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A Post Schultzian View of Food Aid, Trade and Developing Country Cereal Production: Results of a Vector Autoregression on Panel Data using Fixed Effects

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This study provides a theoretical and empirical analysis of the relationship between cereal imports, production, program food aid and targeted food aid in recipient countries. Hypotheses are tested empirically using vector autoregression with fixed effects on panel data from the World Food Programme.

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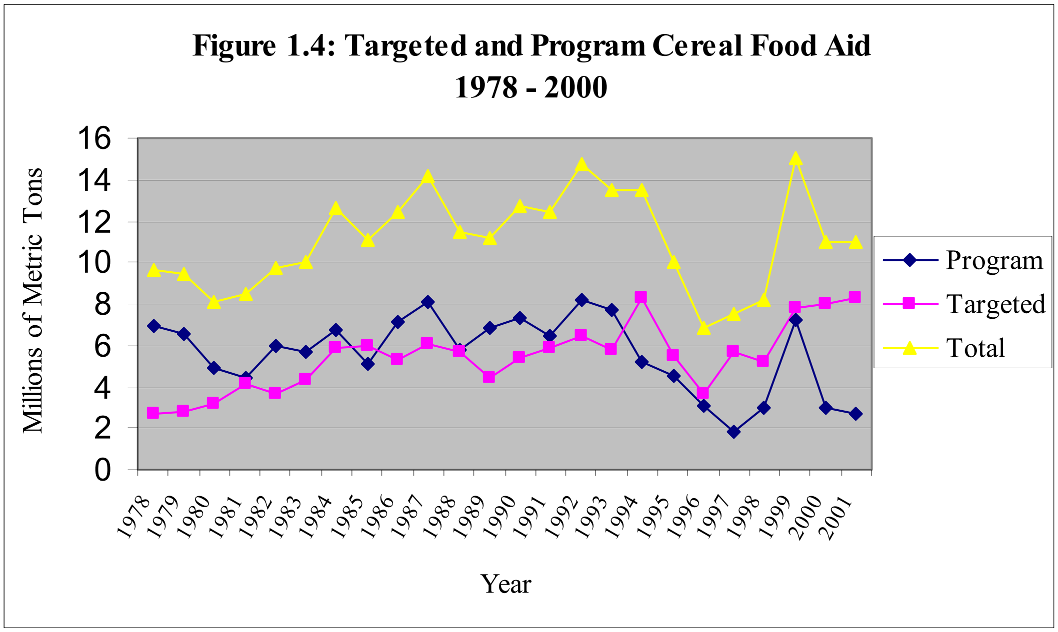
Introduction

For nearly a half century, food aid has aroused considerable debate among economists, however a definitive answer to the fundamental question, "What is the impact of food aid?", has proven elusive. In recent years global food aid shipments have declined and become more volatile. Relief organizations struggle to obtain food and funds for their programs. In such a climate a better understanding of the effect of food aid is needed.

Perhaps the most renowned contribution to the literature on food aid is Theodore W. Schultz's 1960 article, which warned that the United States' Food for Peace program likely had a disincentive impact on farmers in recipient countries. More recently Christopher Barrett has maintained that food aid displaces imports and has little effect on local production (2002). Both of these responses are based on an examination of program food aid, the dominant form of food aid in the 1950s and 60s. Program food aid is given to a recipient country (or sold at a concessionary price); the recipient government then sells the food and generates revenue that is ostensibly used for development projects. However, program food aid is not the only type of food aid. Since the 1960s food aid has evolved to include targeted food aid, which is intended for free distribution to the hungry poor. About half of global food aid was targeted in the 1980s and about two thirds was targeted by the 1990s. Figure1.4 below shows the evolution of the two types of cereal food aid over the period 1978 through 2001; as with the rest of our study the data we use is data for cereal food aid since it represents the vast majority of food aid and proves an appropriate proxy for total food aid.



Our study is unique in that it is one of very few empirical studies that distinguish between program and targeted food aid. We test hypotheses regarding the relationships between targeted food aid, program food aid, imports and production.

A Theoretical Framework

Various attempts have been made to prevent food aid from displacing commercial food trade and discouraging food production in recipient countries. In 1954 the Food and Agricultural Organization of the United Nations founded the Consultative Sub-Committee on Surplus Disposal (CSSD) in an effort to limit market distortions arising from food aid (Food and Agriculture Organization). As described in the CSSD handbook, The Principles of Surplus Disposal, the committee's aim is to "assure that food and other agricultural commodities which are exported on concessional terms result in additional supplies for the recipient country and do not displace normal commercial imports; and similarly, that domestic production is not discouraged or otherwise adversely affected" (FAO). Fundamental economic theory suggests that what the committee proposes to do is impossible. Food aid will always discourage domestic production to a greater or lesser degree and under some conditions it may displace commercial imports. The degree and type of market distortion will, however, be affected by CSSD policy as well as by the type of food aid.

The CSSD introduced the concept of the Usual Marketing Requirement (UMR), or minimal quantities of imports that countries must purchase at non-concessional prices before they are permitted to import program food aid at concessional prices. The UMR quantity and price for a given commodity and recipient country are determined through consultation among representatives of countries that export the commodity to that recipient country. The UMR is set to equal the average quantity and price of commercial imports of the commodity by the recipient country over the preceding five years. By obliging recipients to import the UMR, the CSSD aims to prevent import displacement. In 1963, the FAO established the World Food Programme and introduced targeted food aid as another attempt to provide food aid without displacing imports or discouraging production; targeted food aid is exempt from the UMR.

Economic theory suggests that the effect of program food aid on domestic production is related to the effectiveness of UMR specification and enforcement. Should the UMR be enforced program food aid will cause a larger disincentive to producers in the recipient country than it will should the UMR not be enforced. When the UMR is not enforced not only is production discouraged, but imports are also displaced. UMR enforcement therefore puts the burden on producers alone. When UMRs are not enforced the exporter and the recipient share the burden of disincentives. Production disincentives and import displacement result from targeted food aid; their magnitude is inversely related to the degree to which targeting is successful. We may test these theoretical conjectures using empirical methods, but only to a limited extent since we are constrained by data availability and methodology; given the data we have at hand we have no way of controlling for UMR enforcement or successfulness of targeting. The central hypothesis resulting from our theoretical framework that we are able to test with our empirical model is that targeted food aid discourages local food production and displaces imports less than program food aid does.

Methodology Used in This Study

No published multi-country empirical studies of food aid distinguish between the major types of food aid (targeted and program). We adapt a dynamic empirical model used by Barrett *et al*. (1998) in order to test the hypothesis that targeted food aid discourages local food production and displaces imports less than program food aid does. Our examination of the data is an improvement to the study by Barrett since it uses fixed effects to control for differences between countries. Introducing country specific effects into an autoregressive model calls for sophisticated econometric analysis, but the advantages of doing so prove beneficial. Another key difference between our study and that of Barrett is that since Barrett published his study, data on food aid availability has improved and we have been fortunate to gain access to a dataset that is likely to be more appropriate for this type of work. Quick inspection of global food aid data at the country level shows that U.S. cereal program food aid, which Barrett used as a proxy for global food aid, does not accurately reflect amounts of global food aid because it ignores shipments from countries other than the U.S. and it fails to account for targeted food aid. In 1988 the World Food Programme began recording all food aid transactions made by donor, recipient and type of aid on a monthly basis. This data set, known as INTERFAIS, does not cover nearly as long a period as the data used by Barrett et al, but it has existed long enough for it to be used in a preliminary examination of the short term dynamics of global food aid. Furthermore, it is the single most detailed and complete data set ever compiled on global food aid, but it has not to date been used in a rigorous empirical study using econometric methods. We use this INTERFAIS data together with FAOSTAT data on cereal production, imports and population by country. Once both data sets are combined, the data span 13 years (1988 to 2000) and 64 countries.

We incorporate four variables (other than dummy variables) in the vector autoregression with fixed effects; they are per capita program food aid (FP), per capita targeted cereal food aid (FT), per capita imported cereals (M), and per capita domestic production minus exports (P). The equations for the unrestricted VAR with fixed effects are shown below where C is a country specific dummy variable, D_t is a year specific dummy variable, m is the number of lags and N is the number of countries.

Model: Stationary VAR with Fixed Effects

$$P_{it} = \sum_{j=1}^{m} \theta_{1j} P_{it-j} + \sum_{j=1}^{m} \theta_{2j} M_{it-j} + \sum_{j=1}^{m} \theta_{3j} FT_{it-j} + \sum_{j=1}^{m} \theta_{4j} FP_{it-j} + \sum_{i=1}^{N} \delta_{1i} C_{1i} + \sum_{t=1}^{T} \gamma_{1t} D_t + \varepsilon_{1it}$$

$$M_{it} = \sum_{j=1}^{m} \beta_{1j} P_{it-j} + \sum_{j=1}^{m} \beta_{2j} M_{it-j} + \sum_{j=1}^{m} \beta_{3j} FT_{it-j} + \sum_{j=1}^{m} \beta_{4j} FP_{it-j} + \sum_{i=1}^{N} \delta_{2i} C_{2i} + \sum_{t=1}^{T} \gamma_{2t} D_t + \varepsilon_{2it}$$

$$FT_{it} = \sum_{j=1}^{m} \alpha_{1j} P_{it-j} + \sum_{j=1}^{m} \alpha_{2j} M_{it-j} + \sum_{j=1}^{m} \alpha_{3j} FT_{it-j} + \sum_{j=1}^{m} \alpha_{4j} FP_{it-j} + \sum_{i=1}^{N} \delta_{4i} C_{4i} + \sum_{t=1}^{T} \gamma_{3t} D_t + \varepsilon_{3it}$$

$$FP_{it} = \sum_{j=1}^{m} \psi_{1j} FT_{it-j} + \sum_{j=1}^{m} \psi_{2j} FP_{it-j} + \sum_{j=1}^{m} \psi_{3j} M_{it-j} + \sum_{j=1}^{m} \psi_{4j} P_{it-j} + \sum_{i=1}^{N} \delta_{4i} C_{4i} + \sum_{t=1}^{T} \gamma_{4t} D_t + \varepsilon_{4it}$$

Controlling for country specific effects is likely a promising methodology, but it does require more sophisticated econometric methods than simple VAR estimation. The introduction of dummy variables that do not vary over time precludes the use of seemingly unrelated regression. One must instead estimate the first difference of each equation in the system; the first differences of the equations are shown below.

First Difference of Equations in Model

$$P_{it} - P_{it-1} = \sum_{j=1}^{m} \theta_{5j} (P_{it-j} - P_{it-j-1}) + \sum_{j=1}^{m} \theta_{6j} (M_{it-j} - M_{it-j-1}) + \sum_{j=1}^{m} \theta_{7j} (FT_{it-j} - FT_{it-j-1})$$
$$+ \sum_{j=1}^{m} \theta_{8j} (FP_{it-j} - FP_{it-j-1}) + \sum_{t=1}^{T} \gamma_{5t} (D_t - D_{t-1}) + \varepsilon_{1it} - \varepsilon_{1it-1}$$

$$M_{it} - M_{it-1} = \sum_{j=1}^{m} \beta_{5j} (P_{it-j} - P_{it-j-1}) + \sum_{j=1}^{m} \beta_{6j} (M_{it-j} - M_{it-j-1}) + \sum_{j=1}^{m} \beta_{7j} (FT_{it-j} - FT_{it-j-1})$$
$$+ \sum_{j=1}^{m} \beta_{8j} (FP_{it-j} - FP_{it-j-1}) + \sum_{t=1}^{T} \gamma_{6t} (D_t - D_{t-1}) + \varepsilon_{2it} - \varepsilon_{2it-1}$$

$$FT_{it} - FT_{it-1} = \sum_{j=1}^{m} \alpha_{5j} (FT_{it-j} - FT_{it-j-1}) + \sum_{j=1}^{m} \alpha_{6j} (FP_{it-j} - FP_{it-j-1}) + \sum_{j=1}^{m} \alpha_{7j} (M_{it-j} - M_{it-j-1})$$
$$+ \sum_{j=1}^{m} \alpha_{8j} (P_{it-j} - P_{it-j-1}) + \sum_{t=1}^{T} \gamma_{7t} (D_t - D_{t-1}) + \varepsilon_{1it} - \varepsilon_{1it-1}$$
$$FP_{it} - FP_{it-1} = \sum_{j=1}^{m} \psi_{5j} (FT_{it-j} - FT_{it-j-1}) + \sum_{j=1}^{m} \psi_{6j} (FP_{it-j} - FP_{it-j-1}) + \sum_{j=1}^{m} \psi_{7j} (M_{it-j} - M_{it-j-1})$$
$$+ \sum_{j=1}^{m} \psi_{8j} (P_{it-j} - P_{it-j-1}) + \sum_{t=1}^{T} \gamma_{8t} (D_t - D_{t-1}) + \varepsilon_{2it} - \varepsilon_{2it-1}$$

Estimation of the first differences of each equation introduces a simultaneity problem, which is resolved by employing instrumental variables. The list of available instrumental variables changes for each period and in period t it is:

$$Z_t = \{FT_{t-2}, FT_{t-3}, ...FT_{1988}, FP_{t-2}, FP_{t-3}, ...FP_{1988}, M_{t-2}, M_{t-3}, ...M_{1988}, P_{t-2}, P_{t-3}, ...P_{1988}\}$$

Ideally all of the available instruments would be used to estimate each equation, however vector autoregressions with fixed effects become increasingly difficult to solve as the number of variables, the lag length, and the time period of the data set increase. This is because as the size of the instrument matrix increases it becomes more difficult to solve the model using standard mathematical techniques for inverting matrices (Holtz Eakin). We therefore restrict the instrument matrix to include only the lagged values of the dependent variable. In order to limit the size of the instrument matrix we must also reduce either the number of lags in our estimation or the number of years used in the estimation. After preliminary testing to determine whether 4 lags are necessary, we choose a 3 lag structure. Unfortunately we are only able to estimate it using observations for years 1991 through 2000; estimations using the entire range of data (1988 through 2000) result in near singular matrix errors when we attempt to invert manipulations of the instrumental variables matrix. The estimation is carried out for each equation separately; let us illustrate the procedure using the production equation. For the production equation the instrument matrix for the ith country is as follows:

$$Z_i = \begin{bmatrix} P_{93-91} & \mathrm{d}_{95} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & P_{94-91} & \mathrm{d}_{96} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & P_{95-91} & \mathrm{d}_{97} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & P_{96-91} & \mathrm{d}_{98} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & P_{97-91} & \mathrm{d}_{99} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & P_{98-91} & \mathrm{d}_{00} \end{bmatrix}$$

The first row provides the instruments for the year 1995: per capita production for 1993, 1992 and 1991 (abbreviated $P_{93\text{-}91}$) and a dummy variable for 1995 (denoted d_{95}). The estimation is achieved in two stages. The first stage is unweighted instrumental variables estimation which amounts to a GMM estimation using Z'Z as the weighting matrix. The parameter estimates for the production equation are calculated as shown below where X is the matrix of independent variables and Y is the dependent variable (per capita production in this case).

$$\theta_{1stStage} = \left[X'Z(Z'Z)^{-1}(Z'X)\right]^{-1} X'Z(Z'Z)^{-1}(Z'Y)$$

The residuals from the first step are used to create a weighting matrix that is used in the second stage, a weighted GMM estimation of the parameters. The weighting matrix for the second step, which we will refer to as omega, must be calculated for each country and summed over the countries; the formula is below.

$$\Omega = \sum_{i=1}^{N} Z_i'\hat{u}_i\hat{u}_i'Z_i$$

Finally, the parameters are estimated using the generalized method of moments and the weighting matrix omega. The parameter estimates are calculated as shown below.

$$\theta_{2ndStage} = \left[X'Z(\Omega)^{-1}(Z'X)\right]^{-1} X'Z(\Omega)^{-1}(Z'Y)$$

This methodology follows that used by Greene (2003) and Dahlberg and Johansson (1998), both of whom cite Holtz-Eakin's 1988 article on VAR with fixed effects as the source of the formulae.

Hypothesis Testing

Hypothesis tests may be conducted using a variety of statistics; again we follow the guidelines set forth by Greene (2003), Dahlberg and Johansson (1998), and Holtz-Eakin (1988) and use the Sargan statistic, also known as the GMM criterion function, to carry out nested hypothesis testing. The Sargan statistic (which we denote as q) is calculated as shown below.

$$q = \hat{u}'Z\Omega Z'\hat{u}$$

The order of hypothesis testing is critical; various authors have shown that initial tests for model specification and validity of instruments should be followed by tests for lag length and finally tests for the exclusion of particular variables (Dahlberg and Johansson).

To test the model specification and validity of the instruments we compare q to the critical value given by the chi squared distribution at degrees of freedom equal to the number of instruments minus the number of parameters. Should q be smaller than the critical value than we can not reject the null hypothesis of correct model specification and valid instruments.

Each equation in the system is estimated using a lag length equal to m and then using a lag length equal to m-1 until the lag length is equal to zero. In testing the null hypothesis that a lag length of m-1 is superior to a lag length of m, the difference between q (the Sargan statistic) given m and q given m-1 lags is calculated as the test statistic; it is distributed according to the chi square distribution with m degrees of freedom. Should the test statistic be larger than the critical value for the chi squared distribution at m degrees of freedom then the null hypothesis is rejected and the lag length is set as m.

After the model is determined to be correctly specified and the proper lag length is established Granger causality testing is carried out. Conditional upon a given lag length the appropriate independent variables will be chosen using the criterion of Granger causality. Should inclusion of a particular independent variable lead to better forecasting of the dependent variable than would be accomplished were that particular independent variable excluded, the independent variable is included since it exhibits Granger causality toward the dependent variable (Lavy). In order to test the null hypothesis that targeted food aid should be excluded from the production equation we estimate the production equation using all independent variables and then estimate it using all independent variables except for targeted food aid. The difference in the Sargan statistic for the two estimations is distributed according to the chi squared distribution with m degrees of freedom. Should the test statistic be larger than the relevant critical value, we may reject the null hypothesis that targeted food aid does not Granger cause production.

Results

We must use fewer lags than did Barrett since our data (see previous section) only covers a 13 year period, and because we are using more variables than Barrett did. Preliminary estimation with a short time period suggested that 4 lags were unnecessary and 3 lags sufficient for most equations. We therefore chose to begin formal hypothesis testing using a 3 lag specification. Table 1 below shows the results of nested hypothesis testing on each equation using an initial lag length of 3 and using years 1991 through 2000. We may not reject the null hypothesis of correct model specification and valid instruments for any of the equations since in all cases q is less than X^2. Turning to the question of lag length, only the production equation appears to require a lag length of two; for all other equations we may reject the null hypothesis that two lags is superior to three since q for ii. is greater than the chi squared test statistic at four degrees of freedom. We now turn to the question of which variables should be excluded. Interestingly, for the production and imports equations we find that targeted food aid should be excluded from the set of independent variables; this would suggest that targeted food aid neither Granger causes production nor does it Granger cause imports. Program food aid does affect both production and imports in the sense of Granger causality. This is consistent with our hypothesis that program food aid interferes with production and trade more than targeted food aid does. The other finding from Granger causality testing is that imports do not Granger cause program food aid allocation. This could possibly reflect the successful implementation of UMRs.

Table 1: Nested Hypothesis Testing using 3 Lags and Years 1991 through 2000 (N=64)

Production Equation					
***Null Hypothesis*:**	***Q***	***Df*** $_Q$	***L***	***Df*** $_L$	X^2
i. Model Correctly Specified, Valid Instruments, m=3	21.98	27			36.74
ii. 2 lags are superior to 3 lags	**27.70**		**5.72**	**4**	**9.49**
iii. 1 lag is superior to 2 lags	45.03		17.33	4	9.49
iv. No lag is superior to 1 lag	45.56		0.53	4	9.49
v. Imports should be excluded given ii.	33.86		6.16	2	4.60
vi. Targeted Food Aid should be excluded given ii.	**28.30**		**0.60**	**2**	**4.60**
vii. Program Food Aid should be excluded given ii.	34.67		6.97	2	4.60
Imports Equation					
***Null Hypothesis*:**	***Q***	***Df*** $_Q$	***L***	***Df*** $_L$	X^2
i. Model Correctly Specified, Valid Instruments, m=3	**26.27**	**24**			**33.20**
ii. 2 lags are superior to 3 lags	39.49		13.22	4	9.49
iii. 1 lag is superior to 2 lags	40.12		0.63	4	9.49
iv. 0 lags superior to 1 lag	45.79		5.67	4	9.49
v. Production should be excluded given i.	36.32		7.39	3	6.25
vi. Targeted Food Aid should be excluded given i.	**28.17**		**1.90**	**3**	**6.25**
vii. Program Food Aid should be excluded given i.	34.09		7.82	3	6.25
Targeted Food Aid Equation					
***Null Hypothesis*:**	***Q***	***Df*** $_Q$	***L***	***Df*** $_L$	X^2
i. Model Correctly Specified, Valid Instruments, m=3	**15.42**	**21**			**29.61**
ii. 2 lags are superior to 3 lags	39.76		24.34	4	9.49
iii. 1 lag is superior to 2 lags	39.96		0.20	4	9.49
iv. 0 lags superior to 1 lag	63.23		23.27	4	9.49
v. Production should be excluded given i.	39.57		24.15	3	6.25
vi. Targeted Food Aid should be excluded given i.	29.40		13.98	3	6.25
vii. Program Food Aid should be excluded given i.	24.00		8.58	3	6.25
Program Food Aid Equation					
***Null Hypothesis*:**	***Q***	***Df*** $_Q$	***L***	***Df*** $_L$	X^2
i. Model Correctly Specified, Valid Instruments, m=3	**30.83**	**24**			**33.20**
ii. 2 lags are superior to 3 lags	45.60		14.77	4	9.49
iii. 1 lag is superior to 2 lags	48.88		3.28	4	9.49
iv. 0 lags superior to 1 lag	62.20		13.32	4	9.49
v. Production should be excluded given i.	37.72		6.89	3	6.25
vi. Targeted Food Aid should be excluded given i.	**33.44**		**2.61**	**3**	**6.25**
vii. Program Food Aid should be excluded given i.	38.15		7.32	3	6.25

The restricted VAR implied by our hypothesis testing is thus as follows. The first difference of production is a function of 2 lags each of the first difference of production, imports and program food aid. The first difference of imports is a function of 3 lags each of the first difference of production, imports and program food aid. The first difference of targeted food aid is a function of 3 lags each of the first difference of production, imports, targeted food aid and program food aid. Finally, the fourth equation expresses the first difference of targeted food aid is a function of 3 lags each of the first difference of production, imports, targeted food aid and program food aid. This restricted model is shown below.

Restricted VAR

$$P_{it} - P_{it-1} = \sum_{j=1}^{2}\theta_{5j}(P_{it-j} - P_{it-j-1}) + \sum_{j=1}^{2}\theta_{6j}(M_{it-j} - M_{it-j-1}) + \sum_{j=1}^{2}\theta_{8j}(FP_{it-j} - FP_{it-j-1}) +$$
$$\sum_{t=1}^{T}\gamma_{5t}(D_t - D_{t-1}) + \varepsilon_{1it} - \varepsilon_{1it-1}$$

$$M_{it} - M_{it-1} = \sum_{j=1}^{3}\beta_{5j}(P_{it-j} - P_{it-j-1}) + \sum_{j=1}^{3}\beta_{6j}(M_{it-j} - M_{it-j-1}) + \sum_{j=1}^{3}\beta_{8j}(FP_{it-j} - FP_{it-j-1}) +$$
$$\sum_{t=1}^{T}\gamma_{6t}(D_t - D_{t-1}) + \varepsilon_{2it} - \varepsilon_{2it-1}$$

$$FT_{it} - FT_{it-1} = \sum_{j=1}^{3}\alpha_{5j}(FT_{it-j} - FT_{it-j-1}) + \sum_{j=1}^{3}\alpha_{6j}(FP_{it-j} - FP_{it-j-1}) + \sum_{j=1}^{3}\alpha_{7j}(M_{it-j} - M_{it-j-1})$$
$$+ \sum_{j=1}^{3}\alpha_{8j}(P_{it-j} - P_{it-j-1}) + \sum_{t=1}^{T}\gamma_{7t}(D_t - D_{t-1}) + \varepsilon_{1it} - \varepsilon_{1it-1}$$

$$FP_{it} - FP_{it-1} = \sum_{j=1}^{3}\psi_{5j}(FT_{it-j} - FT_{it-j-1}) + \sum_{j=1}^{3}\psi_{6j}(FP_{it-j} - FP_{it-j-1}) + \sum_{j=1}^{3}\psi_{8j}(P_{it-j} - P_{it-j-1}) +$$
$$\sum_{t=1}^{T}\gamma_{8t}(D_t - D_{t-1}) + \varepsilon_{2it} - \varepsilon_{2it-1}$$

Table 2 below shows the parameter estimates for the restricted model. As shown by the t-statistics in parentheses, the majority are significant. The signs of some of the parameters are counter intuitive, however the majority of articles treating this subject matter focus more on hypothesis testing than they do interpretation of parameter estimates. We therefore caution the reader from literal interpretation of the parameter estimates.

The production equation shows production declining over time since the parameters associated with lagged differences of production are negative. Increased imports seem to result in increased production since the parameters for imports in the production equation are positive values. Finally, program food aid discourages production heavily since one of the parameters associated with it is a very large negative value (-4.0999), whereas the other parameter for program food aid is a fairly small positive value (0.2029).

The imports equation exhibits a negative correlation between production and imports as revealed by the negative sign on the parameters for lagged first differences of production in the imports equation. The parameters for the imports equation are contrary to expectations in some cases. The first difference of imports is negatively related to lagged values of the first difference of imports; the reason for this negative parameter is not obvious. Lastly, given the results found by Barrett's study of program food aid using VAR without fixed effects, we expected to find that program food aid discourages imports to the recipient country. The results from our hypothesis testing showed that program food aid does Granger cause imports, but in looking at the parameter estimates it seems that the magnitude of the effect on imports is minimal in comparison with the effect on production. The parameter estimates for the first and second lags of the first difference of program food aid are negative, but not statistically significant (t values of -0.569 and -0.787 respectively). The third lag is positive and slightly larger in magnitude than both the first and second lag combined; the third lag is also statistically significant. Due to the statistical insignificance of the first two lags drawing a firm conclusion is not advisable, but the combined results suggest that program food aid slightly discourages imports to the recipient country for a very brief period and encourages imports after a few years.

Parameters for the targeted food aid equation may be interpreted as the effect of the independent variable on allocation of targeted food aid. Parameters for production are all positive and statistically significant, suggesting that increased cereal production would lead to the allocation of larger amounts of targeted food aid. This could be evidence of poor judgment in allocation decisions. The first and second lags of the first difference of imports are negatively related to targeted food aid, whereas the third lag is positively related; none of the parameters are of large magnitude. Parameters for lagged differences of targeted food aid are all negative and statistically significant, indicating that targeted food aid is declining over time for a given country; to the extent that dependency is considered undesirable this decline in targeted food aid is an encouraging sign. Lagged differences of program food aid enter into the targeted food aid equation with positive parameter values; this seems to be evidence that many countries receiving program food aid are also receiving targeted food aid.

The equation for program food aid allows us to examine allocation for that type of aid. Parameters for lagged differences of production exhibit high statistical significance, but are not large in magnitude. The combined effect suggested by the three parameters is that program food aid is delivered in the short term as a response to decreased production since the parameter for the first lag is negative, but over the longer term program food aid is actually allocated to countries that recently experienced slight increases in cereal production as evidenced by the positive parameter values for the second and third lag of the first difference. These effects are, however, minor in comparison with the effects of other variables in the system since the magnitude of the parameters is negligible. Targeted food aid enters into the program food aid equation with statistical significance, and seems to suggest that over the three year period its net effect is a decrease in program food aid allocation. That is, a country receiving targeted food aid is less likely to receive program food aid. Parameters for the lagged first differences of program food aid are statistically significant, but very small in magnitude; the cumulative effect over the three year period is a slight decline in program food aid allocation over time.

Table 3: Parameter Estimates for Restricted Model				
	Production Equation	**Imports Equation**	**Targeted Food Aid Equation**	**Program Food Aid Equation**
Independent Variable:	**Θ (t statistic)**	**β (t statistic)**	**α (t statistic)**	**ψ (t statistic)**
P1	-0.816	-0.248	0.117	-0.0335
	(-42.175)	(-7.439)	-2.538	(-12.763)
P2	-0.108	-0.4078	0.197	0.0456
	(-5.899)	(-7.468)	-2.678	-11.36
P3	-	-0.2016	0.122	0.0782
		(-6.690008)	-2.008405	-22.454
M1	0.047	-0.626	0.050604	-
	(-0.296)	(-11.643)	-2.0668	
M2	1.174	-0.521	0.00958	-
	(-12.846)	(-9.90012)	-0.395	
M3	-	-0.191	-0.0878	-
		(-4.367)	(-1.996)	
TFA1	-	-	-0.368	-0.166
			(-17.349)	(-4.927)
TFA2	-	-	-0.358	0.279
			(-27.132)	-7.027
TFA3	-	-	-0.246	-0.282
			(-32.129)	(-5.624)
PFA1	0.203	-0.05205	0.3605	-0.0087
	(-0.789)	(-0.569)	-0.738	(-2.528)
PFA2	-4.1	-0.1106	0.356	0.0082
	(-6.353)	(-0.787)	-1.82	-3.198
PFA3	-	0.278	0.222	-0.0342
		-6.800705	-0.796	(-12.433)
D95	8.0865	0.73008	4.382	-0.64
	-2.6073	-0.422	-1.387	(-1.555)
D96	-15.516	0.763	-1.529	-0.15767
	(-3.575)	-0.444	(-0.760)	(-1.0424)
D97	-6.382	4.965	-0.69	-2.652
	(-2.520)	-3.165	(-0.365)	(-8.587)
D98	-5.966	8.248	0.851	2.0406
	(-2.852)	-5.568	-1.1055	-10.832
D99	-5.422	3.515	0.2806	-1.76
	(-1.988)	-2.153	-0.252	(-8.767)
D00	-12.454	3.746	1.282	-0.338
	(-3.3705)	-3.6209	-3.216	(-1.394)

Conclusions

Although we caution the reader that these results are not final, they are quite interesting. The main interest of this study is that it is the only empirical investigation of the dynamic effects of global food aid on imports and production that distinguishes between targeted and program food aid. It also uses more rigorous econometric techniques and more appropriate data than any other existing studies on this topic. The major finding of the study is that targeted food aid neither causes food production in the countries receiving it, nor does it cause food imports to recipient countries. In contrast to this, program food aid does affect production and imports to recipient countries. Should the final empirical results lead to the same conclusion, once the uncertainty over calculating omega is resolved, such a conclusion could prove invaluable to food aid policy. It may be that the focus of the Consultative Committee on Surplus Disposal should not be UMR enforcement but rather the phasing out of program food aid in favor of targeted food aid.

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