on food aid. These factors include the level of biofuel-induced price increases, changes in relative commodity prices, donor-recipient relationships and the sources from which food aid is procured.

This article provides an analysis of biofuel-related factors affecting food-aid shipments and indicates how biofuel policies will affect deliveries. No attempt is made to forecast or predict the magnitude of the fall in food-aid shipments that may be caused by biofuel policies. Rather, the effects of biofuel policies on key points in the food-aid supply chain are identified and analysed.

Biofuel Policies

Several governments have initiated policies that encourage domestic demand for, and production of, biofuels. These policies have several forms: 1) mandated minimum usage requirements, 2) production subsidies, 3) tariff barriers, and 4) tax exemptions. Mandated minimum-usage requirements generate new and artificial demand for biofuels – demand shifters. Biofuel production subsidies reduce costs and shift out supply, while tariffs on biofuel products increase prices in importing countries, thereby increasing domestic production. The granting of tax relief to biofuel products makes consumer prices of

biofuels cheaper relative to fossil fuels and increases biofuel demand through substitution among fuel products.

Each of these policies has the same qualitative effect on grain prices; higher biofuel production levels shift out the derived-demand for grain inputs and increase prices, *ceteris paribus*. The feedstocks for biofuels, however, vary across countries. Maize is the primary biofuel input in the US, sugarcane in Brasil, and EU countries use a variety of oilseed crops in production of biodiesel. Prices for each of these commodities increase in response to biofuel expansion.

There are also significant indirect effects of biofuel production on the prices of grains that are not used as inputs. As the prices of grain inputs rise, land that was once devoted to cultivation of other crops may be converted into biofuel-input crops in efforts to capitalise on high prices. Livestock producers who historically relied on, for example, maize as a feedgrain may substitute for alternate grains. The price effects of biofuel policies ripple through grain markets.

The magnitude of biofuel-related grain price increases depends on several factors. The larger are the policy incentives, the greater will be the supply and demand shifts that impact grain prices. Many biofuel production facilities are only feasible with policy-related support measures, and their feasibility is closely tied to the price of crude oil. Biofuels and gasoline are imperfect substitutes and the higher are gasoline prices, the higher is the demand for biofuels. Biofuel production becomes more economically feasible as gasoline prices rise, and production becomes less dependent on policy support.

Several authors have attempted to quantify the effects of biofuel production on grain prices. Anderson *et al.* (2008) employ a vector autoregression model to estimate the effects of a maize-price increase on related commodities and retail food prices. Fridfinnson and Rude (2008) generate trade and price effects of a shock to biofuel-feedgrain demand using the OECD AgLink model. Elobeid and Hart (E&H) (2007) use the concept of a long-run equilibrium breakeven price to estimate the effects of expanded biofuel production on grain prices in the FAPRI model. The E&H model imposes an exogenous crude oil price shock, which increases the competitiveness of biofuels and enhances the feasibility of using grain crops as feedstock for biofuel production. The model allows biofuel production, and therefore derived demand for grains, to increase until the prices of grain feedstocks are high enough to render further expansion infeasible. This set of grain prices is the long-run equilibrium that results from biofuel production.

This paper uses the results of E&H as a baseline effect of biofuel production on grain prices. E&H is the only study, to our knowledge, that has been peer-reviewed, and generates price effects for important food-aid commodities (wheat, maize and rice). Scenario 2 from E&H assumes an exogenous

US$10 increase in the price of crude oil, and generates long-run equilibrium price increases for wheat of 16%, 37% for maize and 0.4% for rice. These increases almost certainly understate the effects, primarily because the price of oil has increased more than US$10 since the publication of this article. These results are still useful, however, because the goal of this article is to identify the important structural changes in the food supply chain that will affect shipments. An overall biofuel-induced increase in grain prices is inevitable, and it is the change in *relative* prices (maize increases more than wheat, which increases more than rice) that is most germane to this analysis.

Recipient-Specific Effects

A recipient-region's annual aid is a function of several factors, including recipient-country need[i], donor stocks, world prices and political relationships with donor countries. Grain prices are very important; a plot of global aid shipments against grain prices (figure 1) illustrates a strong negative relationship. There is little debate that biofuel-related grain price increases will reduce food-aid shipments. The more interesting result is the change in *relative* cereal prices. E&H predict sharply higher maize prices, with more moderate effects on wheat and rice prices. A change in relative prices is important because, while total aid shipments respond to overall prices, the composition of an individual country's food-aid basket may respond to relative prices.

The degree to which food-aid baskets adjust to changing relative prices is a quantitative question, and is addressed below. A sharp increase in the relative price of, say, maize will have more significant effects on relatively maize-dependent food-aid recipients, however, than on rice-dependent recipients. Figure 2 provides a comparative static snapshot of how recipient-countries' food-aid baskets could be affected by biofuel-related grain price increases. The map in figure 2 is generated by calculating the average shares of wheat, maize and rice[ii] in all food-aid recipients' baskets over the past five years (UN(a)). The price increases from E&H are applied to these baskets to generate estimated cost increases for each recipient's representative food-aid basket.

The variation in cost increases across recipients clearly illustrates one of the important effects that biofuel policies will have on food-aid shipments; changing relative commodity prices will have markedly different effects across recipients. Those countries whose food-aid baskets are most heavily weighted by maize are likely to be most adversely affected by large relative increases in maize prices. Countries in southern Africa, Rwanda, Burundi, Malawi and Somalia; many of which are frequently near the top of the food aid-recipient list. The countries whose food-aid baskets exhibit smaller price increases are characterised by less reliance on maize. Countries in south western Africa, and South and

Southeast Asia receive primarily rice as food aid, and the costs of these representative baskets do not increase sharply.

Figure 2 simplifies the effects of biofuel-related price increases on food aid. First, it considers only wheat, maize and rice; though cereal grains comprise approximately 80-90% of food-aid shipments. Second, the price effects in figure 2 only consider the costs of raw commodities, and do not factor in fortification or processing costs. These are significant contributors to programme costs, however the relative costs of fortification across cereals are not likely to be significantly affected by biofuel policies. Third, the price effects are likely understated. Finally, the static comparison of food-aid basket costs does not allow for substitution between commodities based on relative price changes. However, the salient point of differential effects across recipients remains clear.

Commodity Substitutability in Food-aid Baskets

Figure 2 provides an insightful static snapshot of the effects of relative price changes, however it may be unrealistic to expect that (for example) Zimbabwe will receive 37% fewer food-aid calories as a result of a 37% increase in the cost of its historically-representative food-aid basket. Demand theory (if we view donors as consumers) suggests that as relative commodity prices change, food-aid baskets will adapt to contain larger shares of the commodities whose relative prices have fallen. Using the example of Zimbabwe, one would expect that as the price of maize increases more than the prices of wheat and rice, then the shares of wheat and rice in Zimbabwe's food-aid basket would rise. That is, the own-price elasticity of demand for food-aid commodities should be negative (and cross-price elasticities positive).

As the price of a commodity rises, the total volume of that commodity that is shipped as food aid falls (see figure 1); however the responsiveness of the *mix* of commodities to relative price changes may help to determine the impact of biofuel-related price changes on recipients. The responsiveness of the mix of commodities depends on a few key factors. First, one expects that donors would substitute away from relatively expensive to relatively cheap commodities. The response of, say, wheat's portion of a food-aid basket to wheat prices should be negative and significant, *ceteris paribus*. There are, however, two confounding factors that may mitigate this response.

First, most food-aid donor organisations make concerted efforts to provide culturally appropriate food-aid baskets. Procuring commodities that match local tastes is foremost among donor organisations' policy objectives, and conversations with staff at the World Food Programme and the Canadian Foodgrains Bank reinforced this point. The strong efforts to procure specific commodities,

even at high prices, suggest that selection of commodities within food-aid baskets may be quite price inelastic.

Further, different categories of food aid may be more or less elastic, depending on the policy goal underlying the food aid. There are three categories of food aid; 1) programme food aid is donated bilaterally to a recipient-country's government and sold on the open market with proceeds used to address balance of payments and budgetary concerns, 2) project food aid is distributed by food-aid NGOs or multilateral agencies, then sold on the open market with the proceeds directed towards specific developmental projects, and 3) emergency food aid is delivered by all of the aforementioned groups to increase or maintain caloric and nutritional intake during crises . The objectives and operational details vary considerably, particularly between emergency aid and programme and project (P&P) aid. The primary goal of emergency aid is immediate provision of food that is procured as quickly and cheaply on spot markets as possible. Most donors still strive to provide culturally appropriate commodities, but we expect this motivation to be reduced somewhat in emergencies; the composition of emergency food-aid baskets may exhibit significant price responsiveness. The delivery of P&P food aid is motivated by several factors. P&P food aid is often planned for a period of years at the beginning of a project, and a quantity of specific commodities may be committed for that period. P&P food aid has also been associated historically with political and domestic policy motivations (Barrett and Maxwell, 2005; Neumayer, 2005; Diven, 2001; Zahariadis, Travis and Ward, 2000). For these reasons, the composition of P&P food-aid baskets may be less response to relative price changes than emergency food aid.

Food-aid baskets are ultimately chosen by donor organisations, and it should be donor responses to price changes that determine the magnitude of relative price effects. An ideal econometric investigation would measure commodity responsiveness to changing relative prices by country across food-aid categories. The most comprehensive source for food-aid data does not provide the type of information required, however. The FAOSTAT food-aid database reports total shipments by donor and commodity and by recipient, but these data do not convey donor procurement behaviour. Most donor countries provide a combination of cash-based and in-kind aid[iii], and the FAOSTAT data do not separate the two. This is important because data (for example) for Canadian wheat aid shipments in 2000 include both wheat that was procured in Canada by Canadian agencies and wheat that was procured by multilateral agencies abroad using funds provided by Canadian agencies. The data do not convey the response of specific donors to changes in relative commodity prices. The FAOSTAT database also does not contain an historical time series of aid by commodity by category (i.e. emergency vs. P&P).

As information on donor commodity selection and on selection across food-aid categories cannot be observed, we measure the responsiveness of baskets to price changes using an alternative approach. The FAOSTAT database provides shipments to all food-aid recipients by commodity, so we can observe how the composition of baskets to recipients has responded to price. This approach does not provide measures of how donors respond, but we are primarily interested in the effects of biofuel policies on recipients. The other unobservable, donations by category of aid, is more challenging to remedy. The WFP Interfais data do provide short time series for major recipients that separate aid receipts by category. This information can be used to separate those recipients who are primarily emergency aid recipients from those who receive mostly P&P aid. Table 1 contains this information from WFP Interfais for a sample of large food-aid recipients. There is not always a clear distinction between categories; many countries receive all three forms of food aid, and the shares vary over time. However several of the top aid recipients exhibit persistent reliance on either emergency or P&P food aid. The econometric analysis is conducted along these lines.

The objective of the econometric model is to estimate how the commodity makeup of recipients' food-aid baskets has varied in response to changing relative commodity prices over time. We avoid modelling total food-aid shipments because we are primarily interested in the *composition*, not the *size*, of those baskets, and because modelling the size of food-aid deliveries is beyond the scope of this research.[iv] FAOSTAT food-aid data are used to generate historical shares for wheat, maize and rice for each recipient's food-aid basket (shares sum to one). The responses of these shares to price movements are estimated in a singular system framework. Each share is represented as

$$(1) \qquad FA^i_{j,t} = f\left(P_{w,t}, P_{m,t}, P_{r,t}\right) + e^i_{j,t}, \ where \ \sum_{j=1}^{3} FA^i_{j,t} = 1,$$

$$i = \text{recipient country}, j = \text{wheat, maize and rice, and } t \text{ is a time subscript.}$$

FA is the share of each country, *i*'s, food-aid basket made up of commodity *j*, *P* are logs of commodity prices and *e* is an error term. The three share equations are estimated for each recipient in a singular system using Zellner's Seemingly Unrelated Regression methodology. Coefficients on the price terms from each equation should convey information on how the commodity makeup of food-aid baskets has responded to changes in relative prices. Were it not for confounding factors, we would expect own-price effects to be negative and cross-price effects to be positive. The efforts of donor organisations to meet local tastes may override, or least reduce the significance of, price effects. Also, different categories of aid may exhibit different responses. Regression results from countries that receive

primarily emergency aid may exhibit more price responsiveness than results from countries that receive mostly P&P food aid.

The SUR representations in equation (1) are estimated for a sample of countries that persistently appear near the top of the WFP's food-aid recipients list.[v] Food-aid data are from FAOSTAT and price data are from the FAO's Commodities and Trade Division (UN(b)).[vi] Countries that are primarily emergency recipients and countries that are primarily P&P recipients are selected so that results can be compared across categories. The econometric specifications do not explicitly control for category of aid because this is unobservable, however the sorting of countries prior to estimation allows a comparison across groups. Sample countries include Ethiopia, Sudan, Uganda, Afghanistan (large recipients of emergency food aid), and Bangladesh, India and Haiti (recipients of primarily P&P aid).

Table 2 contains parameter estimates for Sudan, a country that has received almost exclusively emergency food aid in recent years. The price effects are mostly intuitive; negative own price and mostly positive cross-price responses. The own-price effects for wheat and maize are significant at the 10% level; the insignificance of the rice parameter is not surprising as Sudan has received only a trickle of rice over the 35-year sample. Ethiopia, Uganda and Afghanistan exhibit similar results, though own-price responses are not as uniformly significant as for Sudan. These results lend moderate support to the hypothesis that emergency food-aid shipments have been responsive to changes in relative commodity prices.

The results for those countries that traditionally rely on P&P aid are less intuitive. Table 3 contains estimation results for Haiti. Many price effects are not intuitive, and most parameter estimates are statistically insignificant. The results for Bangladesh and India are similar; several counterintuitive signs and very few significant results. Food-aid baskets to P&P-dependent countries do not exhibit strong price effects.

Data constraints limit the empirical investigation, but the econometric results lend support to the hypothesis that different categories of food aid exhibit a range of responses to commodity price changes. This suggests that biofuel policies that affect the relative prices of important food-aid commodities will impact recipients of emergency aid to a different degree than recipients of P&P aid; emergency food-aid baskets may be more responsive to changing prices and donors may respond by altering the commodity composition of their baskets. This effect is likely to be less significant for P&P food-aid baskets.

Source of Food Aid Procurement

Food aid is procured from three sources; in-kind aid is purchased in a donor country and shipped to recipients, local aid is purchased in a recipient country or region, and regional aid is procured in a country nearby the recipient. There has been a strong push from NGOs to increase the share of food aid that is purchased locally or regionally (LRP, for local and regional procurement). The motivation for moving to LRP is based on four factors. First, procurement in developing countries can increase demand for domestic agricultural production. Second, food aid can often reach recipients much faster if purchased closer to target markets; US food-aid shipments can take from five months for emergency aid to two years for non-emergency aid (Barrett and Maxwell, 2005). Food purchased closer to target markets can also provide more culturally-appropriate commodities than aid that is sourced in developed donor countries. Finally, food aid that is purchased closer to target markets usually entails lower transport costs. This last point has been particularly important recently due to high fuel costs and high insurance rates for shipping around the horn of Africa.

Most food-aid recipient countries are not closely integrated with world markets. A comparison of food-aid receipts per capita and degree of trade openness reveals a negative relationship (figure 3), and food-price pass through from world to regional markets can be quite low in relatively closed developing countries (Dawe (2008)). Biofuel-related price effects may not be as significant in developing-country as in developed-country markets. Is it reasonable to presume that the movement towards LRP will help to insulate food-aid procurement from biofuel-related price effects? We argue that this effect will be small for two reasons.

First, more than half of LRP aid is bought regionally, not locally (WFP Interfais). For Africa, most of this (60%) is purchased in South Africa (see figure 4) which is characterised by well-developed and internationally-integrated grain markets relative to major African food-aid recipient countries (Sudan, Ethiopia and Somalia). The dealers from whom food aid is purchased in South Africa have the option of exporting their products, and are therefore subject to international price movements.

Second, food aid that is procured in recipient countries is usually purchased from large traders with commercial reputations. Large-scale traders, instead of smallholder farmers, are contracted to provide food aid for several reasons. Food-aid tenders are often too large to be met by smallholders. Also, smallholders are rarely able to meet the requirements of short-term orders, or able to guarantee minimum safety standards. Donors also prefer to deal with traders who have commercial reputations or with whom they have previous experience. The probability of post-contractual opportunism by traders who default on contracts is reduced.

The large-scale traders from whom the majority of LRP food aid is purchased engage in international trade and respond to world commodity-price movements. So despite the relatively closed nature of many food-aid recipient countries, a movement towards LRP is unlikely to significantly insulate food-aid purchases from biofuel-related commodity price changes. The WFP has been shown to be effective at switching between local and regional sources to secure the lowest prices (Tschirley and del Castillo, 2007), so donors may not necessarily pay more than prevailing world prices. The directions of food-aid costs will, however, track global commodity prices.

Concluding Remarks

Biofuel policies in major agricultural economies will continue to affect grain prices. The broad consensus is that these policies will increase prices for all grains, and that the relative prices of food-aid commodities will change (the largest increases in maize, followed by wheat, followed by rice). Higher foodgrain prices will reduce food-aid shipments, particularly by those donors constrained by fixed budgets. Changing relative commodity prices will have differential effects across food-aid recipients. Those most reliant on maize for food aid will experience the most significant effects. However, there may be some room for restructuring of food-aid baskets as donors substitute to relatively inexpensive foodgrains. This effect is likely to be most significant for emergency food aid.

The complexity of food-aid procurement and delivery channels does not allow, however, succinct proclamations that quantify the effects of biofuel policies on food-aid shipments (such as those in this article's introduction). There will be a spectrum of effects, depending on the characteristics of each recipient. Broadly, the more reliant that a recipient is on emergency [programme and project] food aid, the smaller [larger] will be biofuel-related decreases in shipments. Also, the larger is the share of maize in a recipients' food-aid basket, the more detrimental will be the impact of higher foodgrain prices. Movements toward local and regional food-aid procurement are unlikely to significantly insulate food-aid shipments from biofuel-related price increases because most aid is procured from large-scale traders who respond to global prices.

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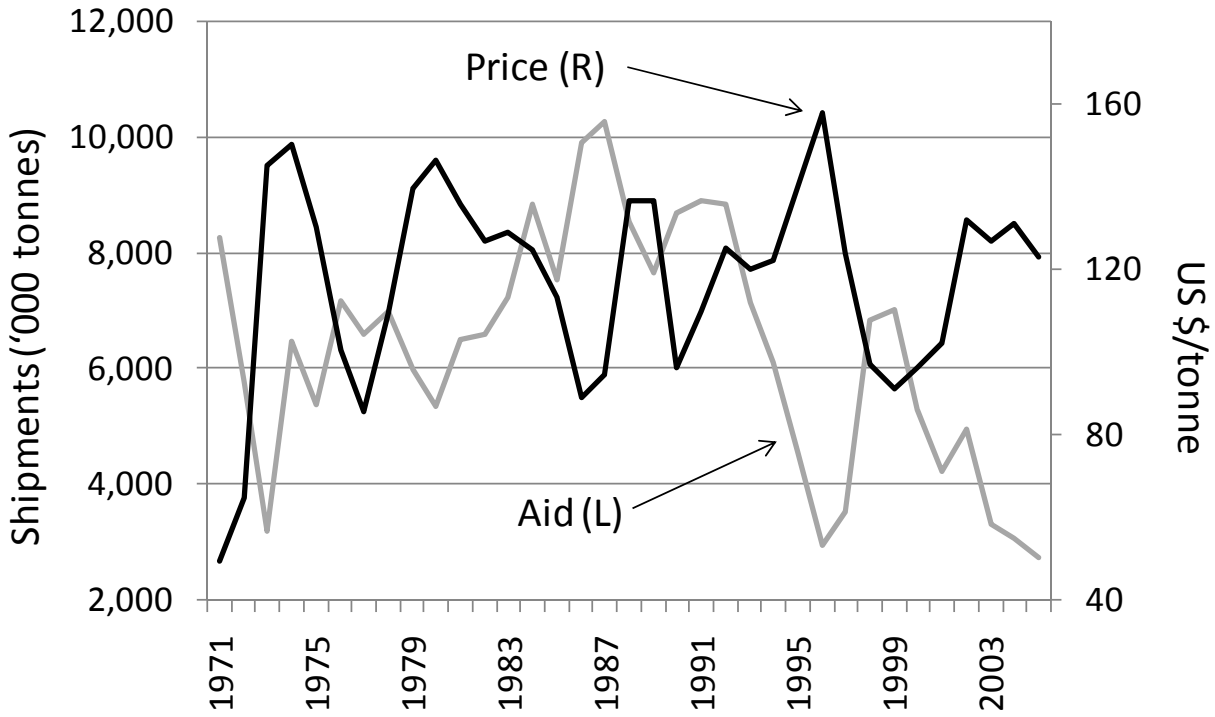
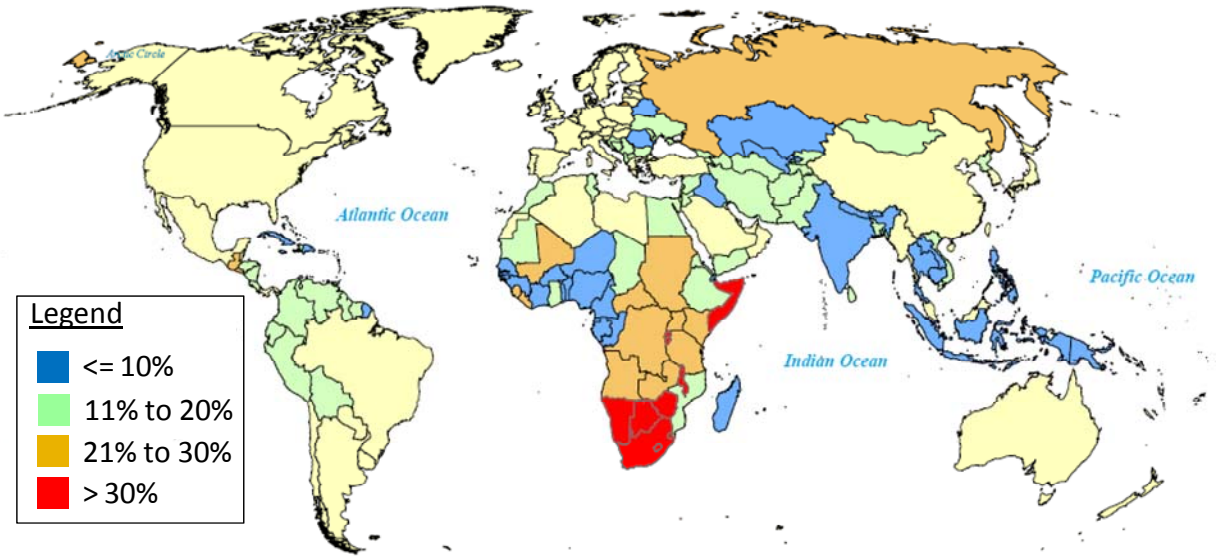
Figure 1. Global Food Aid and Commodity Prices (wheat)



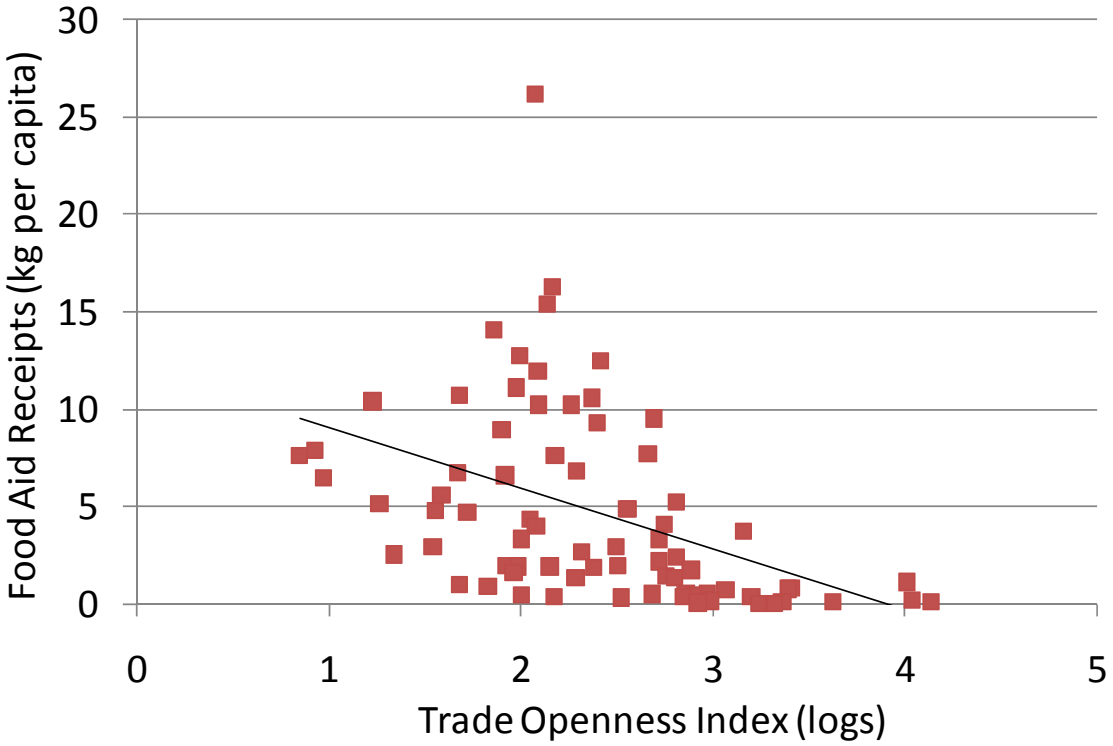
Source: UN(a)

Figure 2. Estimated Cost Increases of Representative Food Aid Baskets



Sources: UN(a), E&H (2007), authors' calculations

Figure 3. Food Aid Receipts and Trade Openness



Sources: WFP Interfais, Squalli and Wilson (2006), authors' calculations

Figure 4. Regional Food Aid Flows in Africa

Source: Tschirley and del Castillo (2007)

Table 1. Share of Food Aid by Category, 2007

	Emergency	Programme and Project
Sudan	0.99	0.01
Ethiopia	0.92	0.08
Afghanistan	0.91	0.09
Uganda	0.86	0.14
Haiti	0.11	0.89
Bangladesh	0.10	0.90
India	0.01	0.99

Souce: WFP Interfais

Table 2. SUR Estimates for Sudan

	Wheat Equation	Rice Equation	Maize Equation
Intercept	1.19	0.04	-0.23
	(0.99)	(0.05)	(0.99)
Wheat	-1.49*	-0.02	1.51*
	(0.61)	(0.02)	(0.61)
Rice	0.16	-0.01	-0.14
	(0.26)	(0.01)	(0.26)
Maize	1.28*	0.03	-1.31*
	(0.67)	(0.03)	(0.67)

standard errors in parentheses

* indicates 10% significance

Table 3. SUR Estimates for Haiti

	Wheat Equation	Rice Equation	Maize Equation
Intercept	0.05	1.06*	-0.11
	(0.57)	(0.54)	(0.59)
Wheat	-0.52	-0.37	-0.15
	(0.35)	(0.33)	(0.37)
Rice	-0.30*	0.09	0.21
	(0.15)	(0.14)	(0.15)
Maize	-0.05	0.06	-0.01
	(0.39)	(0.37)	(0.40)

standard errors in parentheses

* indicates 10% significance

Endnotes

[i] The term "need" is vaguely defined in the food aid literature. It can mean deviation from trend consumption, deviation from trend production or from trend stocks. See Young and Abbott (2008) for a discussion of these issues.

[ii] Wheat, maize and rice make up more than 90% of cereal food aid shipments. (WFP Interfais)

[iii] The US is an exception. See note v.

[iv] Modelling volume of food aid shipments involves modelling stocks, deviations from trend stocks and consumption, political ties and other factors. See Barrett and Heisey (2002), Diven (2001) and Abbot and Young (2008) for attempts at modelling total food aid shipments.

[v] The same SUR model was run for US donation data. The results were not intuitive and were mostly insignificant. This is not surprising given the myriad food-aid organisations and motivations in US policy.

[vi] Food aid donors do not always pay prevailing world prices for commodities. International prices were used to capture biofuel-related relative price movements, however, and food aid price movements likely track the movements of world prices (see below).