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FOOD AID DISINCENTIVES AND ECONOMIC DEVELOPMENT: SOME RECONSIDERATIONS IN LIGHT OF THE TUNISIAN EXPERIENCE

by

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ABSTRACT

The disincentive effects of total food assistance on the Tunisian economy were analyzed using simultaneous equations. The analysis showed that no significant price disincentives were evident. The authors attributed these results to effective government pricing policy combined with a strong positive relationship between food aid and per capita income.

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Introduction and Purpose

International food assistance remains a cornerstone of U.S. agricultural policy and an important tool of the U.S. and other developed countries' foreign policies. However, food aid has been criticised on both theoretical and empirical grounds because of its potential disincentive effects on recipient governments and food producers.

The purpose of this paper is to analyze the disincentive effects of food aid on the economy of Tunisia. Specifically, econometric estimates are made of the supply, demand, income and imports of cereals in the Tunisian economy in order to measure food aid disincentives on domestic grain production. The approach follows the methods used by Mann, Rogers, et. al, Seevers, and Hall. The paper extends the previous work by giving more attention to the developmental implications of the income effects of food aid. The analysis includes total food aid from all sources, not just P.L. 480. Also, this represents the first known attempt to rigorously estimate food aid disincentives for an African country.

Background and Related Research

The attention of this profession was focused on the disincentive effects of food aid after Schultz raised the question as a theoretical possibility. Fisher provided a rigorous framework for analyzing disincentives, demonstrating that a change in the domestic (recipient country) quantity supplied in response to an increase in food aid de-

pended upon: (a) the price elasticities of supply, and demand, and (b) the ratio of total quantity demanded to total quantity supplied domestically.

Maxwell and Singer's review of twenty-one studies of food aid imports revealed that only six reported any significant disincentives, and four of these were studies of the India experience. They subsequently concluded that price disincentives had mostly been avoided "by an appropriate mix of policy tools" (p. 231). Isenman and Singer and Blandford and von Plocki criticized the econometric models used in previous studies. The former charged that previous work ignored "the dynamic effects of the food aid on growth in output and employment and, hence, on demand for food grains in subsequent periods" (p. 211). The latter demonstrated that both the value and the sign of elasticity measures were unstable and could easily lead to the wrong conclusions about the price responsiveness of farmers and related production declines due to disincentives.

Fisher raised a more fundamental question about the validity of using simultaneous equations which assume market determinations of prices when most food aid recipients engage in administered prices and other price controls. Data limitations, especially for government and farmer-held stocks in recipient countries, were recognized by Mann and Hall. Clearly, econometric results must be carefully interpreted within the institutional structure of the recipient country. The assumption of a policy vacuum is untenable, as government actions are always important policy variables.

Hall's analysis of Brazil was the most exhaustive and attempted to meet the criticism of Fisher. Hall specified a wheat support price

equation to measure the effect of the government's policy of selling wheat to mills at prices above the import price. The revenue gained by the government was subsequently used to subsidize higher domestic price supports for Brazilian wheat growers. Consistent with Maxwell and Singer, Hall's analysis revealed that food aid had not caused producer disincentives in Brazil and, if anything, served to stimulate additional domestic production.

None of these empirical studies provided an adequate conceptual framework to assess the longer-term, dynamic implications of food aid on the economic development of the recipient country. The dynamic impacts of food aid on the consumption patterns of low-income people, on human capital, and asset formation were emphasized respectively in recent articles by Mellor, Schuh, and Deaton.

Tunisian Food Policy

Grain prices in Tunisia are strictly regulated by the government in order to provide incentive prices to stimulate domestic production. "Price fluctuations on the world market are isolated from domestic prices, so producers are sheltered from price uncertainty" (United Nations, 1978, p. 237). Trade movements and profit margins at all stages of the marketing chain are regulated by the Office of Cereals (United Nations, 1978, p. 237).

Government subsidies cover any difference between domestic and import prices in Tunisia. Thus, the domestic market works in isolation from international price movements, even though severe financial pre ssure may be placed on the central government. Resulting macro-

economic implications of such food-aid induced revenue squeezes have not been analyzed, and are barely recognized in the literature.

The Tunisian government plans to expand grain storage facilities from the current level of 450,000 tons to 750,000 tons in order to provide a six month supply over and above normal consumption. The national stock policy is intended to provide national food security and guarantee regular and adequate supplies of grain and grain products. In spite of these figures, data on stock levels and adjustments is unavailable. Its potential impacts, however, should be recognized.

Given that the Tunisian government correctly establishes incentive prices for producers, then quantity adjustments occur in commercial exports, imports, and levels of food aid. Hence, the supply, demand, and imports can be estimated simultaneously with wholesale prices determined endogenously, even though they are "fixed" by the government. In other words, government price fixing must take into account all other variables that impinge on successful price and quantity outcomes. Therefore, a simultaneous equation system can be utilized without seriously violating its properties. However, derived policy conclusions will have to be determined in view of the government's role in the economy.

Economic Model

The theoretical framework of analysis is formulated in terms of (1) a supply equation, (2) a demand equation, (3) a commercial import equation, (4) income generation equation, and (5) a market clearing identity as follows:

$$QS_t = f_1 (PQ_{t-1}, QS_{t-1}, YA_t) \quad (1)$$

$$QD_t = f_2 (PQ_t, YR_t, PS_t) \quad (2)$$

$$IC_t = f_3 (QS_t, PQ_t, FA_t) \quad (3)$$

$$YR_t = f_4 (QS_t, QI_t) \quad (4)$$

$$QD_t = QS_t + IC_t + FA_t \quad (5)$$

where:

QS_t = per capita supply of food grains from domestic production

PQ_t = wholesale price index of food grains

YA_t = average yield of food grain

FA_t = per capita food aid imports (including P.L. 480)

QD_t = per capita domestic demand for food grains

YR_t = real per capita consumer income

PS_t = wholesale price index of food grain substitutes

IC_t = per capita commercial imports of food grains

QI_t = an index of industrial production

By definition domestic grain production is equal to acreage multiplied by yield per acre. Ideally separate functions for yield and acreage would be estimated. However, yield is a function of a variety of factors such as weather, agricultural prices, employment, etc.,for which Tunisian data are unavailable. Therefore, yield per acre is incorporated as an exogenous variable. The supply response of grains to a change in price is positively related, but is usually not immediate. Therefore a one year lagged price is used. Domestic production lagged one period is included in the supply equation in order to account for ongoing technological and institutional changes which cannot be incorporated into the model. A positive relationship is expected.

Quantity demanded of food grains is assumed to be a function of food grains prices, per capita income, and the price of substitute commodities. The price measure of substitutes is specified as a weighted

index of other foods prices, and a positive relationship is expected following standard theory. Theory also suggests that the sign on PQ_t should be negative and the sign on YR_t positive (assuming food grain is a normal good).

Commercial imports are assumed to supplement food supplied domestically. Previous research indicates that food aid is a substitute for commercial imports in spite of U.S. requirements that attempt to prevent commercial displacement by P.L. 480 food aid (Stevens, Hall). The sign on QS_t and FA are expected to be negative. Commercial imports are expected to increase as domestic price (PQ_t) increases. Finally, in the income-generation function QS_t and QI_t are expected to have a positive sign. Model closure is obtained through the market-clearing condition that quantity demanded equals quantity supplied, with quantity supplied being composed of domestic production, commercial imports and food aid.

Since a major purpose of this paper is to estimate the impact of food aid on domestic agricultural production via its depressing effect on domestic food prices in the recipient country, the decision was made to treat food aid as exogenous. Food stocks were not included in the model because data is unavailable. For a net-food importing nation such as Tunisia government stocks are maintained at a level low enough that annual changes likely have insignificant price effects.

Statistical Model

The statistical models estimating the structural equations are:

Supply equation,

$$QS_t + \gamma_{11}PQ_{t-1} + \gamma_{12}QS_{t-1} + \gamma_{13}YA_t = U_1 \qquad (6)$$

Demand equation,

$$QD_t + \beta_{21}PQ_t + \gamma_{21}YR_t + \gamma_{22}PS_t = U_2 \qquad (7)$$

Commercial-Imports equation,

$$IC_t + \beta_{31}QS_t + \beta_{32}PQ_t + \gamma_{31}FA_t = U_3 \qquad (8)$$

Income-Generation equation,

$$YR_t + \beta_{41}QS_t + \gamma_{41}QI_t = U_4 \qquad (9)$$

Market-clearing identity,

$$QS_t + QD_t + IC_t + FA_t = 0 \qquad (10)$$

where the β's and the γ's are the structural coefficients of the endogenous and exogenous variables respectively, and the U's are stochastic disturbances. FA_t, PS_t, QI_t, YA_t, and YR_t are treated as exogenous variables. Hence, given values of the exogenous variables, the object of the statistical models is to determine jointly the values of the endogenous variables, QS_t, QD_t, PQ_t, IC_t, and YR_t. The model consists of five equations and five endogenous variables, (four stochastic and one identity). The system is complete.

Thus, all structural parameters are estimable and the system is over identified. Two-stage least squares (2SLS) and three-stage least squares (3SLS) estimation techniques were utilized to estimate the structural parameters of the model. QS_t, YA_t, FA_t, QD_t and IC_t are measured in metric ton, YR_t is measured in U.S. dollars, and PQ_t, PS_t and QI_t are indices. The equations were estimated for the 20 year period, 1960-69 inclusive, with data obtained from U.S.D.A. and UNIFAO sources (see references).

Results of Statistical Estimations

The results of the estimation are presented below. The numbers in parenthesis are standard errors.

2SLS Method

Supply-Food Grains,

$$QS_t = \underset{(0.0479)}{0.0072} - \underset{(0.0007)}{0.0011}PQ_{t-1} + \underset{(0.0552)}{1.2432}QS_{t-1} + \underset{(0.0967)}{0.1804}YA_t$$

$$\bar{R}^2 = .9715 \qquad D.W. = 3.26$$

Demand-Food Grains,

$$PQ_t = \underset{(6.9807)}{6.9141} - \underset{(2.0016)}{0.6986}QP_t + \underset{(0.0248)}{0.0399}YR_t + \underset{(0.1331)}{0.9319}PS_t$$

$$\bar{R}^2 = .9732 \qquad D.W. = 2.27$$

Commercial Import-Food Grains,

$$IC_t = \underset{(0.0772)}{0.0309} + \underset{(0.0585)}{0.8678}QS_t - \underset{(0.0006)}{0.0002}PQ_t + \underset{(0.0001)}{0.0001}FA_t$$

$$\bar{R}^2 = .9382 \qquad D. W. = 1.44$$

Income-Generation,

$$YR_t = \underset{(50.6256)}{3.2411} + \underset{(64.1731)}{42.1306}QS_t + \underset{(0.5008)}{3.2493}QI_t$$

$$\bar{R}^2 = .7542 \qquad D.W. = 1.19$$

3SLS Method:

Supply-Food Grains,

$$QS_t = \underset{(0.0432)}{0.0079} - \underset{(0.0006)}{0.0008}PQ_{t1} + \underset{(0.0547)}{1.2397}QS_{t1} + \underset{(0.0834)}{0.0849}YA_t$$

Demand-Food Grains,

$$PQ_t = \underset{(6.3801)}{3.0199}\ \underset{(1.9434)}{1.0283}QD_t + \underset{(0.018)}{0.0578}YR_t + \underset{(0.1073)}{0.8384}PS_t$$

Commercial Import-Food Grains,

$$IC_t = \underset{(0.0652)}{0.0535} + \underset{(0.0575)}{0.8667}QS_t - \underset{(0.0005)}{0.0001}PQ_t + \underset{(0.0001)}{0.0002}FA_t$$

Income-Generation,

$$YR_t = \underset{(49.1951)}{43.5736} + \underset{(57.4359)}{141.904}QS_t + \underset{(0.481)}{2.6946}QI_t$$

All parameters in the supply equation have the expected sign except for the negative PQ_{t-1}. However, when the same equation is estimated with

aggregate rather than per capita quantity of food supply as the dependent variable, the sign of the price coefficient is positive as expected. This suggests that the unexpected sign may result from the rapidly growing population which reduces the per capita food supply more rapidly than production. In the demand equation, all coefficients are of the expected sign and indicate an overall good fit.

The sign on FA_t in the commercial imports equation is opposite to that which was hypothesized. The raw data reveals that both food aid and commercial imports have been increasing through time, suggesting that U.S. policy may be effective in preventing commercial displacement. The sign on YA_t, YR_t, and PS_t in all equations are as expected. Both coefficients in the income-generation equation are of the expected sign and indicate a good fit.

The results presented above indicate that the use of 3SLS consistently reduces the standard errors of all variables, indicating that efficiency is being gained through the use of 3SLS. Hence, our analysis will proceed from the equations estimated by 3SLS-method.

Analytical Framework

Our objective is to determine the immediate and cumulative impact of total food aid on domestic production via domestic price during a single period and the total impact over time. Interim multipliers were also obtained but not reported in this paper. This objective is fulfilled by deriving the reduced forms analytically from the estimated structural equations: $\hat{\Pi} = -\hat{\beta}^{-1} \Gamma$

These derived reduced form equations (or impact multipliers) are presented in Table 1 below:

Table (1): Impact Multipliers

Endo. Variable	Exogenous Variable					
	PQ_{t-1}	QS_{t-1}	YA_t	PS_t	FA_t	QI_t
QS_t	0.0068	1.2397	0.0849	0	0	0
PQ_t	0.9839	1.2233	0.0721	0.0132	1.0	0
IC_t	0.0047	1.0667	0	0	0.0003	0
YR_t	0.1092	0.913	1.0473	0.2193	0	2.69
QP_t	0.0925	0.0119	0.045	0.0157	0.0731	0.1574

Interim and total multipliers can be derived from $D^t = A^{t-1}$ (AB) and $(I-A)^{-1}B$ respectively. D^t equals the net effect of changes in exogeneous variables on endogenous variables t time periods later. A is the coefficient matrix of the lagged endogeneous variables and B is the coefficient matrix of the current exogenous variables. The total (or cumulative) multipliers, as time approaches infinity, are presented in table (2).

Table (2): Total Multiplier

Endo. Variable	Exogenous Variable			
	YA_t	QI_t	FA_t	PS_t
QS_t	0.762	0	-0.0001	0
PQ_t	-0.6838	0	-0.0001	0.0081
YR_t	0.2413	2.69	0.0014	0
IC_t	-0.1024	0	-1.0887	0
QD_t	0.0718	0.1512	-0.0042	-0.0361

Analysis

Assuming that there are no other shocks in the system and the stability conditions are met, an increase of one metric ton in food aid in the current year has no effect on domestic supply and real income in

the current year, but is expected to result in a reduction of 1.0 unit in the value of the prices index and an increment of 0.0003 metric tons in commercial imports in the same year (Table 1). By examining Table (2), the long run cumulative multiplier which describes the effect of food aid on domestic prices is 0.0001. This indicates that a one metric ton increase in food-aid in time t will result in a decrease of domestic supply by 0.0001 in time t' (where $t' > t$). This suggests that a thousand metric tons of food-aid will result in a 0.1 metric ton decline in domestic production, other things being non-variant. Similarly, a thousand metric ton increase in food-aid will lead to a $1.4 increase in real per capita income. Other coefficients could be interpreted in the same manner.

These results, consistent with Hall's findings in Brazil, suggest that food-aid doesn't have any significant disincentive in either short-run or long-run time periods in Tunisia. Both studies are based on countries whose governments take an active role in domestic pricing with the intent of preventing disincentive prices.

Conclusions

The intent of this paper was to gain insight about the impact of total food aid on the domestic economy of Tunisia. The equations specified represent only a sketch of the macro-economic forces shaping dynamic adjustments in the Tunisian economy. However, the system of simultaneous equations provides short-term, interim and cumulative multipliers for measuring the dynamic implications of food aid. This information can be useful for policy analysis and decision-making particularly if adequate attention is given to the model's sensitivity to poor data and market imperfections.

The $1.4 multiplier for the impact of food aid on real income (Table 2) appears to be unusually high. On the other hand, the income effects are probably the most overlooked positive aspect of food assistance programs. The income effects of food aid are expected to be much higher if the program reaches lower income groups of the recipient country because of their relatively greater income elasticity of demand for food. Perhaps this income effect suggests that food aid in Tunisia over the 1960-79 period effectively reached the lower income segments of the population. In general, econometric models do not answer the important question of who within the recipient countries receives the benefits of food assistance. The probable weakness of the data and model sensitivity makes us very cautious in drawing policy conclusion without more extensive testing and corroborative research.

The results of this analysis suggests that food aid has not created serious disincentives in Tunisia. Following the earlier conclusions of Hall, Maxwell and Singer, and Schuh, it appears that government policy can effectively prevent disincentives. The broader macro effects of food aid may hold more significant consequences for economic development and need to be addressed by alternative research methods.

REFERENCES

Blandford, D., and J. A. Von Plock, Evaluating the Disincentive Effect of P.L. 480 Food Aid: The Indian Case Reconsidered; Dept. of Agricultural Economics, Cornell International Agr. Mines, No. 55, Cornell University, July 1977.

Dahl, R. P., Agricultural Marketing, Transportation, and Storage In Central Tunisia, Food and Feed Grain Institute, Kansas State University, 1978.

Deaton, B. J., "Public Law 480: The Critical Choices," American Journal of Agricultural Economics, 62(1980):988-92.

Dudley, L., and R. Sandilands, "The Side Effects of Foreign Aid: The Case of Public Law 480 Wheat in Colombia," Econ. Development and Cultural Change, 23(1975):325-36.

Economist Intelligence Unit, Quarterly Economic Review: Libya Tunisia and Maltha, various issues.

Fisher, F. M., "A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries," J. Farm Econ. 45:863-875, 1963.

Hall, L. L., "Evaluating the Effects of P.L. 480 Wheat Imports on Brazil's Grain Sector," American Journal of Agricultural Economics, 62(1980):19-28.

Isenman, P. J., and H. Singer, "Food Aid: Disincentive Effects and Their Policy Implications," Economic Development and Cultural Change, 25(1977):205-37.

Mann, J. S., "The Impact of Public Law 480 Imports of Prices and Domestic Supply of Cereals in India," American Journal of Agricultural Economics, 49(1967):131-46.

Maxwell, S. J., and H. W. Singer, "Food Aid to Developing Countries: A Survey," World Development, 7(1970):225-47.

Rogers, K. D., V. K. Srivastava and E. O. Meady, "Modified Price, Production and Income Impacts of Food Aid Under Market Differentiated Distribution," American Journal of Agricultural Economics, 54:201-08, 1972.

Schuh, G. E., "Improving the Development Effectiveness of Food Aid," prepared at the request of the U.S. Agency for International Development, (draft), September 1979.

Schultz, T. W., "Value of U.S. Farm Surpluses to Underdeveloped Countries," J. Farm Econ., 42(1960):1019-30.

Seevers, G., "An Evaluation of the Disincentive Effect Caused by P.L. 480 Shipments," American Journal of Agricultural Economics, 50(1968): 630-42.

Stevens, Christopher, Food Aid and the Development World, Overseas Development Institute, London, 1979.

United Nations, African Statistical Yearbook: North Africa, various issues.

United Nations, FAO National Grain Policies, 1978.

United Nations, FAO Production Yearbook, various issues.

United Nations, Statistical Yearbook, various issues.

United Nations, World Food Program Reports, various issues.

U. S. Department of Agriculture, U.S. Agricultural Exports Under P.L. 480, ERS No. 395, 1974.