RESOURCE BENEFITS AND COSTS OF FOOD-AID: AN ANALYSIS OF INDIAN SHIPMENTS

Thesis for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

GARY L. SEEVERS

1968

This is to certify that the

thesis entitled

Resource Benefits and Costs of Food-Aid:
An Analysis of Indian Shipments

presented by

Gary L. Seevers

has been accepted towards fulfillment
of the requirements for

Doctor of Philosophy degree in Agricultural Economics

Dale E. Hathaway
Major professor

Date May 15, 1968

O-169

ABSTRACT

RESOURCE BENEFITS AND COSTS OF FOOD-AID: AN ANALYSIS OF INDIAN SHIPMENTS

by Gary L. Seevers

On November 11, 1966, the United States enacted the Food For Peace Act of 1966. Although in broad outline it continued the program launched in 1954, commonly known as P.L. 480, the new Act contained among its provisions the "phasing out" of sales of U. S. food-aid for the currencies of recipient countries. The legislation required sales for dollars on long term credit to replace the "local currency" sales by the end of 1971.

The questions posed by this legislation are: to what extent does food-aid transfer resources to recipient countries; and will substituting credit for local currency sales significantly diminish the foreign assistance recipient countries derived from food-aid? This study attempt to answer these questions for India by, first, quantifying the benefits from displacement of regular commercial purchases and reallocation of resources to commercial (export) crops, using 1952-63 data, and then projecting the benefits to 1972. By comparing benefits defined in this way with the resource costs

under local currency and credit sales, the study provides estimates of India's net resource gains attributable to food-aid (Title I) shipments.

After specifying a six-equation recursive model, least squares estimation was employed to estimate the model's parameters. These parameters provide the basis for investigating the effects shipments have had on cereal and commercial crop production, commercial cereal imports and cereal consumption. Because the empirical estimates are subject to error, five additional "hypothetical models" provide checks on the results by imposing parameters that represent realistic limits to the true parameter values.

When benefits -- through import displacement and commercial crop production -- are assigned dollar values, the estimated resource benefits for the empirical model are $636,800 per million dollar shipment; and for the hypothetical models, the benefits vary from $362,300 to $797,800. The two lowest estimates correspond to models restricted to a zero import displacement and to no impact on domestic crop production, respectively. A model in which producers are assumed to be highly responsive to cereal prices (elasticities of .4 for cereals and -.7 for commercial crops) provides the highest estimated benefits.

On the cost side, the local currency sales that prevailed through 1963 are estimated to have cost $205,600 per million dollar shipment. The principal component came from U. S. expenditures of 15 percent of the rupees paid to them by the Indian government; the remainder (25 percent) can be attributed to ocean freight charges. Even after deducting these costs, the net benefits from food-aid were some $431,200 per million dollar shipment. Aggregating over total shipments, the estimated net benefits came to 700 million dollars during the period ending in 1963. Food-aid also contributed an estimated 10.6 million metric tons to consumption over and above the net resource benefits.

When the benefits are projected to 1972, they remain fairly stable for alternative assumed price and yield increases. But the projected costs increase more noticably. Under the relatively lenient credit arrangement (called "convertible local currency credit") designed for payments deficit countries like India, repayments over a 40 year period with a 10 year grace period led to a present cost of $289,400 per million dollar shipment when discounted at a .10 rate. If, instead, the United States requires India to procure part or all shipments under the "dollar-credit" arrangement that requires repayment over 20 years with a two year grace period, the 1972 projections calculate to $528,200.

While food-aid will remain less costly than regular commercial purchases of cereals in world markets, the Food for Peace Act would appear to render shipments less attractive to India from a net resource gain standpoint. By raising the resource costs, the United States has elevated food-aid toward a regular commercial transaction. Whether this action will reduce India's incentive to participate in the program to the extent she has in the past depends, of course, on the overall political, social and economic context in which policy decisions are reached.

RESOURCE BENEFITS AND COSTS OF FOOD-AID: AN ANALYSIS OF INDIAN SHIPMENTS

By

Gary L. Seevers

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1968

ACKNOWLEDGMENTS

My graduate program was financed in large measure through a National Defense Education Act fellowship. For the wisdom of those who fostered the legislation and to those at Michigan State University who solicited and administered the program, my family and I are sincerely grateful. I wish also to thank Dr. L. L. Boger for financial support provided by the Department of Agricultural Economics during the final year of my program.

I especially appreciate the encouragement given by Professors D. E. Hathaway (chairman), R. L. Gustafson, V. L. Sorenson and T. R. Saving who served on my Guidance Committee. Their expertise in the course of this dissertation combined with the stimulation of faculty and students made graduate work a transforming experience.

TABLE OF CONTENTS

LIST OF TABLES

Table | Page

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

BACKGROUND: THE STUDY IN PERSPECTIVE

The divergence between the economic position of developed and developing countries has become a growing concern to many policymakers. Although per capita incomes are improving in nearly all countries, the divergence tends to enlarge over time because incomes are increasing relatively faster in developed countries, partly due to their slower population growth rates. In addition to its welfare implications, the divergence poses a potential threat to stable international relations as well as internal stability in some developing countries. One way in which the developed countries respond to their more favorable economic positions is by transfering resources -- as foreign exchange, commodities, physical and human capital -- directly to the developing countries.

Against such a background, this study examines the contribution of food-aid to the resource transfers between developed and developing countries. Just as it is limited to a particular kind of transfer -- food -- the study encompasses only two participants: The United States as the donor country and India as the recipient country.[1] Moreover,

---

[1]Several terms will be used more or less interchangeably depending on the context: "developing", "recipient", "borrowing" (for loans), "less developed country (LDC)", all apply to the country receiving and benefiting from the transfer. A "developed" country may also be referred to as a "donor" or "loaning" (for loans) country.

the orientation is toward the resource benefits to India rather than the costs to the United States. Because the recipient's benefits will not generally equal the donor's costs, a different analysis would be required to investigate each.

India's Food Situation: A Short History

India's history is marked by a series of food shortages and famines. From 1865 to 1943, Bhatia reports that 21 famines have been observed; some were limited to individual states or major cities and other covered the greater part of the country.[2] When shortages are included, it is apparent that the adequacy of food supplies was a major economic and political problem during these years. A review of India's food situation since the early 1940's will show not only that her food problem has been only partially solved but how food-aid has become an integral part of food policy.

The food shortages that developed during the Second World War were regarded as short run phenomena. Therefore, when the first Indian Foodgrains Policy Committee (1943) recommended

---

[2]B. M. Bhatia, Famines in India: A Study of Some Aspects of the Economic History of India, 1860-1945, Asia Publishing House, Bombay, 1963.

a program of distribution for deficit rural areas, the longer run implications were not fully explored. By 1947, ".....54 million persons were served by statutory rationing and another 90 million by other forms of public distribution".[3] The government's commitment to consumers had already become substantial. Public procurement of domestic supplies failed to keep pace with the commitments and commercial foodgrain imports had to be expanded.

Concerned about the growing dependence on imports and the difficulties of internal public procurement in shortage years, the second Foodgrains Policy Committee (1947) recommended a program of gradual liquidation of imports and public distribution commitments while taking steps to increase domestic production. When followed, this policy failed because ".....it became politicially impossible to neglect the [subsequent] rise in prices."[4] So the Foodgrain Procurement Committee (1950), reasoning that public procurement on a voluntary basis tended to chase prices up, recommended "monopoly procurement at the village level, abolition of free

---

[3]V. M. Dandekar, Food and Freedom, Karnatak University, Dharwar, India, 1967, p. 2. The discussion in this section relies heavily on this set of lectures delivered in March, 1967.

[4]Ibid., p. 4.

market and of free movement of food-grains outside the village, and a complete statutory or near-statutory rationing elsewhere. The policy was never tried because it was believed to be both administratively and politically impossible."[5] Although two policy alternatives, free markets and complete control, were debated during 1947 to 1951, the operating policy tended to be the more moderate one of partial procurement and some rationing.

Beginning in 1952, domestic output increased and the government moved to a free market policy for most areas. When food prices began to rise significantly in 1956 and some action was again required, the government had an alternative to reinstituting public controls and procurement. Instead of procuring supplies internally, the government turned to importing foodgrains on concessional terms from the United States under P.L. 480.[6] Endorsed by the Foodgrains Enquiry Committee (1957),

---

[5] Ibid., p. 5.

[6] P.L. 480 is shorthand for The Agricultural Trade Development and Assistance Act of 1954. On November 11, 1966 the U.S. Congress passed the most recent and sweeping amendment (P.L. 89-808) to the earlier Act, entitling it the "Food for Peace Act of 1966". Although the program is still referred to as P. L. 480, the term "food-aid" will be used in this study; this term is defined later in the Chapter.

the new alternative source became a long run policy that continued through 1966. It was politically acceptable, administratively expedient and allowed relatively free movement of domestic supplies because food-aid, supplemented with some commercial imports, was available to meet public distribution commitments, especially those to low income families who would have otherwise suffered when prices rose.

Until late 1963, India followed "....essentially a policy of complete free trade in food-grains, fortified and supplemented by large quantities of imports under P. L. 480 agreements."[7] But when domestic output declined in 1963 and 1964, prices began to rise and the government returned to greater control. Procurement of internal supplies increased, trade in foodgrains became restricted and food-aid shipments increased sharply. However, the Foodgrains Policy Committee (1966) expressed the following concern about the policy of dependence on food-aid: "As is now well-known, imports are not likely to be either large or easy in the future....Imports from the U.S.A. will not only be less, but will have to be paid in dollars, not rupees". The committee also observed that, "Our dependence on inports was undesirable. In the future,

---

[7]Dandekar, Food and Freedom, p. 9.

it may not even be feasible. This is a development which must radically affect both food policy and its implementation...for there can no longer be reliance on imports; there can only be self-reliance."[8] This concern was justified inasmuch as the Food for Peace Act of 1966 specified that all foreign currency sales should be replaced by sales for dollars on long term credit by the end of 1971. It also required that recipient countries be evaluated on a set of "self-help" measures which should be implemented to expand domestic production before agreements would be reached.

Apart from doubts about the realism of the committee's recommendation, one can question whether a shift away from food-aid would be economically justified. The answer depends on both the benefits of food-aid to the Indian economy and the cost when credit sales replace rupee sales.

Objectives and Methodology

This study attempts to provide some quantitative evidence on the attractiveness of food-aid from India's standpoint. The major objective is to estimate the resource transfer -- the net resource gain -- of food-aid shipments. In particular, the study will provide estimates to answer the following questions:

---

[8] *Ibid*., pp. 10-11.

1. What was India's net resource gain from shipments during the 1952-1963 period?
2. What would have been the gain if shipments had been for dollar-credit rather than rupees during 1952-1963?
3. What will be the probable gain in 1972 if the United States implements the new long term credit policy?

Estimating the resource benefits is the most forbidding task from both a theoretical and empirical standpoint. Chapter II surveys the various theoretical issues and postulates a simple six equation recursive model that incorporates the relevant effects of shipments. The empirical estimates of resource benefits for 1952-1963 are developed in Chapter III, using single equation least squares regression analysis to estimate the recursive model. Chapter IV examines the resource costs under dollar-credit sales by discounting future payments to arrive at present or resource costs. These estimates are compared with the resource costs implicit in sales for rupees. In Chapter V, the resource benefit and cost estimates are combined to answer the questions above.

Chapter VI summarizes the study's major findings and discusses the implications of the dollar-credit sales policy.

The remainder of the present chapter considers the concept of food-aid as it is employed in the study and previous studies that relate to this one.

The Concept of "Food-Aid"

Public Law 480, the basic legal authority for U.S. food-aid, provides food under several arrangements. Two are relevant to this study: sales for foreign currencies (former Title I) and sales for dollars on long term credit (former Title IV). Both have been combined into Title I of the 1966 Act. Shipments for foreign currencies (rupees) flow into India's markets in two ways. First, the government maintains a system of some 100,000 retail outlets known as "fair-price-shops" that function along-side local markets. Due to the preference for home-grown foodgrains, shipments sold through these shops are typically priced below local supplies and provide an alternative source, particularly for low-income consumers. Distribution to private roller flour mills serves as a second outlet for shipments. This outlet has grown steadily in importance from 15 percent of government distribution in 1957 to over 50 percent in 1962. Unlike shops, sales to mills are ultimately consumed in various grain products and tend to be

purchased by higher income segments of the population.[9] While Title I shipments sold through fair-price-shops compete directly with domestic supplies, the sales to flour mills would be expected to influence local market prices by diminishing the mills' demand in these markets. Although India had received no shipments under the dollar-credit arrangement through 1966, it may be assumed that they too would be distributed in a similar fashion.

In contrast, shipments under other arrangements (formerly Titles II and III, now Title II) have been made for emergency relief in cases of natural disaster, school lunch programs, special development projects, distribution by voluntary U.S. agencies and barter for strategic materials.[10] The new Title II also includes U.S. contributions to the World Food Program which provides food for emergency relief and development projects. Except for barter arrangements, shipments in these categories are on a donation basis and move, in the main,

---

[9]The relative importance of shops and mills and regional variation in food-aid distribution through 1962 are discussed in: Nilakanth Rath and V.S. Patvardhan, Impact of Assistance under P.L. 480 on Indian Economy, Gokhale Institute of Politics and Economics, Asia Publishing House, Bombay, 1967, pp. 70-95. (Subsequently referred to as Impact of P.L. 480).

[10]Various titles and shipments under each through 1966 are discussed in: Twelve Years of Achievement Under Public Law 480, ERS-Foreign 202, U.S. Department of Agriculture (USDA), November, 1967, pp. 1-17.

outside regular marketing channels and do not compete with domestic supplies. Following standard practice, they are excluded from the present study.[11] Thus this study's definition of food-aid includes only shipments under new Title I -- rupee and dollar-credit sales. Also excluded are donations by other countries, especially Canada and Australia, that were of relatively minor importance during the 1952-63 period.

Table 1.1 gives the value of shipments to India under Titles I through IV of the 1954 Act. It shows that Title I has been far more important than other Titles in the case of India. Through fiscal year 1966, Title I contributed 91.5 percent of all shipments. Even if the remaining Titles generate the same effects as Title I, they do so indirectly and these effects would be relatively unimportant, quantitatively.

One further distinction is that the present concept includes only shipments of cereals -- wheat, corn, grain sorghums and rice. It excludes dairy products, soybean and cottonseed oil, tallow, canned fruits, cotton and tobacco. In aggregate, these contributed only 10.7 percent of the value of Title I shipments through 1966. Consequently, the concept

---

[11]For an example of this precedent and the rationale see: G. R. Allen, The Impact of Food Air on Donor and Other Food-Exporting Countries, World Food Program Study No. 2, Food and Agriculture Organization (FAO), Rome, 1965, pp. 40-41.

Table 1.1: Public Law 480 shipments to India under specified titles, value of all commodities, fiscal years, 1956 through 1966

Fiscal Years	Title I	Title II	Title III		Title IV
	Sales for foreign currencies (rupees)	Famine and other emergency relief	Donations	Barter	Dollar-credit sales
			-thousand dollars-[a]		
1955	--	125	18,632	497	-
1956	--	2,134	19,452	-	-
1957	152,311	654	9,978	1,897	-
1958	126,313	936	13,914	1,747	-
1959	233,295	453	12,620	b	-
1960	253,426	-	5,337	67	-
1961	298,130	124	13,118	11,101	-
1962	163,386	742	17,199	22,064	-
1963	309,223	595	9,054	1,050	-
1964	367,862	2,633	14,150	-	-
1965	488,706	1,944	23,736	15,846	-
1966	511,006	7,368	27,259	11,337	-
TOTAL	2,903,658	17,708	184,449	65,606	-

[a] valued at U.S. export prices

[b] less than $500

Source: <u>Twelve Years of Achievement Under Public Law 480</u>, ERS-Foreign 202, U.S. Department of Agriculture, 1967, Table 10.

of food-aid employed here encompasses slightly over 80 percent of the total value under all Titles.[12]

Finally, this study concerns the so-called "program approach" to food-aid rather than the "project approach". The latter involves supplying food to support specific projects either through paying wages in kind or selling food in local markets to offset demand increases from higher money wages. The World Food Program and U.S. Title II contribute food on a project basis. Indian officials have always insisted on the program approach, arguing that food-aid should be integrated with the total development program.[13] As a result, it will not be necessary to evaluate the benefits of shipments in the context of particular projects. It is assumed that local currencies (generated by Title I shipments) loaned to India for specific projects include only projects that were already included in the development program so that food-aid does not alter the pattern of development expenditures. If, instead, food-aid led to a different combination of projects, some allowance would need to be made for the possibility that the resulting expenditures were less productive.

---

[12]From the year of the first Title I shipments (1956) through 1963, food-aid contributed some five percent of the total physical quantities of cereals available from consumption in India.

[13]S.R. Sen, "Impact and Implications of Foreign Surplus Disposal on Underdeveloped Economies: The Indian Perspective", Journal of Farm Economics, December 1960, pp. 1030-42.

Previous Research

Although excellent studies have been conducted on several countries, limited research has been devoted to evaluating Indian shipments.[14] Of the few Indian studies, three merit explicit comment. The Food and Agriculture Organization (FAO) conducted a pilot study in 1955 under the direction of M. Ezekiel.[15] The study examined various ways that food-aid could be used to finance additional investment and concluded that food-aid could finance some 40 to 45 percent of additional general investment. Because the study specified the now accepted FAO "principles" that food-aid should not displace commercial imports or depress domestic prices it ruled out two of the effects that will be examined in the present study. Indeed, by considering the incremental investment permitted by food-aid, the FAO study represents an alternative to the net resource gain approach taken here.

---

[14] For a review of several country studies, see Lawrence Witt and Carl Eicher, The Effects of United States Agricultural Surplus Disposal Programs on Recipient Countries, Research Bulletin 2, Michigan State University, 1964. (Subsequently referred to as Effects of Surplus Disposal).

[15] Uses of Agricultural Surpluses to Finance Economic Development in Under-developed Countries: A Pilot Study in India, Commodity Policy Studies No. 6, FAO, Rome, 1955.

The second notable study has been reported by Mann.[16] Employing a simultaneous equation model, he concluded that, despite its price and domestic output depressing effects, the net increase in consumption from marginal changes in P.L. 480 was 68 percent of actual shipments during the 1956-63 period. Like the FAO study, he did not evaluate food-aid's resource contribution. But his study does provide an analytic framework that with modifications will be employed here to estimate the resource benefits of food-aid.

Another comprehensive evaluation of P.L. 480 shipments through 1962 was conducted by the Gokhale Institute of Politics and Economics under U.S. Department of Agriculture sponsorship.[17] The study credits food-aid with restraining inflationary pressures resulting from expanded development programs and with providing for increased consumption in the short run. But it indicates that middle and upper income consumers have received a large part of the benefits and that cultivators have born part of the burden of development via lower product prices. And even additional short run consumption

---

[16]Jitendar S. Mann, "The Impact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India," <u>Journal of Farm Economics</u>, February, 1967, pp. 131-146.

[17]Rath and Patvardhan, <u>Impact of P.L. 480</u>, especially pp. 199-202.

may be a passing benefit if, as is conjectured, India has not developed the agricultural capacity to feed her population. In particular, it is suggested that food-aid has led to government complacency with respect to price policy (food-grain prices have been allowed to fall too low) and structural-technological changes in production, especially of wheat.

CHAPTER II

RESOURCE BENEFITS: THEORETICAL CONSIDERATIONS

A program as large as P.L. 480 has many facets and the extensive literature on the subject reflects the program's broad scope. The first task, therefore, is to delineate the issues included in this Chapter.

In a recent survey of P.L. 480 research needs, Witt proposed the six-category classification shown across the top of Figure 2.1[1] While it is recognized that certain considerations would fall in more than one category,[2] this study will be limited primarily to economic issues. Witt's classification helps place these issues in perspective relative to other relevant issues arising from food-aid shipments. A second dimension in Figure 2.1 concerns the country from which the analysis is viewed; this dimension covers donor, recipient and third countries. Since this study focuses on the effects of food-aid in a particular recipient country, the shaded area encompasses the issues to be discussed in the next section.

---

[1]Lawrence Witt, A Program of Research on Food for Peace, Part I, Michigan State University, 1966, pp. 13-38.

[2]E.g., the composition of foods offered (wheat, cotton, dairy products, tobacco, etc.) could be included in most categories.

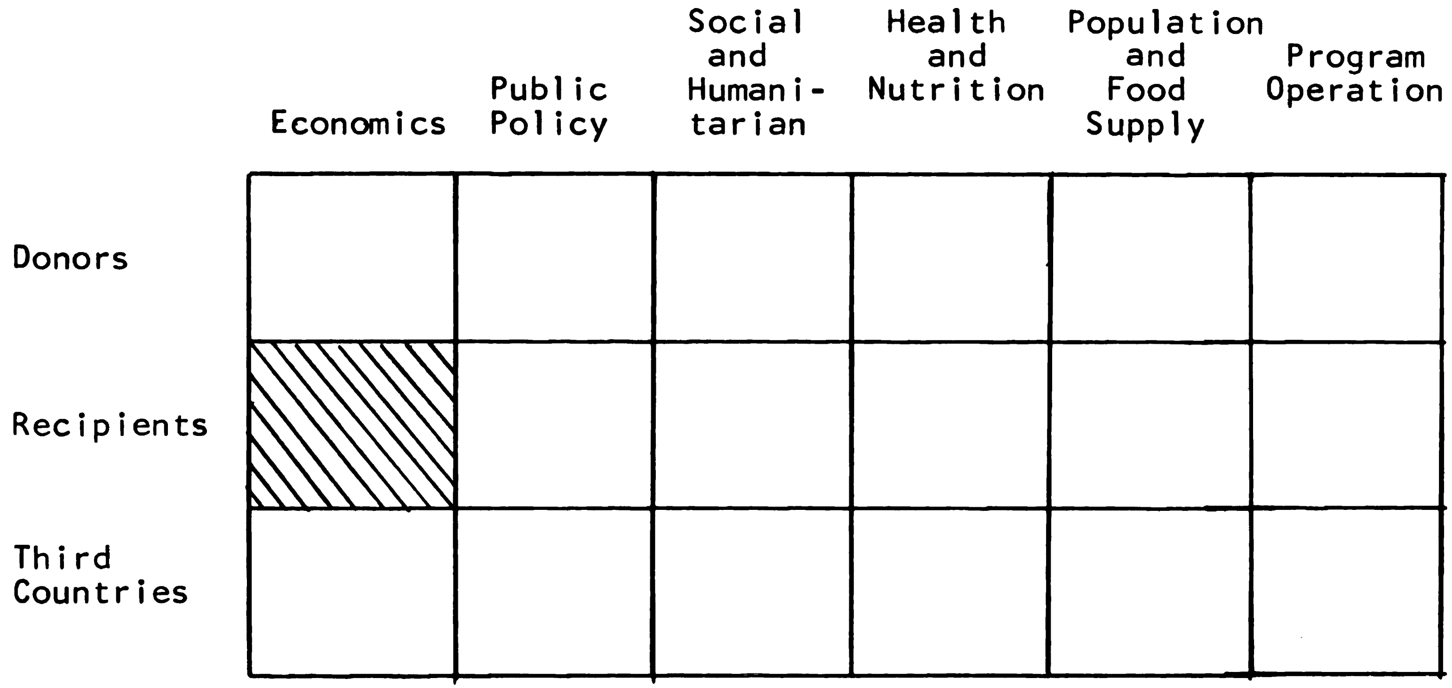

Figure 2.1: Classification of research issues and country orientation for Public Law 480 research.

Theoretical Effects of Food-Aid[3]

When food-aid enters a country's economic system and competes with domestic supplies in retail or wholesale markets, the system will respond in some way. From a conceptual standpoint, one can identify the responses that would be expected to occur and, ideally, empirical techniques would permit their quantification.

Unfortunately, the matter is considerably more complex. Recipient countries are characterized by rapid rates of population growth which press against the capacity of the economy to supply nutritionally adequate diets; uneven income distributions which impede low income groups from demanding the food they need even when supplies are adequate; unstable domestic supplies which lead to severe shortages in some periods; subsistence producers who often consume more than they sell; marketing systems which inadequately connect shortage and surplus regions, especially growing urban centers; and food customs and taboos which inhibit changes in consumption patterns.[4] In such situations, theoretical issues are not easily separated from humanitarian considerations and the

---

[3]One of the few works that treats the various issues in a comprehensive framework is: Witt and Eicher, Effects of Surplus Disposal, especially pp. 63-68.

[4]These characteristics are explained in: The World Food Problem, A Report of the President's Science Advisory Committee Panel on the World Food Supply, Vol. I, White House, May, 1967, pp. 11-17 (subsequently referred to as Food Panel Report).

latter of necessity often dominate short run political decisions. Even when the theoretical issues are separated and resolved, empirical work on the effects of food-aid suffers from a lack of reliable and comprehensive data over extended periods.

Nevertheless, this section examines the theoretical issues in the spirit that they bear directly on the actual resource benefits of food-aid even if humanitarian and political factors determine short run decisions. Furthermore, Indian data surpasses that of most recipient countries and will, it is believed, support the empirical work in Chapter III.

Ths issues are divided into two groups: the "direct effects" and the "indirect benefits" of food-aid. Collectively, the direct effects determine the resource transfer or benefits plus the incremental consumption inherent in food-aid. These effects are necessary implications of food-aid in the sense that they are certain to occur. They do not depend, in total, on the policies followed by the recipient government although the relative magnitude of individual effects can be influenced by various policies. In contrast, the indirect benefits will not typically be realized without special efforts by the recipient country to bring them about. The distinction between direct effects and indirect benefits is crucial in this study since only the former will be quantified to estimate the resource benefits of food-aid. Because indirect benefits are not associated with resource transfers, they will be discussed only in qualitative terms.

Direct Effects

Of all the aspects of food-aid, the leading issue has been the potential "disincentive effect" on producers in recipient countries. It is reasoned that when food-aid joins domestic supplies at some point in the marketing system, prices fall. In turn, prices received by producers decline and their production is reduced after some time lag. If domestic production falls substantially the net increase in food supplies will be correspondingly smaller than the quantity of food-aid shipped. Moreover, the longer run capacity of the country to feed itself would be endangered by dampening producers' incentive to invest in new technology. This possibility, while widely recognized, has been advanced most notably by Professor Schultz.[5] Fisher gave a rigorous analytical treatment in support of this argument in 1963.[6]

---

[5]T. W. Schultz, "Value of U.S. Farm Surpluses to Underdeveloped Countries," Journal of Farm Economics, December, 1960, pp. 1019-30. More recently, he has stressed a public disincentive effect whereby the recipient government tends to neglect investment in foodgrain production. This issue is examined later as one of the indirect "benefits" of food-aid.

[6]Franklin M. Fisher, "A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries," Journal of Farm Economics, November, 1963, pp. 863-75.

Although questions have been raised about the magnitude of price declines and how efficiently these are transmitted to producers, the principal controversy centered around the supply response of producers. Khatkhate argued that subsistence producers adjust production in order to sell enough to meet fixed cash expenditures and for this reason lower prices would increase their output.[7] Several writers in the late 1950's expressed the view that subsistence producers respond negligibly, if at all, to price changes and therefore food-aid wouldnot alter domestic production. Instead of supporting this thesis, empirical investigation in the 1960's points in the direction of a positive supply response in developing countries. In a recent summary of this evidence, Krishna classifies the supply elasticities for foodgrains as positive, but low, ranging from zero to .4. He observes that "....the price elasticity of wheat and rice acreage in poor countries equals that of grain in the United Kingdom and maize in the United States."[8] Based on research to date, a

---

[7]Deena R. Khatkhate, "Some Notes on the Real Effects of Foreign Surplus Disposal in Underdeveloped Countries," Quarterly Journal of Economics, May, 1962, pp. 186-96.

[8]Raj Krishna, "Agricultural Price Policy and Economic Development," in Agricultural Development and Economic Growth, edited by Herman H. Southworth and Bruce F. Johnson, Cornell University Press, Ithaca, 1967, pp. 504-08. (Subsequently referred to as Price Policy).

disincentive effect would be expected to result from food-aid and it will be included in our analysis.

The second theoretical issue concerns the shift of resources to alternative commercial (cash) crops when food-grain prices decline -- the "allocative effect" of food-aid shipments.[9] Shifts of land to commercial crops is limited to the decline in foodgrain acreage for countries such as India where available land is fully utilized. In addition, more complete utilization of labor through diversification of crop production and increased opportunities for the employment of purchased inputs may permit greater price responsiveness for commercial crops than decreases in foodgrains would imply. Based on his review of available research, Krishna summarized commercial crops such as jute, cotton and sugarcane as having supply elasticities ranging from .1 to .7 and he observes that "....the elasticity [acreage] for cotton in India, Pakistan or Egypt turns out to be about twice that in the United States."[10] Although the available studies report

---

[9]For brevity the possibility of resources shifting to other alternatives such as vegetables is not considered.

[10]Krishna, Price Policy, p. 505. Since the studies reviewed have acreage as a function of relative prices, the cross elasticity of supply would equal the negative of the own-price elasticity.

acreage responses, they certainly suggest that food-aid may induce a significant allocative effect by changing the relative prices of foodgrains and commercial crops.

Among several writers who have stressed the potential importance of the allocative effect, Dantwala's view is representative:

> The expected consequence of this relative shift in prices in favour of commercial crops would be a shift in agricultural inputs for their production. Assuming that this is exactly what happened, would such a development be necessarily injurious to Indian agriculture or the Indian economy as a whole? It is, of course, true that higher foodgrains production is very vital to India's economy, but a stimulated growth in non-foodgrains crops is of no less importance for the overall national economy, particularly in regard to the international balance of payments.[11]

Because of the interrelationship between the disincentive and allocative effects, both should be considered in an overall evaluation of food-aid. The relative quantitative importance of each will depend on the way producers respond to changes in foodgrain prices. From a normative standpoint, the relative

---

[11] M.L. Dantwala, "Incentives andDisincentive in Indian Agriculture," Indian Journal of Agricultural Economics, April-June, 1967, p. 11.

importance is determined by the country's comparative advantage in producing the two types of crops as well as its policy regarding self-sufficiency in foodgrain production. In this study, no judgment is advanced on the question of comparative advantage between foodgrains and commercial crops. The study does examine the wisdom of India's desire for foodgrain self-sufficiency in terms of resource benefits and costs from food-aid.

Critics of food-aid have focused almost exclusively on the disincentive effect and have generalized it to an "aggregate effect". Schultz, for example, states that

> We have reasons to be worried about the adverse side effects of the [P.L. 480] program upon farm production within the recipient countries. In India it may well be that Indian farmers have been receiving less for the rice and wheat they have been producing than they would have received had there not been large imports of United States' farm products made available under the P.L. 480 programs. But can India afford this kind of underpricing and thus discourage her domestic production of farm products?[12]

The validity of the criticism depends on two assumptions: first, the food-aid lowers agricultural prices, in aggregate,

---

[12]T. W. Schultz, Economic Crises in World Agriculture, University of Michigan Press, Ann Arbor, 1965, p. 3.

relative to non-farm prices; and, second, that aggregate output responds negatively to decreases in producers' terms of trade.[13] While the first assumption is defensible, the second has little evidence to support or reject it. To quote Krishna; "So far the least amount of work has been done on the response of aggregate output (of all agricultural products or all crops) to the ....terms of trade of agricultural production."[14] Our model does not explicitly contain either aggregate production or aggregate terms of trade variables. However, by including both a disincentive effect and an allocative effect from a change in price, it implicitly allows for the net difference, which could be interpreted as an aggregate effect.

The fourth response pertains to the substitution of food-aid for regular commercial foodgrain imports -- the "import displacement effect." This issue was very controversial in the early years of the P.L. 480 program and continues to receive some attention.

---

[13]Two meanings of "terms of trade" need to be distinguished. (i) consumption terms of trade that relate agricultural product prices and prices of consumer goods purchased by producers, and (ii) production terms of trade which relate product and input prices. The implications of food-aid will differ for each meaning.

[14]Kirshna, Price Policy, p. 512.

Criticism came not only from developed exporting countries, especially Canada and Australia, but underdeveloped countries such as Thailand and Argentina. When the program was revised in 1958, the new legislation included specific reference to the need for safeguarding normal commercial trade patterns. Inasmuch as the concern in this study is with the effects of food-aid on a single recipient country, the multilateral issues associated with import displacement which have quite naturally received major attention in the literature will be omitted.[15]

In a recipient country, the incentive to substitute food-aid for commercial purchases is likely to be strong. If foodgrains are imported privately, the same dampening effect on foodgrain prices that causes the disincentive effect will also decrease the profitability of imports. In many recipient countries, including India since 1943, the government controls commercial imports either by licensing or public monopoly of facilities. In this situation, the opportunity to shift foreign exchange, typically in short supply, from foodgrains to other types of expenditures provides the incentive to displace commercial purchases.

---

[15] G.R. Allen has dealt with the broader issues in: The Impact of Food Aid on Donor and Other Food Exporting Countries, World Food Program Study No. 2, FAO, Rome, 1965.

When imports are publicly controlled, the only external pressure to limit a complete displacement would be restrictions on the availability of food-aid or policies of donor countries that discourage such substitution. The current U.S. policy states that:

> The President shall take reasonable precautions to safeguard usual marketings of the United States and to assure that sales under this title will not unduly disrupt world prices of agricultural commodities or normal patterns of commercial trade with friendly nations.[16]

Although this provision undoubtedly limits to some extent import displacement, the term "normal" is a fluid concept including quantities based on some historical period and quantities in the absence of food-aid. Therefore, "to comply with the Congressional mandate, U.S. government officials have had to implement P.L. 480 programs pragmatically..."[17] Because the legislation is imprecise, it seems reasonable to expect that some displacement occurs and that it may be quantitatively important for certain recipient countries.

---

[16] U.S. Congress, Food for Peace Act, 80 Stat. 1526, 1966, sec. 103c.

[17] Lyle P. Schertz and Gabrielle Rice. "U.S. Loans Under Public Law 480: Comment", Journal of Farm Economics, August, 1966, p. 750.

The contribution of food-aid to incremental consumption in the recipient country -- the "consumption effect" -- is the fifth response identified. Because of food-aid reaches final consumers (except for wastage), this effect must be viewed as a net concept. That is, the disincentive and import displacement effects must be deducted from the total quantity of food-aid to arrive at incremental consumption. Despite its humanitarian importance, one should avoid thinking of the "consumption effect" as if all food-aid necessarily is a net increase in consumption.

One of the guiding principles established by FAO in the early 1950's was that all food-aid <u>should</u> contribute to incremental consumption. For this "additionality" principal to hold when shipments are sold in regular market channels, some extreme conditions would have to exist for the elasticities of demand and supply, commercial imports and government expenditures. Even though these conditions can be made explicit, their implausibility for any given country would make it a rather fruitless exercise. In reality, it seems safe to conclude that part of food-aid contributes to incremental consumption and that another part displaces imports and domestic production.

Population is one factor that deserves special comment in this connection, however, If increases in foodgrain demand

due to population growths just offset increases in food-aid shipments, constant foodgrain prices will prevail, assuming there is no decrease in commercial imports. The additionality principal is achieved in the sense that all food-aid enters incremental consumption. But in another sense, domestic production and/or imports are less than they would have been in the absence of food-aid and this is the economically meaningful way in which to perceive food-aid. Perhaps this can be stated more clearly by assuming that domestic supply shifts at the same rate as population due to favorable developments in agricultural input markets. Then stable prices would prevail without food-aid. But with increases in shipments, prices will decline and presumably so will domestic production. Suppose the shift effect outweighs the disincentive effect so that there is a net increase in domestic production. We do not conclude that food-aid _increases_ domestic production because the net increase came from an autonomous source. Likewise, population growth is autonomous with regard to food-aid and to depend on such growth for the achievement of the additionality principle seems unwarranted.

The "monetary effects", the last to be examined, include internal and foreign exchange effects. Because this study measures resource benefits and costs in foreign exchange, this aspect of the monetary effects will be discussed later.

To examine the internal monetary effect, it is necessary to recall the distribution procedure for food-aid. After receiving shipments, the recipient government exchanges them for local currencies in domestic markets (usually directly to consumers but in some cases to processors). The currencies are then deposited in U.S. accounts from which U.S. officials allocate part (10-15 percent in India) for purchases of goods and services that would other wise have been purchased with dollars. Some of the currencies are loaned or granted to the recipient government or private businesses. The remainder accumulates in U.S. accounts and represents a net withdrawl from the money supply.

The _ceteris paribus_ result of such transactions is deflationary. However, if the recipient government's monetary system can adjust the money supply, the deflationary effect can be offset by monetary policy. For a particular country, therefore, the question becomes: how have the local currency operations affected the money supply? Khatkhate analyzed this question for India and concluded that: "....the monetary impact of the accumulation of P.L. 480 deposits with the commercial banking system in India was neutral".[18] For this

---

[18] D.K. Khatkhate, "Money Supply Impact of National Currency Counterpart of Foreign Aid: An Indian Case", _Review of Economics and Statistics_. February 1963, p. 82. See also Rath and Patvardan, _Impact of P.L. 480_, pp. 19-30.

reason as well as the fact that a deflationary policy would not have impinged directly on resource benefits and costs, the internal monetary effect will be ignored in subsequent analysis and estimation.

Indirect Benefits[19]

Several potentially favorable effects of food-aid are detailed below. Unlike the direct effects, the indirect benefits do not represent a resource benefit in the transfer sense defined in this study. And frequently they can be achieved through policies and programs that do not depend directly on the presence of food-aid shipments.

Food-aid can contribute to price stability -- a condition almost unanimously viewed as desirable in developing countries because it removes some of the uncertainty that hinders adoption of new production techniques. When effectively programmed, shipments remove seasonal price fluctuations as well as year-to-year price swings arising from weather induced

---

[19]Because these benefits are widely recognized, they are only sketched here with limited documentation. Some theoretical discussion relevant to these issues has been provided by Alfred E. Kahn, "Agricultural Aid and Economic Development: The Case of Israel", Quarterly Journal of Economics, November 1962, p. 568-91.

supply shifts. Moreover, if the marketing system normally has wider price fluctuations than can be justified on the basis of storage costs alone (because of speculation, e.g.) this too can be modified by timely distribution of food-aid shipments.

The role of food-aid in preventing seasonal fluctuations is clear; some caution should be exercised, though, to avoid removing normal seasonal price changes which are needed as incentives to private traders for their provision of storing and handling services. Regarding year-to-year price changes, food-aid can contribute to a buffer stock which will restrain prices when domestic crops are short but it offers little help in abundant crop years when prices fall below acceptable levels.[20]

A second alleged indirect benefit arises because food-aid forces improvements and expansion of physical marketing facilities -- processing, storage and transportation. Most developing countries stand to gain from better marketing facilities and food-aid could contribute by stimulating the needed expansion and, perhaps, by encouraging some new processing plants that are able to count on shipments to ensure a regular supply. One may be somewhat skeptical of

---

[20]Food-aid has served a constructive price stability function in Pakistan. See Walter P. Falcon, "Comment" to Krishna, <u>Price Policy</u>, pp. 542-44.

the real benefits, however, because food-aid requires expansion mainly of port facilities and facilities to move shipments from ports to urban deficit areas. Such expansion may correspond only slightly to the internal expansion which will enhance indigenous storage and movement of domestic supplies.

Food-aid may serve as an expedient taxing mechanism, especially in countries where revenue collection is administratively difficult. But in a nation with sophisticated monetary authorities, Witt and Eicher have noted that "Title I local currency is simply an alternative means of financing development....Because of the interest charge and rules imposed by the U.S. government, it usually is more cumbersome than alternative internal financing procedures".[21] Therefore, food-aid serves as a taxing mechanism, not because it provides revenues to the government, but for the more fundamental reason that it decreases private aggregate demand for consumer goods. This permits the recipient government to finance (internally) additional expenditures by a proportional amount with no general inflationary pressure. Since the tax falls on foodgrain producers through lower prices for their products, it is simply the counterpart of the disincentive effect discussed earlier. The point here, however, is that

---

[21] Witt and Eicher, Effects of Surplus Disposal, p. 66.

there is a shift of real income away from producers and to other sectors of the economy. If the marginal propensity to save is larger for those who benefit, the redistribution of income will increase the proportion of real income invested and could favorably affect long run growth. The decline in producers' income will be less if producers shift resources to commercial crops, especially if the elasticity of demand for commercial crops is high.

Last, there is the possibility that food-aid will affect government development programs either by increasing the size of these programs, in general, or changing the allocation of expenditures between food production and other sectors. The former possibility has been formulated in the concept of "development through food". Rather than measuring (conceptually or quantitatively) the resource benefits, this concept moves directly to the questions: how can the transfer of food contribute to economic development? A characteristic reply is the following:

> Investment expenditures raise domestic incomes through the payment of wages, the purchase of local raw materials and the stimulus of economic activity generally. The increase in incomes causes an increase in demand for consumer goods, including food. At the average level of income per head in underdeveloped countries, a large proportion of the increment in income, from an effective employment of partially or totally unemployed labor, will be spent on food, particularly food grains. This proportion may, under

> special circumstances, be as high as 50 percent. If adequate additional supplies of food are not available, food prices will rise sharply. This could lead to inflation and jeopardize the whole development program.[22]

Because this rationale provides an alternative orientation to evaluating food-aid from the viewpoint taken in this study, it merits further comment. Apart from the presumption that inflation is undesirable, the concept has two premises. First, that there are unemployed resources that can be put to work by expanded development programs. While this is often true, at least for labor, one should recognize that food-aid is not necessary in itself to bring about the expanded programs for utilizing unemployed workers. The resources could be employed without food-aid if the accompanying inflation or some other factor was not an obstacle. Thus, the second premise is the crucial one: because food is a major item in consumer expenditures, a rise in its price contributes significantly to inflation.

Once it is established that achieving "development through food" rests on controlling inflation, one important point from the discussion on direct effects should be emphasized.

---

[22] Development Through Food, Basic Stucy No. 2, FAO, Rome, 1962, p. 15.

Only that portion of food-aid which represents incremental consumption can function as an anti-inflationary tool. The portion that displaces commercial imports and domestic production, and provides a resource benefit to the recipient country, cannot also assist in controlling inflation. In other words, the total quantity of shipments cannot be counted both as a resource benefit and a tool for inflationary control. Only the consumption effect is available for the latter purpose. In this sense, resource benefits from the direct affects and incremental investment based on food-aid are mutually exclusive. The larger the proportion of food-aid which enters incremental consumption, and is available to combat inflation, the smaller the proportion that contributes to a net resource transfer.[23]

It is sometimes argued that incremental government investment induced by food-aid will negate the disincentive effect. While it is true that nominal prices could be maintained in this way by expenditures of some multiple of the incremental consumption, the investment will also increase prices of other consumption commodities. Consequently, the

---

[23]Resource benefits and incremental consumption can be viewed in a complementary fashion. Incremental consumption offsets increases in foodgrain demand stimulated by payments to unemployed labor and resource benefits provide additional capital--that may not be available domestically--so that inflation does not develop in capital goods markets.

producers' terms of trade will decline and the disincentive effect will be negated only if producers react to nominal foodgrain prices. Whether or not the disincentive effect is eliminated, the use of food-aid to expand development programs by controlling inflation would appear to bring about a deterioration in the real incomes of foodgrain producers through price increaases for items they purchase.

Another possibility is that recipient governments allocate fewer investment expenditures to food production because they can rely on food-aid, especially in years of unusually short crops. This type of disincentive is distinct from the private disincentive effect discussed above and, like other indirect benefits, does not directly influence the country's stock of resources. Instead, the alleged disincentive pertains to public investment allocation decisions. Several writers have become critics of the P.L. 480 program in this regard.[24] Apparently the criticism was a major factor in bringing about a policy change in the 1966 Food for Peace Act. In considering

---

[24] See, for example, Harry G. Johnson, Economic Policies Toward Less Developed Countries, Brookings Institute, Washington, D.C., 1967.

a request for food-aid, the new Act requires the potential recipient to be evaluated on a set of "self-help criteria" aimed at appraising the country's efforts to expand domestic food production. Because this issue lies outside the resource transfer approach of the present study, no attempt will be made to quantify it.

Depending on the policies followed by the recipient country, the portion of food-aid that enters incremental consumption may yield benefits by:

(1) contributing to price stability;

(2) expanding marketing facilities;

(3) serving as a taxing mechanism;

(4) controlling inflation; or

(5) shifting government investment expenditures from food production to other needed areas.

The last item is, of course, a dubious benefit if the country concerned substitutes less productive programs for the development of its food production capacity.

Conceptual Framework

In broad terms, the previous section divided the effects of food-aid into those which, collectively, augment the recipient's stock of resources (direct effects) and those which do not contribute to a resource transfer (indirect

benefits). Although food-aid will often serve as a convenient tool in achieving indirect benefits, the premise here is that the direct effects also represent an important contribution to India's economic development through the resource benefits they provide.

Based on the discussion above, the relevant direct effects induced by an increase in food-aid are:

(1) the decrease in domestic foodgrain production -- the disincentive effect (ΔS);

(2) the increase in commercial crop production -- the allocative effect (ΔE);

(3) the decrease in commercial imports -- the import displacement effect (ΔM); and

(4) the increase in foodgrain consumption -- the consumption effect (ΔD).

In terms of physical quantities, the consumption effect is simply the quantity of food-aid minus the import displacement and disincentive effects. These latter effects do not in any way represent losses to the recipient country because what they formerly provided is now supplied through food-aid. Indeed, M serves as a pure benefit in that a corresponding amount of foreign exchange no longer is devoted to commercial foodgrain purchases. Similarly, ΔA represents a benefit to the extent that a decrease in domestic foodgrain production corresponds to an increase in commercial crop production. Thus the benefits (B) are defined as follows:

(2.1) $B = \Delta M + \Delta E + \Delta D$

This expression requires that all terms have the same dimension. For several reasons, they will be expressed in foreign exchange -- dollars. One reason is that the cost (C) of food-aid (to be determined in Chapter IV), will be expressed in dollars. Consequently the net resource gain (G) can be calculated simply as $G = B - C$. But more important, the exchange rate between dollars and rupees probably has not represented their true relative values during the 1952-63 period studied. If rupees were used as the unit of measurement, it would be inaccurate to convert ΔM which is expressed in dollars to a rupee value at a fixed exchange rate. Finally, in light of India's chronic balance of payments deficits, foreign exchange appears to be the most relevant single measure of the resource benefits and costs of food-aid.

While ΔM is directly expressable in dollars, ΔE and ΔD are not. In Chapter V, the details of converting the allocative effect to a dollar value are presented. The rationale followed is that increases in commercial crop production can be viewed as increasing foreign exchange earnings since India exports part of her production of these crops. The consumption effect does not offer a resource benefit in the sense that India's real resource stock is enlarged. However, because the final estimates in Chapter V allow for various alternative valuations of this component, it is included in (2.1).

Prior to developing the economic model, the following two subsections review several characteristics of the Indian economy and specify assumptions underlying the analysis.

Indian Economic Characteristics[25]

India is primarily an agricultural economy. Over two-thirds of the people depend on farming for their livelihood; nearly half the national income is derived from agriculture, and crop production is far more important than livestock production. The large agricultural labor force includes many landless farmworkers who are chronically underemployed. Those who own land tend to have small plots and engage in subsistence agriculture.

---

[25]Taken mainly from: Agriculture in India, ERS-Foreign 64, USDA 1964, and Trends in India's Agricultural Trade, Foreign Agricultural Economic Report No. 15, USDA, 1964.

Most of the cropland is planted to foodgrains -- cereals and pulses -- and less than one-sixth is devoted to commercial crops. Nevertheless, commercial crops contributed from 35 to 45 percent of the value of Indian exports, annually, during the 1951-61 period. Tea is the major commercial crop, providing half of the earnings from agricultural exports. Cotton, oilseeds, and tobacco are also important export crops. In addition to the 35 to 45 percent that agricultural products contribute to export earnings directly, approximately 30 percent more comes from textile yarns, fabrics and related products produced from jute and cotton. Although India is a major cotton producer, imports provide an additional supply for manufacturers and exceed the quantities of raw cotton exported.

India's balance of payments has been in deficit for many years. During 1951-55, the annual deficit averaged \$185 million. Beginning in 1956, there was an abrupt rise in imports with little change in exports. Consequently, the deficit increased and has remained large, averaging \$758 million annually during the 1958-61 period. Deficits have been financed by borrowing, foreign assistance and reduction in gold and foreign exchange reserves.

India may be best known for her large and rapidly growing population. This presents problems for providing all types of consumer goods, especially foodgrains. It dampens savings and the potential for economic growth. Presumably the population problem accounts in large part for India's slow growth in real national product estimated at 3.7 percent annually for the 1950-64 period, and even slower per capita increase.[26]

Assumptions

The following assumptions are made explicit inasmuch as the estimates in later chapters are conditional on the validity of these assumptions during the 1952-63 period.

i) If a decline in foodgrain prices, *ceteris paribus*, caused a decline in foodgrain production, then it either shifted resources to commercial crops or led to unemployment; that is, there were no production increases in nonfarm sectors when foodgrain production declined and, therefore, no need to include any such increases in the resource benefit estimates.

---

[26] *Development Assistance Efforts and Policies*, Organization for Economic Cooperation and Development, Paris, 1966, pp. 20-21.

ii) If an increase in foodgrain prices, _ceteris paribus_, caused an increase in foodgrain production, then it shifted resources from commercial crops but did not withdraw employed resources from other sectors; any new resources entering the agricultural sector were unemployed in other sectors and did not, therefore, decrease output in those sectors.

The implication of assumptions i) and ii) is that the resource benefits of food-aid need not be adjusted for resource movements between agricultural and other sectors. If the assumptions did not hold, the resource benefit estimates will understate the true benefits. India's chronic labor surpluses, and, to a lesser extent, unused capacity lend credence to these assumptions.

iii) During 1952-63, some secular growth in acreage planted to foodgrains and commercial crops occured exclusive of changes in product prices. Since there have, in fact, been upward trends in acreage devoted to these crops, especially commercial crops, this assumption permits these trends to be removed in the statistical analysis. An expanding labor force resulting from population growth and technological developments in other input markets that lowered prices or provided new inputs could have contributed to such trends.

iv) Food-aid shipments sold through India's system of fair-price-shops or distributed to the roller flour mills influenced market prices. This assumption is essential because the disincentive and allocative effects depend on changes in foodgrain prices. Only the import displacement effect would remain of food-aid did not affect prices. In a statistical sense, the price effect of shipments alone is difficult to isolate because food-aid contributed less than five percent of total foodgrain consumption during 1952-63. Although we can estimate the price effect of a change in total quantity, to attempt to estimate the price effect of food-aid alone would be unrealistic. This assumption implies that a change in food-aid will have the same affect on prices as an equivalent change in domestic output.

A Study Team of Fair-Price-Shops (1966) provided some support for this assumption.[27] Due to the preference of Indian consumers for domestic products over food-aid shipments, there is a differential between open market and fair-price-shop

---

[27]Reported in Dandekar, Food and Freedom, pp. 18-20. See also discussion by Uma Kant Srivastava, "The Impact of Public Law 480 Imports in Prices and Domestic Supply of Cereals in India: Comment" and "Reply" by Jitendar S. Mann, American Journal of Agricultural Economics, February, 1968, pp. 143-47.

prices. But the two are still related to each other. A rise in open market prices increases demand at the fair-price-shops and vice versa. Particularly in periods of rising prices the shops function as a restraint on open market prices. Equally important is the distribution of shipments through the roller flour mills. When this occurs, shipments replace utilization of domestic supplies, and therefore, decrease the demand by processors in local markets. Conversely, if fewer shipments are utilized by the mills, prices would be expected to increase in local markets.

v) Incremental government investment programs stimulated by shipments had a neutral effect on real foodgrain prices; general prices rose at the same rate as foodgrain prices. This assumption implies that the direct effects are not altered if food-aid caused the Indian government to expand its general development program.

vi) Any food-aid that entered stocks in one period was moved into markets in later periods and had its influence on prices and other variables.

Economic Model

An economic model designed to estimate the direct effects needs to encompass most of the agricultural economy and will, therefore, represent about one-third of the total economy. A partial equilibrium macroeconomic model is postulated below. It is partial in the sense that the model abstracts from several sectors; namely, mining, manufacturing and small enterprises, the marketing and services sectors, and all non-grain foods as well as plantation crops (tea, rubber, coffee). Because it aggregates the several types of food-grains and commercial crops into single variables, it is a macroeconomic model.

The model includes four types of structural equations:

1. Foodgrain Supply
2. Commercial Crop Supply
3. Foodgrain Imports
4. Foodgrain Demand

These equations are viewed as a recursive system because of the nature of crop production processes.[28] Crops are harvested and marketed several months after producers decide the quantities of land, labor and other resources to allocate

---

[28] Recursive systems have been advocated by Wold and seem particularly appropriate for agricultural supply responses; H.O.A. Wold and L. Jureen, Demand Analysis. John Wiley and Sons, New York, 1953, pp. 48-53.

to various crops. Thus, there is a lag of several months between the time producers decide what to produce and the time when the resulting production influences market prices. Production in one period, therefore, depends on a set of variables that were determined in some previous period. The recursiveness continues as current prices affect producer decisions and, in turn, subsequent production.

For each separate crop, theoretically, a supply equation could be specified in which quantity supplied is a function of expected prices of that crop and substitute crops, costs of inputs, weather, technological developments and other variables that owing to ignorance cannot be explicitly specified. But it will be helpful in later analyses to separate changes in quantity supplied into two components -- acreage adjustments and yield fluctuations. Then the production of a particular crop is defined as:

$$Q^s = A \cdot Y$$

where Q^s is the quantity supplied,

A is the acreage planted, and

Y is the average yield per acre planted.

The reasoning below proposes that average yield (Y) was largely beyond the control of individual producers in India during 1952-63 and, therefore, that acreage planted (A) serves as a valid indicator of "desired" production decisions during the period. Although a general "crop" is discussed here, this will later be interpreted as either "foodgrains" or "commercial crops".

Fluctuations in yields from year to year arise primarily from variations in growing conditions, particularly rainfall. Trneds in yields depend on the state of technology facing producers and the increased availability (or lower cost) of traditional inputs. The impact of rainfall on actual yields in India is widely recognized. Because of weather's vagrancy, the production of a crop is left partly in the hands of nature despite producers' allocations of inputs under their control. To some extent this uncertainty can be overcome by irrigation facilities but these depend on public investments to expand existing facilities. There are, of course, other technological developments such as new seed varieties, insecticides, methods of disease control and production techniques. As such developments occur, they favorably influence yields although not necessarily at an uniform rate over time nor at the same rate for all crops. Expanded availability of existing inputs, particularly fertilizer, also improves yields as such inputs become available at lower costs to producers or through relaxation of rationing. Together new inputs and increased availability of existing inputs have been responsible for the modest increases in yields (over time) of various crops in India. From 1949-50 to 1964-65, the annual compound increase was 1.61 percent for foodgrains and 1.06 percent for non-foodgrains (mostly commercial crops).[28] Yet, like weather, technological progress depends on research and market developments that are governed in large measure by outside forces, especially government investment. While product prices relative to input prices influence the adoption of new practices, it is postulated here that over the 1952-63 period, weather and the state of technology were the primary determinants of yields and that these were largely beyond the control of individual producers.[29]

[28]Dantwala, "Incentives and Disincentives in Indian Agriculture", p. 3.

[29]Krishna has provided this same rationale for densely populated areas, Price Policy, p. 515. Lack of statistical relationship between yields and product prices over a similar period for West Pakistan was reported by Walter P. Falcon, "Farm Response to Price in a Subsistence Economy: A Case Study of West Pakistan", American Economic Review, May 1964, pp. 586-87. Fertilizer has accounted for much of the yield increases inIndia; the importance of availability (or the lack of it) in contrast to profitability has been argued by Dantwala, Ibid., pp. 14-15.

This leaves land, labor and other resources committed to crop production as the primary factors over which producers have explicit control. Although producers can affect yield and thus production by the way they allocate non-land inputs, it seems reasonable to assume that non-land inputs are varied in proportion to land so that the allocation of land to each crop indicates the "desired" level of production of that crop. As used here, "desired" does not mean the level of production if producers had complete flexibility in shifting acreage among crops but rather their planned production within the constraints set by the availability of labor, considerations of disease control and minimums required for subsistence needs. Adjustments in acreage planted to various crops, then, is taken as the indicator of desired production and the variable to be explained, both conceptually and empirically (in Chapter III).

Conceptually, acreage planted to a crop depends on the expected prices of that crop and substitute crops, the expected yields of various alternative crops and certain other variables -- including the constraints mentioned in the previous paragraph. One of the "other variables" that affects planting decisions is the rainfall prior to planting dates. If it is unusally wet or dry, producers may be unable or unwilling to plant the same area as they would under normal

conditions. Due to lack of appropriate data on an all-India basis, rainfall is omitted from the subsequent analysis. A trend variable is included in the specification to account for the general expansion in acreage that has taken place in India. From 1949-50 to 1964-65, the annual compound rate of increase for foodgrains and non-foodgrains was 1.34 and 2.52 percent, respectively.[30]

Acreage planted, then, is expressed as:

(2.2) $A = f\ (P^*, P_s^*, Y^*, T)$

where

A is the actual acres planted to a crop,

P^* is the expected price of the crop,

P_s^* is the expected price of substitute crops,

Y^* is the expected yield of the crop relative to substitute crops, and

T is a trend variable representing general acreage expansion.

Both A and Y* are defined for crop years (July-June) whereas P* and P_s* refer to calendar years. This is done because acreage planted in a specific crop year (say, 1959-60) results in production that is marketed primarily in the ensuing calendar year (1960) so that prices and other variables defined

---

[30] _Ibid_., p. 3.

in the demand equations are most conveniently expressed on a calendar year basis. Except for A and Y*, all other variables in the study are defined on calendar years.

For the price expectations, two possibilities will be considered:

i) $P^* = P_{t-2}$

ii) $P^* = 1/2\ (P_{t-1} + P_{t-2})$

where P^* is the expected price in period t, and P_{t-1} and P_{t-2} are the actual prices in periods (t-1) and (t-2), respectively.

In support of the first, acreage decisions in (t-1) determine quantity available for consumption in t. Since planting occurs predominately from May to October, (t-1) prices alone may not be appropriate. The simpliest alternative is (t-2) prices.

An argument can be advanced for giving weight to (t-1) prices, however. A careful study of nine price expectation models for wheat concluded that the 3-month preplanting prices were superior to several alternative specifications in explaining the allocation of acreage to wheat.[31]

---

[31] Jai Krishna and M. S. Rao, "Dynamics of Acreage Allocation for Wheat in Uttar Pradesh: A Study in Supply Response", Indian Journal of Agricultural Economics, January-March, 1967, p. 51.

Thus, prices through part of (t-1) may be expected to influence producers' planting decisions. The second specification was included to account for this possibility.[34]

Because yields affect the production and thus the profitability of alternative crops, Y* is included as an explanatory variable. To preserve degrees of freedom in later statistical analysis, equation (2.2) specifies <u>relative</u> expected yields rather than including a separate explanatory variable for each expected yield -- the conceptually more general alternative. Producers are viewed as forming their yield expectations from actual yields the preceeding crop year, so that for period t:

$$Y^* = \frac{Y_{t-1}}{Y^s_{t-1}}$$

where Y_{t-1} is the actual average yield of the crop in period (t-1), and

Y^s_{t-1} is the actual average yield of substitute crops in period (t-1)

---

[34]Except for the convenience of defining identical price variables for both supply and demand equations, a number of other price expectations could be explored, e.g. the average of twelve month preplanting prices.

One justification for this yield expectation relates to technological developments. As new practices become available and improve yields in one period, they influence producers' yield expectations the succeeding year. Suppose, for example, that a new yield increasing variety was introduced in the 1959-60 crop year for the crop in question. Then producers react by shifting acreage to this crop in 1960-61. Conversely, if yields of substitute crops increase in one year, Y* decreases the following year and producers shift acres to substitute crops. Although this expectation model adjusts with weather fluctuations, these may be assumed to affect both crops about equally so that Y* is reasonably stable with respect to weather.

Input prices are excluded from equation (2.2) because of the lack of data. Although it would be preferable to include prices of variable inputs such as fertilizer, insecticides and irrigation water, this omission may not be serious if, as might be expected, such changes do not markedly alter the relative profitability of alternative crops. Indeed, the discussion on yields argued that during 1952-63 it was the general availability of inputs that limited their use rather than prices. But even when input prices do affect their use, price changes for a major input such as fertilizer would probably have only moderate effects on acreage allocations.

Using the previous conceptualization of supply, two broad categories of crops -- foodgrains and commercial crops -- are examined next.

1. Foodgrain supply

Food grains in India consist of cereals (rice, wheat, barley, corn, sorghums and millets) and pulses (legumes such as peas and beans). Rice is by far the principal crop, accounting for slightly over 50 percent of total tonnage of foodgrains. Rice grows under a fairly wide range of climatic conditions and therefore is produced in many parts of India. Next to rice in importance are wheat and pulses which, combined, typically average 25 percent of foodgrain production. Unlike rice, wheat is produced primarily in the northern region where winters are cooler. Pulses include several different crops and are grown throughout India. The other prominent individual crop is jowar (sorghum) that can be produced in the warmer, drier regions in west-central India.

Since this study concerns aggregate crop relationships, foodgrain production (represented by acreage as a proxy variable) is aggregated into the following supply equation:

(2.3) $$A_g = f_1 \, (P_g^*, P_c^*, Y^*, T)$$

where the subscripts g and c refer to foodgrains and commercial crops, respectively. In this aggregate context, foodgrains, compete with commercial crops in acreage allocation decisions. Each variable is understood to have a subscript t = 1, 2,..., n over the n observations. Based on production theory and the known acreage trends, the expected signs of the partial derivatives are:

$$\frac{\partial A_g}{\partial P_g^*} > 0, \frac{\partial A_g}{\partial P_c^*} < 0, \frac{\partial A_g}{\partial Y^*} > 0, \frac{\partial A_g}{\partial T} > 0.$$

2. Commercial Crop Supply

Indian statistics report four categories of commercial crops: oilseeds, fibers, plantation crops and miscellaneous. Each is further divided into the specific crops shown in Table 2.1. Their relative importance individually, as well as their combined importance in the total index of agricultural production can be gauged by the value weights (1949-50 = 100) assigned to each in computing the total index. As shown in Table 2.1, production of most crops had increased substantially by 1964-65, most notably cotton and sugarcane.

Plantation crops will be exluded from the model because their production is specialized on a relatively few acres (less than .5 percent of all cropped acreage) and, being

Table 2.1 Commercial crop categories, assigned weights in computing the Indian Index of Agricultural Production and 1964-65 index

Crop	Weights		1964-65 Index	
	(total = 100)		(1949-50 = 100)	
Total Oilseeds	9.9		163.4	
Groundnuts		5.7		182.3
Other (including rope, mustard, sesamum, linseed and castorseed)		4.2		137.8
Total Fibres	4.5		201.1	
Cotton		2.8		206.0
Jute		1.4		184.2
Mesta		0.3		234.4
Total Plantation crops	3.6		156.9	
Tea		3.3		141.6
Coffee		0.2		341.5
Rubber		0.1		293.2
Total Miscellaneous	15.1		178.9	
Sugarcane		8.7		202.1
Tobacco		1.9		132.2

Source: Report on Currency and Finance, Reserve Bank of India, Bombay, 1965, Statement 7.

tree crops, would not be affected by short-run changes in foodgrain prices. Of the remaining crops, all are potential production substitutes for foodgrains even though the possibilities vary substantially in various regions. Jute substitutes for rice in the more humid mid-eastern regions; sugarcane is grown widely and substitutes for rice and wheat. Cotton and groundnuts compete with sorghums, millets and rice in the southern half of India.

Like foodgrains, commercial crops are aggregate into a single supply relationship having acreage as the dependent variable. The same rationale applies: changes in expected prices of foodgrains and commercial crops and changes in relative expected yields determine the allocation of acreage between the two crop aggregates; acreage planted is an indicator of desired production under the assumption that (i) actual yields depend principally on exogenous influences, particularly weather, and (ii) non-land inputs at the command of producers are shifted proportionally to acreage. The commercial crop equation is:

$$(2.4) \qquad A_c - f_2\ (P^*_g,\ P^*_c,\ Y^*,\ T)$$

All partial derivates (except the trend variable) are expected to have opposite signs from those of equation (2.3).

3. Foodgrain Imports

Inasmuch as the Indian government has controlled commercial imports since 1943, the foodgrain import equation must be interpreted as a behavioral function for public officials rather than for private importers. The following rationale is postulated: domestic output in period t is determined by previous production decisions and weather, the quantity available from this source is approximately known to officials near the end of (t-1) period; the next sources to which officials turn are its own stocks and food-aid; the quantity available from stocks, although flexible, is limited by actual stocks and the reluctance of officials to lower holdings below some critical level; the quantity available from food-aid is also flexible but constrained by shipment agreements already contracted, U.S. willingness to reach additional agreements and Indian reluctance to become unduly dependent on food-aid.

Once officials know the quantities available from domestic output, stocks and food-aid, combined with subjective or target estimates of desired per capita consumption, they turn to commercial imports to supply additional needs. Maximum imports, though, are limited by India's foreign exchange

shortage and minimum imports by requirements in food-aid agreements, explicit or implicit, to maintain "normal" imports.

A slightly more definitive explanation, consistent with the one above, focuses on the distribution requirements of the fair-price-shops. Given domestic output, officials have an estimate of the quantity that will be needed to meet the demand of, primarily, low income consumers at the shops. If output is below normal, open market prices will rise increasing the demand at shops and flour mills; and conversely when output is above normal. Although officials can procure some domestic supplies, such action tends to chase up prices and, in turn, the demand at shops. So they must turn to stocks, food-aid and finally, commercial imports as postulated above.

Bearing in mind that it is atypical, the following structural equation for imports is proposed:

(2.5) $M = f_3\ (Q_g^s,\ S,\ F)$

where M is the total quantity of commercial imports,

S is the net withdrawal from government stocks,

F is the total quantity of food-aid shipments, and

Q_g^s is the total quantity of foodgrains available for consumption from domestic production.

All variables are for period t (calendar years except for Q_g^s).

Domestic production in the crop year ending in July of period t, and available for consumption largely in calendar t, is given by:

(2.6) $Q_g^s = A_g \cdot Y_g$

where Y_g is the average foodgrain yield per acre.
All partial derivates in equation (2.5) are expected to be negative.

4. Foodgrain Demand

An identify is required to define the quantity of foodgrains available for consumption (Q_g^a) from the four sources in equation (2.5):

(2.7) $Q_g^a = Q_g^s + M + S + F$

Employing consumer demand theory and the equilibrium condition that quantity available equals quantity demanded, the final structural equation is:

(2.8) $P_g = f_4\ (P^*, Q_g^a\ , Q_s^a\ , N)$

where P_g is the price of foodgrains,

P^* is the expected price of foodgrains,

Q_s^a is the quantity of substitute food commodities available for consumption, and

N is total population at midyear (July 1).

As before, all variables are understood to have a subscript referring to period $t = 1, 2, \ldots, n$.

Equation (2.8) includes a price expectation variable because it is believed that consumer behavior in India responds to more than just the actual quantities available for consumption and other relevant variables. In particular, it is hypothesized that consumer expectations influence prices and that these expectations are formed as follows:

$$P_t^* = P_{t-1}$$

That is, consumers expect past prices to continue. When prices are high in period (t-1) due, for example, to a short crop, the effect of this shortage is carried over into subsequent periods so that once prices start to rise (or fall), this tendency persists for several periods.[33]

---

[33]An alternative formulation that leads to the same estimating equation as equation (2.8) -- expressed in linear form -- is the Nerlove "adjustment lag" model. One government imposes certain rigidities in foodgrain markets to maintain price stability. Thus actual prices do not adjust to the fully extent indicated by quantities available for consumption and the pressure for prices to change is delayed to later periods. The rationale given above was judged superior to the Nerlove interpretation, however.

The expected signs of the partial derivatives with respect to P* and N are positive; with respect to Q_g^a and Q_s^a, the signs are expected to be negative.

The effect of food-aid on prices is implicit in Q_g^a; increases in shipment increase Q_g^a and lower prices. Although this demand function differs from the standard one in that Q_g^a is not the dependent variable, the specification agrees with the postulated system of recursive causation. Equations (2.3), (2.5), (2.6) and (2.7) determine Q_g^a which, in turn, becomes an explanatory variable for Pg. Graphically, supply in period t is simply a vertical line that intersects the demand function in a price-quantity diagram. Increases in N and Q_s^a shift the demand function away from the origin and raise equilibrium prices.

Income has been omitted from equation (2.8) for both practical and theoretical reasons. From a practical standpoint, the Indian income series is reported on a fiscal year (April-March) basis but it includes agricultural production for crop years (July-June). Thus the series overlaps the Q_g^a variable and does not correspond with the calendar year on which other variables are defined.[34] When Q_g^a is deleted

---

[34]For an elaboration of this problem, see Rath and Patvardan, Impact of P.L. 480, p. 141n.

from the income series and the remaining income is converted to calendar years on some arbitrary basis, the resultant series is simply a trend and is highly correlated with population. Although population may capture part of the effects of increases in non-farm income in later statistical analysis, this was viewed as preferable to either including only income or both variables and having problems of multi-colinearity. Regarding the theoretical reason for excluding income, it is necessary to note the definition of Pg employed in the study. Nominal foodgrain prices are deflated by the general price level index so that Pg represents real foodgrain prices. In this specification, increases in real income would not be expected to increase Pg if the marginal propensity to consume foodgrains is equal to or less than the marginal propensity to consume all commodities. For these reasons, income has been omitted from education (2.8).

Prices of commercial crops are assumed to be exogenously determined because India exports a high proportion of such crop production either directly or in processed form. To the extent that quantity supplied affects domestic prices, the model excludes repercussions working through the demand equation for commercial crops when food-aid causes producers to shift from foodgrain to commercial crop production.

Summary

This chapter's purpose was twofold: (1) to identify the various theoretical effects of food-aid and justify selecting a subset -- the direct effects -- which collectively determine the resource benefits; and (2) to formulate an economic model suitable for measuring the direct effects.

In measuring only the direct effects, this study turns aside further consideration of such indirect benefits as price stabilization, inflation control, and mobilization of unemployed resources. While these benefits occupy an increasing proportion of the literature, some skepticism must be voiced about total preoccupation with them. A recipient government will often be able to achieve these objectives through other measures -- food-aid offers a convenient tool. Whether or not it is economically efficient will depend on the inherent resource benefits and costs that this study sets out to measure for India.

To measure the resource benefits, a recursive model was postulated. The next chapter contains the empirical estimates of the model's parameters.

CHAPTER III

RESOURCE BENEFITS: ESIMATION

The first section of this chapter specifies the statistical model corresponding to the economic model presented in Chapter II. After a section dealing with the data employed, the regression results obtained from applying the ordinary least squares estimation procedure are given. Selected results are then employed to estimate the direct effects in the final section.

Statistical Model

To state the statistical model, it is necessary to specify the functional form of the structural equations and incorporate disturbance terms in the behavioral relationships. Without *a priori* evidence to support a particular functional form, all equations are specified as linear. The disturbance terms are also included linearly for each behavioral equation. Expressed in conventional econometric notation, the six equations postulated in the economic model can be restated in the following form:

Domestic foodgrain acreage,

(3.1) $y_1 + g_{11}\ x_1 + g_{12}\ x_2 + g_{13}\ x_3 + g_{14}\ x_4 = u_1$

Commercial crop acreage,

(3.2) $y_2 + g_{21}\ x_1 + g_{22}\ x_2 + g_{23}\ x_3 + g_{24}\ x_4 = u_2$

Domestic foodgrain supply,

(3.3) $-y_1 y_g + y_3 = 0$

Commercial foodgrain imports,

(3.4) $b_{43} y_3 + y_4 + g_{45}\ x_5 + g_{46}\ x_6 = u_4$

Foodgrain availability,

(3.5) $-y_3 - y_4 + y_5 - x_5 - x_6 = 0$ and

Foodgrain demand,

(3.6) $b_{65}\ y_5 + y_6 + g_{67}\ x_7 + g_{68}\ x_8 + g_{69}\ x_9 = u_6$

where each variable is understood to have a subscript $t = 1, 2, \ldots, n$ referring to the calendar year observations.

For the six endogenous variables and the nin predetermined variables, the economic and statistical models correspond as follows:

endogenous	predetermined
$y_1 = A_g$	$x_1 = P_g^*$
$y_2 = Ac$	$x_2 = P_c^*$
$y_3 = Q_g^s$	$x_3 = Y^*$
$y_4 = M$	$x_4 = T$
$y_5 = Q_g^a$	$x_5 = S$
$y_6 = P_g$	$x_6 = F$
	$x_7 = P^*$
	$x_8 = Q_s^a$
	$x_9 = N$

The variable Y_g is average foodgrain yield per acre as defined in the economic model. Further elaboration and specification of other variables appears in the next section.

Equations (3.1) through (3.6) may be stated more concisely in matrix notation. Let Y be a vector of endogenous variables,

$$Y = (y_1, y_2, y_3, y_4, y_5, y_6),$$

x a vector of predetermined variables,

$$X = (x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9)$$

and U a vector of disturbance terms and zeros for the two identies,

$$U = (u_1, u_2, 0, u_4, o\ u_6)$$

Let B be a 6 x 6 matrix of parameters (the b's) for the endogenous variables,[1]

$$B = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ -Y_g & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & b_{43} & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & 1 & 0 \\ 0 & 0 & 0 & 0 & b_{65} & 1 \end{bmatrix}$$

and G a 6 x 9 matric of parameters (the g's) for the predetermined variables,

---

[1]Strictly speaking, Y_g (yield per acre of foodgrains) is not a parameter. But as argued in Chapter II, Y_g is exogenous and therefore may be included in the transitional equation (3.3) above without complicating the estimation of the system.

$$G = \begin{bmatrix} g_{11} & g_{12} & g_{13} & g_{14} & 0 & 0 & 0 & 0 & 0 \\ g_{21} & g_{22} & g_{23} & g_{24} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & g_{45} & g_{46} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & g_{67} & g_{68} & g_{69} \end{bmatrix}$$

In this notation, the structural equations become

$$BY + GX = U$$

When B is a triangular matrix -- as it is above -- the system is referred to as "recursvie". Moreover, when the disturbances in vector U are independent, the system is defined as "diagonally recursive". In this latter case, "...full-information maximum likelihood [estimation] is identical with ordinary least squares applied to each equation in turn"[2] assuming the disturbances have a normal distribution function. The appropriateness of ordinary least squares in a diagonally recursive system will be utilized in this study.

---

[2]J. Johnson, Econometric Methods, McGraw-Hill, New York, 1960, p. 206.

The stochastic properties assumed for the system are:

i) $E(U_t) = 0$ for $t = 1,2,\ldots,n$.

ii) $E(U_t^1 U_t) = S$ (where S is a 6x6 diagonal matrix) for all $t = 1,2,\ldots,n$.

iii) $E(U_t^1 U_{t'}) = 0$ which is nxn and tt $t' = 1,2,\ldots,n$.

Assumption i) states that the expected value is zero for all disturbances over each observation; assumption ii) specifies homoskedasticity for the disturbance in each equation and independence among disturbances in different equations; and iii) states the assumption that serial correlation does not occur in the system.

The assumption that the system is diagonally recursive would appear realistic for equations (3.1), (3.4), and (3.6). Errors in equation (3.1) result from production decision errors and the effects of other unspecified variables that influence producers.[3] For equation (3.4), the disturbance term involves errors associated with technical importing processes and decisions of policymakers. Consumer expectations provide a probable source of error for equation (3.6). Similarly

---

[3]Any relevant variables excluded from equation (3.1), as well as other structural equations, are assumed to be uncorrelated with the included explanatory variables. If this assumption is invalid, the estimated parameters will be biased and statistically inconsistent.

errors in equation (3.2) would be independent of disturbances in equation (3.4) and (3.6). The two supply equations, however, are more likely to have correlated disturbances because of coexistent decision errors for producers who grow both foodgrains and commercial crops. Full information maximum likelihood estimation could be employed to account for correlation among the disturbances.

The Data[4]

Most less developed countries lack complete and reliable aggregate data for econometric analysis. India is not immune to this deficiency despite the superiority of her data relative to many developing countries. Nevertheless, researchers increasingly are applying modern statistical techniques to Indian data and this study joins that trend. India's crop production and price data are of particular interest here.

Major responsibility for actual data collection in India rests with individual states. The result has been substantial variation in completeness, reliability and comparability among

[4]Jitendar S. Mann deserves special appreciation for supplying his data, part of which was employed in this study. Some of the remainder provided a basis for checking other sources.

the various states.[5] One particular weakness is that crop production figures are not comparable from year to year. Officials arrive at production estimates by first estimating area devoted to each crop and then estimating the average yield per area unit. Thus errors stem from expansion in the area covered by those responsible for gathering statistics and from changes in yield estimating techniques. Fortunately, officials publish an index of area planted to various crops that is corrected for changes in coverage. All acreage data in this study were obtained by applying the indexes of area planted to the actual 1961-62 reported acreage for various crops.

Improvements in the technique of estimating yields have been introduced mainly after 1950 and also must be considered when employing Indian production data. In the older method, estimated yields were based on generally observed deviations from typical growing conditions and normal yields. This

---

[5]Based on the replies of individual states, the aggregate crop estimates become the responsibility of the Directorate of Economics and Statistics, Ministry of Food and Agriculture. Several minor crops (spices, dyes and drugs) are not reported. The area represented by these excluded crops and non-reporting of included crops is about ten percent of total cropped area. This information as well as that above was taken from: <u>Statistical Abstract of the Indian Union</u>, Central Statistical Organization, New Delhi, 1963 and 1964, p. 44.

technique has been gradually replaced by actual yield checks at randomly selected points. To obtain comparabilityover time, officials have constructed indexes of crop production, known collectively as the Index of Agricultural Production, by linking each year's production estimates under the new method with the previous year's estimates based on the combination of fold and new method used that year. Operationally, they calculate production in a particular year by both the current and previous year's methods. This isreferred to as the "chain base method" and leads to a moving index that, in any year, is comparable over time. Since this study required quantity data so that food-aid and imports could be aggregated with domestic production, the indexes were applied to the 1959-60 production estimates to obtain quantity estimates for all years.

Another data problem concerns the appropriate observation period. Because production estimates are reported for crop years (June-July), they are not strictly comparable with calendar year price data. Moreover, there are two distinct crop seaons in a crop year. The summer or <u>kharif</u> season and the winter or <u>rabi</u> season. The majority of foodgrain crops (rice, small millets, maize, bajra and ragi) are grown in the kharif season and are harvested in the final quarter of the calendar year or early the following year. These are assumed to become available for consumption the following calendar year, e.g. the 1955-56 crop is marketed in calendar year 1956. Wheat and barley, the principal rabi crops, are harvested from March to June; 75 percent are assumed to become available for consumption during the year harvested and the remaining 25 percent the following calendar year. Jowar (sorghum) is grown in both seasons but it is assumed to become available in the same fashion as kharif crops. To account for seed and other uses, the Indian practice of deducting 12.5 percent from total production has been followed.

Lacking data on actual quantities consumed, the "availability" concept was adopted for calculating the quantity demanded. Equation (3.5) defines quantity available as equal to quantities supplied from domestic production, commercial imports, food-aid and domestic stocks. If adequate data on "marketed surplus" from domestic production had existed, they would have been employed rather than aggregate figures.

The most complete and reliable price data in India comes from the Wholesale Price Index.[6] The various subseries in

---

[6]For a discussion of Indian price data and the merits of wholesale prices, see: Indian Society of Agricultural Statistics, 1963, p. 101.

this index supplied the price data for the present study. Annual data are published which are simple averages of monthly prices collected in numerous market centers. The parameter estimates in the next section should be viewed as applying at the wholesale level rather than at farm or retail levels. Most estimates of crop response have been based on wholesale prices so they can be compared to this study's results.

When analyzing aggregate price and quantity data, one should recognize certain deficiencies in these series. First, the regional variation in Indian prices has been substantial, particularly in shortage years when the periodic zonal restrictions on foodgrain movement between regions were imposed in varying degrees. Although regional variation alone would not invalidate the use of a single price series if prices varied the same percentage from the base year prices in all regions, this has not been true in India. In some years, nominal prices were increasing in certain regions at the same time that they were falling in other regions.[7]

---

[7]This is discussed in connection with zonal restrictions by Uma Kant Srivastava, "The Impact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India: Comment", American Journal of Agricultural Economics, February, 1968, pp. 143-45.

Whether this inconsistency exists in the price series employed here depends on the regional variation in the general wholesale price index inasmuch as all nominal prices have been deflated by the general index for the purposes of this study. A second problem arises because quantities of several different grains have been aggregated and their respective price series are not completely correlated. And since wheat made up 92 percent of food-aid shipments through 1963, it can be argued that all variables should be specified for wheat. But actually food-aid has been widely distributed in India and would have affected prices of other foodgrains in the regions where no wheat is grown. Finally, by defining prices on an annual (calendar year) basis, the data abstract from seasonal price variations.

Appendix A contains the specific sources and actual data employed in the regression analysis. However, the classification given in Table 3.1 below defines the principal characteristics of each variable and collates the notation employed earlier with the computer notation adopted in the next section. It should be noted that for several variables defined earlier, more than one specification was included in the actual estimation. In addition to the two alternative price expectations for the supply equations,

Table 3.1: Classification and definition of economic, statistical and regression variables

Economic-Statistical Variables	Regression Variables	Variable Dimension	Definition[a]
$A_g = y_1$	ACER	1,000 acres	Total acres planted to cereals. Acreage index (1961-62 = 100) times actual reported acreage in 1961-62.
$A_c = y_2$	ACOM	1,000 acres	Total acres planted to oilseeds, fibres, sugarcane and tobacco. Acreage index for each crop (1961-62 = 100) times actual reported acreage in 1961-62.
$Q_g^s = y_3$	QCERS	million metric tons	Total quantity of cereals available for consumption from domestic production. Adjusted from crop to calendar years; 12.5 percent deducted for seeds, feed and other uses.
	QCERSPC	pounds per capita	Above adjusted to a per capita basis.

Economic-Statistics Variables	Regression Variables	Variable Dimension	Definition[a]
$M = y_4$	IMPORTS	million metric tons	Quantity of commercial cereal imports.
	IMPORTPC	pounds per capita	Above adjusted to a per capita basis.
$Q_g^a = y_5$	QCERAV	million metric tons	Total quantity of cereals available for consumption from domestic production, commercial imports, government stocks and food-aid $Q_g^s + M + S + F$).
	QCERAVPC	pounds per capita	Above adjusted to a per capita basis.
$Pg = y_6$	PCER	index	Wholesale price index of cereals (1952-53 = 100) deflated by the wholesale price index of all commodities.
$P_g^* = x_1$	PECER	index	Producer price expectation for cereals; the simple average of PCER in (t-1) and (t-2) periods.
	PCERL2	index	Producer price expectation for cereals; PCER in (t-2) period.

Economic-Statistics Variables	Regression Variables	Variable Dimension	Definition[a]
$P^*_C = x_2$	PECOM	index	Producer price expectation for commercial crops (fibres and oil-seeds only); weights used were .099 and .045, respectively; the simple average of prices (deflated) in (t-1) and (t-2) periods.
	PCOML2	index	Above for (t-2) period only.
$Y^* = x_3$	YRCC	index	Ratio of yield indexes for cereals and commercial crops in (t-1) period.
$T = x_4$	T	Years	time 1952 = 0, 1953 = 1, ..., 1963 = 11
$S = x_5$	STOCKS	million metric tons	Withdrawal of cereals from government stocks.
	STOCKSTC	pounds per capita	Above adjusted to a per capita basis.

Economic-Statistics Variables	Regression Variables	Variable Dimension	Definition[a]
$F = x_6$	PL 480	million metric tons	Shipment of cereals under Title I of Public Law 480.
	PL 480PC	pounds per capita	Above adjusted to a per capita basis.
$P^* = x_7$	PCERLI	index	Consumer price expectation for cereals; PCER in (t-1) period.
$Q_s^a = x_8$	QPULAV	million metric tons	Total quantity of pulses available from domestic production.
$N = x_9$	POP	millions	Total Indian population at midyear (July 1).

[a]Variables y_1, y_2 and x_3 defined for crop years; all others defined for calendar years, 1952-1963.

import and demand equations have been estimated on a per capita basis as well as the aggregate specification given in Chapter II. This is why there are more variables defined in Table 3.1 than the six endogenous and nine predetermined ones included in the economic and statistical models.

Three poinds should be emphasized in connection with the results reported in the next section. First, pulses have been omitted from the analysis because supply equations estimated for pulses alone did not prove satisfactory. In particular, pulse acreage was positively related to cereal prices and negatively related to pulse prices. So when cereals and pulses were aggregated into foodgrains, the resulting equations gave apparently satisfactory results but for the reason that pulse acreage was correlated to foodgrain prices through cereal prices rather than pulse prices. Thus it was decided to abstract from the unusual and unexplained behavior of pulse acreage. Likewise the demand equations for foodgrains were not as satisfactory as for cereals where pulses were viewed as a consumption substitute. Consequently all subsequent discussion is in terms of cereals rather than foodgrains. Second, because of the adjustment from crop years to calendar years, the quantity available from domestic production in a given calendar year is not synonymous with the corresponding crop year production.

For instance, 1960 availability is equal to 1959-60 production of kharif crops, and 75 percent of rabi (wheat and barley) production in 1959-60 and 25 percent of 1958-59 rabi production. The third point relates to interpretation of the cereal price variable. Because it is deflated by the wholesale price index of all commodities, the model is not suited to an analysis of food-aid's relation to the general price level. For example, a decrease in cereal prices as defined here could occur concurrently with a rise in nominal cereal prices if the general price level rose at a faster rate.

All results are based on 12 calendar year observations from 1952 through 1963. Prior to 1952 there was greater government intervention in markets and data are sketchy, particularly for prices which would need to go back to 1949 figures to include even 1951 in the observations. Furthermore, P.L. 480 shipments did not begin until 1956 and to include years prior to 1952 would only extend the number of observations for which the main studied variable had a zero value. After 1963, the India food economy has been most erratic owing not only to crop failure but also speculative activity in foodgrains associated with more rapid population growth in the 1960's.

Regression Results

This section reports the parameter estimates when ordinary least squares estimation was applied to the data and linearly specified equations. If the disturbance terms were uncorrelated, as assumed, the estimates will be unbiased, efficient and consistent.

There are four groups of estimated equations: cereal acreage (supply), commercial crop acreage (supply), cereal imports and cereal demand. Under each, the equations reported were selected from a larger number actually estimated. Decisions to include or exclude a particular equation were based on the plausibility of the results (the signs of the coefficients), the statistical significance of the estimated parameters and the explanatory power of the variables (or R^2, the coefficient of multiple determination).

Standard errors are given in parentheses under all estimates. For those estimates that were signficantly different from zero at a .05 level of test, three asterisks (***) are attached to the standard errors. Two asterisks (**) are attached for .10 significance. Because only twelve observations were included, there were few degrees of freedom in any equation -- only eight in the equations with three explanatory variables -- and so estimates that were statistically significant at a .30 level of test are identified by a single asterisk (*). The Durbin-Watson test statistic (d) for serial correlation appears below the R^2 for each equation. A value of d below 1.4 suggests positive serial correlation. This situation only arose in some of the demand equations.[8]

For each of the four structural equations in the model, one "preferred" equation was selected and is reported below. These four equations become the basis for estimating the resource benefits from food-aid in the remainder of the study. However, several hypothetical models are also studied by imposing different values for selected parameters so that the estimated benefits may be evaluated for situations that might have existed during the 1952-63 period. This "sensitivety analysis" was suggested, in part, by the alternative parameter estimates obtained under different specifications. Some of these results are also reported below.

---

[8]The above tests depend on the assumption that disturbances are normally distributed. If one prefers one-way significance tests for economic parameter estimates, the notation above would apply at half the stated levels of test. e.g., (***) would correspond to a .025 rather than a .05 level of test. For a discussion of the Durbin-Watson test, see Arthur S. Goldberger, Econometric Theory, John Wiley and Sons, New York, 1964, pp. 243-244.

Cereal and Commercial Crop Acreage

As postulated in Chapter II, cereal and commercial crop acreage are functually related to producers' price expectations for each crop aggregate, the average (relative) yields the preceding year and time.

The following represent the results of regressing cereal and commercial crop acreages on these explanatory variables:

Cereal acreage:

$$(3.7)\ ACER - \underset{(34{,}156.126)^{***}}{198{,}816{,}467} + \underset{(179.740)^{*}}{291.997\ PECER} - \underset{(146.323)^{***}}{383.031\ PECOM}$$

$$+ \underset{(228.759)}{225.242\ YRCC} + \underset{(33.942)^{***}}{2{,}850.543\ T} \quad ; \quad R^2 = .956, \quad d = 2.42$$

and commercial crop acreage:

$$(3.8)\ ACEM = \underset{(17{,}219.728)^{***}}{71{,}768.853} - \underset{(90.615)^{**}}{174.786\ PECER} + \underset{*73.769)}{41.786\ PECOM}$$

$$- \underset{(115.328)}{122.146\ YRCC} + \underset{(168.356)^{***}}{1{,}410.759\ T} \quad ; \quad R^2 = .953, \quad d = 2.32$$

All signs are consistent with <u>a priori</u> expectations and the coefficients for cereal prices are signficantly different from zero at the .15 and .10 levels in equation (3.7) and

(3.8), respectively. Commercial crop prices are significant at the .04 level in (3.7) but did not turn out to be important in the commercial crop equation. This may be because PECOM includes only prices of fibres and oilseeds -- which were available -- and does not include prices for sugarcane and tobacco which make up about 15 percent of total commercial crop acreage. Relative yields were not statistically significant given the type of hypothesis tested above. But they do have the expected signs and if a one-way test had been conducted the variables would have been significant at a .20 level of test.

The R^2's compare favorably with other attempts to explain acreage variations for Indian crops.[9] Much of the explanatory power must, however, be attributed to time -- when T was deleted, the remaining variables explained 50 and 48 percent of the variation in cereal and commercial crop acreage, respectively. Even though the inclusion of time as an explanatory variable is generally undesirable, it was considered

---

[9]See, e.g., Raj Khrisha, "Farm Supply Response in India-Pakistan: A Case Study of the Punjab Region", Economical Journal, September 1963, pp. 477-87. For 11 equations, he reported, R^2's varied from .26 to .92.

necessary here to remove the known trend in acreage over the 1952-63 period. An alternative approach would have been to include population in place of time since it is also a trend variable and was arguably a major reason for acreage expansion.[10] At any rate, the simpler model with time as a variable was judged to be the best specification for present purposes, assuming that the general trend in acreage was independent of price movements.

Overall, the results lend some additional support to the belief that producers in less developed countries respond rationally to prices. In this aggregate specification, however, the larger and more market-oriented producers could have accounted for the significant price coefficients even though the majority of smaller, subsistence cultivators did not respond, or responded irrationally.

The acreage elasticities implied by price coefficients in equations (3.7) and (3.8) and computed at the mean values of the relevant variables are (asterisks refer to the statistical significance of the estimated coefficients):

---

[10]Still another specification would have been a Nerlove distributed lag model. When this was explored, the results were plausible although difficult to interpret because lagged acreage was correlated with the trend in acreage. And the trend was probably not due primarily to an "adjustment lag" mechanism since prices did not show a corresponding trend over the period.

	PECER	PECOM
ACER	.12*	-.20***
ACOM	-.26**	.08

Interestingly enough, the estimates for cereal acreage fall near the middle of the .0 to .4 range in the Krishna classification discussed in Chapter II. However, the results above are at the lower end of the .1 to .7 range he gave for commercial crops.[11]

If these equations had been estimated with the restriction that total acreage allocated to both crops was fixed in any one year, the coefficients of PECER and PECOM would have been numerically the same in both equations. Inasmuch as the acreage planted to cereals was on the average quadruple the acreage in commercial crops, the elasticities for the latter at the means would also have been four times larger. This did not materialize because no such restriction was included in the estimation process. Instead, the parameters were allowed to assume

---

[11]Krishna, Price Policy, p. 504. The research results from which he arrives at these ranges specify acreage as a function of relative prices (the ratio of the crop's price to a price index of substitute crops) and other variables. With this specification, the elasticities of acreage with respect to own-price and relative prices are identical; and they equal the negative of the cross-elasticity (with respect to prices of substitutes). Thus both the elasticities and cross-elasticities above can be meaningfully compared to Krishna's ranges. Note, however, that our specification does not restrict the relationships among the elasticities in this way.

whatever values were indicated by the data. For instance, the coefficients of PECER indicate that a unit increase in PECER would increase acreage planted to cereals by 291,097 acres; decrease commercial crops by 174,786 acres; and thus lead to a net increase of 116,311 acres planted. While some of these acres might come from other crops or idle acres, part presumably would result from more double-cropping of existing area. For PECOM, the results are not as easily interpreted -- an increase leads to a net decrease in acreage planted -- and should therefore be viewed with some caution.

Equations (3.7) and (3.8) have price expectation variables that give equal weight to (t-1) and (t-2) period prices. The alternative specification proposed in Chapter II has (t-2) prices for price expectations. The results for this specification in the cereal equation are given below for comparative purposes. The price coefficients were not statistically significant for commercial crop acreage even though they were of the expected sign.

$$
\begin{array}{llllll}
(3.9) & ACER = 200{,}873 & + 235.441\ PCERL2 & & -283.825\ PCOML2 & \\
 & (31{,}661.412)^{***} & (151.929)^{*} & & (119.074)^{***} & \\
 & + 135.411\ YRCC & + 2377.970\ T & ; & R^2 = .950 & \\
 & (249.096) & (346.282)^{***} & & d = 2.22 &
\end{array}
$$

Commercial Cereal Imports

Shipments of food-aid enter the postulated system in two ways: by increasing the quantity of cereals available for consumption, and by influencing the quantity of commercial imports. Estimated equations for the latter are reported here. Equation (3.10) specifies quantity supplied, withdrawals from stocks and food-aid shipments as separate explanatory variables on a per capita basis. The results are more plausible and statistically significant than when an aggregate specification was employed -- equation (3.11). For a given year, the two equations are comparable since the population variable would have been constant. Equation (3.10) says that for a one million metric ton increase in the quantity of food-aid, commercial imports decrease by 43.1 percent or 431,000 tons. The estimated displacement in equation (3.11) is 19.8 percent. For later analyses, equation (3.10) will be employed as the basic equation although for comparative purposes, results based on equation (3.11) will also be reported.

$$
\begin{array}{llll}
(3.10) \quad \text{IMPORTPC} = & 67.659 & -.198\ \text{QCERSPC} & -\ .431\ \text{PL 480PC} \\
 & (16.8430)^{***} & (.059)^{***} & (1.33)^{***} \\
 & -\ .712\ \text{STOCKSPC}\ ; & & R^2 = .806 \\
 & (.323)^{**} & & d = 1.69
\end{array}
$$

$$\text{(3.11)} \quad \text{IMPORTS} = 6317.392 - \underset{(.061)^{*}}{.090\ \text{QCERS}} - \underset{(.248)}{.158\ \text{PL 480}} - \underset{(.468)}{.332\ \text{STOCKS}}\ ; \qquad R^2 = .584, \quad d = 1.34$$

When population was added to the explanatory variables in equation (3.11), a surprising result emerged. The R^2 improved markedly, all explanatory variables (except the constant) were significant at the .005 level of test, and the magnitudes of all coefficients rose sharply.

$$\text{(3.12)} \quad \text{IMPORTS} = \underset{(5.312)^{***}}{-16.726} - \underset{(.051)^{***}}{.269\ \text{QCERS}} \underset{(.267)^{***}}{-1.209\ \text{PL 480}} \underset{(.368)^{***}}{-1.551\ \text{STOCKS}} + \underset{(.019)^{***}}{.084\ \text{POP}}; \qquad R^2 = .895, \quad d = 2.38$$

In this equation, the coefficient on food-aid indicates that commercial imports were more than completely displaced by food-aid shipments. A statistical test for this coefficient compared with unity -- exact displacement -- would lead to the conclusion that shipments completely displaced commercial imports during the 1952-63 period. Although this conclusion would be extreme in light of the attempted restriction on import displacement in P.L. 480 agreements, if it actually reflects the true state of affairs, then food-aid was as valuable to India as dollar-aid because the latter would have in this context been allocated to commercial imports. The coefficient for population implies that increases in population with other variables fixed led to expanded commercial imports at the rate of 185.2 pounds per capita. Relative to the average annual per capita cereal consumption of approximately 300 pounds during 1952-63, this estimate appears quite realistic.

Cereal Demand

The recursive model conceptualized in Chapter II specifies that current cereal prices are functionally related to the quantity of cereals and substitute commodities available for consumption, the prices of cereals lagged one period and current population. Pulses have been included as the most feasible substitute for cereals in consumer diets. The results are given below:

$$\text{(3.13)}\quad \underset{(44.306)}{PCER = 21.534} - \underset{(.976)^{***}}{2.467\ QCERAV} + \underset{(1.827)}{1.416\ QPULAV}$$

$$+ \underset{(.216)^{*}}{.351\ PCERL1} + \underset{(.176)^{**}}{.390\ POP}; \qquad R^2 = .708, \quad d = 2.29$$

Except for the positive coefficient on the quantity of pulses, which is not statistically significant, all coefficients have the expected signs. Although the R^2 is not particularly high, the price-quantity coefficient is significant at the .05 level and it was in all alternative specifications explored. Equation (3.13) has an implicit price elasticity of demand of -.4 at the mean values of prices and cereal availability. This estimate was obtained from the inverse of the flexibility and it shows for long run adjustments through lagged cereal prices. Unfortunately, there is little evidence with which to compare the above elasticity estimate. The National Council of Applied Economic Research has provided one of the few estimates: -.34 for the 1938-39 through 1959-60 period.[12]

For comparison, the demand equation given below has quantity available expressed on a per capita basis. The results are similar to the aggregate specification although the implicit price elasticity of demand is somewhat higher: -.71.

---

[12]Long Term Projections of Demand for and Supply of Selected Agricultural Commodities, 1960-61 to 1975-76, National Council of Applied Economic Research, New Delhi, 1962, p. 80.

$$(3.14)\quad PCER = \underset{(27.307)^{***}}{149.384} - \underset{(.071)^{***}}{.284}\ QCERAVPC + \underset{(.185)^{*}}{.296}\ PCERLI;$$

$$R^2 = .675$$

$$d = 1.74$$

When lagged cereal prices were omitted from the specification, the price elasticities increased to around unity for both the aggregate and per capita specifications; and the Durbin-Watson statistic indicated the possibility of positive seral correlation. Because of these alternative results, the estimated direct effects include a model that allows for the possibility of a significantly higher price elasticity than the one given by equation (3.14).[13]

Estimated Direct Effects

The estimated direct effects follow directly from the regression analysis and depend, for their accuracy, on

---

[13]When prices of pulses was included as an explanatory variable instead of the quantity of pulses, the R2's increased in the various equations to .82 to .86 but the implicit elasticity estimates rose to over -3.0 and the d statistic dropped to below one. Since the price of cereals was the dependent variable, the inclusion of pulse prices as an explanatory variable was considered inappropriate and therefore these equations are not detailed above.

the reliability of the estimated parameters.[14] From the theoretical discussion in Chapter II, we note that the direct effects correspond, one-for-one, to the endogenous variables in the system. When we solve for the system's reduced form, the current period effects generated by changing a predetermined variable are given by the partial derivative of each endogenous variable with respect to the predetermined variable. But the presence of lagged endogenous variables (cereal prices in this system), implies additional effects in subsequent time periods. Conceptually, changing a particular predetermined variable "shocks" the system out of equilibrium and it returns to equilibrium through a series of adjustments over a time span. The length of this span depends on the type of lags in the system.

Goldberger refers to econometric models that contain lagged endogenous variables as "dynamic models"; he terms

---

[14]An alternative approach would have been to express the economic model in Chapter II in deterministic equations, and solve for the endogenous variables in terms of the predetermined variables and parameters. Then we could have selected parameter estimates from other research, substituted them in the system and analyzed the effects of a change in any predetermined variable, including food-aid. This alternative was not taken because of the lack of empirical estimates of many parameters in our model. Furthermore, few crop supply equations have specified the general cereal price variable needed to relate supply to the aggregate demand equation. Some account of other research is incorporated by considering hypothetical models.

the current period effects as "impact" multipliers, and the effects in later periods as "delay" multipliers.[15] Summing the effects in all time periods gives the "cumulated" multipliers. These multipliers are useful in investigating two types of questions. First, what will be the effects in the present and subsequent time periods if a predetermined variable is either (i) increased by one unit in the present period and then restored to its previous level (a "one-shot" increase) or (ii) increased in the present period and continued at this new level (a "sustained" increased)? The impact and delay multipliers provide the answer to this question for a particular period and the "cumulated" multipliers for the sum of effects through some future period. The second question is of greater interest in this study: what will be the total effects on endogenous variables after equilibrium is restored if a predetermined variable is increased by one unit? The "cumulated" multipliers calculated after the system has returned to equilibrium answer this question. For a one-shot increase, the cumulated multipliers

---

[15]Goldberger, Econometric Theory, pp. 373-76.

give the total effects after the original equilibrium has been restored; for a sustained increase, the cumulated multipliers give the effect after the system has adjusted to a new equilibrium. The calculated effects are identical with either a one-shot or sustained increase but are interpreted differently. For the former, they occur only once and are distributed over the adjustment period; for a sustained increase, the effects occur every period (after a short adjustment) and the new equilibrium differs from the original one.[16] This latter interpretation is simply a comparative statics analysis. Either interpretation is applicable to the results below.

Goldberger has derived a method for calculating the "cumulated" effects after the system has returned to equilibrium.[17] For brevity, only the multipliers for changes in food-aid shipments are reported here.

---

[16]These interpretations are analogous to multipliers in national income-expenditure theory for single period vs. permanent changes, say, in government expenditures. This is discussed in Don Patinkin, Money, Interest and Prices, Second Edition, Harper and Row, 1965, pp. 343-48.

[17]Goldberger, Econometric Theory, p. 375.

$$\bar{D}_F = \begin{matrix} g_{11}\ b_{65}\ (1-g_{46})/d^* \\ g_{21}\ b_{65}\ (1-g_{46})/d^* \\ g_{11}\ b_{65}\ (1-g_{46})Y_g/d^* \\ -\ g_{11}b_{65}b_{43}\ (1-g_{46})Y_g/d^* - g_{46} \\ (1-g_{46}) - g_{11}\ b_{65}\ (1-g_{46})\ (1-b_{43})Y_g/d^* \\ -\ b_{65}\ (1-g_{46})/d^* \end{matrix}$$

where $d^* = 1 - g_{11}\ g_{65}\ (1-b_{43})\ Y_g + g_{67}$

$\bar{D}_F$ is a vector with six elements that, in order, give the cumulated effects (after equilibrium is restored) on:

i) cereal acreage (A_g)

ii) commercial crop acreage (Ac)

iii) cereal production (Q_g^s)

iv) commercial cereal imports (M)

v) cereal availability for consumption (Q_g^a), and

vi) cereal prices (P_g)

The effects correspond to a one million metric ton increase in food-aid shipments.[18] Even for a relatively simple six-equation model, the multipliers are reasonably complex. They take into account all the necessary interactions among the

---

[18]By changing the dimension of the cereal quantity variables, say from a million to a thousand metric tons, the estimated coefficients in the regression equations would change so that $\bar{D}_F$ would give the effects of a 1,000 m.t. change in shipments.

variables for the system to return to equilibrium.[19]

Before proceding, it may be instructive to examine the $\overline{D}_F$ matrix for a comparable but simpler system. Consider the following simple cobbweb model:

$$q^s = bp_{t-1} \quad , \; b > 0$$

$$q^d = q^s + m$$

$$p = a + cq^d \quad , \; c < 0$$

where q^s = quantity supplied,

q^d = quantity demanded,

m = quantity from imports,

p = current prices, and

p_{t-1} = current prices lagged one period.

Now suppose the system is shocked from initial equilibirum by a one unit and one-period increase in the exogenous variable m during period t. The following sequence occurs:

time period	- effects - q^s	q^d	p
t	0	1	c
t+1	bc	bc	(bc)c
t+2	$(bc)^2$	$(bc)^2$	$(bc)^2c$
t+3	$(bc)^3$	$(bc)^3$	$(bc)^3c$
.	.	.	.
.	.	.	.
.	.	.	.
∞	0	0	0

[19]For the system to be stable, the matrix of reduced form coefficients of the lagged endogenous variables (A), augmented by columns of zeros for variables that are not lagged, must have the following property $\lim_{r \to \infty} A^r = 0$

This condition is met for the estimated parameters in our system.

Prices fall in t, output falls and prices rise in (t+1), output rises and prices fall in (t+2), etc., until the original equilibrium is restored.[20] In a stable system $|bc| < 1$ and so the effects decrease in magnitude each period and eventually reach zero. The cumulated effects are just the sum of each (geometric) series, and are given by

$$\bar{D}_m = \begin{bmatrix} bc/(1-bc) \\ 1 - bc/(1-bc) \\ c/(1-bc) \end{bmatrix}$$

Although there are only three terms in $\bar{D}m$, they are similar in form to the terms in $\bar{D}_F$. For instance, the price effect contains all the three properties that distinguish $\bar{D}_F$ and $\bar{D}_m$. In the numerator, the price coefficients from the demand equations appear in each but in $\bar{D}_F$, the term $(1-g_{46})$ is also included because an increase in food-aid initially displaces commercial imports to the extent of g_{46}, leaving only $(1-g_{46})$ to affect prices. In the denominator, $\bar{D}_F$ contains the coefficient g_{67} corresponding to lagged prices in the demand equation. No corresponding parameter

---

[20]This assumes that the system is stable which it will be if $|bc| < 1$, i.e. the supply curve is steeper than the demand curve. If $|bc| > 1$, the system explodes.

exists in $\overline{D}m$ because lagged endogenous prices are excluded from the demand equation in the simpler model. Also included in the denominator of $\overline{D}_F$ is the term $(1-b_{43})$. This accounts for the effect of changes in domestic supply on commercial imports -- again, a term that does not appear in $\overline{D}m$ because commercial imports are not functionally related to domestic supply in the latter system.

Had we considered a sustained increase in m, the same "direct effects" terms in $\overline{D}m$ could be derived in a manner similar to the procedure just outlined except that the final expression would represent the direct effects for every period after equilibrium is restored. In either case, the system would return to equilibrium rather quickly. After four periods, the endogenous variables would have completed at least 94 percent of their adjustments.[21]

Before relating the estimated direct effects, one final point should be noted about $\overline{D}_F$. It contains a small number of parameters -- only six of the fifteen parameters in the system. In addition, it includes the average yield per acre

---

[21]Despite the more complicated lags involved, the adjustment occurs even more rapidly in this study's model. Within three time periods, the disincentive and allocative effects adjust to within one percent of their total adjustment.

of cereals over the 1957-63 period when food-aid would have influenced domestic supply. This figure was 257.5 metric tons per thousand acres (or 556.7 pound per acre); so for the dimensions of the variables employed in the statistical analysis (millions of m.t's), yg = .0002525.

To determine the direct effects, the estimated parameters from equations (3.7), (3.8), (3.10) and (3.13) were substituted in $\bar{D}_F$ with all signs reversed since the statistical model had variables left of the equality sign and the empirical results were reported with only the dependent variables left of equality. Table 3.2 contains the estimates for these equations under Model I -- the empirical model -- as well as estimates from five hypothetical models. Each hypothetical model is a derivative of Model 1, as follows:

Model II - Acreage supply parameters (g_{11} and g_{21}) imposed so that the elasticities of acreage planted to cereals and commercial crops with respect to cereal price expectations would be +.4 and -.7, respectively, at the means of the relevant variables. There were selected as upper limits from Krishna's classification. The results will illustrate the sensitivity of the direct effects to changes in the supply parameters.

Table 3.2: Direct effects of a one million metric ton increase in food-aid shipments to India, six alternative models, 1952-63 period

Direct Effects	Models					
	I	II	III	IV	V	VI
1. Allocative (1,000 acres)	309.022	570.445	0	139.829	543.060	446.054
2. Disincentive a. acres (1,000)	-516.620	-1,210.138	0	-232.878	-904.438	-742.880
b. million metric tons	-.130	-.306	0	-.059	-.228	-.188
3. Import Displacement (million m.t.'s)	-.405	-.370	-.431	-.419	.045	-.141
4. Consumption (million m.t.'s)	.465	.324	.649	.522	.817	.671
5. Prices (index)	-1.768	-1.231	-2.163	-.800	-3.107	-2.552

<u>Model III</u> - A model with restrictions imposed on the supply parameters so that there are no disincentive or allocative effects, i.e. $g_{11} = g_{21} = 0$. Several interpretations may be given to the results provided by this model: (1) an effective price support program in which producers were isolated from price depressing effects of food-aid; (2) a situation in which producers were not responsive to prices in their allocation of acreage between cereals and commercial crops; and (3) a situation in which food-aid was distributed in such a way that it did not alter open market prices. In case (3), the price effect given in Table 3.2 would also be zero.

<u>Model IV</u> - A model in which the cereal price coefficient in the demand equation has been adjusted so that the price elasticity of demand is unity. This model was suggested by demand equation (3.13) and illustrates the sensitivity of the estimates to changes in b_{65}.

<u>Model V</u> - In this model, a restriction was placed on import displacement so that the initial impact of food-aid on commercial import was zero ($g_{46} = 0$).

<u>Model VI</u> - Model I with the import equation replaced by the results of the aggregate specification reported in equation (3.11). Here g_{46} = .158 rather than .431; and b_{43} = .090 rather than .198.

Referring to Table 3.2, the results for Model I indicate that one million metric tons of food-aid increased commercial crop acreage by 309,022 acres and decreased cereal acreage by 516,620 acres. Based on average yields per acre, during the 1957-63 period, the food-aid shipments led to an estimated decrease in domestic cereal production of 130,000 metric tons, or 13 percent of the quantity of shipments. Displacement of commercial imports turned out much higher in Model I -- 405,000 metric tons or 40.5 percent of food-aid shipments. The net increase in cereal consumption was 465,000 metric tons or 46.5 percent of shipments. On a per capita basis, the estimated annual incremental consumption was some 5.1 pounds for the mean population of 430 million during the 1956-63 period.

Based on these results, several previously qualitative statements can now be asserted quantitatively. The controversial disincentive effect appears to have been rather small -- about 13 percent of shipments. Even if this is multiplied by the average annual quantities shipped during 1956-63

(2.84 million m.t.'s), the decrease in domestic production has been only 1.9 pounds per capita, annually during the period of shipments.[22] This is small indeed compared with probable "leakages" in the flow of foodgrains to consumption due to rodent damage, spoilage and other wastage. As viewed here, the disincentive effect represents a potential gain to India if land and other resources are transferred to commercial crop production. Since the allocative effects given in Table 3.2 are expressed only in acres, the valuation of this effect will be delayed to Chapter V.

Commercial imports have been affected substantially more than domestic output. Slightly over 40 percent of food-aid represents the equivalent of dollar-aid because of Indian government would have otherwise allocated this much more of its foreign exchange to commercial cereal imports. While writers have recognized that food-aid displaced some of India's commercial imports,[23] the quantitative magnitude is revealing

---

[22]Due to the lag in supply response, some of this decrease would not be realized until after 1963.

[23]Witt and Eicher, Effects of Surplus Disposal, p. 62.

because this effect provides a real resource benefit to India. Commercial imports averaged 1.12 million metric tons during 1952-63, and, in the absence of food-aid, our estimates indicate that they would have averaged about 1.15 million more annually during the period of food-aid shipments (1956-63) or .76 million metric tons more annually during the entire period.

The effect on consumption has also been substantial; nearly one-half of food-aid has contributed to incremental consumption. This meant that just over one-half generated a resource transfer by saving or increasing earnings of foreign exchange. Although incremental consumption does not bring about any resource benefits, it may allow the India government to achieve one or more of the indirect benefits outlined in Chapter II.

Sensitivity Analysis

Model II shows what would have happened if producers were more responsive to prices than the empirical results indicate. Parameters were imposed in Model II so that the elasticities for cereals and commercial crop were .4 and -.7, respectively, compared with the empirical elasticity estimates of .12 and -.26 in Model I. As expected, this upper supply sensitive model yields sharply larger disincentive and allocative effects than Model I. In fact, these effects have greater magnitudes than for any other model examined. The lower domestic production has a larger secondary affect on commercial imports so that the displacement effect is somewhat reduced in Model II. The net increase in consumption is relatively small, representing only 32.4 percent of food-aid shipments.

In contrast to Model II, Model III illustrates the effects when there are no impacts on cereal and commercial crop production. Thus no secondary repercussions take place and the estimated direct effects are simply the first period impacts on commercial imports and cereal prices. For this Model, the import displacement is the only resource benefit and it is larger than for any of the other models.

An analysis of the quantity coefficient in the demand equations revealed that the estimated effects are sensitive to this parameter. In particular, when the coefficient was set at a value that implied a unitary price elasticity of demand, the estimates (Model IV) deviated noticably from the other models in several ways. As expected, prices declined much less and this caused smaller supply responses than in the other models with the exception of Model III in which supply responses were restricted to zero. Although the disincentive effect diminishes, import displacement increases slightly compared with Model I. But the net effect on consumption is still greater than in Model I, constituting 52.2 percent of food-aid shipments.

Model V represents the case where food-aid shipments do not replace commercial imports. Despite this requirement there is still a small change in imports but here they increase as a result of the secondary effect of lower domestic cereal production. The principal point emerging from Model IV pertains to the magnitude of the consumption effect. Without import displacement, 81.7 percent of food-aid ends up in the form of incremental consumption. To absorb this much food-aid, prices fall more in Model V than in any other model and, in turn, the effects on domestic production are nearly as large as in the upper supply sensitive model. In this case, the resource benefits from food-aid accrue from the allocative effect primarily; the large consumption effect may enable more of the indirect benefits outlined in Chapter II to be realized, however,

Finally, Model VI represents an interim position between Models I and V inasmuch as the coefficient for food-aid in the commercial import equation (g_{46}) is .198 in contrast to .431 in Model I and zero in Model V. The most notable feature of this model is the relatively low import displacement

effect and, consequently, the rather large consumption effect.

The estimated effects from Mann's model are given below for comparative purposes. All are in pounds per capita terms but they can be viewed as percentages since he examined a one pound per capita change in shipments.[24]

disincentive = .31

import displacement = .30

consumption = .39

The next chapter examines the resource cost of food-aid shipments, and in Chapter V we return to the task of placing a dollar estimate on the resource benefits. Chapter V also provides the analysis and major results of the study by combining the benefit and cost estimates.

---

[24]He calculated only the disincentive effect and subtracted it from the one pound increase in food-aid to arrive at a consumption effect of .69. I included his effects on stocks (.10) in the import effect, assuming that stock increases later displace imports. His model did not include an allocative effect. Mann, "Impact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India."

CHAPTER IV

RESOURCE COSTS: THEORY AND ESTIMATION

In the two preceding chapters, the groundwork has been laid for estimating the resource benefits of food-aid. This chapter provides the basis for answering the related question: "What are the resource costs inherent in food-aid?" Although treated lightly in the literature, this question becomes increasingly important under the dollar-credit sales policy recently adopted by the United States. After discussing the new policy, this chapter outlines a procedure for estimating resource costs of dollar-credit sales and provides some alternative numerical estimates. The estimates are then compared with resource costs for foreign (local) currency sales. The balance of payments effects of the two sales arrangements are examined in the final section.[1]

---

[1]Unlike the resource benefit estimates, the costs are not unique to a particular country. Because of this, the discussion in the present chapter is somewhat more general than in other chapters. For example, the term "foreign currency" is appropriate when speaking of Title I sales, in general, but the synomynous term "local currency" is commonly employed when referring to a particular country.

A major shift in United States food-aid policy was contained in the Food for Peace Act of 1966. Instead of emphasizing primarily sales for the local currency of the recipient country, as was the case in the 1954 Act, the new Act stresses sales on long-term dollar loans. It states that:

> The President shall....take steps to assure a progressive transition from sales for foreign currencies to sales for dollars... at a rate whereby the transition can be completed by December 31, 1971.[2]

At the time the Act was passed, dollar-credit sales which first began in 1961 under an amendment (Title IV) to the 1954 Act, had been relatively insignificant, comprising only 5.6 percent of the value of foreign currency sales through December 31, 1966. They assumed greater relative importance in recent years, however, amounting to 13.7 and 19.1 percent as much as local currency sales in fiscal years

---

[2]U.S. Congress, Food for Peace Act, 80 Stat. 1526, 1966, Sec. 103b. The Act actually permits conversion to another type of sale on what is termed "convertible local currency credit" (CLCC). Under CLCC sales, the U.S. has the option at the time of payment of asking for either dollars or other convertible ("hard") currencies, or the recipient country's currency to the extent needed for U.S. expenditures. Although any of these options is equivalent to repaying in dollars, the advantage of CLCC sales derives from the more lenient repayment terms they permit. Since this alternative was apparently designed for countries such as India that could not easily switch to dollar-credit, CLCC will be included in the estimates below. The narrative, however, will deal primarily with dollar-credit sales. (The information on CLCC came from personal correspondence with Frank D. Barlow, Jr., USDA, March 20, 1968).

1965 and 1966, respectively. Table 4.1 shows the sharp increase in dollar-credit sales since the first shipments occured in fiscal 1962. Nevertheless, they remained significantly below the volume of foreign currency shipments and, more important, India had received no food-aid on long-term dollar loans through 1966. Thus recipient countries as a group will be converting themajor portion of United States food-aid from foreign currency to dollar-credit sales if the 1971 deadline is to be met; for India, the conversion will be one-hundred percent.

In view of this basic policy change, two questions about the resource cost of food-aid arise. Is the repayment of a loan in dollars over a long period of time a significant burden to a recipient country? And how does it compare with the resource cost of foreign currency sales?

The "Discounted Present Cost" Procedure

To help investigate the first question, a large amount of literature has appeared in recent years in which the discounted present value method has been applied to foreign assistance loans to determine their grant elements. This work was motivated by the fact that loans and grants receive equal weights in the official definition of aid agreed upon in 1961 by the Development Assistance Committee of the Organization for Economic Cooperation and Development

Table 4.1: United States shipments under Title I (foreign currency) and Title IV (dollar-credit), Years ending June 30, 1962 through 1966

Type of Sale	1962	1963	1964	1965	1966	1962 thru 1966
			- million dollars -			
Dollar-credit (1)	19	57	48	157	173	454
Foreign Currency (2)	1030	1090	1064	1144	906	5234
			- percent -			
(1) as a percent of (2)	1.84	5.23	4.51	13.72	19.09	8.67

Source: Twelve Years of Achievement Under Public Law 480, USDA, ERS-Foreign 202, 1967, p. 5.

(OECD). Pincus attempted "to establish an economically meaningful definition of what constitutes aid" by applying the discounting method to loans.[3] Since his article appeared, others have expanded on the procedure and have reported formulas and tables to determine the grant element in nominal loans under various interest rates, grace periods, maturities and amortization arrangements.[4]

Briefly stated, the reasoning underlying the procedure runs as follows. When one country loans, say, one million dollars to a second country on concessional terms[5] -- more lenient than existing commercial terms -- the loaning country provides a form of assistance to the borrower. This assistance

---

[3]John A. Pincus, "The Cost of Foreign Aid", Review of Economics and Statistics, Vol. 45, November 1963, pp. 360-67.

[4]See, e.g., Goran Ohlin, Foreign Aid Policies Reconsidered, OECD, Paris, 1966, Annex.

[5]"Terms" is a general word which refers to the specific conditions of the loan; it encompasses interest rates to be paid on outstanding principal, the pattern of principal amortization, grace periods when no principal and/or interest is paid, and any other conditions which change the burden of repayment.

has been called the "grant element" of a concessional loan and may be defined as "the difference between the face value of a loan and the present value of all future repayments (amortization and interest payments), discounted at a proper rate of interest".[6] The present value of repayments is just a "commercial investment" that yields the same annual rate as the discount rate.

From the borrowing country's perspective, however, the grant element will not generally equal the one for the loaner. First of all, unless both countries have the same discount rate, the grant elements computed in the manner of the preceding paragraph will differ.[7] Furthermore, the borrowing country will presumably view a loan as containing three components rather than two. First, there is the discounted present cost of future repayments -- the cost of the loan -- which is the same as the "commercial investment" component defined above except it is a cost to the borrower. The remainder -- the grant element defined above -- divides into the second and third components of a loan. The second

---

[6]Ohlin, p. 101.

[7]For an interesting analysis of the importance of different discount rates in determining the optimum combination of loans and grants, see: Wilson E. Schmidt, "The Economics of Charity: Loans vs. Grants", Journal of Political Economy, August, 1964, pp. 387-95.

component can be attributed to the differences in concessional and commercial terms and is, to the borrower, the grant element in a loan. Finally, the third component is simply the "expected gain" on commercial loans; it exists whenever the borrower's discount rate exceeds the commercial interest rate.[8]

To estimate the resource costs of food-aid, only the discounted present cost (DPC) of future payments is relevant. Indeed the grant and expected gain components do not exist as such since food-aid shipments rather than dollars are received by the borrowing country. For dollar loans, the net gain from a one million dollar loan equals one million dollars minus the DPC, i.e. the grant and expected gain components. But for food-aid, the net gain equals the benefits of food-aid minus the loan's DPC. The DPC is interpreted as the "resource cost" of food-aid in the sense that it transforms future payments into an estimate comparable to

---

[8]By neglecting the "expected gain" component, the procedure begun by Pincus and now used in some OECD foreign assistance estimates implicity credits the "expected gain" to the grant element. See, Development Assistance Efforts and Policies: 1967 Review, OECD, Paris, 1967, pp. 177-79.

the resource benefit estimates with respect to both time and unit of measurement. If an appropriate discount rate is selected, the procedure should give a realistic estimate of the true resource costs.

To state formally the DPC of a dollar-credit sale of one million dollars, let:

V = the nominal value of the loan ($1,000,000);

C = the discounted present cost of the loan (DPC);

I_t = interest payment in period t;

A_t = principal repayment (amortization) in period t;

r = the borrowing country's discount rate (the appropriate discount rate will be discussed below);

i = the interest rate on outstanding principal;

T = maturity of the loan; the period when final amortization occurs (for a 20 year loan, $T = 20$); and the index $t = 1,2,\text{---},T$.

Because dollar credit sales require interest payment on outstanding principal only, we can specify the interest payment in year t as:

$$(4.1) \qquad I_t = i\left(V - \sum_{j=1}^{t-1} A_j\right).$$

A general formula covering all dollar-credit loan terms is given below.

$$(4.2) \quad C = \frac{I_1 + A_1}{(1 + r)^1} + \frac{I_2 + A_2}{(1 + r)^2} + \ldots + \frac{I_t + A_T}{(1 + r)^T}$$

$$= \sum_{t=1}^{T} \frac{I_t + A_t}{(1 + r)^T}$$

Formula (4.2) allows any number of combinations of loan terms as particular cases. But there are two extreme cases that serve as bounds if we assume that the discount rate equals or exceeds the loan's interest rate, i.e. that the borrowing country behaves rationally. As a lower bound, the cost will be zero if there is no interest or principal repayments required. This is simply a grant. The upper bound where the cost equals the value of the loan will be attained if i = r, i.e., the borrowing country must pay in interest the amount earned annually on the principal outstanding. There is no net gain and, presumably, the borrowing country will be indifferent between borrowing dollars and not borrowing. But if the loan is tied to the purchase of food as required under food-aid loans, and if the borrower values the food-aid at less than its nominal value (V), then the borrowing country will not rationally enter food-aid agreements. Although only interest rate and the amortization requirement determine the upper and lower bounds, the cost also depends on two additional items whenever the conditions for being at one of the bounds fail to hold.

These items are (1) grace periods on amortization and/or interest, and (2) maturity of the loan.

Grace periods on amortization and longer maturity loans both decrease the discounted present cost of a loan by extending the time over which the borrower has possession of the principal. If there is a grace period, say of five years, during which no principal is repaid, then the borrower has control of the principal's earning power over a longer period. Likewise, extending the maturity of a loan, say from 10 to 30 years, allows a longer period to use the principal for productive purposes.[9]

Suppose in addition to a grace period on amortization, the loan terms specify that the borrower need not pay interest on outstanding principal for the first, say, five years. This reduces the effective rate of interest charged on the loan and consequently lowers the cost. The relevance of grace periods will be seen in the "resource cost estimates" section below where food-aid loan terms under the 1966 Act are specified.

---

[9] In the case of food-aid loans, the borrower receives food rather than dollars, and so the argument for grace periods and longer maturities must be in terms of earnings foregone from relinguishing dollars earlier for loans with a shorter maturity and/or grace period.

The Discount Rate

While loan terms can be made explicit and therefore raise no special problems in estimating the resource costs, the same is not true for the discount rate. Many researchers would probably agree with Ohlin that "the discount rate should reflect the return on public capital in optimal employment".[10] But just how the return on public capital should be reflected is subject to debate. For example, because of its chronic shortage in many LDC's, should foreign exchange be discounted at a higher rate than the domestic return on public investment? Or should the discount be set at the International Bank for Reconstruction and Development (IBRD) rate of 5.75 percent inasmuch as this represents an alternative source of capital to LDC's?[11] Conceptually, Pincus says that because of overvaluation of

---

[10]Ohlin, Foreign Aid Policies Reconsidered, p. 71.

[11]This rate varies somewhat because the IBRD borrows on private markets and sets its own rate to cover borrowing costs and other expenses. The 5.75 percent figure is representative, however; See The Flow of Financial Resources to Less-Developed Countries, 1961-1965, OECD, Paris, 1967, p. 145.

currency, the relevant rate (the free market rate for long term loans to LDC's) should be estimated in two steps, assuming a fixed quantity of foreign exchange. These are, first, an estimate of the price of foreign exchange if sold on a free auction market in the borrowing country, and second, an estimate of the interest rate that individual borrowers would be willing to pay for the use of foreign exchange, so valued, in investment projects. Although conceptually accurate, this method is handicapped empirically because "the long-term private lending market to underdeveloped countries is too thin to allow a precise estimate."[12]

The usual reaction to this dilemma is to consider several possible discount rates and report results accordingly. One is thereby left with multiple and often highly disparate estimates. For instance, a twenty year loan at two percent interest, when discounted at five percent, will yield a cost of 87.1 percent of the loan value; when discounted at ten percent, the cost will be only 55.5 percent. But to consider several discount rates, and consequently report alternative estimates, seems preferable to the alternative:

---

[12] John A. Pincus, Economic Aid and International Cost Sharing, Rand Corporation, Santa Monica, California, 1965.

to select a single discount rate with a large probability of being incorrect. Four alternative rates are included in the estimates below.

Further Considerations

Several factors are not incorporated in the resource cost estimates of a concessional loan below. Therefore, before presenting the quantitative results, four factors are examined that could adjust a borrowing country's overall evaluation of a loan's resource cost.

Because a recipient country repays a loan in dollars, it must either expand exports or decrease imports, or both, to provide the required balance of payments surplus. Assuming a fixed exchange rate, upward trends in the dollar price of traded commodities will mean that either fewer actual commodities need to be exported or a smaller quantity of imports must be sacrificed, or both to meet payments. So when inflation occurs over the period when interest and principal repayment occur, the real burden will be reduced in that a smaller quantity of commodities will be needed to repay any fixed amount of dollars.

There are two reasons why the estimates below fail to account for dollar inflation of goods and services traded by India. First, India's export and import price indexes have

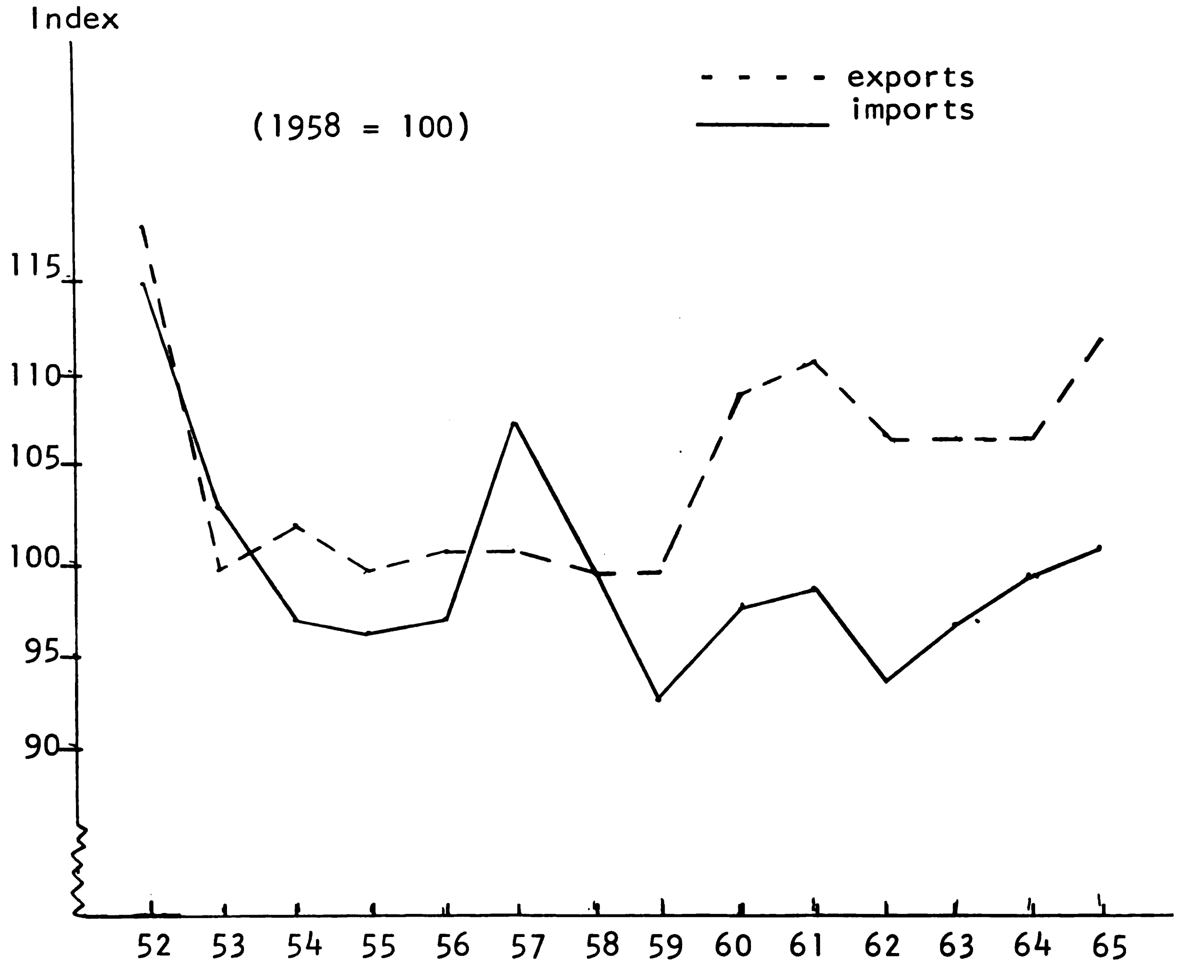

Figure 4.1: Price indexes of Indian exports and imports, 1952 through 1965.

Source: International Financial Statistics, International Monetary Fund, Washington, D.C., Supplement to 1966-67 Issues, p. 123

shown no notable trends in recent years. (Figure 4.1) Prices seem about as likely to increase as decrease in any particular year. To assume a trend in prices under these circumstances did not appear warranted.[13]

The second reason for excluding possible price changes is that expected inflation may be taken into account in the discount rate. If Indian officials expect inflation to occur, a higher discount rate will be appropriate. In this sense, the discount rates are monetary, reflecting the real rate of return on foreign exchange as well as the expected inflation which lowers the real value of dollars in the future.

In addition to price trends, there is the question of how to handle the rupee devaluation that occured in June, 1966. By lowering the dollar price of exports, devaluation means that a larger quantity of exports are required to meet a fixed dollar payment. In the case of India, all dollar-credit sales will occur after devaluation so that, assuming no further devaluation occurs, the resource cost estimates will not be affected. Nevertheless, the 1966

---

[13]Resource costs were calculated under the assumption that prices of both exports and imports increase one percent every other year. (Not one-half percent per year). This lowered the resource cost of loans by only 4.5 percent compared with no inflation.

devaluation will limit our ability to compare directly the resource cost estimates for the 1952-63 period and the projections to 1972 in Chapter V below.

The estimates also exclude possible benefits accruing to the food-aid recipient country due to introduction of lower cost methods of production in its export industries. If, over time, resources can be reorganized in production, or new techniques are developed that increase productivity, then fewer resources will be required to repay a nominally fixed loan, assuming constant export prices and no devaluation. Any such increase in productivity will lower the resource cost of loan repayment.

A related justification for borrowing by a developing country is that the repayment burden will be less in the future because real national product (GNP) will have increased. While it is true that the relative burden declines as GNP increases, the absolute burden remains the same. Even though giving up a unit of output when a country has, say, 1000 units may be a greater sacrifice than giving up a unit when it has 1200 units, to assume diminishing marginal utility for a less developed nation seems less warranted than to assume that the burden does not change with growth estimates that follow is that per capita output and aggregate ou

la

to

d

a

t

output will not change in a constant proportion if population also changes. It is uncertain whether the sacrifice to individuals or the nation as a whole is more relevant.

Resource Cost Estimates

Once the loan terms are known and an appropriate discount rate is selected, the cost of a food-aid loan to a recipient country can be easily determined. To the extent that the terms vary from loan to loan, and alternative discount rates are employed, the number of estimates will multiply.

The Food for Peace Act of 1966 states the following loan terms:

> Payment may be made in reasonable annual amounts over periods of not to exceed twenty years from the date of last delivery of commodities in each calendar year under the agreement, except that the date for beginning such annual payment may be deferred for a period not later than two years after such date of last delivery, and interest shall be computed from the date of last delivery.[14]

The minimum interest rate is one percent for the grace period and 2.5 percent for the remaining years.

---

[14] Food for Peace Act, 1966, Sec. 106a.

ann

uni

are

in

"re

lib

int

two

con

ann

te

pr

de

fo

F
p

The fact that principal may be repaid in "reasonable" annual amounts renders precise calculations impossible unless the amortization requirements of a particular loan are known. Foreign assistance loans typically are repaid in equal annual installments but the incorporation of "reasonable" into dollar loans was originally intended to liberalize repayments;[15] presumably this was also the intent in the 1966 Act. To account for both possibilities two types of loans will be studied. The first has the conventional requirement that loans be repaid in equal annual installments. And the second has fairly lenient terms in that the borrowing country repays most of the principal near the loan's maturity. The Type III loan described below represents the more lenient repayment terms for food-aid sold for CLCC (see footnote 2, above).

Type I - Equal annual amortization over a 20 year period with a two year grace period.

Type II - Amortization over 20 years on a linearly increasing schedule after a two year grace period.

Type III - Equal annual amortization over a 40 year period with a ten year grace period.

---

[15] Monetary Effects of Financing Agricultural Exports, Foreign Agricultural Economic Report No. 12, USDA, 1963, p. 3.

Wi

is

nc

af

th

th

Ty

fi

m

a

a

m

With a Type I loan of one million dollars, 50,000 dollars is repaid each year after an intial two years in which no principal repayments occur. A Type II loan specifies, after an initial two years, repayment of about \$4,760 the first year, \$9,520 the second year, and so on, until the final payment in the twentieth year is \$95,200.[16] The Type II loan is not intended to represent amortization terms for an actual loan but to serve as an approximation of the more liberal terms that are possible in the case of food-aid loans.

Payment of interest on outstanding principal is in addition to amortization. The amount will depend on the rate charged which is assumed to be identical for the two

---

[16] In the notation defined for formula (4.2), a Type II loan specifies that $A_t = bt$ where be is a constant to be determined. The requirement $V = \sum_{t=1}^{T} A_t$ implies that:

$$V = b \sum_{t=1}^{T} t = b \frac{T(T+1)}{2}, \text{ or}$$

$$b = \frac{2V}{T}(T+1) = \frac{V}{210}$$

types of loans.[17] As specified in the Act, the most favorable terms for dollar-credit sales are a two year grace period on amortization with the interest at one percent and a twenty year maturity with interest at two and one-half percent.[18]

Four alternative discount rates were selected: .0575, .08, .10 and .15. The IBRD rate (.0575) should be the appropriate lower rate since India has the alternative of borrowing there. When future payments are discounted at this rate, the result shows the present cost in comparison with the cost -- the value of the loan -- if the IBRD provided the loan. The nominal value of the loan minus the present cost, in other words, shows the grant element arising because the loan is at a lower interest rate than the IBRD rate. The

---

[17]This does not imply that the annual interest payments will be identical. For a Type I loan, interest payments decrease by the same amount each year after the grace period. But for a Type II loan, interest payments remain high in early periods when amortization is small, and then decrease sharply toward the loan's maturity.

[18]As noted earlier, India is likely to receive the more lenient terms of the Agency for International Development loans; namely, 10 year grace period at .01 interest and 40 years maturity at .025 interest.

next two rates, .08 and .10, probably approximate the rate of return on government investment in many LDC's. Pincus believes that .10 is a satisfactory rough approximation.[19] The higher rate (.15) is included in the event that the rate of return on foreign exchange is significantly higher than the probable return on investment -- not an unlikely possibility for recipient countries that typically have foreign exchange shortages.

Upon applying these four discount rates to the two types of loans, the results shown in Table 4.2 were obtained. For the lower discount rate (.0575), the resource cost of the loan is relatively high -- about two-thirds of the loan value. At higher discount rates, the cost declines for each type but the decline is greater for Type II loans where the bulk of amortization occurs near the loan's maturity. Forty-four percent of the principal is repaid in the last five years for a Type II loan.

Three conclusions emerge from Table 4.2. First, the discount rate significantly affects the cost of loans. A

---

[19] Pincus, Economic Aid and International Cost Sharing, pp. 124-25.

Table 4.2: Resource costs of loans as a percent of the loan's nominal value: under terms approximating alternatives specified in the 1966 Food for Peace Act and alternative discount rates

	Discount Rates			
	.0575	.08	.10	.15
	(percent)			
Type I	70.3	57.5	48.8	34.0
Type II	65.1	50.7	41.3	26.2
Type III	44.9	30.7	22.9	12.6

recipient country that, for any reason, discounts at a high rate will perceive food-aid loans as much less costly than another country that discounts at rates near the IBRD rate. Second, the possibility of delaying principal repayments in a manner similar to a Type II loan will lower the cost, especially at higher discount rates. Third, although the magnitude of the repayment burden varies considerably -- from 13 to 70 percent -- it is clear that concessional loans are substantially more costly to the borrowing country than a dollar grant. In the present context, however, the estimates in Table 4.2 should be compared not with dollar grants but with (1) the resource benefits of food-aid and (2) the costs of local currency sales. The second comparison is discussed in the next section.

Dollar-Credit Versus Foreign Currency Sales

When food-aid under a foreign currency sale is shipped to a recipient country, the U.S. accounts are credited with the nominal value of the shipments. These proceeds are earmarked for various purposes including grants and loans to the recipient government, common defense, loans to private enterprise (U.S. and host country), and the U.S. uses such as embassy and other governmental expenses, educational-scientific activities and publications, market development and expenses of U.S. tourists. This latter category -- U.S. uses -- has been considered the cost of shipments and on an aggregate basis ranges from 20 to 25 percent of their nominal value. For example, the OECD deducts 20 percent to estimate the net value of U.S. food-aid shipments under local currency sales; the larger 25 percent figure has been employed in some USDA calculations.[20]

While the actual amount earmarked for U.S. uses was 23.2 percent for agreements signed through 1963 with all recipients, only 12.8 percent had been earmarked for this purpose in Indian agreements. The magnitude of Indian shipments limited the proportion that could be realistically designated for expenditures on U.S. uses permitted in the legislation. As a result, the cost has been lower for India than for recipient countries in total. The remaining 87.2 percent of Indian sales through 1963 were earmarked as follows:[21]

---

[20]See, The Flow of Financial Resources to Less Developed Countries, p. 101; and Foreign Agricultural Economic Report No. 12, USDA.

[21]Not all of these earmarked funds have been utilized, some have simply accumulated in U.S. accounts because of the inconvenience associated with a government borrowing its own currency from the U.S. For a discussion of this problem, see Edward S. Mason, "Foreign Money We Can't Spent", Atlantic Monthly, May, 1960, pp. 78-86.

	Percent
Grants for Economic Development	32.3
Loans to the Indian Governemtn	48.1
Loans to Private Enterprise	6.8
	87.2

In this analysis, grants and loans to the Indian government are assumed to have zero cost. Although this assumption is valid for grants, its justification for loans is that the "U.S. use" category supplied all the funds needed for U.S. programs; that is, loan repayments are not used by the U.S. to claim further resources but instead are either loaned again or accumulated in U.S. accounts. The category earmarked for "loans to private enterprise" represents a resource cost to the extent that such loans displace private U.S. investment in India that otherwise would have been procured with dollars. To account for this possibility, 2.2 percent is added to the 12.8 percent for U.S. uses, resulting in a 15 percent total "use-portion".

The resource cost, then, of sales for rupees will be taken as 15 percent of the total value of shipments. This is about one-third the cost of receiving food-aid on long-term dollar-credit discounted at .10 and repaid in equal annual installments; and, it is less than any of the costs of dollar-credit sales reported in Table 4.2.

As expected, a shift to dollar loans would raise the cost of food-aid, probably by over 100 percent, and would elevate it to a psuedo-commercial basis. If India were required to convert to dollar-credit sales (in contrast to CLCC sales) by the end of 1971, the change in cost would be substantial, especially since no dollar-credit sales had been contracted through 1966. Assuming that local currency sales continued to cost 15 percent and dollar-credit sales 50 percent of the nominal value of food-aid, and that the conversion would be 10 percent in 1967 and 1968 and 20 each year thereafter, the cost per million dollars would increase as shown in Figure 4.2. As dollar-credit sales displace local currency sales, the cost rises and reaches $500,000 in 1972.

Balance of Payments Effects

Compared with regular commercial sales, the advantage of dollar-credit sales comes from the opportunity to delay payments coupled with the principle that the present cost is less than the nominal cost of a future repayment. Although the discounting procedure is valid for estimating resource costs, it conceals the magnitude of future nominal payments.


$1,0
500
400
300
200
100

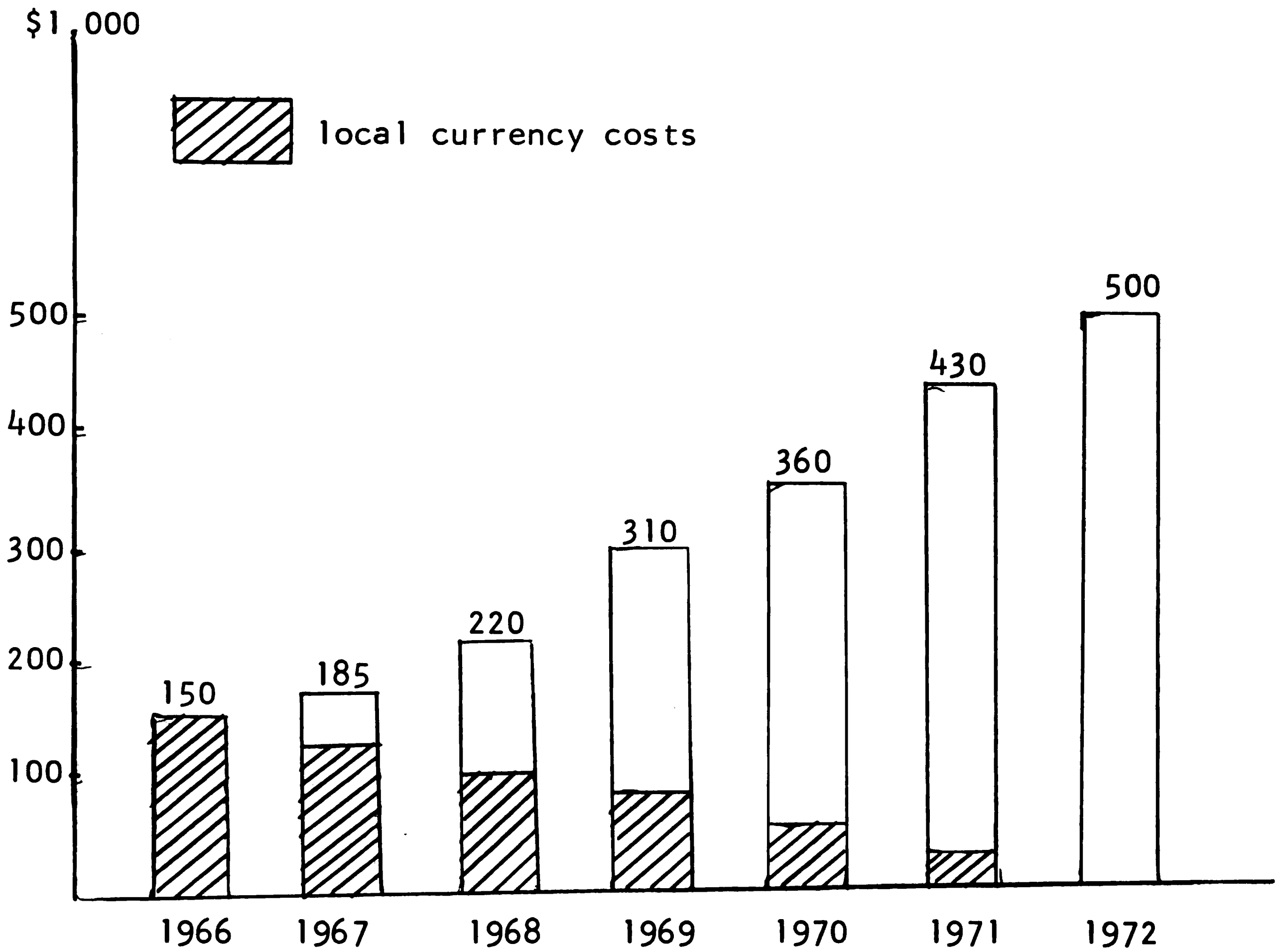

Figure 4.2 Resource costs per million dollars of food-aid shipments to India, during transition from local currency to dollar-credit sales, excluding ocean freight, 1966 to 1972.

These can become extremely large for a country like India that depends on loans to carry on many development programs. Already "debt service" absorbs 20 percent of India's foreign exchange earnings and this is expected to double by 1970-71.[22]

Therefore, it will be worthwhile to examine the payments position of the recipient country by considering only nominal flows. For local currency sales, there is only a negative flow to India because the U.S. replaces dollar purchases with local currency purchases. The U.S. ships food for which it is paid in rupees and, in turn, 15 percent of these currencies are assumed to be spent for goods and services that in the absence of food-aid would have commanded dollars.

When dollar-credit sales (again, in contrast to CLCC sales) replace currency sales, two new and opposite flows begin. The first one -- repayments -- takes place over a 22-year period and goes from the recipient country to the U.S. The second flow from the U.S. to the recipient country begins because the U.S. now must purchase in dollars the goods and services if formerly bought with rupees.[23]

---

[22] K. N. Raj, India, Pakistan and China: Economic Growth and Outlook, Allied Publishers, Bombay, 1967, p. 34.

[23] If the U.S. has accumulated rupees and elects to utilize them, the second flow may be delayed. Although important from a practicel standpoint, this possibility is omitted here for simplicity in comparing the two types of sales arrangements.

of p
sale
bala
V be
amo
valu
for

Tha
lea
a c
Int
by
cor
wi
wh
an

If we assume that the U.S. continues its previous level of purchases (the 15 percent use-portion under local currency sales), the long-run result would operate against the balance of payments position of the recipient country. Let V be the nominal value of food-aid, and consider only amortization. Then, if 15 percent of the local currency value of food-aid would have been spent by the U.S., the foreign exchange loss of a credit purchase would be:

$$\text{Loss} = V - .15V$$

That is, the net outflow of foreign exchange will be at least $850,000 more for a one million dollar shipment under a dollar-credit than under a local currency arrangement. Interest charges on a Type I loan will enlarge this difference by another $282,500. The pattern of dollar flow is, of course, much different. For local currency sales, the loss will typically occur within a year or two after shipments whereas the new dollar credit outflow is spread over 22 years and this latter fact is what the discounting procedure takes

into account.[24]

From the standpoint of the delt-service problem, the nominal flows may be more crucial than the discounted flows, depending on how much the benefits of food-aid increase future export earnings (or decrease imports), and how much they improve internal growth without altering the balance

---

[24]The balance of payments effects of the two types of sales were analyzed in a publication that arrived at the misleading conclusion that replacement of local currency sales by credit sales could, and likely would in some cases, improve the recipient's balance of payments. This conclusion arose from the incorrect assessment of the shift in U.S. dollar purchases. In one situation (reported in Tables 4, and 5, pp. 15 and 17) a figure was selected, apparently arbitrarily, which leads to a net gain. But it is always possible to increase U.S. dollar expenditures (E) such that $E > V + 1$ if we ignore the requirement that $E \leq .15V$ which is necessary to compare credit and local currency sales. With this restriction on E, cases 1, 2, 4, 5 in Table 6 (p. 20) are unfeasible. In a second situation (Table 7, p. 26) a 25 percent U.S. use-portion was applied to five consecutive annual loans of $40 million so that the shift in U.S. dollar purchases was $10 million annually. But then this shift was continued not over the five years but for the full 24 years when repayments occurred so that the total shift was $240 million, or 120 percent of the total value of the food-aid. See, For. Agr. Econ. Report No. 12, USDA.

of payments. During 1960 through 1964, the average net official borrowing by India from bilateral and multilateral sources was 406 million dollars annually. The value of all Title I food-aid shipments (excluding ocean freight) averaged 316 million annually.[25] If shipments to India during this period had been for dollars, India's future debt-service incurred during 196064 would have increased 78 percent. Although this would vary somewhat if the interest terms differed for food-aid and other foreign assistance loans, the shift to dollar-credit sales clearly implies a substantial increase in India's debt-service burden.

Summary

The discounted present value procedure applied to food-aid loans gives an estimate of the present (resource) cost to recipient countries. This cost depends on (1) the terms of the loan; and (2) the discount rate. The numercial results indicate that the resource cost of dollar-credit sales

---

[25]Data on official flows to India came from: Geographical Distribution of Financial Flows to Less-Developed Countries, 1960-64, OECD, Paris, 1966. The value of Title I shipments came from: USDA, FAS, SDS-11-63-Revised, March 2, 1965 and SDS-1-67, May 15, 1967.

is probably about 50 percent of the nominal value of loans, although the estimated costs in the cases examined range from 26 to 70 percent for dollar-credit sales and 12 to 45 percent for CLCC sales. The possibility that the U.S. will not require repayment, or more likely that it will simply extend loans, was not considered even though this may well influence policy decisions in recipient countries. Instead, the resource cost estimates as well as the balance of payments effects might be relevant to U.S. officials in deciding whether recipient countries can and should be expected to repay. For the purposes of this study, the resource cost estimates will contribute to the analysis in Chapter V.

In comparing dollar-credit and local currency sales, it is evident that: (1) recipient countries will bear a much higher cost with credit sales; and (2) credit sales will accentuate balance of payment and debt service problems.

CHAPTER V

THE BENEFITS AND COSTS COMPARED

Having estimated the direct effects and resource costs, it remains to express the direct effects in dollars and then to compare these resource benefits with the costs. By using dollars as the unit of measurement, the benefits and costs are expressed in terms of a common resource measure which is appropriate for a country such as India that faces a chronic balance of payments deficit.

The first section of this chapter details the method of converting the direct effects to an estimate of food-aid's resource benefits. In the second section, the benefits for various models are compared with the resource costs of dollar-credit and local currency sales. It provides the study's basic results -- estimates of the net resource gain from food-aid shipments to India. After projecting the benefits to 1972 under various assumptions about changes in prices and yields, a fourth section summarizes the chapter's principal results.

Resource Benefit Estimates

Beginning with the resource benefit (B) expression developed in Chapter II,

(5.1) $B = \Delta M + \Delta E + \Delta D$,

the benefits from the import displacement effect (M) will be examined first. Because food-aid is sold at competitive world prices, the dollars saved when food-aid displaces commercial imports is simply the market value of food-aid (V) times the import displacement effect (M^e).

(5.2) $\Delta M = V \cdot M^e$

where M^e is interpreted either as (i) the effect on equilibrium annual commercial imports induced by a one million metric ton sustained change in food-aid, or (ii) the cumulated effect until the original equilibrium is restored of a single period increase in food-aid.

The average export price of Indian shipments during 1952-63 was \$64 per metric ton.[1] To this should be added

[1]This includes wheat, corn, grain sorghums and rice. The \$64 figure came from dividing the total value by the total metric tons. The average prices of wheat, corn, sorghums and rice were \$61, \$50, \$40, and \$124, respectively. But wheat made up 91.5 percent of the total tonnage and carried this much weight in the average price calculation. Rice contributed 5.5 percent. The remaining 3 percent came mostly from corn. Wheat prices, computed by six-month periods, varied from \$58 to \$62 per ton. Computed from USDA, FAS: SDS-7-61 (May, 1961), SDS-11-63-Revised (March, 1965) and SDS-1-67 (May, 1967).

an estimated \$8 per ton for ocean freight charges.[2] Thus, a one million metric ton increase in shipments combined with the Model II import displacement effect (.405) would lead to dollar benefits from this source worth \$29,160,000. This is 40.5 percent of the total value (including ocean freight) of \$72 million implied by a million metric tons of shipments and represents the principal component of the estimated resource benefits.

The second source of resource benefits in expression (5.1) is ΔE. It stems from the allocative effect of food-aid shipments and is more difficult to express as dollar benefits because commercial crops were measured in acres. To express the acreage estimates in dollars, several conditions are assumed to exist. First, changes in commercial crop acreage are proportional to changes in output under average weather conditions. In Chapter II, it was assumed that acreage is a valid indicator of "desired" output on the part

---

[2]Actual ocean freight rates for four U.S. to India routes were available for the last three years of the 1952-53 period. For foreign-flag vessels -- the appropriate alternative in the case of commercial imports -- these averaged \$9.30 per metric ton. Foreign Agricultural Trade of the United States, USDA, February, 1967, p. 44. The lower \$8 figure was lower. See below for further considerations of ocean freight in cost estimates.

of producers; to this is now added the assumption that under average weather conditions, realized output equals desired output. Second, a shift in acreage is distributed in proportion to the average total acreage planted to each crop. Based on the period under study during which food-aid could have affected commercial crops (1957-63), the "proportional weights" for the principal commercial crops are:

Groundnuts	.3647
Cotton	.4446
Jute	.0430
Sugarcane	.1249
Tobacco	.0228
	1.000

Sixty-two percent of average annual commercial crop acreage was planted to these crops. The remaining crops were mesta (a fibre crop), rape, mustard, sesamum, linseed and castor-seed. All except mesta are oilseed crops of less quantitative importance than groundnuts.

The third assumption needed to convert the allocative effect into dollar benefits is that shifts to commercial crops can be totally measured in expanded exports, i.e., a given increase in commercial crop production will be exported.

Some or all of the production will actually be processed before being exported and some may enter domestic consumption. But the assumption implies that export prices represent the unit value to the Indian economy of increases in the quantity of commercial crop production caused by food-aid shipments.[3] Finally, we assume that twenty percent of the export price should be deducted to compensate resources required to move the crops from the producers to shipping points. The E can now be expressed, in general, as:

$$(5.3) \qquad \Delta E = .8A^e \sum_{i=1}^{5} w_i v_i$$

where w_i is the "proportional weight" for crop i,

v_i is the value per acre for crop i,

A^e is the allocative effect which is interpreted in the same two ways as M^e in expression (5.2), and

i = 1 is groundnuts,
2 is cotton,
3 is jute,
4 is sugarcane, and
5 is tobacco

[3]Because of the small magnitude of output changes under consideration, it is also assumed that they do not affect export prices; or equivalently that India faces an infinitely elastic demand curve for these crops because of her small share of the world market.

In Appendix B, the v_i have been calculated. Combined with the w_i and the .8 to remove marketing costs, an estimated \$54 per acre can be assigned to the allocative effect.

For Model 1, A^e = 309,022 acres and so the additional export earnings induced by a one million ton increase in food-aid during 1952-63 is estimated to have been \$16,687,188. Since the corresponding total value of the shipments would have been \$72,000,000, the resource benefits from the allocative effect are 23 percent of the value of shipments.

The third term in the resource benefit expression (5.1) is the incremental consumption (ΔD) made possible to food-aid. This term may be viewed as bounded by two limits. At the upper one, the consumption effect would contribute, from a humanitarian standpoint, as much to India's current income as if the food had been purchased commercially. The fact that it would not have been procured in the absence of food-aid, at least according to our model, does not necessarily mean that it is worth less than full market value to India. From a resource standpoint, this argument would be supported if incremental consumption raises labor productivity of the present labor force as well as future labor forces through better diets for children. The extent to which the human resource can be expanded in this way determines whether or not full-value should be given to the consumption effect. At the lower limit it might be argued that incremental consumption adds nothing to India's resources directly and that it has only negligible effects on human resources. Both arguments are highly speculative; the truth, no doubt, lies between them.

A more concrete case can be offered for assigning positive resource benefits to incremental consumption. Without food-aid, Indian officials might have diminished nonfood investment programs and turned resources toward food production to provide at least some portion of the consumption effect. In other words, rather than allowing consumption to fall by the full consumption effect (465,000 metric in Model I) if food-aid shipments had decreased by one million metric tons, the government could have decided to place greater emphasis on domestic foodgrain production.[4] Thus, the resource benefits from the consumption effect would be the

---

[4]Several writers have argued that P.L. 480 allows recipient governments to "neglect" foodgrain production in this way. (See, Chapter II). This reasoning implies that domestic resources would be more productive in foodgrain production than in alternative uses -- which depends, of course, on the particular country's comparative advantage. If it has an advantage in foodgrains, then the difference in productivity should be deducted from the resource benefits estimates. On the other hand, if resources are more productive in nonfood alternatives, the difference should be credited to the resource benefits. In this study, the estimates are not adjusted for such differences.

opportunity cost of resources which, without food-aid, would have been directed to foodgrain production.

To allow for variations in the benefits from incremental consumption, the following expression will be employed:

(5.4) $\Delta D = kVD^e$

where k is a constant ($0 \leq k \leq 1$)

D^e is the consumption effect and can be interpreted in the same two ways as M^e and A^e.

If $k = 0$, a zero benefit is assigned to the consumption effect; if $k = 1$, it receives full market value. For comparison, resource benefit estimates will also be reported for $k = .5$.

Expression (5.1) can now be restated in terms of (5.2), (5.3), and (5.4); all terms have dollars as their measurement unit.

(5.5) $B = VM^e + ZA^e + kVD^e$

where Z is the per acre dollar value of commercial crops and all other symbols have been defined previously.

Turning to the cost side of the equation discussed in Chapter IV, the resource cost (C) expression becomes:

(5.6) $C = Vc$

where c is (i) the per dollar present (resource) cost of food-aid loans under dollar-credit sales, or (ii) the percent of the rupee value of food-aid which is spent by the United States for goods and services in India.

The resource benefits and costs will be estimated by substituting the various results from Chapters III and IV into expressions (5.5) and (5.6), respectively. Appropriate prices of food-aid and commercial crops are the only additional information needed to complete the estimates and, for 1952-63, these were given in the discussion on the value of the import displacement and allocative effects.

Net Resource Gain: 1952-63

Estimates of the "net resource gain" from food-aid are reported in this section. The concept is defined simply as the difference between resource benefits and costs:

$$G = B+C$$

where G is the net resource gain.

The estimates help answer the question: "What has food-aid contributed to India's resource position during the 1952-63 period?" They are expressed per million dollars of food-aid.

Since this corresponded to only slightly over one ounce per capita annually, we are examining a "marginal" change in shipments. For such a marginal change, Table 5.1 shows the dollar value of resource benefits to India during 1952-63.[5] It includes the empirical Model I and the five hypothetical models examined in Chapter III and three alternative valuations of consumption.

The estimated resource benefits in Model I are $636,800 for each million dollar shipment when incremental consumption receives no credit in calculating the resource transfer (k = o). Food-aid transfered nearly two-thirds as many

[5]One might argue that the benefits, like the costs, do not all occur in the period in which food-aid is shipped and therefore the discounting procedure should also be applied to them. For a one-shot increase, however, nearly all the import displacement is realized in the same year and to the extent it is not, benefits from such displacement are greater the first few years than they are after the original equilibrium is restored. Benefits from the allocative effect, though, occur _after_ the year of shipment. But 90 percent of the allocative effect is realized within two years and all but one percent within three years. Thus the two tend to offset each other. A .10 discount rate applied to the flow of benefits from imports and commercial crops in Model I lead to estimated benefits 95.6 percent as large as the nondiscounted benefits in Table 5.1. For a sustained increase in shipments, a discrepency would exist only until the new equilibrium was achieved -- largely within three years -- and thereafter the effects would be fully realized in the year of shipment.

Table 5.1: Estimated resource benefits per million dollar of food-aid shipments to India, 1952-63[a]

Model [b]	Assumed Consumption Benefits		
	k = 0	k = .5	k = 1
		- thousand dollars -	
I	636.8	869.3	1,101.8
II	797.8	959.8	1,121.8
III	431.0	765.5	1,000.0
IV	523.9	784.9	1,045.9
V	362.3	770.8	1,179.3
VI	474.4	811.0	1,146.5

[a]The term "benefits" assumes that shipments increase. If they decrease, the figures are negative and could be interpreted as the "cost" of reducing shipments by one million dollars.

[b]Models refer specifically to those estimated and reported in Table 3.2, Chapter III.

resources as as untied dollar grant of one million dollars, neglecting for now the resource costs. Of these benefits, import displacement supplied 64 percent and increases in commercial crop production provided the remaining 36 percent. It is apparent that food-aid was an effective instrument in transferring resources to India during the period examined if the parameter estimates and assumptions underlying the analysis are valid reflections of the real situation.

When Model I is compared with its five derivative models for k = 0, the estimates change rather dramtically.[6] Model II -- the upper supply sensitive model -- assumes a .4 supply (acreage) elasticity for cereals and a -.7 cross elasticity of supply (acreage) for commercial crops. The resource benefits are therefore higher (by 25 percent) in Model II due to a larger allocative effect which more than offsets a somewhat smaller import displacement of 37.0 percent of shipments rather than 40.5 percent. The remaining supply sensitive model -- Model III -- imposes the restriction that

---

[6]Models II through VI differ from Model I because one or more parameers were substituted for the estimated ones in Model I.

there is no impact on domestic supply of either cereals or commercial crops. As discussed earlier, such a situation could result from an effective price supply scheme, from producers who are not responsive to price or from a distribution system for food-aid that does not alter domestic cereal prices. In Model III, only import displacement provides resource benefits and they equal 43.1 percent of the value of shipments. Only Model V -- where the initial import displacement is assumed to be zero -- yields a lower estimate of resource benefits.

Turning to Model IV in which a unitary price elasticity of demand has been imposed, the resource benefits diminish by 18 percent relative to Model I. This decrease occurs because a smaller price effect is required to absorb the food-aid and correspondingly the allocative effect is less. Eighty percent of the benefits come from import displacement and only 20 percent from the allocative effect.

The remaining two models reported in Table 5.1 deviate from Model I by imposing different conditions on import displacement. Model V specifies that the initial impact of food-aid on commercial imports is zero and so only later repercussions operating through lower domestic production influence commercial imports. And here the effect is to

increase imports as domestic supply declines. The net result is that only the allocative effect provides benefits and part of these are offset by slightly greater purchases of commercial imports; consequently, the resource benefits in Model V are the lowest of any of the hypothetical models -- slightly over one-third of the value of shipments. In Model VI, an interim import displacement between Models I and V of 14.1 percent of shipments leads to estimated resource benefits equal to slightly under one-half of the value of food-aid.

When a positive value is assigned to incremental consumption, the estimated resource benefits in Table 5.1 (under k = .5, and k = 1.0) increase for every model. But the increase is greater for those models having a relatively high consumption effect. For instance, Model V has the largest consumption effect -- 81.7 percent of shipments -- and this is enough to make its estimated benefits the largest of all models for k = 1.0 even though Model V rated at the bottom when no value was assigned to incremental consumption. A notable aspect of the results for k = 1.0 is that the estimated benefits in all cases except Model III are larger than the value of shipments. This happens because the value of the allocative effect exceeds the decrease in domestic cereal production (the disincentive effect) valued at the price of food-aid (\$72/m.t.). Food-aid "forces" a

redistribution of land and other resources to a more valuable crop.[7]

Overall, the principal conclusions to be drawn from Table 5.1 is that food-aid was probably over fifty percent as effective as dollar grants in transfering resources to India during 1952-63 and, depending on the value assigned to incremental consumption, it could have been even more effective from India's point of view.

When the Model I results are generalized to total shipments of 1,636 million dollars, the aggregate resource benefits to India probably have been on the order of one billion dollars.[8] Nearly one-half of shipments -- 10.6 million metric tons -- have become available for additional

---

[7]With assumed marketing costs equal to 20 percent of the value of commercial crop production, the per acre value is $54 compared with $18 per acre for cereal production available for consumption (87.5 percent of actual production). Two possible sources of bias should be noted in the $54 figure: (1) the 20 percent deduction for marketing costs may be too low, and (2) the assumption stated in Chapter II that any additional resources required to produce commercial crops came from an unemployed status either in the farm or nonfarm sector may be inappropriate.

[8]The U.S. supplied only 1,454 million dollars of cereals through 1963 under Title I but when ocean freight at $8 per m.t. is included, the value increases to 1,636 million dollars.

consumption during the period. These figures are subject to the reservation that the model's parameters were estimated with food-aid shipments at a positive level. For large changes in food-aid, the linearity of the commercial import equation may not be a correct specification. For example, as food-aid shipments approach zero, the import displacement effect may become negligible. The linearity assumption in the demand equation would not appear to be invalidated for large shifts in food-aid because shipments represent a very small proportion (5 percent) of the total quantity available.

The estimates should not be applied to very large <u>increases</u> in shipments because India's physical facilities would not have handled substantial additional shipments during the period.[9] Moreover, the commercial import equation would certainly not account for, say, a doubling of shipments since in several years food-aid shipments were several times larger than commercial imports. Food-aid shipments were 4,909 thousand tons in 1960 (the peak year) and commercial imports were only 393 thousand tons.

---

[9]See, Guy L. Haviland, Foreign Agriculture, USDA, July 31, 1967, p. 5.

Turning to the resource cost estimates, all sales during 1952-63 were for rupees. For comparison, however, the cost of dollar-credit sales are included in Table 5.2 for Types I and II loans. Two estimates of the local currency costs have been included. The lower one of 10 percent assumes that part of United States local currency expenditures (e.g., educational materials and programs) were really a benefit to India and would have otherwise been purchased by India. The larger 15 percent estimate probably represents an upper limit of the resource cost of food-aid.[10] Because the cost per million dollars does not depend on the discount

[10]The estimates include ocean freight charges as follows. For the 50 percent that India paid directly, \$8 per metric ton (or \$55,600 per million dollar shipment) was added to the costs calculated in Chapter II. The ocean freight on the remaining 50 percent that was shipped on U.S. flag vessels (under the Cargo Preference Act) was paid in rupees. The average rate for such vessels during 1961-63 was \$21. To allow for lower rates in earlier years, this was reduced to \$16. Since the million dollar shipment included \$8 per m.t. ocean freight, the rate of U.S. vessels equaled the combined freight implied in our definition of a million dollar shipment. Thus the cost of such a shipment was equal to the use-portion (10-or 15 percent) <u>plus</u> the freight India paid directly of \$55,600. For dollar-credit sales, the same procedure was followed by substituting the appropriate DPV for the use-portion under the assumption that ocean freight on U.S. vessels would have been included in the total loand. Compare footnotes 2 (above) and 17 (below).

Table 5.2: Estimate of resource costs per million dollars of food-aid shipments to India, local currency and dollar-credit sales, 1952-63.

Type of Sale	Discount Rate			
	.0575	.08	.10	1.5
	- thousand dollars -			
Local Currency (10 percent)	155.6	155.6	155.6	155.6
Local Currency (15 percent)	205.6	205.6	205.6	205.6
Dollar-credit (Type I loan)[a]	758.5	630.7	543.4	345.1
Dollar-credit (Type II loan)[b]	707.0	562.9	468.4	317.4

[a]Equal annual principal repayments.

[b]Principal repayment at a linearly increasing rate (see Chapter II)

rate for local currency sales, the estimated cost is 155.6 and 205.6 thousand dollars with United States' "use-portions" of 10 and 15 percent, respectively. The estimates given in Table 5.2 for dollar-credit sales show what the cost would have been if sales during 1952-63 had required India to repay the principal in dollars over a 20 year period. These estimates are for the particular loan types described in Chapter II; a 2-year grace period with interest at .01 and 20 years for repayment with interest at .025. Type II loans are less costly because most the principal repayments occur toward the end of the 20 years.

Table 5.3 shows the "net resource gain" estimates for various benefit models, local currency sales and Type I dollar-credit loans. In these estimates, no value is assigned to the consumption effect (k = 0) and consequently they should be interpreted as lower bounds to the overall benefits of food-aid. It is evident from Table 5.3 that shipments improved India's resource position on a net basis. Over one-half of the resource benefits were a net gain under the local currency sales that prevailed during the period; the remaining total benefits were lost through United States expenditures of rupees in India.

Table 5.3: Estimated net resource gain per million dollars of food-aid shipments to India for various benefit and cost alternatives, 1952-63[a]

Costs (type of sale)	Benefits (model)					
	I	II	III	IV	V	VI
	- thousand dollars -					
Local Currency						
-10% use portion	481.2	642.2	275.4	368.3	206.6	319.9
-15% use portion	431.2	592.2	225.4	318.3	156.6	269.9
Dollar-credit (discount rate)						
.0575	-121.7	39.3	-327.5	-234.6	-396.3	-283.0
.08	6.1	167.1	-199.7	-106.8	-258.5	-155.2
.10	93.4	254.4	-112.4	- 19.5	-181.2	- 67.9
.15	241.7	402.7	35.9	128.8	- 32.9	80.4

[a]Derived from Tables 5.1 and 5.2; no value assigned to incremental consumption; Type I loan for dollar-credit sales.

However, had India procured food-aid under the dollar-credit arrangement, the net gain would have been substantially reduced. India's discount rate on foreign exchange would have had to be at least .08 for the Model I resource benefits to cover the discounted present costs of interest and principal repayments. And even if the appropriate discount rate had been .15, the net benefits would have been only above one-half as large compared with local currency sales.

When the hypothetical models are studied, the net benefits for Model II exceed those for the other models substantially. Nonetheless, if any of these models is a better approximation of reality than Model I, the net resource benefits to India would still have been positive and significant under local currency sales. But under dollar-credit sales the net benefits become negative for Models III through VI except at discount rates above .10.

On a net basis, it is apparent from Table 5.3 that the estimated contribution of food-aid to India's resource position (based on Model I and the two local currency use-portions) has been on the order of 40 to 50 percent of untied dollar grants even when no value is credited to incremental consumption. But had dollar-credit sales prevailed the net resource gain could have been positive or negative depending on the appropriate discount rate.

One further observation in regard to dollar-credit sales is that the nominal (undiscounted) flows of dollars would have been much more severe then for local currency sales. Whereas only U.S. expenditures of rupees represents exchange losses for the latter, India's principal and interest payments would total 1,282,500 dollars for a Type I loan. Against this flow, India would receive an additional 150,000 dollars (for a 15 percent use-portion) from U.S. purchases. But the net additional outflow would still be 1,132,000 dollars -- more than the nominal value of a million dollar shipment. Although these nominal flows do not account for the fact that India's net dollar receipts increase in the short-run (through U.S. expenditures and the resource benefits via import displacement and export crop expansion), and that these receipts presumably could be invested in such a way as to provide dollars for later payments, the impact of dollar-credit on India's longer run debt-serving problem would have been adverse.

Net Resource Gain: Projections to the 1972

Although India's future food situation is clouded by uncertainties, it will be desirable to investigate what this study's empirical model implies about future effects of food-aid shipments. Specifically, the parameter estimates from

Model I will be employed to determine possible effects of changes in prices of food-aid export crops, and changes in per acre crop yields. These variables would appear to be quite likely to change in the future and will bring about some alterations in the estimated resource benefits. For this analysis, the parameter estimates of Model I will be assumed valid.

One feature of the model should be noted, however. The cereal and commercial crop equations have time as an explanatory variable to account for general expansion in cropped area during 1952-63. Since then acreage increases have been small due to limits on available crop land and these limits will exist in the future. To the extent that time was a proxy variable for pressures for increased production resulting from population growth, it is possible that India's mounting population will affect the acreage allocations at a differential rate. Nevertheless, as long as such a situation does not alter the price coefficients in the equations, the estimated benefits below will still be valid.

For concreteness, 1972 has been selected because this is the year in which local currency sales are to be totally terminated under present legislation. The intent is that India will be receiving shipments under the CLCC arrangement by 1972,

and possibly some dollar-credit sales are planned for a portion of Indian shipments.[11] But the local currency alternative is retained below for comparison and in the event that the U.S. returns to that policy prior to 1972. The dollar-credit alternative shows the projected costs if India should be forced to this more costly alternative.

With the current emphasis on improved cereal production technology, both in India and by foundations and governments internationally, it seems realistic to expect some rather marked improvements in per acre yields. As well as the improved varieties that are already coming into use in India, the increase in fertilizer availability, irrigation facilities and the development of insecticides and other yield-increasing inputs are almost certain to increase production.[12] Higher per acre yields imply that a given

---

[11]As discussed in Chapter IV, convertible local currency credit (CLCC) is an arrangement that enables payments deficit countries like India to receive shipments under more lenient terms than dollar-credit -- 40 years with a 10 year grace period rather than 20 years with a 2 year grace period.

[12]A discussion of the possibilities of increasing yields in India is given by Nathan M. Koffsky, "The Food Potential of Developing Countries", Journal of Farm Economics, December 1967, pp. 1108-13.

change in food-aid shipments will, by decreasing acreage in cereals, have a larger disincentive effect.[13] Along with cereals, the per acre yields of commercial crops will also increase but the improvement will probably not be as large judged either from the evidence over the 1950-65 period or the current emphasis being given to commercial crop yields relative to cereals in India. Two alternative assumed increases will be considered: (1) a compound annual rate of 1.6 percent for cereals and 1.0 percent for commercial crops -- this is based on the actual rates during 1950-65;[14] and (2) a compound rate of 3.5 percent for cereals and 2 percent for commercial crops.[15] Based on the midyear (1960) of the 1957-63 period over which average yields were calculated in the earlier analysis, the two alternatives assumptions would project the yield increases by 1972 as follows:

---

[13]A distinction can be drawn between strictly yield increasing technological developments and developments that improve the quality of production (e.g., through higher quality protein content in some new varieties). Here, the concern is with quantitative rather than qualitative changes.

[14]Dantwala, "Incentives and Disincentives in Indian Agriculture", p. 3, His aggregates were somewhat broader than this study's -- foodgrains and non-foodgrains.

[15]The 3.5 percent rate was suggested by Koffsky, "The Food Potential of Development Countries", p. 1112.

	Cereals	Commercial Crops
Assumption (1)	21%	13%
Assumption (2)	51%	27%

Because cereal and commercial crop yields are assumed to increase at differential rates, the explanatory variable representing relative yields in the supply equations (YRCC) will also change. This will induce some shifts in acreage toward cereals so that cereal production will increase by more than indicated by yield improvements alone. While this is important in predicting the overall effect of policies to increase cereal yields more rapidly than commercial crop yields, it will not change the impact of food-aid so long as the price coefficients remain the same.[16]

To account for possible increases in prices of food-aid and India's export crops, four alternatives are given in Table 5.4:

---

[16]More important perhaps is the impact of the substantially greater cereal production under assumption (2) operating through the demand equation. This could alter the quantity coefficient and, in turn, the effects of food-aid. In terms of cereal prices, however, the projected population increases of 2.5 to 3.0 percent would largely offset such a projected increase in cereal production. (Increases in income would reinforce the population growth although for the reasons discussed in Chapter II it has been excluded from the model). In Model I, the effects of food-aid on prices are measured independently of population growth.

Table 5.4: Resource benefit estimates per million dollars of food-aid shipments to India, Projections to 1972[a]

Yield Assumptions	Price Assumptions			
	(1) constant	(2) 20% higher (food-aid)	(3) 20% higher (export crops)	(4) 20% higher (both)
	- thousand dollars -			
(1)[b]	642.5	607.2	694.0	651.2
(2)[c]	651.3	613.9	707.1	661.5

[a]Based on Model I and no value assigned to incremental consumption.

[b]Compound annual yield increases of 1.6 and 1.0 percent for cereals and commercial crops, respectively.

[c]Compound annual yield increases of 3.5 and 2.0 percent, respectively.

(i) constant prices, column (1);

(ii) 20 percent higher food-aid prices only, col. (2);

(iii) 20 percent higher export prices only, column (3); and

(iv) 20 percent higher prices for both, column (4).

Assuming that ocean freight rates will increase to $12 per m.t., a 20 percent increase in the prices of food-aid (from $64 to $77 per m.t.) implies a cost of $89 per m.t. A 20 percent increase in export crop prices would increase the per acre value from $54 to $65.

Cursory inspection of Table 5.4 leaves the impression that various price and yield increases do not substantially alter the estimated benefits per million dollar shipment. Furthermore, the benefits differ only marginally from the Model I estimate of $636,800 for the 1952-63 period. Thus the principal conclusion to be drawn from Table 5.4 is that the resource benefits for 1972 are likely to be similar to those of 1952-63 period.

Although no marked changes materialized in the 1972 estimates, several points are still worth noting. First, the quantity involved in a one million dollar shipment during 1952-63 was 13,899 m.t.'s. But this decreased to 13,158 m.t.'s for 1972 with food-aid prices constant but ocean freight at $12 per m.t.; and for 20 percent higher food-aid prices, the quantity declined to 11,111 m.t.'s. In addition, the consumption effect decreased from 46.5 percent of shipments in Model I in the earlier analysis to 44.8 and 42.6 percent under yield assumptions (1) and (2), respectively, in the 1972 projections. Thus the consumption effect is only 4,733 m.t.'s for assumption (2) and the 20 percent higher food-aid prices in Table 5.4 compared with 6,458 m.t.'s during the 1952-63 period. Coupled with this is the larger Indian population by 1972 which widens the consumption effect disparity when expressed on a per capita basis. As India's population grows, larger and larger quantities of food-aid will be required to meet a given per capita shortage and, in addition, the dollar cost of this food-aid will increase even faster if world prices of cereals also increase. In this situation, it will be even more important that resource benefits per million dollar shipment equal or exceed the costs for otherwise India would have a net resource loss while providing diminishing incremental per capita quantities.

The second conclusion one can draw from Table 5.4 is that the more commercial crop prices increase relative to food-aid prices, the larger the estimated resource benefits (compare columns (2) and (3)). Finally, it may be noted that if yields are assumed to increase faster, as hown by row (2) -- these are roughly double the rates in row (1) -- the estimated resource benefits do not materially increase.

When resource costs are projected to 1972, they show more notable changes than the benefit estimates. This is due to a new United States policy that requires the recipient country to pay for all ocean freight in foreign exchange, not just the charges for the 50 percent shipped on foreign flag vessels.[17]

Table 5.5 gives the projected resource costs for local currency, dollar-credit and CLCC sales at both the actual

---

[17]After October 8, 1964, the U.S. paid only the difference in rates between U.S. and foreign-flag vessels on the 50 percent shipped in U.S. vessels; the recipient paid the remainder, i.e, the foreign-flag rate. The 1966 Act specifies that, for local currency sales, the recipient country must pay at the time of shipment all foreign-flag costs. But for dollar-credit and CLCC sales the 50 percent of food-aid that must be shipped on U.S. flag-vessels can be included in the loan. By discriminating in this way, the new Act raises the cost of local currency sales. The estimates in Table 5.5 assume a foreign-flag rate of $12 per metric ton. This was selected to account for higher rates than the actual 1964-66 rates to India which were $10.65 per ton. See, Foreign Agricultural Trade of the United States, U.S.D.A., February, 1967, p. 44 and June, 1967, p. 17.

Table 5.5: Resource cost estimates per million dollars of food-aid shipments to India, projections to 1972

Type of Sale	Price of Food-aid: Constant (1957-63 level)	Price of Food-aid: 20 percent higher
	- thousand dollars -	
Local Currency		
10% use portion	242.1	236.7
15% use portion	284.2	279.1
CLCC[a]		
.0575	492.3	490.7
.08	361.5	359.4
.10	289.4	287.1
.15	194.6	192.0
Dollar-credit[b]		
.0575	726.4	725.5
.08	608.6	607.4
.10	528.2	526.7
.15	391.6	389.7

[a]Type III loan (convertible local currency credit)

[b]Type I loan.

price of food-aid during the 1957-63 period and the 20 percent higher price assumed in some of the benefit projections to 1972. Although higher food-aid prices do not materially affect resource costs,[18] the new ocean freight policy has a significant impact on the cost of local currency sales. At the 1957-63 prices of food-aid and a 15 percent U.S. use-portion, their cost increases from $205,600 to $284,200 -- an increase of 38 percent. The estimates for dollar-credit sales, in constrast, decrease somewhat relative to what they would have cost during 1957-63. For instance, the cost declines from $543,400 to $528,300 at a .10 discount rate and constant prices (compare Table 5.2). This surprising result stems from the fact that the ocean freight for U.S. vessel shipments is included in the loan only at the foreign-flag vessel rate ($12/m.t.) under the new ocean freight policy whereas the higher U.S. rate ($16/m.t.) was assumed to apply on shipments prior to October, 1964. Although India paid the U.S. rate in local currencies on the earlier shipments, it was assumed that the same rate would have been included in the loan had dollar-credit sales been transacted.

---

[18]Costs turned out somewhat lower for higher food-aid prices because a larger proportion of a million dollar shipment (which includes ocean freight) is accounted for by the less expensive use-portion or loan.

The combined impacts of the ocean freight policy is $93,700. Local currency sales increase in cost by this amount relative to dollar-credit sales under the new ocean freight policy.

The other main conclusion arising from Table 5.5 pertains to the relative costs of the three alternative sales arrangements. Comparing local currency and CLCC sales, both carry similar costs if the appropriate discount rate is .10; if it is higher, CLCC would offer some advantages. Assuming that the U.S. allows India to convert to CLCC rather than dollar-credit sales by the end of 1971, the resource costs of food-aid would not appear to differ much between CLCC and local currency sales. This arises not only because of the lenient repayment terms for a CLCC loan but also because the ocean freight policy permits India to include 50 percent of the ocean freight costs in the loan rather than paying all freight at the time of shipment. But if the U.S. should apply the more stringent loan terms required for dollar-credit sales, the resource costs would increase rather sharply. At constant food-aid prices and a .10 discount rate, dollar-credit sales are roughly twice as costly as CLCC and local currency sales.

In terms of net gain, the results given in Tables 5.4 and 5.5 point out the rather meager benefits India would receive from food-aid shipped under dollar-credit.[19] And if shipments in 1972 are exclusively on a CLCC basis, the net benefits will decrease somewhat relative to the 1957-63 period. For instance, the net benefits were $431,200 per million dollar shipment in the earlier period (for Model I and a 15 percent use-portion, see Table 5.3). Projected to 1972 at constant prices and a .10 discount rate, the net benefits would be $353,100 (for the lower assumed yield increases).

If these projections are realistic, the attractiveness of food-aid will diminish in the future but the net resource benefits will still remain substantial. Coupled with the incremental consumption and the associated indirect benefits, food-aid would still be a reasonably lucrative form of foreign assistance to India. If, however, the dollar-credit policy is eventually applied to India as it will be to many recipient countries, shipments would lose much of their attractiveness.

---

[19]Since the projected estimates are in dollars, the possibility of general world price inflation in dollar terms could further lower the net resource gain. In this projections, the dollar is assumed to represent constant purchasing power.

Summary

Numerous alternative situations have been examined in this chapter and it will be helpful to consolidate the principal points for Model I, recognizing that the results are subject to various statistical and possibly theoretical errors and that one of the hypothetical models might more adequately represent the impact of shipments on the factors studied. All estimates apply to the 1952-63 period, only. No credit is given to incremental consumption in the resource benefit estimates reported; this effect is listed separately.

Since CLCC sales were not in effect during the period, only local currency and dollar-credit sales will be included as this will contrast the two extreme cost alternatives. An intermediate discount rate of .10 has been selected on the grounds that this probably comes closer to the true Indian rate of return on foreign exchange than either .0575, .08 or .15. For dollar-credit sales, the estimates pertain to a Type I loan. The estimates for local currency sales assume a 15 percent United States use-portion.

Summary Table 5.6 includes an estimate of the effect of the two types of sales on the nominal foreign exchange (F) position in India. Finally, the reference figure of one

Table 5.6: Estimated effects per million dollars of food-aid shipments to India, Summary, 1952-63

Effects	Type of Sale: Local Currency	Type of Sale: Dollar-Credit
	- thousand dollars -[a]	
Value of shipments (V)	1,000.0	1,000.0
Resource benefits (B)	636.8	636.8
-Import Displacement (Δ M)	405.0	405.0
-Allocative (ΔE)	231.8	231.8
Resource Costs (C)	205.6	543.4
Net Resource gain (G)	431.2	93.4
Foreign exchange (F)	-150.0	-1,282.5
Consumption (Δ D)[a]	6,458	6,458

[a]Consumption measured in metric tons; it equals 46.5 percent of the quantity shipped per million dollars.

million dollars is included so that benefits and costs can be seen in relation to the resource benefits of untied dollar grants. Cash grants are interpreted as providing the maximum net resource gain to India among all possible forms of foreign assistance.

The local currency column refers to the estimated actual effects of one million dollar marginal changes in shipments during 1952-63. In contrast, the dollar-credit column answers the question: "What would have been the effects if sales had been on dollar-credit terms?" Both types of sales provide the same resource benefits; about 63 percent of the benefits are attributed to import displacement and the remaining 37 percent to increases in commercial crop production. Such benefits were nearly two-thirds as desirable as a one million dollar grant. For local currency sales, the costs offset less than one-third of the benefits, leaving a net resource gain equal to 43 percent of a dollar grant. Under a dollar-credit sale, the resource costs would have been only slightly lower than the benefits and the net gain would have been only 9 percent of a dollar grant. A dollar-credit sale, moreover, would have resulted in an increase in nominal foreign exchange outflow of 128 percent of a million dollar shipment; the foreign exchange loss for a local currency sale through a decrease in dollar inflows was 15 percent of a million dollar shipment. In comparison to local currency sales, dollar-credit sales would have led to a net decrease in India's balance of payments of $1,132,500 -- approximately the value of the shipment. In both sales arrangements, the consumption of cereals increases by 6,458 metric tons, or 46.5 percent of the actual quantity shipped.

If in the future India receives food-aid on dollar-credit, the shipments will contribute negligibly to her resource position. This is primarily because of the increased resource costs. From Table 5.6, the cost of this new policy alone is $337,800 per million dollar shipment. Coupled with the dollar-credit policy is the requirement that recipient countries pay more of the ocean freight in foreign exchange. Reference to Table 5.5 shows that the cost of the new ocean freight policy combined with 50 percent higher freight rates per million dollar shipment will be $78,600 for local currency sales but a minus $15,200 for dollar-credit sales discounted at .10. These differences occur because after 1964 recipient countries had to pay for the 50 percent of shipments in U.S. flag vessels (at the rate for foreign flag vessels) rather than having this included in the local currency repayment.

For dollar-credit sales, the ocean freight on U.S. flag vessels was included in the loan for the 1952-63 estimates and now only the foreign flag rate is included in the loan. Thus, when the new policies are combined in the 1972 projections, the advantage of local currency sales decreases from $337,800 to $244,000 per million dollar shipment. Nonetheless, resource costs for local currency sales still remain substantially below those of dollar-credit sales for all discount rates examined.

CHAPTER VI

SUMMARY AND POLICY IMPLICATIONS

On the premise that it is approriate to evaluate food-aid shipments in terms of resource benefits and costs to the recipient country, this study set out to quantify the contribution of United States shipments (Title I) to India's resource position. Because foreign exchange has been and continues to be dear to India, it was selected as a suitable measure of resource gains and costs. Specifically, the final estimates have been given in dollars and are comparable to the most desirable type of foreign assistance from India's viewpoint -- untied dollar grants.

To measure India's resource gain, it was first necessary to separate the various conceptual issues which surround food-aid into two groups: the first includes those effects which, collectively, contribute to the recipient country's resource position; and the second, despite whatever indirect benefits they offer, includes effects that do not improve the resource stock of the recipient country. The former group includes what have been termed in this study (i) the "disincentive effect" on foodgrain production, (ii) the "allocative effect" on commercial crop production, (iii) the "import displacement effect" on commercial foodgrain purchases and, (iv), the "consumption effect." In order to estimate these effects, a six equation recursive system was postulated which contained an endogenous variable corresponding to each effect as well as a foodgrain price variable corresponding to the "price effect".

Food-aid enters and affects the system by influencing the quantity of commercial imports and by changing the total quantity available for consumption which alters foodgrain prices. The prices, in turn, influence producers' price expectations and change their allocation of resources in later periods.

After the system's four structural equations were estimated with ordinary least squares and 1952-63 data, the "cummulated" effects of a change in food-aid shipments were determined by deriving the new equilibrium solution and comparing this with the previous equilibrium. The effects were calculated for one empirical model and five additional models that were hypothetical because they contained restrictions on certain parameters. These effects were then converted to dollars in order to estimate the resource benefits from changes in the quantity of shipments during the 1952-63 period and project benefits to 1972. In the empirical model, the estimated resource benefits per million dollar shipment were

$636,800. When the benefits were calculated for the hypothetical models, they varied from $362,300 to $797,800. The benefit estimates include only the value of commercial imports displaced and the dollars earned through increased exports of commercial crops. When the consumption effect was also valued at the same price as the food-aid shipments, the benefits increased by another (465,000 in the empirical model. In terms of quantity, nearly half of food-aid contributed to incremented consumption and the other half displaced commercial imports and domestic production.

Because the 1966 Food for Peace Act contained a policy change -- to be implemented by December 31, 1971 -- that requires recipient countries to pay for food-aid in dollars on long term credit, this arrangement received primary emphasis in the investigation of resource costs. Under so-called "dollar-credit" sales, the maximum repayment period is 20 years with a two year grace period. These payments were discounted to the present in order to estimate the resource cost of the repayment burden accepted in buying food-aid under this arrangement. In the past, India has received shipments (Title I) under the local currency sales arrangement whereby the United States is paid in rupees. The resource cost of local currency sales during 1952-63 was estimated at $205,600 per million dollar shipment. In contrast, the estimated resource cost of dollar-credit sales would have been between \$317,400 and \$758,500 per million dollars of shipments, depending on the appropriate discount rate and the pattern of repayment. For a discount rate of .10 and equal annual repayments, the resource cost would have been \$543,400 under dollar-credit sales.[1] The 1966 Act, however, enables payments deficit countries such as India to convert to a credit arrangement called CLCC (convertible local currency credit) which has a maximum 40 year repayment period and a 10 year grace period. Because of the more lenient repayment terms, the resource costs of CLCC sales at a .10 discount rate would have been \$284,100 -- only \$78,500 greater than local currency sales -- per million dollar shipment during 1952-63.

Conclusions: 1952-63 Period

Nevertheless, since India actually benefited from the lower cost local currency sales during the period ending

---

[1]Food-aid might have had a larger import displacement effect if less emphasis had been placed on maintaining "normal" imports under these pseudo-commercial sales.

in 1963, several conclusions can be drawn from the analysis. The first, and most secure, is that shipments contributed substnatially to India's net resource position. The difference between the resource benefits and costs per million dollar shipment was estimated to have been $431,200 for the empirical model. Thus food-aid was some 43 percent as effective as untied dollar grants as a means of transferring resources to India during the period. When the incremental consumption was valued at the average price of food-aid including ocean freight ($72/m.t.), food-aid became approximately 90 percent as attractive as untied dollar grants.

If the estimates for one million dollars of food-aid are generalized to total shipments worth 1,636 million dollars (including ocean freight), the estimated net resource benefits reach some .7 billion dollars during the period. Combined with incremental consumption of some 10.5 million metric tons of cereals, the aggregate benefits have been favorable and substantial under local currency sales. Although the net benefits from food aid fell short of untied dollar-aid, they were clearly superior to the more costly alternative of purchasing the same quantities commercially.

Conclusions: Projections to 1972

Looking to the future when under the present legislation credit sales will have replaced local currency sales, a changed scene emerges. This is not so much because of a decline in benefits but due to new U.S. policies that alter the costs. Indeed the estimated benefits do not change materially in the 1972 projections when world prices and Indian yields of cereals and commercial crops are assumed to increase at several alternative rates. But the switch to credit sales does increase the resource costs. Compared with the 1952-63 cost of $205,600 per million dollar shipment, the projected cost would be $289,400 for CLCC and $528,200 for dollar-credit sales in 1972.[2] As a result, the magnitude of the cost increase will depend on whether India is required to convert to CLCC or to the more costly dollar-credit arrangement.

---

[2]These estimates are for .10 discount rate, equal annual repayments and constant food-aid (U.S. export) prices (see Table 5.5). Since ocean freight on foreign flag vessels was assumed to increase from $8 during 1956-63 to $12 in 1972 per m.t., the actual quantity per million dollar shipment will be somewhat lower and thus so will the incremental consumption measured in physical units.

Even if the United States should retain the local currency alternative -- which will, of course, be appropriate for a portion of shipments through 1971 -- the resource costs will still increase substantially due to a new ocean freight policy instituted in late 1964 and incorporated into the 1966 Act. This policy requires recipient countries to pay freight charges (at the foreign flag vessel rate) on all local currency sales at the time of shipment, whereas previously the U.S. paid for the 50 percent shipped in U.S. flag vessels under the Cargo Preference Act and included these charges in the relatively cheap local currency repayment. This particular change alone raises the resource costs of local currency sales from \$205,600 to \$284,200 per million dollar shipment, making the cost of local currency sales roughly equivalent to CLCC sales after 1964.

Policy Implications

This study has not attempted to examine food-aid's impact on government policies in India, even though the program has been receiving increasing criticism in this regard.[3] If such "neglect" actually existed because of food-aid, then it would be necessary to quantify how much higher average yields would have been in the absence of government complacency. Since these yields would apply to all cereal acreage, this government "disincentive effect" could have swamped the quantity of shipments, leading to a large negative net contribution to consumption. But against this one would have to weight the benefits accruing from resources invested in alternative productive ventures which, in the absence of food-aid would have been channeled to food production. Instead this study has attempted to measure the real resource flows associated with food-aid under the policies that actually existed in India.

---

[3]The danger of food-aid contributing to complacency about foodgrain production, both in product markets and input investments, by recipient countries has been noted in <u>Food and Fiber for the Future</u>, Report of the National Advisory Commission on Food and Fiber, Washington, D. C., 1967, pp. 132, 322. The Indian situation on this issue has been discussed by Rath and Patvardhan, <u>Impact of P.L. 480</u>, pp. 68-69, 199-202.

Whatever United States food-aid has contributed to India's resource position in the past, and our estimates indicate that the contribution has been substantial, the future seems much less certain. If the United States actually applies its new dollar-credit policy to India by 1972 and continues its ocean freight policy, India stands to receive only negligible resource gains from food-aid. The decision to receive food-aid would then turn on the incremental consumption.[4] Although this consumption is undoubtedly valuable, it must be weighed against the political disadvantage implicit in accepting United States food-aid. However, if the CLCC policy is followed, the resource benefits will remain substantial, though somewhat less than for the 1952-63 period.

Indian officials, at least the Foodgrains Enquiry Committee, have reacted to the new policy with some alarm.[5] Such concern is understandable when the heavy debt-service burden already facing India is taken into account. The dollar-credit policy compounds a major external financing

---

[4]In addition, the "indirect benefits" may be important to Indian officials. Although these have not been estimated in this study, it was argued in Chapter II that many of them could be achieved by alternative internal policies and do not depend on food-aid.

[5]See Chapter I, above. Part of the Committee's concern stems, as well, from the "self-help criteria" included in the 1966 Act. These criteria say, in effect, that unless a recipient country allocates resources to food production in a manner acceptable to U.S. officials, no food-aid agreement will be consummated.

problem for which the solution is not in sight. Even though the United States may quite possibly postpone payments so that, operationally, the loans would be for an indefinite period, this appears to be a second best solution for all parties concerned.

The new dollar-credit policy would leave only the incremental consumption -- nearly 50 percent of shipments -- in the way of benefits to India. Presumably greater allocation of resources to food-grain production could provide this consumption but it would also have its costs in diminished development programs in other areas. So food-aid does not become completely unattractive under the new policy, especially comared with cash purchases. With a rapidly increasing population, food-aid may remain a necessity despite efforts to increase domestic production. On the other hand, if India's programs to control population are successful, the results of this study would indicate that shipments could diminish markedly in the foreseeable future, depending on whether the CLCC or dollar-credit policy is enforced.

In conclusion, the dollar-credit policy seems regretable if the United States purpose is to transfer resources through food-aid. If, instead, the United States is primarily interested in having India and other recipient countries become self-sufficient in food production, raising the resource cost through the dollar-credit policy should certainly contribute to this end.

LITERATURE CITED

LITERATURE CITED

1. Bhatia, B. M. Famines in India: A Study of Some Aspects of the Economic History of India, 1860-1945, Asia Publishing House, Bombay, 1963.

2. Dandekar, V. M. Food and Freedom, Karnatak University, Dharwar, India, 1967.

3. Dantwala, M. L. "Incentives and Disincentives in Indian Agriculture", Indian Journal of Agricultural Economics, April-June, 1967.

4. Fisher, Franklin M. "A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries", Journal of Farm Economics, November, 1963.

5. Goldberger, Arthur S. Econometric Theory, John Wiley and Sons, New York, 1964.

6. Government of India, Central Statistical Organization. Statistical Abstract of the Indian Union, New Delhi, annual issues.

7. International Monetary Fund. International Financial Statistics, Supplement to 1966-67 Issues, Washington, D.C., 1967.

8. Johnson, Harry G. Economic Policies Toward Less Developed Countries, Brookings Institution, Washington, D.C., 1967.

9. Johnston, J. Econometric Methods, McGraw-Hill, New York, 1960.

10. Kahn, Alfred E. "Agricultural Aid and Economic Development: The Case of Israel", Quarterly Journal of Economics, November, 1962.

11. Khatkhate, D. K. "Money Supply Impact of National Currency Counterpart of Foreign Aid: An Indian Case", Review of Economics and Statistics, February, 1963.

12. Khatkhate, Deena R. "Some Notes on the Real Effects of Foreign Surplus Disposal in Underdeveloped Countries", Quarterly Journal of Economics, May, 1962.

13. Kiffsky, Nathan M. The Food Potential of Developing Countries", Journal of Farm Economics, December, 1967.

14. Krishna, Jai and Rao, M. S. "Dynamics of Acreage Allocation for Wheat in Uttar Pradesh: A Study in Supply Response" Indian Journal of Agricultural Economics, January-March, 1967.

15. Krishna, Raj. "Agricultural Price Policy and Economic Development" in Agricultural Development and Economic Growth, edited by Herman H. Southworth and Bruce F. Johnston, Cornell University Press, Ithaca, New York, 1967.

16. __________. "Farm Supply Reponse in India-Pakistan: A Case Study of the Punjab Region", Economic Journal, September, 1963.

17. Mann, Jitendar S. "The Impact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India", Journal of Farm Economics, February, 1967.

18. Mason, Edward S. "Foreign Money we Can't Spend", Atlantic Monthly, May, 1960.

19. National Council of Applied Economic Research. Long Term Projections of Demand for and Supply of Selected Agricultural Commodities, 1960-61 to 1975-76. New Delhi, 1962.

20. Ohlin, Goran. Foreign Aid Policies Reconsidered, Organization for Economic Cooperation and Development, Paris, 1966.

21. Organization for Economic Cooperation and Development. Development Assistance Efforts and Policies, (annual reviews), Paris, 1966 and 1967.

22. __________. Geographical Distribution of Financial Flows to Less-Developed Countries, 1960-64, Paris, 1966.

23. __________. The Flow of Financial Resourses to Less-Developed Countries, 1961-65, Paris, 1967.

24. Patinkin, Don. Money, Interest and Prices, Second Edition, Harper and Row, New York, 1965.

25. Pincus, John A. Economic Aid and International Cost Sharing, Rand Corp., Santa Monica, California, 1965.

26. __________. "The Cost of Foreign Aid", Review of Economics and Statistics, November, 1963.

27. Raj, K. N. India, Pakistan and China: Economic Growth and Outlook, Allied Publishers, Bombay, 1967.

28. Rath, Nilakanth and V. S. Patvardhan, Impact of Assistance under P.L. 480 on Indian Economy, Gokhale Institute of Politics and Economics, Asia Publishing House, Bombay, 1967.

29. Reserve Bank of India. Report on Currency and Finance, annual issues.

30. Schertz, Lyle P. and Rice, Gabrielle. "U.S. Loans Under Public Law 480: Comment", Journal of Farm Economic, August, 1966.

31. Schmidt, Wilson E. "The Economics of Charity: Loans vs. Grants", Journal of Political Economy, August, 1964.

32. Schultz, T.W. Economic Crises in World Agriculture, University of Michigan Press, Ann Arbor, 1965.

33. __________. "Value of U.S. Farm Surpluses to Underdeveloped Countries", Journal of Farm Economics, December, 1960.

34. Sen, S. R. "Impact and Implications of Foreign Surplus Disposal of Underdeveloped Economies: The Indian Perspective", Journal of Farm Economics, December, 1960.

35. Srivastava, Uma Kant. "The Inpact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India: A Comment", American Journal of Agricultural Economics, February, 1968.

36. Tiwari, S. G. "Statistics for National Income Estimation in Agriculture", J. of the Indian Society of Agricultural Statistics, 1963.

37. United Nations, Food and Agriculture Organization. Development Through Food, Basic Study No. 2, Rome, 1962.

38. __________. *The Impact of Food Aid on Donor and Other Food-Exporting Countries*, World Food Program Study No. 2, Rome, 1965.

39. __________. *Trade Yearbook*, Rome, 1965.

40. __________. *Uses of Agricultural Surpluses to Finance Economic Development in Under-developed Countries: A Pilot Study in India*, Commodity Policy Studies No. 6, Rome, 1955.

41. U.S. Congress. *Food for Peace Act*, 80 Stat. 1526, Washington, D.C., 1966.

42. U.S. Department of Agriculture. *Agriculture in India*, ERS-Foreign 64, Washington, D.C., 1964.

43. __________. *Foreign Agriculture*, Washington, D.C., July 31, 1967.

44. __________. *Foreign Agricultural Trade of the United States*, Washington, D.C., February and June, 1967.

45. __________. *Monetary Effects of Financing Agricultural Exports*, Foreign Agricultural Economic Report No. 12, Washington, D.C., 1963.

46. __________. *Title I, Public Law 480: Total Shipments by 6-month Periods, January, 1955 through June, 1959, by Country and Commodity*, SDS-7-61, Washington, D.C., 1961.

47. U.S. Department of Agriculture. *Title I, Public Law 480: Total Amounts Programmed and Shipped Through June 30, 1963, and Shipments by 6-month Periods from July 1, 1959, through June 30, 1963, by Country and Commodity*, SDS-11-63, Revised, Washington, D.C., 1965.

48. __________. *Trends in India's Agricultural Trade*, Foreign Agricultural Economic Report No. 15, Washington, D.C., 1964.

49. __________. *Twelve Years of Achievement Under Public Law 480*, ERS-Foreign 202, Washington, D.C., 1967.

50. U.S. President. *The World Food Problem*, A Report of the President's Science Advisory Committee, Panel on the World Food Supply, Vols. I and II, White House, 1967.

51. __________. Food and Fiber for the Future, Report of the National Advisory Commission on Food and Fiber, White House, 1967.

52. Witt, Lawrence. A Program of Research on Food for Peace, A Report by the Economic and Agricultural Development Institute, Parts I, II, and III, Michigan State University, East Lansing, 1966.

53. Witt, Lawrence, and Carl Eicher. The Effects of United States Agricultural Surplus Disposal Programs on Recipient Countries, Research Bulletin 2, Agricultural Experiment Station, Michigan State University, East Lansing, 1964.

54. Wold, H. O. A., and Jureen, L. Demand Analysis, John Wiley and Sons, New York, 1953.

APPENDICES

APPENDIX A

DATA EMPLOYED IN REGRESSION ANALYSIS, 1952-63, India

Crop Year (July-June)	Acreage Planted (1,000 acres)		Yield Indexes (1961=100) Lagged One Year			Cereal Yield (m.t. 1000 acres)
	Cereals ACER	Commercial ACOM	Cereals YCERLI	Commercial YCOMLI	YRCC	YIELD
1952	193,198.5	53,237.8	76.6	88.9	86.2	207.0
1953	203,315.6	50,982.8	77.5	85.4	90.7	218.7
1954	214,016.4	50,715.3	81.9	84.5	96.9	246.1
1955	212,265.4	56,206.3	91.3	91.3	100.0	236.6
1956	215,378.4	57,725.2	88.5	93.8	94.3	234.0
1957	216,740.3	56,649.4	87.6	88.7	98.8	243.8
1958	214,600.1	59,582.4	91.3	94.1	97.0	224.6
1959	223,160.8	60,259.4	84.2	92.0	91.5	254.1
1960	224,522.7	61,190.6	95.5	102.9	92.8	249.2
1961	227,052.0	62,003.4	94.3	88.7	106.3	267.1
1962	229,775.8	66,605.8	100.0	100.0	100.0	273.1
1962	227,441.1	65,585.8	102.3	98.3	104.1	255.3
Source[a]	1	1	1	1	1	1

Appendix A, continued

Calendar Years	Cereal Availability (1,000 tons)					Pulse Avail.
	Domestic Supply QCERS[b]	Commercial Imports	Government Stocks STOCKS	Food-aid PL 480	Total QCERAV	(1,000 m.t. QPULAV
1952	42,817.7	3,923.0	-620	0.0	46,120.7	9,256.4
1953	45,566.9	2,030.1	+480	0.0	48,977.0	10,000.9
1954	54,571.0	833.7	-200	0.0	55,204.7	11,489.1
1955	52,744.1	601.8	+750	0.0	54,095.9	12,157.2
1956	51,858.7	1,010.5	+600	345.5	53,814.7	12,141.4
1957	54,042.9	975.6	-860	2,678.7	56,837.2	12,611.1
1958	51,153.3	846.5	+270	2,351.6	54,621.4	10,556.7
1959	58,235.9	940.8	-490	2,919.9	61,606.6	13,944.6
1960	58,292.6	39.3	-1,400	4,909.0	61,840.9	12,313.6
1961	61,406.9	1,325.3	+170	2,165.7	65,067.9	13,230.7
1962	62,767.7	534.7	+360	3,166.3	66,828.7	12,452.8
1963	61,538.8	400.1	+20	4,185.1	66,144.0	11,996.6
Source[a]	2	2	3	4	5	1

Appendix A, continued

Calendar Year	Population (millions, July 1)	Wholesale Price Indexes (1952-53=100)[c]				
		Cereals	Cereal Expectations		Commercial Expectations	
	POP	PCER	PECER	PCERL2	PECOM	PCOML2
1952	369.6	96.77	83.15	84.70	119.55	119.99
1953	376.1	96.06	89.19	81.60	110.26	119.10
1954	382.9	84.34	96.42	96.77	106.04	101.42
1955	390.2	79.78	90.20	96.06	106.66	110.65
1956	397.8	89.67	82.06	84.34	99.29	102.66
1957	405.8	93.84	84.73	79.78	103.85	95.90
1958	414.3	94.59	91.76	89.67	111.73	111.78
1959	423.3	90.04	94.22	93.84	109.58	111.67
1960	432.7	85.44	92.32	94.59	107.62	107.49
1961	442.7	81.08	87.74	90.04	112.10	107.74
1962	453.4	83.33	83.26	85.44	120.04	116.46
1963	464.3	83.84	82.21	81.08	119.15	123.61
Source[a]	3	6,7	6	6	6	6

Appendix A, continued

a. Data Sources:

1. Government of India Directorate of Economics and Statistics, Ministry of Food and Agriculture, Indian Agriculture in Brief, Seventh Edition, New Delhi, 1965.

2. Provided by Jitender S. Mann, Ph.D., Dissertation, University of Minnesota.

3. Government of India, Directorate of Economics and Statistics, Ministry of Food and Agriculture, Bulletin on Food Statistics, Sixteenth Issue, New Delhi, 1966, Table No. 11.

4. U.S. Department of Agriculture, SDS - 7-61, 1961. SDS-11-63, 1965 and SDS-1-67, 1967, Washington, D.C.

5. QCERS + IMPORTS + STOCKS + PL 480.

6. Government of India, Central Statistical Organization, Monthly Abstract of Statistics, New Delhi, various issues.

7. Reserve Bank of India, Report on Currency and Finance, Bombay, 1963 and 1964.

b. Calculated from "Index of Production" for cereals; adjusted to 87.5 percent of gross production in order to allow for feed, seed requirements and wastage; wheat and barley adjusted from crop to calendar years.

c. All series deflated by wholesale price index for all commodities.

APPENDIX B

VALUATION OF THE ALLOCATIVE EFFECT

To determine the values per acre for each of the five major commercial crops, the following steps were followed:

1. The "indexes of productivity" correct Indian yield statistics for changes in estimating procedures. These indexes were applied to physical yields per hectare for 1960-61 to generate a series covering the 1957-63 period. This series was then averaged and converted to metric tons per acre (1 hectare = 2.471 acres).

Commercial Crop	Metric Tons per Acre
groundnuts (in shell)	.286
cotton (lint)	.045
jute	.474
sugar (gur)	1.697
tobacco	.318

The indexes came from Indian Agriculture in Brief (source 1, Appendix A) and Statistical Abstract of the Indian Union, Central Statistical Organization, Government of India, 1963-64.

2. The prices per metric ton were obtained by: i) dividing the total value of Indian exports for each crop by the quantity exported during each year, 1959 through 1963, for which data were available; and ii) averaging over the five years. The trade classifications and resulting figures were as follows:

Classification	Dollars per Metric Ton
groundnuts (in shell)	289
cotton, raw	465
jute	209
sugar, raw basis	90
tobacco, unmanufactured	688

These data came from Trade Yearbook, FAO, Rome, 1965.

3. The values per acre were obtained by multiplying metric ton yields per acre by the dollar price per metric ton:

Crop	Value per Acre
v_1 (groundnuts)	\$83
v_2 (cotton)	\$21
v_3 (jute)	\$91
v_4 (sugar)	\$153
v_5 (tobacco)	\$219

These figures give the dollar export value per acre for the respective crops. To account for farm to port marketing costs, 20 percent was deducted from each in the analysis reported in Chapter V.