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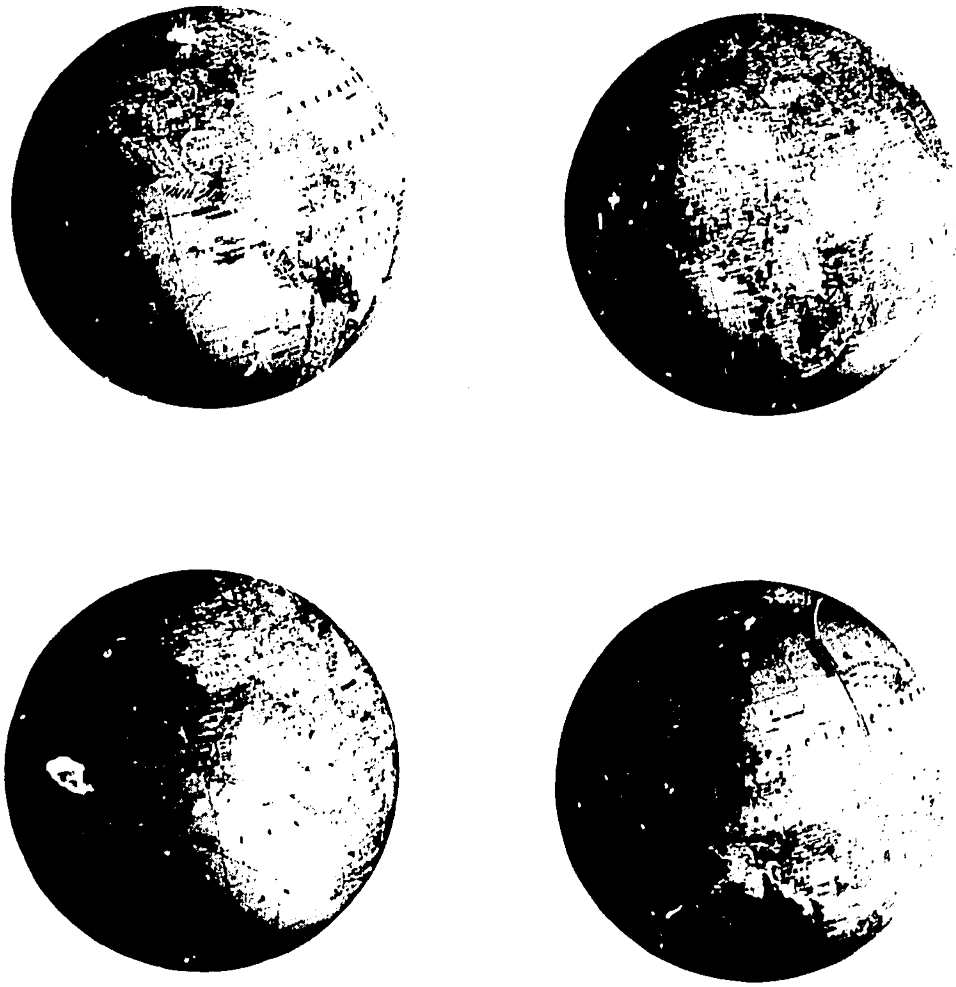

THE EFFECTS OF P.L. 480 WHEAT IMPORTS ON LATIN AMERICAN COUNTRIES

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by

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I. Introduction

The purposes of this study are to analyze the effects of Public Law (P.L.) 480 imports on the agricultural development of Brazil, Colombia, and Peru over the time period 1952-1975, to determine if these imports have been beneficial or detrimental, and to provide a basis with which to evaluate the effects for future food aid policy decisions. The study will focus on P.L. 480, Title I wheat imports as wheat has been the major commodity shipped under the P.L. 480 program, and because Title I sales at concessional terms have been the most important component in total P.L. 480 exports up until 1975.

Food aid has always been an important component of total economic aid from the United States under the P.L. 480 program and its importance is likely to continue in the future along with the prospects of surplus grain supplies in the U.S. European countries too, particularly those of the European Economic Community (EEC), have also increased their interest in participating as donors in food aid programs. Humanitarian considerations as well as the commodity supply management aspect of food aid, in its helping to solve problems of excess supply disposal of agricultural commodities, provide the basis for the increased interest and participation in food aid programs. However, there has been in creasing concern among policymakers and economists as to the relative costs and benefits of food aid and as to its effects on the recipient countries; These effects must be considered in any policy decision reached as to this aid for ethical reasons as well as for the pragmatic reason of evaluating future trading opportunities with food aid recipient .

The primary concern with the effects of food aid on recipient countries focuses on the possible disincentive effects on a country's agricultural production. An increase in food supplies provided by food aid may depress prices received by farmers and/or be the cause of or rationalize inadequate agricultural growth policies leading to decreases in in food production and increasing dependence on food imports. In the short run a decline in crop prices may produce a "reversible" switch to other crops or production possibilities, but in the long run may have "irreversible" negative consequences stemming from lack of adoption of new technologies and investment in agriculture [33]. The consequent dependence of the recipient countries on food imports and food aid will be especially serious in light of the risk of having food aid cut off during a time of scarcity and high world prices for food. Interruptions to development planning that occur as a result of discontinuance of food aid and the foreign exchange difficulties of importing food at high world prices may have severe consequences for the pace of development. If food aid has resulted in a decline in food production, the risk and the consequences of having food supplies cut off or obtainable only at a substantially higher cost may well outweigh any other benefits that have ensued from food aid.

It is important, then, to evaluate the extent of the possible price and policy disincentive effects of food aid in the recipient countries. To do so, these effects should be measured in a quantitative way, preferably with a multiequation commodity model ([23] and [33]). There have been relatively few attempts to do so, particularly for countries other than India. Mann [39] develops an analytical framework to quantify the impact of imports of P.L. 480 cereals on the prices and domestic supply of cereals in India, although he does not differentiate among the cereals. The framework includes 1) a supply equation for cereals as a single commodity, 2) a demand equation, 3) an income generation equation, 4) a commercial imports equation, 5) a withdrawal from stocks equation, and 6) a market clearing equation. Thus, his model includes important variables such as commercial as well as P.L. imports and withdrawals from stocks. Other studies have elaborated somewhat this framework for the Indian case ([46] and [3]).

However, there is a need to expand the analysis, not only to include countries other than India but also to include explicitly demand and supply of individual grains and their interrelationships, rather than aggregating all grains into one commodity, assuming that the grains are perfectly substitutable and that P.L. 480 imports influence all grains uniformly even though wheat may be the principal import under P.L. 480. The interrelationships in production and consumption are particularly important in determining how and why P.L. 480 imports affect agriculture.

Further, there is a need to incorporate specifically government policies affecting agricultural production, consumption, and trade as government intervention in food marketing is prevalent in many developing countries, with the use of producer price supports, consumer price ceilings, and trade restriction policies. The kind and degree of impact of P.L. 480 imports on a country's agriculture would necessarily affect, as well as be affected by, such policies. To attempt to partially close these gaps, this study incorporates specifically production and consumption relationships among grains and agricultural price policies affecting these grains in an econometric model for Brazil, Colombia, and Peru, utilizing the particular food and feed grains of wheat, rice, corn, barley and soybeans.

To gain a clearer understanding of the kind and degree of government market intervention in grain supply and pricing, particularily for wheat, a brief description of this intervention is given below for Brazil, Colombia, and Peru. This description forms the basis for the analytical framework of the econometric model used in the study.

Brazil Grain Price Policies

The government of Brazil exercises control over every aspect of the marketing and processing of wheat, primarily through the Marketing Department for National Wheat (CITRIN), which is a body belonging to the Bank of Brazil and which is under the direction of the National Superintendency for Supply (SUNAB). CITRIN coordinates all purchases and sales of domestic wheat and since 1952 has been the sole supplier of imported wheat, importing the wheat from abroad and selling it to the mills at higher prices. With the difference, domestic wheat producers are paid higher prices than those paid on the international market ([40], p. 141). Thus, the prices paid to producers are separated from the prices paid by the mills for imported and domestic wheat.

Minimum wheat prices to producers are established at the time of sowing through the Commission for Financing Production (CFP) and are intended to cover production costs calculated by the Federation of Wheat Producer's Cooperatives (FECOTRIGO) plus a profit margin considered sufficient incentive to increase production.

The prices to the mills of domestic and imported wheat have in general been set lower than the support price. Before 1962, millers purchased domestic wheat directly from the domestic producers at the price at which imported wheat was sold and the producers were paid the difference between this price and the support price by CITRIN.

Since 1962, however, CITRIN has been the sole purchaser of both domestic and imported wheat and has sold both the domestic wheat and the imported wheat to the mills at a uniform price, generally at a higher price than that which it paid for the imported wheat but at a lower level than the domestic support price. The price at which the wheat is sold to the mills is set such that revenues can be made from importing wheat and also such that the processed product will fit a price range within the purchasing power of the average urban consumer. The selling price to the consumer is obtained by calculating the weighted average prices at which CITRIN sells both the imported and domestic wheat to the mills, and by taking into consideration the prices of flour and other by-products also generally controlled by the government.

The policy can be depicted graphically below in Figure 1. In Figure 1, line SS represents the supply curve of domestically produced wheat and DD the demand curve of Brazilian consumers (or of the millers). The producer price support set at OP^* elicits OQ_1 of domestic production which CITRIN buys. To keep the domestic price to consumers at $O\overline{P}$, the government imports Q_1Q_2 amount of wheat at OP_i and resells OQ_2 of wheat, or the total amount of domestic and imported supplies of wheat at $O\overline{P}$.

thus making profits of ABCD on the transaction. These revenues obtained are then used to cover the subsidy to domestic producers of AEFG resulting from the price support set at level P* ([34], p. 89). The amount of subsidy to producers through higher price supports and the amount of subsidy to consumers through lower consumption prices thus depends on the ability to import at low prices.

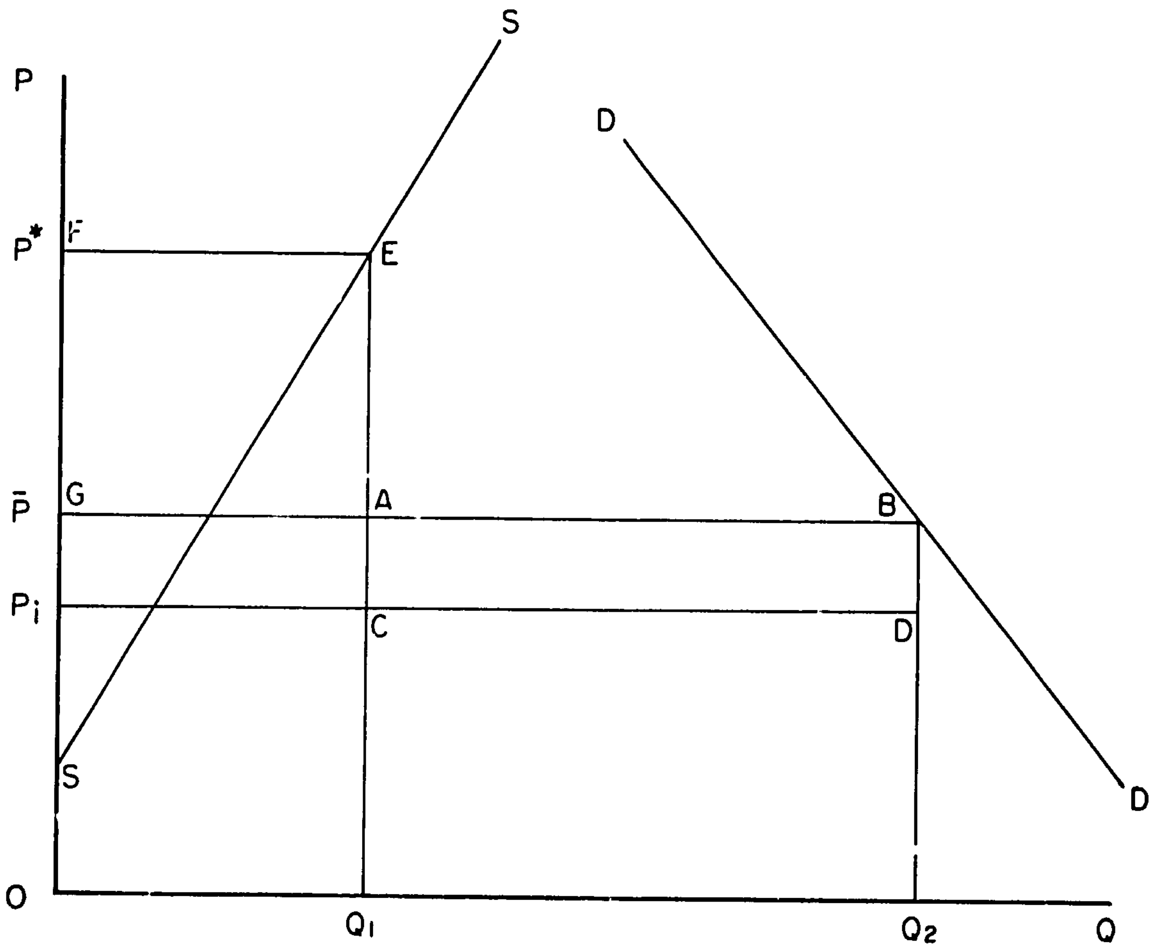
Since 1945, the CFP has also set minimum prices for corn, rice and soybeans which are announced before planting, but their operation has differed from the case of wheat. Unlike the wheat support program which could be financed by the sale of imports, rice and corn have not been imported to any extent; and there were no opportunities for the government to finance the rice and corn support programs by resale operation due to the necessity of keeping the prices low to urban consumers. Thus, financing the guaranteed minimum price schemes has often been a problem in times of surplus.

Before 1967, the quaranteed minimum prices for these crops were mainly established by CFP purchases. Except for a few years, however, there was no real CFP participation in the market. If the market did happen to fall, the program usually failed to prevent prices from going below the support level, owing to lack of financial resources and administrative organization. From 1952 to 1972, there were large purchases of corn and rice only twice and then only 4.5 percent and 3.5 percent of the 1963 and 1965 corn crops, respectively, and 22.4 percent and 7.1 percent of the rice crops in 1965 and 1970, respectively ([40], p. 150). Over the period 1952 to 1972, there were no significant amounts of CFP purchases of soybeans, and support prices were probably not influential in soybean production.

Colombia Grain Price Policies

The Colombian government, through the Instituto de Mercadeo Agropecuario (IDEMA), formerly the Instituto Nacional de Abastecimiento (INA), takes an active role in coordinating price, trade, and supply management policies. IDEMA has the responsibility for integrating price policy with overall agricultural policy and for defending the interests

FIGURE 1. BRAZIL WHEAT IMPORT REVENUES



of both consumers and producers and of stabilizing agricultural prices through stocks policy. Its functions are 1) to promote greater agricultural production of basic food crops and to assure adequate supplies for the national market by guaranteeing minimum prices to farmers and 2) to regulate prices and markets by buying and selling basic food products, such as grains. To this end, IDEMA has had monopoly control over grain imports and distribution of these imports since 1944, being exempt therefore from any import taxes, and has intervened where necessary to control exports, establishing a minimum export price and guaranteeing a suitable supply for the internal market. IDEMA can also authorize imports by third parties, regulating the quantities and destination of the imports (see International Bank for Reconstruction and Development [30] for further elaboration of these policies).

IDEMA, as the sole purchaser and distributor of imported wheat, being exempt from import duties, can sell the imported wheat domestically at a price higher than that which it paid for the imports. Revenues can be made by doing so, and these revenues can be used to finance its operation of grain price regulation [28]. The difference between the buying and selling prices of imported wheat becomes part of IDEMA's operating funds ([1] and [49]). While IDEMA sets support prices to producers for grains and may intervene through market purchases to keep the support prices at the set level, IDEMA is not the sole purchaser of domestic wheat. Thus, while it is possible to support a price to producers by buying up part of the domestic production and shifting the supply curve back, IDEMA does not separate the producer and consumer prices. That is, because IDEMA sells the imported wheat at approximately the domestic support level [24] to keep wheat prices low to consumers, the domestic support price must also be kept low. However, the low international prices of wheat up to 1972 meant that consumer prices could be kept low and revenues still be made by selling imports at a relatively low domestic price support level.

Although the revenues from importing wheat may not be used to support the price to wheat producers, because revenues from importing wheat are used to cover the costs of the price regulation program of IDEMA, the revenues may be used to support the prices to other grain producers.

For example, rice support prices have been kept relatively high (to world market prices) in Colombia; although the intervention of IDEMA in the domestic rice market has been limited at times, it has been gradually increasing, and support levels have been maintained with an increasing degree of success, stimulating adoption of new rice technologies and varieties and raising production levels [47].

The role of support prices in raising agricultural production levels is important in both a static and dynamic context. Price supports can serve as a guarantee of a price floor, reducing risk and inducing more intensive use of available resources, raising production [35], or, where the government actively maintains a support price through stock operations, stabilizing income. The guarantee of a price minimum or reduction of risk may stimulare the adoption of new technologies, improved seed varities, and improved cultural practices. As yields increase and per unit production costs decrease, support prices can be lowered while achieving greater self-sufficiency in production. The case of rice in Colombia illustrates these dynamics.

Peru Grain Price Policies

Except for rice, there has been little government intervention in grain marketing until 1970, the major policy objective having been to keep grain prices low to consumers via wheat imports, keeping internal wheat prices at about the level of imported wheat, and via price controls, at the retail level. The government has subsidized the prices of grains at various times to control inflation and prevent speculation.

Until 1970-71, there was no specific program to support prices to corn and wheat producers, with Empresa Publica de Servicios Agropecuarios (EPSA) becoming responsible for the purchasing, importing and distributing of wheat, corn, and rice, rice prices having always been regulated. Annual import targets are fixed, and in later years EPSA has had to subsidize imports to keep consumer prices low.

General Econometric Model

From the above policy descriptions, it is seen that in countries where wheat is the major grain imported, and where the government has control over the marketing of wheat, the ability and desire of governments to use price supports and to stimulate production increases or to subsidize consumers by keeping grain prices low will depend upon the import price of wheat. Whether the import price affects producer prices and supports or consumer prices positively or negatively depends upon the demand and supply relationships among the individual grains and upon the particular political and institutional context of the importing country.

The greater the amount of P.L. 480 wheat in total wheat imports, the lower the per unit import price and the greater the revenues that can be made by selling the wheat to consumers at a price above that paid for the imports. This is because of the substantial grant element in the P.L. 480 import loans, due not only to low interest rates and long repayment periods but also because of the provision (until 1966 for Brazil and Colombia) for P.L. 480 wheat sales for local currency credit. Thus, because of the role of P.L. 480 in lowering wheat import costs and through the revenues gained from resale of wheat imports in subsidizing domestic grain production through price supports or in subsidizing consumers by lowering grain prices, we will include specifically the amount of P.L. 480 wheat imports in an econometric model to evaluate the effects of P.L. 480 wheat imports on grain production and consumption.

The general econometric model and its component equations are presented below.

Dynamic acreage response equations for each grain i:

$$A_t^i = f\,(A_{t-1}^i,\ FP_t,\ P_{t-1}^i,\ P_t^{*i},\ P_{t-1}^j,\ P_{t-1}^{*j},\ U_t)$$

where t represents time period and $A_{t/t-1}^i$ is acreage harvested of grain i; FP_t is price of fertilizer or other input prices; P_{t-1}^i is producer price received for grain i, where applicable; P_t^{*i} is support price of grain i, where applicable; P^{j}_{t-1} is producer price received for substitute or complementary grain j (in production), where applicable; P^{*j}_{t-1} is support price for substitute or complementary (in production) grain j, where applicable; U_t is a stochastic disturbance term.

A trend term could also be included if relevant. Yield equations for each grain i can not be estimated due to lack of sufficient data for factors affecting yield, so yield is taken as given and

$$A^i_t \times Y^i_t = QS^i_t \qquad (2)$$

Or, acreage times yield equals total quantity supplied, QS^i_t for each grain i.

Dynamic demand equations for each grain i:

$$PCQD^i_t = f(PCInc_t, \overline{P}^i_t, \overline{P}^j_t, CPI_t, PCQD^i_{t-1}, U_t)$$

where $PCQD^i_{t/t-1}$ is per capita quantity consumed of grain i; $PCInc_t$ is per capita disposable income; $\overline{P}^i_t$ is price of grain i to consumers or consumer price ceiling for i; $\overline{P}^j_t$ is price of substitute or complementary (in consumption) grain j to consumers or consumer price ceiling for j; CPI_t is general price index or consumer price index.

$$PCInc = \frac{Inc_t}{N_t} \qquad (4)$$

$$PCQD^i_t = \frac{QD^i_t}{N_t} \qquad (5)$$

where Inc_t is total disposable income; N_t is population; QD^i_t is total quantity consumed of grain i.

Commercial import equation for wheat:

$$M_t^W = f\ (P.L.\ 480_t^W,\ FXR_t,\ QS_t^W,\ \bar{P}_t^W,\ U_t) \qquad (6)$$

where M_t^W is quantity of commercial wheat imported; FXR_t is level of foreign exchange reserves; QS_t^W is domestic quantity supplied of wheat; $\bar{P}_t^W$ is price at which imported wheat is sold to consumers or consumer price ceiling.

Support price equations for each grain i, where applicable:

$$P^{*i}_{t/t+1} = f\ (P.L.\ 480_t^W,\ M_t^W,\ CPI_t,\ IP_t^W,\ U_t) \qquad (7)$$

where $P^{*i}_{t/t+1}$ is support price of grain i, where applicable; IP_t^W is the world or dollar c.i.f. price per ton for wheat.

Other variables are as defined above.

Market clearing identities for each grain i:

$$\text{For } i \neq \text{wheat:} \quad QD_t^i = QS_t^i + M_t^i - Ex_t^i \qquad (8)$$

where M_t^i is imports of grain i; Ex_t^i is exports of grain i; QS_t^i is total quantity supplied of grain i.

Other variables are as defined above.

$$\text{For } i = \text{wheat:} \quad QD_t^W = QS_t^W + M_t^W + P.L.\ 480_t^W \qquad (8')$$

In the above model, we include only those price supports that are relevant and where government participation in the price support program has been more than minimal, i.e., with purchases of more than 8-10 percent of the total domestic crop.

Since wheat is the primary import grain, all other grains in Brazil, Colombia, and Peru being exported or imported only in relatively small quantities, and since wheat is the grain on which the study focuses, an import equation for this grain only is formulated. Because in Brazil, Colombia, and after 1970, in Peru, the government has had monopoly control over the import and distribution of wheat imports, the determinants of the quantity of commercial wheat imported would be the determinants of the government's decision to import wheat. Since the government sells the imported wheat to consumers to maintain a particular consumer price ceiling, $\bar{P}^w_t$, this price should be a determinant of commercial imports in year t, M^w_t, along with total domestic production of wheat in year t, QS^w_t. The greater QS^w_t, the fewer the imports needed to satisfy demand at a given $\bar{P}^w_t$. Because of the overvaluation of the exchange rate and the foreign exchange cost associated with importing, the level of foreign exchange reserves would be an important determinant of M^w_t. We would expect the level of foreign exchange reserves to be a more relevant factor in determining M^w_t and the ability and desire to import than dollar or world price of wheat because of foreign exchange scarcity. The quantity of P.L. 480 wheat imported will also determine M^w_t. This is because of any possible additional imports that are imposed and also because of the role of P.L. 480 in lowering the total cost of wheat imports, depending--along with other factors--upon its effect on commercial wheat imports and the consequent relative proportions of P.L. 480 imports and commercial imports in total wheat imports.

It could be argued, of course, that the quantity of P.L. 480 imports is endogenously determined as well and is determined by the same factors as commercial imports. But because of the nature of P.L. 480 agreements, in that the quantities of imports under P.L. 480 are agreed to a considerable time before the year they are actually imported, it is reasonable to treat P.L. 480 imports as exogenous.

The support price relationship is primarily institutionally based, and the factors determining this relationship are those which determine the government's net revenue from wheat imports. To briefly summarize, because the same government agency has sole responsibility for purchasing, importing, and distributing both domestically produced and imported wheat as well as setting support prices to producers and maintaining price ceilings to consumers, the net revenues made from importing and distributing the wheat determine the subsidies or support prices to producers.

Net revenue from importing wheat can be represented (see Dudley and Sandilands [20] for derivation of this equation for Colombia's wheat import revenues) as:

$$[D(\overline{P}^W) - S(P^{*W})] \; [\overline{P}^W - \lambda\alpha\gamma P_i^W - (1 - \lambda)\gamma P_i^W] \qquad (9)$$

where

$[D(\overline{P}^W) - S(P^{*W})]$ = Total wheat imports.

$\overline{P}^W$ = Price of wheat to consumers or consumer price ceiling.

P^{*W} = Support price to wheat producers.

D = Domestic demand, a negative function of $\overline{P}^W$.

S = Domestic supply, a positive function of P^{*W}.

λ = The proportion of P.L. 480 wheat in total wheat imports.

α = The present value of P.L. 480 payments as a fraction of the nominal value of the loan.

γ = The opportunity cost of foreign exchange in local currency units per dollar.

P_i^W = The international or import price of wheat in dollars.

If we then make the support price a function of the variables of which net revenue is composed, taking α constant, then the support price will be a function of P.L. 480 wheat imports or λ, commercial wheat imports $(1 - \lambda)$, world or dollar price of wheat, P_i^W, and γ, γ being the opportunity cost of foreign exchange which, when there is no overvaluation is the exchange rate.

Although the causes of overvaluation are complex and of a general economic nature, one common cause of overvalued exchange rates is a rapid rate of inflation such that the adjustment of the price of foreign exchange in local currency terms cannot take place fast enough. If we then make the degree of overvaluation of the exchange rate, or the degree to which the perceived opportunity cost of imports in local currency units per dollar differs from the true cost (and thus the degree of foreign exchange cost to imports not represented by the exchange rate). a function of the rate of inflation, we can add this rate of inflation as a factor affecting the costs of wheat imports and the net revenues from imports and, therefore, the support price.

The general specification of any linear dynamic model can be written in matrix form as:

$$\Gamma Y_t + \beta_1 Y_{t-1} + \beta_2 X_t = U_t \tag{10}$$

where

Y_t = G x n matrix of current endogenous variables.
Y_{t-1} = G x n matrix of lagged endogenous variables.
X_t = M x n matrix of exogeneous variables.
U_t = G x n matrix of stochastic disturbance terms.
Γ and β_1 = G x G matrices of the coefficients on the endogenous variables and on their lagged values.
β_2 = G x M matrix of the coefficients on the exogenous variables.

However, the above system is not linear in that the equations

$$QS_t^i = A_t^i \quad Y_t^i$$

$$PCInc_t = \frac{Inc_t}{N_t}$$

and

$$PCQD_t^i = \frac{QD_t^i}{N_t}$$

are nonlinear so that linear approximations must be found. We have used those approximations derived by Womack and Matthews [54].

These linear approximations were then applied to the total supply and per capita quantity demanded equations for each grain and to the per capita income equation. By doing so, the reduced form of the linearized model, equation (10), can be obtained:

$$Y_t = \Pi_1 Y_{t-1} + \Pi_2 X_t + V_t \tag{11}$$

where

$$\Pi_1 = -\Gamma^{-1} \beta_1.$$

$$\Pi_2 = -\Gamma^{-1} \beta_2.$$

$$V_t = \Gamma^{-1} U_t.$$

Multiplier analysis can then be used.

Multiplier analysis, which describes the influence of a unit change in the exogenous variables of the model--such as P.L. 480 wheat imports--on the endogenous variables of the model--such as prices, production, and consumption of grains, can be used to perform historical experimentation with the above model and to gain insights into the effects of policy variables on the agricultural development of a particular country. Through the use of impact, interim, or delay multipliers and cumulative multipliers, the reduced form of the model helps to answer the questions:

1. What is the impact of a unit increase in P.L. 480 wheat imports on the prices, production, and consumption of grains in a single time period?
2. What is the impact during successive periods after the unit change?
3. What is the impact of a unit increase in P.L. 480 wheat imports if this increase is sustained over time?

See Labys [36] for a full explanation of multiplier analysis and derivation of these multipliers from the reduced form.

II. Results of Country Analysis

Brazil

Econometric Model "A". --The specific structural model statistically estimated for Brazil is set up as follows, along the lines of equations (1)-(8), with the endogenous and exogenous variables as indicated.

$$A^i_t = f^i\,(A^i_{t-1}, P^i_{t-1}, FP_{t-1}, P^{*W}_t, CPI_{t-1}, Tr)$$

$$QS^i_t = A^i_t \times Y^i_t$$

$$PCQD^i_t = f^i\,(P^i_t, \overline{P}^W_t, PCInc_t, CPI_t)$$

$$PCQD^i_t = \frac{QD^i_t}{N_t}$$

$$PCInc = \frac{Inc_t}{N_t}$$

$$QD^i_t = QS^i_t + M^i_t - Ex^i_t$$

where i = wheat (w), rice (r), corn (c) and soybeans (s). Where i=wheat, add:

$$M^W_t = f^W\,(QS^W_t, \text{P.L. } 480^W_t, FXR_t, \overline{P}^W_t, Tr, CPI_t)$$

$$P^{*W}_{t+1} = f^W\,(\text{P.L. } 480^W_t, M^W_t, IP^W_t, CPI_t, Tr)$$

and replace QD^i_t with:

$$QD^W_t = QS^W_t + M^W_t + \text{P.L. } 480^W_t$$, Where t equals time period.

The endogenous variables are: A^i_t is acreage of grain i in 1,000 hectares; $\overline{P}^W_t$ is price of wheat in cruzeiros per metric ton; P^i_t is price of grain i in cruzeiros per metric ton; $PCQD^i_t$ is per capita consumption of grain i in kilograms per capita; QD^i_t is total consumption of grain i in 1,000 metric tons; M^W_t is commercial imports of wheat in 1,000 metric tons; P^{*w}_{t+1} is wheat support price in cruzeiros per metric ton; QS^i_t is total quantity supplied of grain i in 1,000 metric tons; $PCInc_t$ is per capita income in cruzeiros per capita.

The predetermined variables are: A^i_{t-1} is acreage of grain i in 1,000 hectares; A^i_t is acreage of grain i in 1,000 hectares. per metric ton; P^{*w}_t is wheat support price in cruzeiros per metric ton; FP_{t-1} is fertilizer price in cruzeiros per metric ton; $CPI_{t \text{ and } t-1}$ is consumer price index (1963 = 100); Tr is time trend; Y^i_t is yield of grain i in metric tons per hectare; N_t is population in millions; P.L. 480^W_t is Public Law 480 imports of wheat in 1,000 metric tons; FXR_t = foreign exchange reserves in millions of U.S. dollars; IP^W_t is international price of wheat in U.S. dollars per metric ton; M^i_t is imports of grain i in 1,000 metric tons; Ex^i_t is exports of grain i in 1,000 metric tons; Inc_t is income in millions of cruzeiros.

There are a total of 23 endogenous variables and 28 exogenous variables including a constant term.

Equation Specification. --The prices and support prices included in the acreage equations are those most relevant for Brazil. Acreages in year t are determined by the previous year's prices for all grains but for wheat and by the current year's support price for wheat such that the support price for wheat issued for production year 1965-66 affects acreage in 1966. The lagged prices of grains other than wheat are used instead of their support prices because of the government's limited purchases, usually less than the 10 percent estimated by Barker [2] needed to carry out effective price stabilization at the targeted level. However, we would expect that, because of the Brazilian government's purchase at the support price of the entire domestic crop of wheat. the wheat support price would affect acreage decisions. Because the price expectation for wheat in year t will be the wheat support price set by the government in year t, under the naive expectations model, the current year's support price for wheat would replace the lagged price P_{t-1} in the acreage response equation for wheat and for other crops for which wheat is a substitute or complement in production. The previous year's fertilizer prices were used in the acreage response equations as an indicator of expectations regarding input prices, and trend was included to measure sources of continuous systematic variation such as technological change or opening up of new land for cultivation.

In addition, in each equation containing price variables, the consumer price index (CPI) was included rather than deflating each price by the CPI. This was done primarily because of the extremely high rate of inflation Brazil has had, rising up to 90 percent in the period 1959-1967. Such inflation may result in such a degree of uncertainty regarding real prices or may affect prices so unevenly that calculation of real prices is almost impossible so that producers and consumers respond to money prices. Leamer and Stern [37] suggest including the general price level as a separate variable rather than assuming the absence of money illusion by using deflated prices in demand equations. Applying the concept to supply equations, acreage regressed on undeflated prices, and the CPI included as a separate variable, would give the result of a change in acreage due to a change in the undeflated price of the crop, keeping prices of alternative crops, fertilizer prices, and the general price level constant. In effect, if the nominal prices of all other goods remain unchanged. a change in the nominal price of a good is a change in its real price.

As regards the wheat support price P^{*W}, since in Brazil net revenues from wheat imports are intended to cover only the cost of the wheat price support program, only the wheat price support is a function of the revenues from importing wheat. We make the wheat support price in time period t+1, P^{*W}_{t+1}, a function of revenues obtained in time period t because of the financing time lag of the government between making revenues from imports in time t and financing the wheat price support program. Because the net import revenues made from importing wheat in time t are determined in part by the quantity of commercial imports, M^W_t, which is itself determined partly be domestic wheat supply, QS^W_t, it is unlikely that these revenues could be calculated exactly enough in advance of the sowing season when the price support for time t, P^{*W}_t, is set (determining acreage and therefore quantity supplied, QS^W_t, subject to yield uncertainty) such that these import revenues would cover the cost of the price support program.

Data Sources and Measurement. --Production, area harvested, and yield are from Anuario Estatistico do Brasil [8] as are exports and imports, supplemented with data from the FAO Production Yearbook [25] and the FAO Trade Yearbook [26], data from the Brazilian government [11], and USDA, FAS sources ([51] and [52]), corresponding to world production years. P.L. 480 shipments of wheat are from USDA, FAS sources [53] and include sales for local currency credit, dollar credit and convertible local currency credit and refer to calendar years. Commercial imports are P.L. 480 wheat imports (not including flour) subtracted from total wheat imports (not including flour). All of these quantities (except for yield in metric tons per hectare) are measured in 1,000 metric tons. Per capita consumption figures were obtained using these production, import, and export data, divided by population figures based on United Nations midyear estimates as published in International Financial Statistics [31] and are measured in kilograms per capita. Per capita income figures, expressed in cruzeiros per capita, are total national income in cruzeiros divided by population from International Financial Statisitics [31].

All prices are in cruzeiros per metric ton. The support prices for domestically produced wheat are from Brazilian government portarias, or official decrees, issued closest to harvest date. From 1954-1964, the prices are from Portarias do Ministerio da Agricultura [10] and from 1965 onwards are from Portarias da Superintendencia Nacional de Abastecimento [12]. These prices to wheat growers are based on cost of production calculated by FECOTRIGO plus a profit margin considered sufficient to encourage the desired annual production increase ([40], p. 141). The support price issued for production year 1965-66, for example, refers to quantity produced in 1966 in the present study.

The prices payable by the mill for wheat, which includes both domestic and imported wheat, are also obtained from government portarias, from value of production (at farm level) figures given in the Anuario [8], and a Brazilian government source [11]. The 1966 portarias data, for example, refer to 1966 consumption figures in the present study.

Prices for crops other than wheat are derived from value of production (at farm level), value and production figures in the Anuario [8], and a Brazilian government source [11]. The 1974 and 1975 prices for corn and rice are from Centro de Estudos Agricolas [5]. For certain years, soybean prices are calculated with data from the Instituto de Economia Agricola [9]. Support prices for rice, corn, and soybeans are from the Comisao de Financiamento da Producao [7] and are minimum prices for the South-Central region. In the present study, minimum prices for rice, corn, and soybeans for the 1965-66 harvest year, for example, refer to 1965 quantity produced.

Fertilizer prices for the state of Sao Paulo are for calendar years and are average prices paid, weighted by apparent consumption of nitrogen, phosphate, and potassium fertilizers. They are from the Instituto de Economia Agricola [9] and are in cruzeiros per metric ton. The consumer price index, for which 1963 is indexed at 100, is for period averages for the city of Rio de Janeiro, calculated by the Getulio Vargas Foundation and published in International Financial Statistics [31], as were foreign exchange reserves of the Bank of Brazil, in millions of U.S. dollars and the exchange rate or the free rate in cruzeiros per U.S. dollar. The international price of wheat is taken to be the f.o.b. Gulf, U.S. no. 2 Hard Winter ordinary protein price, due to lack of a data series on c.i.f. prices, and are taken from International Wheat Council statistics [32]. The international price used for corn is the Chicago Board of Trade contract cash prices for Yellow No. 2; for rice, f.o.b. Bangkok, 5 percent brokens; and for soybeans, the Chicago Board of Trade contract soybean prices for U.S. Yellow No. 2.

Model Estimation Results. --For the empirical estimation of model "A", a stochastic disturbance term was added to the nonidentity equations. Because of the recursive nature of the system, the acreage equations and the wheat support price equation can be estimated consistently with ordinary least squares (OLS). The remaining equations are of a simultaneous nature and were estimated with two-stage least squares (TSLS). Since the results of the support price and commercial imports equations estimation are of most direct interest to this study, only these results are shown below. The results of the supply and demand equations estimation including derivation of elasticities of supply and demand for wheat, corn, rice and soybeans, are shown and analyzed in Appendix A.

The commercial wheat import equation M_t^W, estimated using TSLS (with standard errors in parentheses) is:

$$M_t^W = \underset{(177.62)}{2{,}075.4929} - \underset{(.13)}{.8390}\, QS_t^W - \underset{(.14)}{.8935}\, P.L.\ 480_t^W + \underset{(.06)}{.1008}\, FXR_t$$

$$+ \underset{(1.19)}{2.1811}\, \bar{P}_t^W - \underset{(.74)}{.4558}\, CPI_t + \underset{(16.02)}{30.8590}\, Tr$$

$$D.W. = 2.00.$$

As expected, as the domestic quantity supplied of wheat, QS_t^W, increases, commercial imports decrease. As foreign exchange reserves, FXR_t, increase, commercial imports increase--as they do when the price at which the government sells the wheat to consumers, $\bar{P}_t^W$, increases--since greater revenues from sales can be made at higher $\bar{P}_t^W$. However, when P.L. 480 wheat imports increase, commercial imports decline, indicating little demand creation as a result of P.L. 480 and/or insignificant effect of the Uniform Marketing Requirements (UMR) and little additional effect of the P.L. 480 wheat imports.

While one cannot strictly apply tests of significance to TSLS estimates, the preliminary OLS estimation of M_t^W showed the coefficient of CPI to be totally insignificant; as the OLS and TSLS results differed very little for this equation, we can take CPI as contributing little to an explanation of variation in commercial imports in the TSLS estimation.

With respect to the wheat support price determination in time period t+1, P_{t+1}^{*W}, the estimated equation results (OLS) are:

$$P^{*w}_{t+1} = -23.6371 + .0434\ M^{w}_{t} + .1361\ P.L.\ 480^{w}_{t} + .2781\ IP^{w}_{t} + .6367\ CPI$$
$$\qquad (12.4) \qquad (.05) \qquad (.06) \qquad (.96) \qquad (.09)$$

$$- 12.8860\ Tr$$
$$(7.6)$$

D.W. = 1.63.

We may interpret the positive coefficient on CPI as being due to the effects of inflation on exchange rates. That is, as the rate of inflation, or CPI, increases, the greater the degree of overvaluation of the exchange rate and the cheaper imports appear in terms of their opportunity costs in foreign exchange. Thus, as imports become cheaper in terms of their opportunity costs, greater revenues are made from these imports and are used to support higher wheat prices. Of course, as the degree of overvaluation of the exchange rate increases, the more likely are foreign exchange reserves to become scarcer so that there is a foreign exchange cost to imports not represented by the exchange rate. But this foreign exchange cost may not be perceived immediately by the importing agency, or the degree to which there exists a cost may be mitigated by other general economic factors which are not included in the analysis.

As commercial wheat imports increase, so does the wheat support price. This could be for two reasons. Depending upon the domestic supply and demand conditions (including the $\overline{P}^{w}_{t}$ at which the government sells the imported wheat), the net revenue made from wheat imports may increase and so will the support price in time period t + 1 since P^{*w}_{t+1} is formed from import revenues in time t. Or, also because of government control over imports and concern with domestic self-sufficiency in food production, the increase in commercial imports may prompt the government to raise the domestic support price in an attempt to reach this self-sufficiency and decrease reliance on imports and particularly on commercial imports using up scarce foreign exchange reserves. We would expect that this is also the reason for the positive coefficient on international price--government response to such an increase is to raise the wheat support price and, thus, domestic production to allow fewer imports at the higher international price.

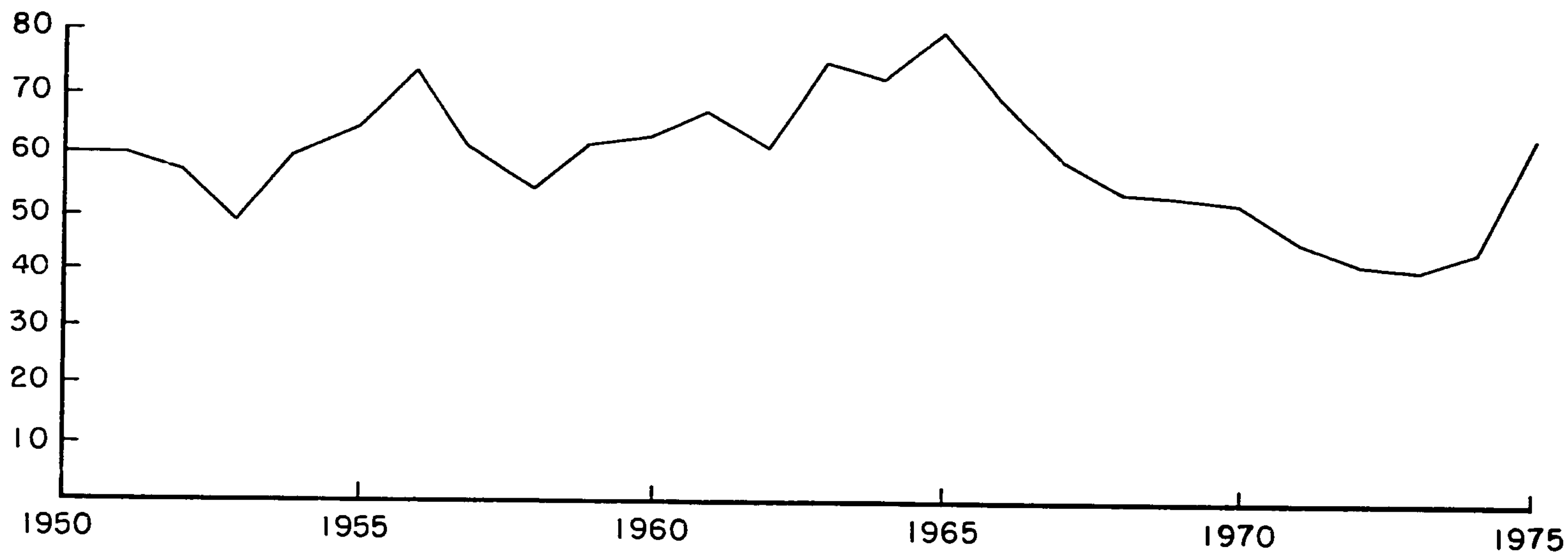
The coefficient in which we are most interested, that for P.L. 480 wheat, is positive and supports the hypothesis that P.L. 480 wheat, by lowering import costs and increasing government revenues from imports in time period t, makes it possible for the government to increase the price supports to producers in time period t+1 with the revenues earned.

It cannot be said that, because the terms of P.L. 480 wheat sales changed in 1967 from sales for local currency to sales for dollar credit, the price of wheat imports to the Brazilian government necessarily increased. But if it had increased as a result of a change in the P.L. 480 terms, in order to be unambiguous about the effect of P.L. 480 wheat imports on wheat support prices, we should examine visually the trend in support prices (Figures 2 and 3 below). That is, we should like to ascertain that the positive effect of P.L. 480 wheat on wheat support prices was through its effect on government revenues, making it fiscally more feasible to raise support prices rather than an increase in imports costs after 1967 prompting the government to increase domestic production through support price increases.

As can be seen, after 1967 there was a definite downward trend in support prices for wheat, refuting the suggestion that support prices were increased after 1967 because P.L. 480 import costs increased. Rather, it appears that the positive correlation between P.L. 480 and the wheat support price in t+1 is due to the effects of P.L. 480 on import revenues. Thus, from the results of the estimation of the support price equation, P.L. 480 wheat imports, by lowering the total cost and raising the revenues from wheat imports, have reinforced the domestic wheat self-sufficiency goals of the Brazilian government.

<u>Multiplier Analysis and Interpretation</u>. --From the empirical estimation of the statistical model, the reduced form of the system can be obtained and the multiplier analysis performed, as described above, with which to determine the impacts of P.L. 480 wheat imports. The reduced

FIGURE 2. BRAZIL WHEAT SUPPORT PRICES (100 cruzeiros per metric ton)



Sources: From (19) and (21)

FIGURE 3. BRAZIL -- P.L. 480 TITLE I WHEAT IMPORTS (1,000 metric tons)

Source: From (53).

form is shown in Table 1 below. Only the relevant elements of Π_1 and Π_2 for this study are shown, with the endogenous variables of the model shown in the far left-hand column and the partial listing of the exogenous or predetermined variables shown along the uppermost row of the table.

As regards the effects of P.L. 480 wheat on grain prices, from Π_2 in Table 1 and from the elements under the column variable P.L. 480, the initial impact of a unit increase of 1,000 metric tons of P.L. 480 wheat during a single time period is to increase the wheat consumption price, $\overline{P}^w_t$, by .0137 units or 13 cruzeiros as seen in the fifth row. From the sixth and seventh rows, the impact of P.L. 480 wheat on corn and rice prices is to increase the corn price by .00415 units or 4 cruzeiros and to increase the rice price by .0265 units or 26 cruzeiros. From the eighth row, the impact of P.L. 480 wheat on soybean price is negative--a unit increase of 1,000 metric tons of P.L. 480 wheat decreases the soybean price by .02533 units or by 25 cruzeiros.

Depending upon the demand interrelationships among the different grains the own- and cross-price elasticities of substitution, an increase in P.L. 480 wheat imports may result in an increase in the wheat consumption price and/or in prices of other grains. For example, if, as in the present study (see Appendix A), the own-price elasticity of demand for wheat plus the elasticity of substitution of wheat for rice (the rate at which a rice price increase will cause consumers to substitute wheat for rice) is less than the own-price elasticity of demand for rice plus the elasticity of substitution of rice for wheat (the rate at which a wheat price increase causes consumers to substitute rice for wheat), then given an initial increase in the wheat price, both rice and wheat prices may increase as may wheat consumption.

Of a total increase of 1,000 metric tons of P.L. 480 wheat, only about 19 percent would be reflected in a net increase in consumption of wheat (as seen by the element in the fifteenth row of Π_2), or about .00243 kilograms per capita. There is such a small increase in net consumption because, as seen in Π_2 in the tenth row under the column variable P.L. 480, 80 percent of the unit increase in P.L. 480 results in a displacement of commercial imports. The reduced form showed a zero impact of P.L. 480 on the consumption of corn, rice, and soybeans.

Table 1

Brazil: Reduced Form

Endogenous	Predetermined Π_1									
	A^w_{t-1}	A^c_{t-1}	A^r_{t-1}	A^s_{t-1}	P^w_{t-1}	P^c_{t-1}	P^r_{t-1}	P^s_{t-1}	P^{*w}_t	M^w_{t-1}
A^w_t	.79094								6.2814	
A^c_t		.3836				1.8272			8.4091	
A^r_t			.4572			- 9.8027	7.2875		3.4634	
A^s_t				.1387		-18.2543		.1710	-6.8075	
$\bar{P}^w_t$										
P^c_t						- .8008				
P^r_t							.6189			
P^s_t								.3646		
P^{*w}_{t+1}									- .1236	
M^w_t										
$PCQD^w_t$										
$PCQD^c_t$										
$PCQD^r_t$										
$PCQD^s_t$										
QD^w_t										
QD^c_t										
QD^r_t										
QD^s_t										
$PCInc_t$										
QS^w_t									4.9644	
QS^c_t						2.4051				
QS^r_t							11.0850			
QS^s_t								.2172		

(Continued on next page.)

--continued.

Endogenous	Predetermined							
	Π_2							
	Constant	FP_{t-1}	CPI_{t-1}	Y^w_t	. . .	$PL480^w_t$	. . .	
A^w_t								1.
A^c_t								2.
A^r_t								3.
A^s_t								4.
$\overline{P}^w_t$						.01371		5.
P^c_t						.00415		6.
P^r_t						.02655		7.
P^s_t						-.02533		8.
P^{*w}_{t+1}						.10096		9.
M^w_t						-.80906		10.
$PCQD^w_t$						.00243		11.
$PCQD^c_t$								12.
$PCQD^r_t$								13.
$PCQD^s_t$								14.
QD^w_t						.19093		15.
QD^c_t								16.
QD^r_t								17.
QD^s_t								18.
$PCInc_t$								19.
QS^w_t								20.
QS^c_t								21.
QS^r_t								22.
QS^s_t								23.

The impact of P.L. 480 on the wheat support price, P^{*w}_{t+1}, is positive. As seen in the ninth row, an increase of 1,000 metric tons of P.L. 480 wheat increases the wheat support price by .10096 units or 100 cruzeiros. This result is due to the positive correlation between wheat support price and P.L. 480 imports of wheat found in the above statistical estimation of the support price equation. While the positive correlation was postulated,on the basis of the political (policy) and institutional context of the country,as being due to the use of government revenues from P.L. 480 wheat imports to support the price to wheat producers, the direction of causality was not established. Likewise, multiplier analysis makes no statement as to causality; it simply reflects the statistically estimated relationships of the model, and the results from multiplier analysis in terms of the impact of P.L. 480 must be so evaluated.

The interim or delay multipliers, indicating the impact of P.L. 480 during successive time periods, must be used to evaluate the effect of P.L. 480 on production because of the use of lagged price in the acreage response equation and are given in Table 2 below. These multipliers indicate an initially positive impact of P.L. 480 wheat imports on wheat, corn, and rice production in the first time period after the initial change, that is, in year one, with the effects declining over time and in an oscillatory fashion for wheat and corn. Thus, an increase of 1,000 metric tons of P.L. 480 wheat would lead to an increase of 500 metric tons of domestic wheat in the first year, declining rapidly thereafter, until the fifth year when there is zero affect. For corn, it leads to an increase of about 9 metric tons in the first year and reaches zero effect in the eighth year; it leads to an increase of 294 metric tons of domestic rice production, declining thereafter until the seventh period when the effect is zero. The impact on soybean production is negative in the first time period and in successive periods, but not very severely negative, leading to an initial decline of only about 5 metric tons of domestic production and reaching zero effect in the fifth year.

TABLE 2

Brazil: Production Multipliers

Year	Wheat	Corn	Rice	Soybeans
	Delay Multipliers			
1	.50121	.00998	.29430	-.00550
2	-.06192	-.00799	.18214	-.00201
3	.00765	.00640	.11236	-.00073
4	-.00012	-.00410	.04318	-.00010
5	.00000	.00169	.00633	-.00009
6		-.00029	.00014	-.00000
7		.00001	.00000	
8		.00000		
	Cumulative Multipliers			
1	.50121	.00998	.29430	-.00550
2	.43929	.00199	.47645	-.00751
3	.44693	.00839	.58881	-.00824
4	.44682	.00428	.63198	-.00833
5	.44682	.00597	.63832	-.00834
6		.00569	.63846	-.00834
7		.00569	.63846	

The cumulative multipliers, showing the effect of a sustained unit increase of P.L. 480 wheat over time, are the cumulative sums of the delay multipliers and are also shown in Table 2. The long-run or equilibrium multiplier is when the value of the cumulative multiplier reaches a stable value defined to a particular decimal place. For wheat, the long-run multiplier is .447; that is, a sustained increase of 1,000 metric tons of P.L. 480 wheat results in an increase of 447 metric tons of domestic production, an increase of about 5 metric tons of corn production, an increase of 638 metric tons of rice production, and a decrease of 8 metric tons of soybeans. So, increasing the P.L. 480 wheat imports per year by 1,000 metric tons over a period of seven years would lead to an increase in total domestic production of wheat, rice, corn, and soybeans of 1,083 metric tons (obtained by adding the long-run multipliers of each grain). Or, expressed differently, the net effect is to increase domestic food production by 108 percent of this 1,000 metric ton P.L. 480 wheat import increase. Thus, the overall effect on grain production as a whole is positive.

Section III below undertakes to evaluate these results for Brazil in terms of the contribution of P.L. 480 to self-sufficiency in food production and to keeping consumer prices low and in terms of the comparison of results with other countries. In brief, however, it does appear that Brazil has managed to use P.L. 480 wheat imports in a beneficial way for local production. Primarily through the wheat support price relationship, P.L. 480 wheat imports have helped to allow domestic wheat production to triple from 1952-1971 and, as a percentage of total domestic consumption, to increase from 30 percent to 53 percent during the same time period, although per capita consumption has remained fairly constant. While total imports have also increased, they have not quite doubled over this period. The corn and rice exports of Brazil have been relatively successful and soybean exports also, although it was not until 1969, after the P.L. 480 imports had diminished, that soybean exports began to grow rapidly.

The concern of policymakers that P.L. 480 imports not depress local food production, then, does not seem too serious for Brazil. However, the concern that P.L. 480 wheat not disrupt commercial wheat markets internationally may be serious in that increases in P.L. 480 imports of wheat seem to have displaced commercial wheat imports in spite of the Usual Marketing Requirements that supposedly were imposed. The comparison of Brazil with the use of P.L. 480 imports in Colombia and Peru may provide further insights into the ways in which recipient countries can derive benefits for producers as well as for consumers from these imports as well as any losses that may ensue as a result of these imports.

Colombia

Econometric Model "B". -- The specific structural model to be statistically estimated for Colombia is shown below, with the endogenous and exogenous variables as indicated.

For each grain i, i = wheat (w), corn (c), rice (r), and barley (b):

$$A_t^i = f^i\ (A_{t-1}^i,\ P_{t-1}^i,\ P_{t/t-1}^{*j},\ Tr)$$

$$P_t^{*i} = f^i\ (P.L.\ 480_t^w,\ M_t^w,\ XR_t,\ IP_t^{iw})$$

$$PCQD_t^i = f^i\ (PCInc_t,\ P_t^i,\ P_t^j,\ PCQD_{t-1}^i,\ Tr)$$

$$QS_t^i = A_t^i \times Y_t^i$$

$$PCQD_t^i = \frac{QD_t^i}{N_t}$$

$$PCInc_t = \frac{Inc_t}{N_t}$$

$$QD_t^i = QS_t^i + M_t^i - Ex_t^i.$$

For i = wheat (w) add:

$$M_t^w = f^w \left(P.L.\ 480_t^w,\ P_t^w,\ QS_t^w,\ FXR_t\right)$$

and replace QD_t^i with:

$$QD_t^w = QS_t^w + M_t^w + P.L.\ 480_t^w$$

where the endogenous variables are as follows: A_t^i is acreage harvested of grain i in 1,000 hectares, P_t^{*j} is support price of complementary or substitutable grain j for grain i in pesos per metric ton; P_t^{*i} is support price for grain i in pesos per metric ton; M_t^w is commercial wheat imports in 1,000 metric tons; $PCQD_t^i$ is pesos per metric ton; P_t^i is price of grain i in pesos per metric ton; P_t^j is price of substitutable or complementary grain j for grain i to consumers in pesos per metric ton; QS_t^i is total quantity supplied of grain i in 1,000 metric tons; QD_t^i is total consumption of grain i in 1,000 metric tons; $PCInc_t$ is per capita income in pesos per capita.

The predetermined variables are as follows: A_{t-1}^i is lagged harvested acreage of grain i in 1,000 hectares, P_{t-1}^i is lagged price of grain i in pesos per metric ton; P_{t-1}^{*j} is lagged support price of substitutable or complementary grain j for grain i in pesos per metric ton; Tr is time trend; P.L. 480_t^w is P.L. 480 wheat imports in 1,000 metric tons; XR_t is the exchange rate in Colombian pesos per U.S. dollar; IP_t^{iw} is ratio of international price of grain i to the international price of wheat; $PCQD_{t-1}^i$ is lagged per capita consumption of grain i in kilograms per capita; Y_t^i is yield of grain i in metric tons per hectare; N_t is population in millions of people; Inc_t is income in millions of pesos; M_t^i is imports of grain i, i ≠ wheat (w), in 1,000 metric tons; Ex_t^i is exports of grain i, i ≠ wheat (w), in 1,000 metric tons; FXR_t is foreign exchange reserves in millions of U.S. dollars.

There are a total of 26 endogenous variables and 36 exogenous variables, including a constant term, for Colombia.

Equation Specification.--Acreages in year t are functions of the harvested acreage of the previous year, of the price received during the previous year conforming to the naive expectations model, and of the price support for other substitutable or complementary crops for the current (or previous) year. For all four of the grains in Colombia--wheat, rice, corn, and barley--government price supports are established in advance of the planting season, but their maintenance at those levels requires direct intervention in the form of a minimum level of government purchases through IDEMA, the official price-setting and purchasing agency. If this level is 10 percent of domestic production as Barker [2] estimates for effective price maintenance, IDEMA's purchases have only occasionally totaled this percentage for rice, corn, and wheat (figures are not available for barley). We infer then that the support price for grain i would not affect the acreage for that crop because of lack of successful maintenance of the support prices previously. However, it may be that, because of the occasional success of IDEMA in supporting the prices at the announced level, acreages of grain i will be affected by the announced support prices for other grains j.

Since support prices are set and maintained by a single government agency, IDEMA, which is also responsible for importing and distributing wheat, using the revenues from the importing operation to cover the costs of its support price program, the support price for each grain i is made a function of these revenues. Because inflation in Colombia has not been exceptionally high (as compared with Brazil), averaging only about 9 percent per year until 1972, the degree of overvaluation would not be expected to have been exceptionally high, and the opportunity cost of foreign exchange in equation (9) is represented by the exchange rate, XR_t, in the above model.

Revenues from wheat imports are a function also of the import or international price of wheat. But because the international price of grains other than wheat should affect the relative profitability, in terms of import capabilities and export possibilities, of supporting their prices to supporting the price to wheat producers, the support prices for grains other than wheat are functions of the relative international prices of those grains to the international price of wheat. Commercial wheat imports are determined by the variables as discussed in section I. All prices are weighted by the general consumer price index.

Data sources and Measurement. --Acreage harvested, production, and yield for wheat, rice, corn, and barley are from the FAO Production Yearbook [25], USDA, FAS sources ([51] and [52]), and USDA, ERS Report No. 343 [49]; the figures correspond to the world production years. Imports and exports are taken from the FAO Trade Yearbooks [26] and the Colombian government Anuarios or Yearbooks [13]. P.L. 480 Title I wheat shipments are from USDA, FAS [53]. Commercial wheat imports are derived by subtracting the P.L. 480 wheat imports from total wheat imports. All quantities are measured in 1,000 metric tons except for yield, measured in metric tons per hectare. Per capita consumption figures were obtained using these production, import and export data, divided by population, based on United Nations midyear estimates as published in International Financial Statistics [31] and are measured in kilograms per capita. Per capita income figures expressed in pesos per capita are total national income in pesos divided by population and are from International Financial Statistics [31].

All data for support prices are from IDEMA, Oficina de Planeacion [18] and refer to minimum loan prices set by IDEMA in advance of the sowing season for wheat, yellow corn, rice of Category B, and pearl barley. The price actually received for grains by farmers are from USDA, ERS Report No. 343 [49] and the Banco de la Republica as cited in [16]. All prices are in pesos per metric ton and are deflated by the Consumer Price Index, with $CPI_{1963} = 100$ which refers to the index of consumer prices for workers in Bogota for period averages from International Financial Statistics [31].

Foreign exchange reserves of the Banco de la Republica are in millions of U.S. dollars, and the exchange rate used is the principal selling rate (in pesos per U.S. dollar); both figures are from the International Financial Statistics [31]. The international prices are: 1) wheat--f.o.b. Gulf priced U.S. No. 2 Hard Winter wheat from

International Wheat Council Statistics [32]; 2) corn--Chicago Board of Trade contract price for U.S. Yellow No. 2; 3) rice--f.o.b. Bangkok, 5 percent brokens; and 4) barley--U.S. wholesale prices, Minneapolis, No. 3.

Model Estimation Results. --Adding a stochastic disturbance term to the nonidentity equations of the model, the system of equations represented by econometric model "B" was estimated using a two-stage-least-squares (TSLS) procedure because of the simultaneous nature of the system. The results of the two-stage estimation of the supply and demand equations for the individual grains are presented and discussed extensively in Appendix B, and elasticities for supply and demand for each grain are derived.

It is the results of the TSLS estimations for support prices and commercial wheat imports, shown below, which are most interesting to this study. (Standard errors are in parentheses.)

$$P_t^{*w} = \underset{(.78)}{12.7329} - \underset{(.006)}{.0067}\ P.L.\ 480_t^w - \underset{(.005)}{.0055}\ M_t^w - \underset{(.08)}{.1226}\ XR_t + \underset{(.01)}{.0344}\ IP_t^w$$

$$D.W. = 1.18$$

$$P_t^{*c} = \underset{(1.99)}{12.4974} - \underset{(.004)}{.0008}\ P.L.\ 480_t^w + \underset{(.004)}{.0056}\ M_t^w - \underset{(.06)}{.0310}\ XR_t - \underset{(2.39)}{6.7504}\ IP_t^{cw}$$

$$D.W. = 2.72$$

$$P_t^{*r} = \underset{(1.81)}{6.5353} + \underset{(.008)}{.0090}\ P.L.\ 480_t^w - \underset{(.007)}{.0105}\ M_t^w + \underset{(.07)}{.1528}\ XR_t + \underset{(.68)}{.3269}\ IP_t^{rw}$$

$$D.W. = 1.14$$

$$P_t^{*b} = \underset{(2.23)}{7.9466} - \underset{(.005)}{.0058}\ P.L.\ 480_t^w - \underset{(.004)}{.0032}\ M_t^w + \underset{(.06)}{.0944}\ XR_t + \underset{(2.59)}{1.1363}\ IP_t^{bw}$$

$$D.W. = .74$$

$$M_t^W = \underset{(71.10)}{515.7005} - \underset{(.23)}{.5226}\ P.L.\ 480_t^W - \underset{(.47)}{1.6722}\ QS_t^W - \underset{(7.22)}{15.4932}\ P_t^W + \underset{(.10)}{.2245}\ FXR_t$$

D.W. = 2.16.

The commercial wheat import equation, M_t^W, shows that these imports respond positively to increases in foreign exchange reserves, negatively to increases in P.L. 480 imports--indicating that P.L. 480 wheat may displace or substitute for commercial imports--negatively to increases in domestic quantity supplied of wheat, and negatively to domestic wheat price.

That is, as domestic price decreases, we would expect more imports to be needed to meet any increased demand resulting from lower prices. Since the Colombian government sells imports at approximately the domestic support price, the lower the price, the lower the domestic production and the greater the amount of imports needed. Even though the government makes revenues from these wheat imports, when the price at which the government sells the wheat is increased--because this price is also approximately the domestic wheat support price--greater revenues cannot necessarily be made from increased imports if domestic production increases as well. This, then, differs from the Brazilian case in which the price at which the government sells imported (and domestic) wheat is separated from the support price. Increases in the Brazilian selling price (and, therefore, in the Brazilian government revenues) do not necessarily elicit more domestic production.

With regard to the individual support price equations, results differ; support for the hypothesis that revenues from wheat imports are used to support the prices to producers is most substantiated in the case of rice as it is the only equation in which increases in P.L. 480 wheat imports increase the support price. It is difficult to give an interpretation of the differing signs of the coefficients on commercial wheat imports, M_t^W, since M_t^W is simulataneously determined with the support prices and depends upon many factors in supply and demand for all grains; its influence on revenues and corn, rice, and barley support prices is thus difficult to assess.

The wheat support price is seen to respond negatively to P.L. 480 and commercial wheat imports, indicating that the government reduces the incentive for domestic production through the support price when imports increase and there exist revenue-making possibilities from imports. As expected, as the international price of wheat increases and it becomes more expensive to import, the wheat support price increases in attempts to increase domestic production and decrease the imports which have become more expensive. Also, when the ratios of international rice to wheat price and barley to wheat price increase, the support prices of rice and barley increase since it has become more expensive to import these grains relative to wheat. As the ratio of the international corn to wheat price increases, however, the corn support price decreases. This may be due to corn having been exported in the past such that increases in the international price would act as an incentive to domestic production and exports, eliminating the need for domestic price supports as incentives.

Multiplier Analysis and Interpretation. --To see more clearly the effects of the P.L. 480 wheat imports on price, production, and consumption of the Colombian grains, we derive the reduced form of the empirically estimated model and perform multiplier analysis. The reduced form, with only the relevant elements of Π_1 and Π_2, is shown below in Table 3 with the endogenous variables of the model in the far left hand column and the partial listing of the exogenous variables in the uppermost row.

From the reduced form, (using impact multipliers), we see that the initial impact of a unit increase of 1,000 metric tons of P.L. 480 wheat during a single time period is to decrease the wheat, corn, and barley support prices by .0045, .0031, and .0045 units, respectively, and to increase the rice support price, P_t^{*r}, by .0132 units. Of a total increase of 1,000 metric tons of P.L. 480 wheat, about 60 percent would be reflected in a net increase in wheat consumption, or .0349 kilograms per capita; about 5 percent would be reflected in a net increase in corn consumption, or .0028 kilograms per capita; about 5 percent would be

Table 3
Colombia: Reduced Form

Endogenous	Predetermined Π_1										
	A^w_{t-1}	A^c_{t-1}	A^r_{t-1}	A^b_{t-1}	P^w_{t-1}	P^c_{t-1}	P^r_{t-1}	$P*^b_{t-1}$	$PCQD^w_{t-1}$	$PCQD^c_{t-1}$	$PCQD^r_{t-1}$
A^w_t	.6899				5.7968	- .3225	- .0490	.4970			
A^c_t		.5753			-1.3376	39.6988	- .2834	2.8767			
A^r_t			.2811		8.5330[a]	9.2545[a]	2.2349	-22.6851			
A^b_t				.1960	- .2497	- .3485	- .0529	.5670			
$P*^w_t$											
$P*^c_t$											
$P*^r_t$											
$P*^b_t$								- .07150			
M^w_t											
$PCQD^w_t$									.01446		
$PCQD^c_t$										.00914	
$PCInc_t$											
$PCQD^r_t$											.00000
$PCQD^b_t$											
P^w_t					.0510						
P^c_t						- .7910					
P^r_t							.5408				
$P*^b_t$								- .0715			
QD^w_t											
QD^c_t											
QD^r_t											
QD^b_t											
QS^w					5.6892						
QS^c						44.1232					
QS^R							5.5292				
QS^B								.8693			

(Continued on next page.)

--continued.

Endogenous	Predetermined								
	Π_1		Π_2						
	$PCQD^b_{t-1}$	. . .	$PL480^w_t$	XR_t	FXR_t	IP^w_t	IP^{cw}_t	IP^{rw}_t	IP^{bw}_t	. . .
A^w_t										
A^c_t										
A^r_t										
A^b_t										
$P{*}^w_t$			-.0045			.0003				
$P{*}^c_t$			-.0031				-6.819			
$P{*}^r_t$			.0132					.3169		
$P{*}^b_t$			-.0045						1.1090	
M^w_t			-.4037	.32822	.2719	.0020				
$PCQD^w_t$			.0349							
$PCQD^c_t$			.0028							
$PCInc_t$			.0000							
$PCQD^r_t$			.0000							
$PCQD^b_t$	-.00104		-.0031							
P^w_t			-.0078							
P^c_t			.0048							
P^r_t			.1832							
$P{*}^b_t$			.0015							
QD^w_t			.5979							
QD^c_t			.0486							
QD^r_t			.0000							
QD^b_t			-.0532							
QS^w			.0016							
QS^c			.0485							
QS^r			.0000							
QS^b			-.0532							

[a] For column headings P^w_{t-1} and P^c_{t-1}, read $P{*}^w_{t-1}$ and $P{*}^c_{t-1}$.

reflected in a net decrease in barley consumption, or .0031 kilograms per capita; and there would be no change in rice consumption. Forty percent of the unit increase in P.L. 480 wheat would result in a decline in commercial imports, M_t^w.

The impact of a unit increase of P.L. 480 wheat imports is thus seen to result in a net increase in grain consumption, even though P.L. 480 wheat displaces commercial wheat to some extent. Whereas its impact on corn, rice, and barley prices is slightly positive, the negative impact on wheat price, stimulating greater wheat consumption, has contributed most to the net consumption increase. The impact of P.L. 480 on all support prices but rice is negative, indicating that rice producers were the main beneficiaries of whatever revenues made from wheat imports used to finance the price support program.

The delay multipliers, which are used to evaluate the effect of P.L. 480 wheat on grains production, are shown below in Table 4. They indicate an initially negative impact of P.L. 480 wheat imports on wheat and barley production of 44 metric tons and 3.9 metric tons, respectively, in the first time period after the initial change (in year 1), the effects declining over time and in an oscillatory fashion for barley until the fourth year when there is zero production effect. The effect of P.L. 480 on corn and rice production is initially positive, producing an increase of 212 metric tons of corn production and 1,013 metric tons of rice production, but the effect on corn production oscillates over time until the eighth period when there is zero effect. The effect on rice production remains positive but declines over time until the seventh period with zero effect.

The cumulative multipliers, also shown in Table 4, give the effect of a sustained unit increase of P.L. 480 wheat imports over time and are the cumulative sum of the delay multipliers. At their equilibrium level, they indicate that a sustained increase of P.L. 480 wheat results in an increase of 1,951 metric tons of rice production and 126 metric tons of corn production, a decrease of 47 metric tons of wheat production and 4 metric tons of barley production, resulting in a net positive effect on grain production if P.L. 480 wheat imports were sustained at 1,000 metric tons per year.

Table 4

Colombia: Production Multipliers

Year	Wheat	Corn	Rice	Barley
	Delay Multipliers			
1	-.04432	.21223	1.01300	-.00393
2	-.00226	-.16788	.54785	.00028
3	-.00012	.13279	.29629	-.00002
4	-.00000	-.08309	.08666	.00000
5		.03253	.00741	
6		-.00050	.00005	
7		.00012	.00000	
8		-.00000		
	Cumulative Multipliers			
1	-.04432	.21223	1.01300	-.00393
2	-.04658	.04435	1.56086	-.00365
3	-.04669	.17715	1.85714	-.00367
4	-.04669	.09406	1.94380	-.00367
5		.12659	1.95122	
6		.12609	1.95127	
7		.12621	1.95127	
8		.12621		

In summary, given the particular structural demand and supply characteristics of Colombia's grain sector, the small negative impact of P.L. 480 on wheat production and large positive impact on rice production has resulted in net increases in total grain production and consumption. Although the effect of P.L. 480 on grain support prices through government wheat import revenues will have contributed to this effect via raising the rice price support, it may be that the structural characteristics of the grain sector of Colombia contributed more to this effect. That is, because the rice production of Colombia has been the recipient of large technological advances (high-yielding varieties, etc.) and is more mechanized and financially modernized than is wheat production (such production being more oriented toward subsistence and being relatively technologically backward) these factors will have contributed substantially to the results we see here: net gains in grain production and consumption, particularly in rice.

Peru

Peru was included in the analysis to represent a country which was not a recipient of large amounts of P.L. 480 wheat and that did not have any government intervention in the importation of wheat or in the setting of minimum prices, which was the case in Peru until 1970. By contrasting the results of multiplier analysis in Colombia and Brazil with those of Peru, an evaluation of the effects of wheat imports with a substantial component of P.L. 480 imports and with substantial government intervention relative to the effects of wheat imports in a country with an open market and which had very little P.L. 480 imports may be made.

However, apparently because of the unreliability of the data or because of the restriction of the equations to a linear form, only the acreage equations shown in Appendix C and the commercial wheat import equation could be estimated successfully in preliminary ordinary least squares (OLS) estimation procedures.

The commercial import equation is shown below, standard errors in parentheses.

$$M_t^w = \underset{(381.16)}{729.8264} - \underset{(1.16)}{2.2175}\ P.L.\ 480_t^w - \underset{(2.08)}{3.7856}\ QS_t^w + \underset{(.25)}{.2385}\ FXR_t + \underset{(1.10)}{.5284}\ IP_t$$
$$+ \underset{(8.16)}{8.6204}\ WP_t^w$$

$$R^2 = .68 \qquad D.W. = 1.67$$

or

$$M_t^w = \underset{(399.86)}{608.5059} - \underset{(1.21)}{1.9222}\ P.L.\ 480_t^w - \underset{(2.12)}{1.1227}\ QS_t^w + \underset{(.17)}{.4639}\ FXR_t$$
$$- \underset{(5.23)}{10.4938}\ IPFX_t^w + \underset{(7.93)}{5.9058}\ WP_t^w$$

$$R^2 = .71 \qquad D.W. = 2.24$$

where $IPFX_t^w$ is the international wheat price in local currency terms.

Commercial wheat imports were found to respond negatively to increases in P.L. 480 imports and to increases in local production, QS_t^w, and positively to increases in foreign exchange reserves, FXR_t. In Peru, private traders rather than the government imported wheat up until 1970. The foreign exchange reserves may serve as a proxy for the degree of controls on imports (i.e., tariffs, licenses, etc.), which there have always been to a greater or lesser degree in Peru, instead of being a factor which enters directly into government import decisions as in Brazil and Colombia.

The significance of the negative response to increases in the world or international price of wheat varies according to whether the international price is formulated in dollar or local currency terms. It is more significant with the latter formulation which may be expected when private traders, responding to local currency prices rather than to dollar prices, are importing. Futher, the response of commercial wheat imports to increases in the wholesale price of wheat, WP_t^W, is positive, thereby increasing import incentives, although this response is not very significant.

Without successful estimation of the grain demand equations, however, we are unable to obtain a reduced form and perform multiplier analysis with which to determine the impact of P.L. 480 wheat on grain sector relationships other than that of commercial wheat imports.

III. Evaluation of Results

In this section the results from the Brazilian and Colombian analyses are compared, and the reasons for these results are discussed in greater detail.

In Brazil, P.L. 480 wheat imports, because of the use of government revenues from wheat imports to support prices to wheat producers, affected wheat support prices and production positively, whereas in Colombia, P.L. 480 wheat imports affected wheat prices and production negatively. There are two mutually inclusive reasons for these varying price and production effects: 1) differing degrees of political pressure from the different grain producers and 2) differing structural characteristics of the Colombian and Brazilian wheat sectors.

In Colombia, wheat is a "mixed" crop, from a technological standpoint, with use of strictly hand cultivation (with a hoe), oxen, and tractors. About 34 percent of the wheat area was mechanized (that is, tractors are used for land preparation for sowing) in 1958, but the use of improved varieties of wheat is low and fertilization is well below the recommended usage ([49] and [50]). Farm size is relatively small and many are subsistence units. In Cundinamarca, one of the major wheat-producing states in Colombia, nearly 40 percent of the wheat is grown on farms with a total size of less than 10 hectares and an average of only slightly more than 1 hectare of wheat per farm [1]. As a consequence wheat farmers, while organized, are not a politically active or powerful pressure group and have not been able to agitate successfully for more positive wheat production policies and higher wheat prices.

In Brazil, wheat farmers are strongly organized in to an association of producers' cooperatives, FECOTRIGO, primarily in the State of Rio Grande do Sul, and are integrated sufficiently into government policy making to exert an influence on policy. Further, FECOTRIGO constitutes an important institution for diffusing new technology [34]. Although wheat farming in Brazil is also technologically mixed, in 1962-1966 the mechanized technique was used on 72.4 percent of the wheat area and medium to large farms, on which the mechanized technique is primarily used, occupied 70.9 percent of the wheat area. While there has not been a high-yielding wheat variety developed for wide adoption in Brazil, fertilizers are widely used on the mechanized farms, corresponding to 70-80 percent of the cultivated area ([34], pp. 40-41 and [40], pp. 181-182). These factors would make it more politically and economically feasible to support wheat production in Brazil as compared to Colombia. The short- and long-run elasticities of acreace response to price changes were correspondingly found to be quite high in Brazil (1.14 and 5.46) as compared to Colombia.

The high price elasticity of wheat acreage response (See Appendix A) relative to other grains, combined with a comparative lack of land restriction in Brazil, meant an expansion of wheat production could take place relatively easily without much of a reduction in acreages of grains substitutable in production for wheat. Being self-sufficient in corn, rice, and soybeans and often an exporter of these grains, the Brazilian general import substitution policy meant that wheat production should and could be encouraged without diminishing net grain production and would be an optimal strategy given the policy objectives discussed in section I.

In contrast to its wheat sectors, Colombia's rice sectors are modernized. Although rice is produced in both an irrigated (and mechanized) sector and in an upland sector (which depends on rainfall), over 90 percent of the rice produced now comes from the irrigated sector. In 1966, 50 percent of the production came from the upland sector; but largely because of the introduction of the new rice varieties better suited to irrigated culture, a comparative yield advantage was given to the irrigated sector ([47], p. 26). Rice production is concentrated in large holdings and there has been some tendency for concentration to increase over time, especially in the irrigated sector. In this sector, farms over 50 hectares accounted for 39 percent of all farms where rice was the principal crop in 1959 and accounted for 50 percent in 1970 ([47], p. 47). In addition, the National Rice Grower's Federation

(FEDEARROZ) has played an important role in the development of the Colombian rice industry and has lobbied for favorable government rice support schemes.

The Colombian government, through IDEMA, by using the revenues from wheat imports to support rice production over wheat production, would be more likely to elicit greater production increases and find more political support for doing so. Further support would come from the technological advances made in rice production through the high-yielding varieties which have been adopted in almost the entire irrigated sector. With the decline in per unit production costs brought about by these higher yielding varieties, rice support prices could be lowered and still maintain a favorable returns ratio or an assurance of an acceptable minimum and rice price stability. In fact, as purchases of IDEMA have increased, rice support prices have not fallen as rapidly as have producer prices received, providing a guaranteed price floor and reducing risk while production costs fell and output increased. The low price elasticity of supply (long-run elasticity of acreage response to price change being .14) would support such a policy since a decline in prices would not reduce acreage by much, rice production being more influenced by technological advances and production cost declines.

Thus, with limited financial resources, IDEMA's policy of supporting rice prices over wheat prices with import revenues may have been a better strategy for increasing grain production given the conditions described above. This conclusion ignores, of course, income distribution and welfare issues of a price policy favoring a relatively well-off (in terms of economic and political resources) group of producers (i.e., the irrigated rice producers) over not-so-well-off groups (i.e., the upland rice producers and the primarily subsistence wheat producers). That these issues are very complex and judgments regarding them are controversial is well known. No attempt is made to do so here, but it should be kept in mind that these issues do present qualifications to the results and conclusions of this study. Evaluation as to Colombian and Brazilian achievement of self-sufficiency objectives is made below.

Self-Sufficiency Evaluations

Have the P.L. 480 imports increased dependence on grain imports? In order to determine what wheat imports would have been had there been no P.L. 480 wheat imported, the Brazilian and Colombian models were simulated over the sample period, 1952-1975, from the estimated reduced forms, using the total method of simulation in which commercial wheat imports were predicted given values of the lagged endogenous variables and of the exogenous variables ([36], Chapter 9). Commercial wheat imports were then generated assuming P.L. 480 wheat imports were zero throughout the sample period.

It was found that over the period 1955-1970, Brazilian commercial wheat imports would have been 43 percent higher without P.L. 480, and Colombian wheat imports would be 20 percent higher, indicating that, as far as wheat imports are concerned, dependence on imports was reduced as a result of P.L. 480--less so for Colombia than for Brazil. Of course, this result partly reflects the substitution of P.L. 480 for commercial wheat imports found with multiplier analysis, but it also includes the rise in Brazilian domestic wheat production which has reduced reliance on imports. While Brazilian per capita consumption of wheat increased 12 percent from 1955-1959 to 1970-1974, total wheat imports, as a percentage of total consumption, decreased from 67 percent to 54 percent. Colombia, utilizing the revenues from wheat importing to raise production of grains other than wheat, has not reduced reliance on wheat imports. Total imports in 1970-1974 constituted 86 percent of total consumption compared to 40 percent in 1955-1959, while per capita consumption increased only 14 percent. The greater amounts of commercial wheat imports that would have resulted without P.L. 480 would be due in Colombia, then, primarily to the substitution of P.L. 480 for commercial imports.

To more fully evaluate whether self-sufficiency in grains has been achieved, grains other than wheat should be considered. From 1955-1959 to 1970-1974, Colombian per capita consumption of rice increased by 79 percent as contrasted to a 14 percent and a 23 percent increase in per capita wheat and barley consumption and a 40 percent decrease in per capita consumption of corn. Rice seems to have increased in importance in grain consumption expenditures relative to corn and wheat, per capita consumption of rice rising to more than two and one-half times greater than that for corn in 1970-1974, whereas in 1955-1959, rice per capita consumption was not quite half as great as that for corn and only one and one-half times as great as that for wheat. Barley imports have increased and so have corn imports, although corn imports constitute only a small percentage of total consumption. Rice, however, has become a small export crop so that, while total grain exports have increased somewhat, there has been an increase in grain consumption supplied by domestic production and, given the decline in real rice prices over time, at lower prices to consumers.

The optimality of grain price policies producing these results would depend on the opportunity costs of so doing. International prices can be considered one measure of such opportunity costs, although the overvaluation of exchange rates makes calculation of internal to external price ratios difficult. Scobie and Posada ([47], p. 119), evaluating the competitive position of Colombia in the international rice market, found that it was not until 1973 that the internal price of rice was competitive internationally, indicating that some degree of protectionism was needed for the development of the Colombian rice industry. But the higher internal prices of rice relative to wheat and the potential for future rice exports may have meant that, in a dynamic sense, this policy of encouraging domestic rice production and consumption while continuing wheat imports and effectively discouraging domestic wheat production was more nearly optimal in the long run.

In Brazil, per capita consumption of all grains increased from 1955-1959 to 1970-1974-by 24 percent for corn, by 21 percent for rice, and by almost 200 percent for soybeans. When domestic consumption is satisfied, Brazil does export these grains. Per capita consumption has increased least for wheat--by only 14 percent--indicating that relative to other grains, pricing policies to contain consumption and to increase domestic production of the grain which must be imported will have contributed positively to achievement of self-sufficiency.

Was this policy optimal in terms of cost efficiency? Knight ([34], p. 100) arrived at the conclusion that, given the high domestic resource cost of wheat production, the index of static efficiency of domestic resource use for wheat was much lower than for corn and soybeans, for example. He determined that in 1967 it cost Brazil $2.20 worth of domestic resources to save a dollar's worth of wheat imports. Contador [19] finds that the social cost of self-sufficiency exceeded the benefits by a median value of 100 percent but points out that the method used to arrive at this figure ignores the noneconomic aspects of a policy of self-sufficiency and which may be as important in any policy evaluation. Also, the foreign exchange savings which came of not having to import as much wheat to meet domestic needs when international wheat prices increased in 1973 and the diminution of the risk of further losses during another possible sharp increase will have increased the benefits from greater wheat self-sufficiency. These are difficult factors to quantify, of course, and would mean a dynamic rather than static analysis of costs and benefits. We mention them here to indicate the complexity of evaluation and areas for further research.

IV. Summary and Conclusions

To analyze the effects of P.L. 480 wheat imports on the production and consumption of grains in Brazil, Colombia, and Peru, this study has disaggregated the grains, incorporated their interrelationships in production and consumption, and specifically included government policies. To do this, an econometric model was developed, and the results of the analysis indicate favorable (i.e., positive) effects on the net production and consumption of grains in Brazil and Colombia but varying effects on individual grains such as wheat. The motivating force for these effects was primarily the intervention of the government in grain marketing and the use of producer price support policy, while the interrelationships among the grains provided the dynamics for these effects.

That is, because of the control of the government over commercial and P.L. 480 wheat imports; the government's use of the revenues from the resale of these imports to support prices to producers of wheat or of other grains; and the role of P.L. 480 in increasing the amount of government import revenues, the effect of P.L. 480 on producer prices and on domestic production could be positive. The government's ability to separate consumer prices (including the price at which wheat imports are sold) and producer prices (as with support prices) by virtue of its grain market control and intervention provided the basis for the econometric model. The individual grain support price equations statistically estimated in the econometric model were formulated on the basis that this government revenue-making possibility existed. That increased revenues resulting from P.L. 480 imports were used to increase wheat support prices in Brazil and to increase rice support prices in Colombia was supported by the positive and significant statistical correlation between these individual grain support prices and the quantity of P.L. 480 wheat imports. The multiplier analysis used to evaluate the effect of P.L. 480 on production, and with which the effect of P.L. 480 on net grain production was found to be positive, reflected this positive statistical correlation between P.L. 480 and support prices (reflecting, in addition, of course, other price, production, and consumption interrelationships).

It should be noted that, while the Brazilian and Colombian governments can and do make revenues from the domestic resale of P.L. 480 wheat imports, using the revenues to subsidize producers and consumers of grains, revenues from P.L. 480 imports are not, obviously, the sole determinant of support prices to producers. The level of support prices is determined also by political factors which cause governments to support farmers to a greater or lesser degree depending on the degree of political influence exerted. For this reason, support prices do not depend solely on the revenues from wheat import sales, nor will support prices necessarily decline if import revenues decrease; resources from other programs may be diverted to prevent this. For example, the Brazilian government's import substitution policy upon which the use of wheat import revenues to support the price to wheat producers is based would likely mean that producer prices would continue to be supported to some degree even if these revenues decreased. However, import revenues would make the degree of support of producer prices more rather than less.

This study has focused primarily on price policy. There are, of course, other governmental policies which also affect grain acreage and production-credit and input price policies being two which readily come to mind. It is likely, however, that price policies are a good indication of the relative bias, if any, of other government policies. For example, in Colombia from 1967 to 1973, the accumulated credit utilized by rice, as a commercial crop, was 35.2 percent of total value of credit given by the Agrarian Finance Fund (Fondo Financiero Agrario), compared to 9 percent for wheat and 8.9 percent for corn, as seen in Table 5. While these loans are intended primarily for commercial and mechanized agriculture and the Agrarian Bank (Caja Agraria) does make loans more specifically to medium and small farmers, loans from the Fondo are an important part of Caja Agraria operations [38].

Fertilizer prices were included specifically in the Brazilian model estimation, and total credit given to rice, wheat, and corn production from 1969 to 1976 is shown in Table 6 below. Although credit has been greatest for rice, it has in general been well balanced between the

Table 5

Colombia: Utilized Credit from the Fondo Financiero Agrario

Crops	Credit utilized		Area financed	
	1,000 pesos	percent	1,000 hectares	percent
Coffee				
Traditional crops (beans)	44.0	0.6	27.8	0.9
Mixed cultivation	836.3	11.5	488.7	15.5
Potatoes	123.8	1.7	33.2	1.1
Corn	646.8	8.9	418.1	13.3
Wheat	65.7	0.9	37.4	1.2
Plantation crops				
Commercial crops	6,397.9	87.9	2,628.4	83.6
Barley	79.7	1.1	48.6	1.5
Cotton	2,702.9	37.1	1,146.8	36.5
Rice	2,560.9	35.2	735.7	23.4
Sorghum	535.7	7.4	361.7	11.5
Soybeans	430.3	5.9	269.1	8.6
Others	88.4	1.2	66.5	2.2
TOTAL	7,278.5	100.0	3,145.7	100.0

Sources: From [16] and [22].

Table 6

Brazil: Total Credit Given for Production Expenses

Year	Rice	Corn	Wheat
	1,000 cruzeiros		
1969	487,672	349,963	145,280
1970	433,731	486,753	262,294
1971	539,886	514,698	390,618
1972	826,449	600,226	650,280
1973	1,316,813	1,270,357	492,681
1974	2,736,033	1,936,439	1,821,364
1975	5,376,860	3,292,155	3,809,637
1976	7,047,172	4,737,946	5,674,084

Source: From [4].

three crops, indicating no specific credit policy favoring wheat production, for example, over rice or corn.

An important finding from the multiplier and simulation analyses is that P.L. 480 did substitute for commercial wheat imports and that commercial imports would have been greater without P.L. 480, either because of this substitution effect or because of increases in domestic production supported by wheat import revenues [48]. For example, through Colombian use of P.L. 480 revenues to support rice production, P.L. 480 may have contributed to a potential rice competitor in the world rice market. This, of course, has implications for third world wheat exporters who may have suffered some export market losses because of P.L. 480 as well as having implications for future wheat and rice exports from the United States. Thus, these factors must be balanced against the positive contribution of P.L. 480 to net grain production and consumption and to overall agricultural development and achievement towards self-sufficiency in Brazil and Colombia.

It is unlikely that any aid policy can be made without any cost involved. In the case of P.L. 480, the benefits to agricultural production and development that can take place given appropriate governmental marketing policies, as in Brazil and Colombia, can be said to have been substantial. Whether these benefits to recipient countries outweigh the costs borne by the developed countries in terms of actual and potential market loss is a difficult question. However, if humanitarian goals and income redistribution from developed to the less-developed countries enter into a joint social welfare function of the developed grain exporting countries, the benefits of P.L. 480 as a food aid device may well outweigh any resultant costs.

Appendix A - Brazil Model Estimation Results

The results of the acreage equations estimation by ordinary least squares with standard errors shown in parentheses are:

$$A_t^w = \underset{(224.35)}{531.2001} + \underset{(.17)}{.7909}\, A_{t-1}^w + \underset{(2.18)}{6.2281}\, P_t^{*w} - \underset{(1.34)}{3.8054}\, FP_{t-1} - \underset{(.61)}{.8117}\, CPI_{t-1} - \underset{(15.21)}{43.7894}\, Tr$$

$$R^2 = .90 \qquad D.W. = 2.24$$

$$A_t^c = \underset{(982.28)}{2{,}586.7662} - \underset{(.25)}{.3836}\, A_{t-1}^c + \underset{(5.21)}{1.8272}\, P_{t-1}^c + \underset{(2.46)}{8.4091}\, P_t^{*w} - \underset{(2.16)}{5.7680}\, FP_{t-1} - \underset{(.86)}{2.0807}\, CPI_{t-1} + \underset{(62.01)}{152.6350}\, Tr$$

$$R^w = .98 \qquad D.W. = 1.79$$

$$A_t^r = \underset{(341.67)}{819.5296} + \underset{(.23)}{.4572}\, A_{t-1}^r + \underset{(3.89)}{7.2875}\, P_{t-1}^r + \underset{(2.26)}{3.4634}\, P_t^{*w} - \underset{(4.42)}{8.8027}\, P_{t-1}^c - \underset{(1.97)}{1.2358}\, FP_{t-1} - \underset{(.89)}{2.0072}\, CPI_{t-1} + \underset{(37.57)}{82.7866}\, Tr$$

$$R^2 = .96 \qquad D.W. = 1.81$$

$$A_t^s = \underset{(63.29)}{-123.9210} + \underset{(.29)}{.13866}\, A_{t-1}^s + \underset{(.47)}{.1710}\, P_{t-1}^s - \underset{(.91)}{6.8075}\, P_t^{*w} + \underset{(3.87)}{18.2543}\, P_{t-1}^c + \underset{(.20)}{1.3354}\, CPI_{t-1} + \underset{(7.49)}{28.8212}\, Tr$$

$$R^2 = .98 \qquad D.W. = 1.74$$

In general, the signs of the coefficients were as expected. The coefficient for the lagged price of corn in the corn acreage equation is not significant. This lack of significance has been found also in previous attempts to estimate corn acreage response ([45], p. 506). The coefficient of P_t^{*w} was positively significant at the 5 percent level in the wheat and corn acreage equations and at the 20 percent level in the rice acreage equation, indicating that wheat is a complementary crop to corn, although this was perhaps due to interaction in the feed grain market rather than due to direct complementarity in production.

We also found that the response of soybean acreage to its own price is insignificant in the soybean acreage response equation containing support price of wheat, to which soybean acreage responds negatively and significantly at the 5 percent level. In an analysis of the impact of changes in the domestic support price of wheat from the 1970-71 level to the level of world prices upon production and resource use, Engler and Singh [21] found that, because of the profitable wheat-soybean double-cropping pattern in the wheat region of Rio Grande do Sul, a wheat support price reduction would increase the relative profitability of soybeans and would result in a shift of land use to soybeans. We might expect then that increases in the support price of wheat would tend to increase wheat acreage over soybean acreage where there is double-cropping. It may be the wheat support price to which soybean producers are more sensitve in determining their acreage decisions.

It is also interesting to point out that the lagged CPI coefficient is negative and significant at the 5-20 percent level for wheat, rice, and corn but positively significant for soybeans, indicating that acreages of wheat, rice, and corn are negatively influenced by expectations regarding inflation or increases in the general price level and soybean acreage positively influenced. This may be due to the status of soybeans as an important export crop since, as the rate of inflation increases and the exchange rate becomes more overvalued, the price for soybeans is increased in foreign currency terms such that an incentive for soybean production is created.

The short- (E_{ps}) and long-run (E_{pl}) elasticities of acreage response to own price were calculated and are shown below in comparison with other published and available estimates of supply elasticities, the present study's estimates indicated as "A". "B" and "C" indicate separate study estimates from Ramalho de Castro and Schuh [45]. The long run acreage response is simply $\frac{E_{ps}}{\delta}$, where $\delta = 1 - b_1$, b_1 being the coefficient on lagged acreage. δ is thus the coefficient of adjustment of acreage from the previous to the present time period.

Wheat:	$E_{ps} = 1.14$	(A)	$E_{pl} = 5.46$	(A)
Corn:	$E_{ps} = 0.02$	(A)	$E_{pl} = 0.05$	(A)
	$E_{ps} = 0.15$	(B)	$E_{pl} = 0.57$	(B)
	$E_{ps} = 0.83$	(C)	$E_{pl} = 3.32$	(C)
Rice:	$E_{ps} = 0.33$	(A)	$E_{pl} = 0.62$	(A)
	$E_{ps} = 0.31$	(B)	$E_{pl} = 1.17$	(B)
	$E_{ps} = 0.42$	(C)	$E_{pl} = 0.69$	(C)
Soybeans:	$E_{ps} = 0.04$	(A)	$E_{pl} = 0.05$	(A).

The supply elasticities calculated in the present study may seem to be somewhat on the low side, but the elasticities calculated for "C" were for the state of Sao Paulo within which the most technologically advanced and modern farmers are located, so we would expect these elasticities to be fairly high. The present study's calculations are seen to be realistic when it is considered that they are for the entire country.

The demand equations, estimated with two stage least squares (TSLS) are shown below--standard errors shown in parentheses. In the preliminary estimation, the coefficients of lagged per capita consumption were totally insignificant for all four grains so were not added in the final TSLS estimation.

$$PCQD^{w}_{t} = \underset{(.84)}{38.4282} + \underset{(.02)}{.0261}\ PCInc_{t} - \underset{(.02)}{.0312}\ \bar{P}^{w}_{t} + \underset{(.01)}{.01768}\ P^{r}_{t} + \underset{(.01)}{.0036}\ CPI_{t}$$

$$D.W. = 1.73$$

$$PCQD^{c}_{t} = \underset{(2.78)}{118.2781} + \underset{(.08)}{.0028}\ PCInc_{t} - \underset{(.09)}{.0900}\ P^{c}_{t} + \underset{(.06)}{.0272}\ \bar{P}^{w}_{t} + \underset{(.03)}{.0208}\ CPI_{t}$$

$$D.W. = 1.62$$

$$PCQD^{r}_{t} = \underset{(2.96)}{62.6747} + \underset{(.08)}{.0385}\ PCInc_{t} - \underset{(.05)}{.0899}\ P^{r}_{t} + \underset{(.01)}{.1742}\ \bar{P}^{w}_{t} - \underset{(.04)}{.0460}\ CPI_{t}$$

$$D.W. = 1.79$$

$$PCQD^{s}_{t} = \underset{(.34)}{.8766} + \underset{(.01)}{.0350}\ PCInc_{t} + \underset{(.003)}{.00759}\ P^{s}_{t} + \underset{(.007)}{.0463}\ P^{c}_{t} - \underset{(.001)}{.0044}\ CPI_{t}$$

$$D.W. = 2.07$$

In general, the signs of the coefficients were as expected <u>a priori</u> for all grains except soybeans in the soybean demand equation, this result obtaining with several different formulations of soybean demand response.

Except for soybeans, own price elasticities of demand (E_{pd}) and income elasticities of demand (E_{yd}) were calculated from the above coefficients.

Wheat: $E_{pd} = -.22$ $E_{yd} = .09$

Corn: $E_{pd} = -.09$ $E_{yd} = .003$

Rice: $E_{pd} = -.31$ $E_{yd} = .08$.

These would be lower limits to elasticities of demand, since the demand equations were estimated using prices wholesalers paid to farmers for these grains, if it is assumed that the quantity moved through the market does not affect marketing margins ([27] pp. 203-204).

Elasticities of substitution of grain i for grain j defined as

$$\eta_{ij} = \frac{\delta C_i}{\delta P_j} \left(\frac{P_j}{C_i} \right)$$

where P_j is price of grain j and C_i is consumption of grain j, were also calculated. η_{ij} will be positive for substitutes and negative for complements.

Elasticity of substitution of wheat for rice = .11
Elasticity of substitution of corn for wheat = .06
Elasticity of substitution of soybeans for corn = .52
Elasticity of substitution of rice for wheat = .71

Appendix B - Colombia Model Estimation Results

The results of the two-stage least squares (TSLS) estimation of the acreage equations are shown below (standard errors in parentheses). Since the ordinary least squares (OLS) and the TSLS results were very similar, the R^2 statistics are shown for the TSLS results.

$$A_t^w = \underset{(61.55)}{1.9502} + \underset{(.21)}{.71738}\, A_{t-1}^w + \underset{(5.22)}{6.0279}\, P_{t-1}^w - \underset{(4.36)}{.61404}\, P_t^{*c} - \underset{(2.42)}{1.3001}\, P_t^{*r} - \underset{(4.40)}{3.7353}\, P_t^{*b}$$

$R^2 = .92$ D.W. = 2.51

$$A_t^c = \underset{(113.88)}{348.8720} + \underset{(.19)}{.6024}\, A_{t-1}^c + \underset{(22.85)}{41.5656}\, P_{t-1}^c - \underset{(11.37)}{18.1097}\, P_t^{*w} - \underset{(9.39)}{2.7982}\, P_t^{*r} - \underset{(3.47)}{8.3742}\, Tr$$

$R^2 = .55$ D.W. = 1.82

$$A_t^r = \underset{(124.67)}{86.7307} + \underset{(.22)}{.28115}\, A_{t-1}^r + \underset{(6.15)}{2.2349}\, P_{t-1}^r + \underset{(6.51)}{8.5330}\, P_{t-1}^{*w} - \underset{(8.88)}{22.6851}\, P_{t-1}^{*b} + \underset{(7.83)}{9.2545}\, P_{t-1}^{*c} + \underset{(2.72)}{7.4525}\, Tr$$

$R^2 = .84$ D.W. = 1.96

$$A_t^b = \underset{(20.11)}{16.1198} + \underset{(.23)}{.19465}\, A_{t-1}^b + \underset{(1.53)}{3.8142}\, P_t^{*b} - \underset{(1.26)}{1.6959}\, P_t^{*w} + \underset{(1.54)}{2.7152}\, P_t^{*c} - \underset{(.90)}{1.1099}\, P_t^{*r} + \underset{(.44)}{.27785}\, Tr$$

$R^2 = .71$ D.W. = 2.35

Since it was more likely that rice acreage in year t responded to lagged support price of complementary of substitutable crops (rice is planted in January of year t following the planting of wheat, rice, and corn in July of year t-1, their support prices having been set in advance of the planting season), these lagged support prices were used. Since there did not exist a barley support price until 1969, the barley support price is defined as the barley producer price until 1969 and as the actual support price set by IDEMA for barley after 1969.

The signs of the coefficients seem to be reasonable although, in the OLS estimation of the rice acreage equation, the coefficient of lagged rice price was not significant. We see that barley and wheat are substitutes in production as are corn and wheat.

The short- (E_{ps}) and long-run (E_{pl}) elasticities of acreage response to own price are shown below and seem to be of a reasonable magnitude, except in the case of rice which appears to be too low considering the large increases in rice production over the last 25 years, although this increase might have been due more to rice technology advances than to price stimulus.

Wheat:	$E_{ps} = .65$	$E_{pl} = 2.23$
Corn:	$E_{ps} = .43$	$E_{pl} = 1.08$
Rice:	$E_{ps} = .10$	$E_{pl} = 0.14$
Barley:	$E_{ps} = .61$	$E_{pl} = 0.76.$

The TSLS demand equations using lagged per capita consumption are shown below; again, the signs of the coefficient appear to be reasonable except for rice, the per capita consumption of rice responding positively to increases in rice price, but in the OLS estimation the coefficient on rice price was totally insignificant. Rice demand appears to be more heavily influenced by per capita income and lagged consumption than to rice price changes.

$$PCQD^w_t = \underset{(13.42)}{14.0035} + \underset{(.51)}{1.0668}\ PCInc_t - \underset{(.68)}{.8795}\ P^w_t - \underset{(1.00)}{.6760}\ P^c_t + \underset{(.38)}{.1695}\ P^r_t$$

$$+ \underset{(1.09)}{.1454}\ P^b_t - \underset{(.23)}{.0493}\ PCQD^w_{t-1} - \underset{(.34)}{.6139}\ Tr$$

$$R^2 = .36 \qquad D.W. = 2.00$$

$$PCQD^c_t = \underset{(25.96)}{74.9692} - \underset{(.53)}{1.2702}\ PCInc_t - \underset{(.76)}{2.7172}\ P^c_t + \underset{(.55)}{1.1346}\ P^w_t + \underset{(.65)}{.1352}\ P^r_t$$

$$+ \underset{(.20)}{.2035}\ PCQD^c_{t-1}$$

$$R^2 = .88 \qquad D.W. = 2.27$$

$$PCQD^r_t = \underset{(17.51)}{-55.0906} + \underset{(.53)}{2.1294}\ PCInc_t + \underset{(1.09)}{.0153}\ P^r_t + \underset{(.48)}{1.2294}\ P^w_t$$

$$+ \underset{(.55)}{1.4066}\ P^c_t + \underset{(.16)}{.3665}\ PCQD^r_{t-1}$$

$$R^2 = .93 \qquad D.W. = 1.97$$

$$PCQD^b_t = \underset{(3.67)}{8.1815} - \underset{(.08)}{.1414}\ PCInc_t - \underset{(.27)}{.2395}\ P^b_t - \underset{(.37)}{.5706}\ P^c_t + \underset{(.24)}{.1538}\ PCQD^b_{t-1}$$

$$R^2 = .18 \qquad D.W. = 2.21.$$

The price (E_{pd}) and income (E_{yd}) elasticities are shown below, along with the long-run price elasticities of demand (E_{pld}) calculated using the coefficient of adjustment δ, where $\delta = 1 - b_2$, where b_2 is the estimated coefficient on lagged per capita consumption. Again, the price elasticities will be a lower limit if the marketing margins are not a function of quantity moving through the market since these elasticities were estimated using prices that wholesalers paid to producers rather than prices consumers paid retailers.

Wheat:	$E_{pd} = -.65$	$E_{pld} = -.62$	$E_{yd} = 1.52$
Corn:	$E_{pd} = -.41$	$E_{pld} = -.52$	$E_{yd} = -.62$
Rice:	$E_{pd} = .005$	$E_{pld} = .007$	$E_{yd} = 1.44$
Barley:	$E_{pd} = -.36$	$E_{pld} = -.42$	$E_{yd} = .57.$

The cross elasticities of demand are:

Elasticity of substitution of wheat for rice	=	.107
Elasticity of substitution of wheat for corn	=	-.296
Elasticity of substitution of wheat for barley	=	.076
Elasticity of substitution of corn for wheat	=	.290
Elasticity of substitution of corn for rice	=	.029
Elasticity of substitution of rice for wheat	=	.433
Elasticity of substitution of rice for corn	=	.294
Elasticity of substitution of barley for corn	=	-.848

Appendix C - Peru Model Estimation Results

The acreage equations for Peru which were estimated successfully by ordinary least squares are shown below (standard errors in parentheses).

$$A_t^w = \underset{(32.93)}{166.8376} + \underset{(.19)}{.2617}\, A_{t-1}^w + \underset{(1.60)}{2.3544}\, P_t^w - \underset{(1.07)}{3.5022}\, P_t^b - \underset{(1.14)}{2.4142}\, P_t^r$$

$$+ \underset{(1.42)}{1.4626}\, P_t^c - \underset{(.40)}{1.5397}\, Tr$$

$R^2 = .64$ D.W. $= 2.37$

$$A_t^c = \underset{(113.55)}{419.9964} - \underset{(.26)}{.4372}\, A_{t-1}^c + \underset{(5.42)}{7.6919}\, P_t^c - \underset{(4.32)}{8.0138}\, P_t^w - \underset{(4.65)}{6.3108}\, P_t^b$$

$$+ \underset{(2.13)}{9.9638}\, Tr$$

$R^2 = .79$ D.W. $= 1.78$

$$A_t^r = \underset{(41.36)}{65.5688} + \underset{(.22)}{.0527}\, A_{t-1}^r + \underset{(1.34)}{1.9698}\, P_t^r - \underset{(1.84)}{2.1727}\, P_t^b - \underset{(2.00)}{2.1146}\, P_t^c$$

$$+ \underset{(.87)}{2.8323}\, Tr$$

$R^2 = .72$ D.W. $= 2.22$

$$A_t^b = \underset{(46.37)}{130.4316} + \underset{(.26)}{.2115}\, A_{t-1}^b + \underset{(.51)}{.5185}\, WP_t^b + \underset{(.36)}{.6043}\, WP_t^w - \underset{(.24)}{.3433}\, WP_t^c$$

$R^2 = .35$ D.W. $= 1.66$

where the variables are as defined in Econometric Model "B" and WP_t^i is the wholesale price of grain i in time t. All prices are weighted by the consumer price index.

The signs of the coefficients in the acreage equations are as expected, and the short- (E_{ps}) and long-run (E_{pl}) elasticities of supply were calculated and are shown below:

Wheat:	$E_{ps} = .319$	$E_{pl} = .432$
Corn:	$E_{ps} = .436$	$E_{pl} = .774$
Rice:	$E_{ps} = .518$	$E_{pl} = .547$
Barley:	$E_{ps} = .068$	$E_{pl} = .087.$

Appendix D - Country Data Tables

1. Commercial wheat imports are total wheat imports minus P.L. 480 Title I wheat imports which include Title I sales for local currency credit, dollar credit, and convertible local currency credit.

2. Total consumption is defined as total production plus total imports minus total exports, except where total imports or exports were very few over the period 1950-1975 and were, for that reason, not included in total consumption.

3. Per capita consumption is total consumption divided by midyear population estimates of the United Nations as published in International Monetary Fund, International Financial Statistics, various issues.

4. International prices: wheat--U.S. No. 2, Hard Winter wheat, f.o.b. Gulf; corn--U.S. Yellow No. 2 (Chicago Board of Trade cash prices); rice--5 percent brokens, f.o.b. Bangkok; soybeans--U.S. Yellow No. 2 (Chicago Board of Trade contract price); barley--U.S. No. 3 (Minneapolis wholesale prices).

APPENDIX TABLE 1

Brazil: Import, Consumption, and Production of Wheat,[a] 1950-1975

Year	Imports			Consumption		International price	Production		
	Total	Commercial	P. L. 480 Title I	Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7	8	9
	1,000 metric tons			1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	1,305.50	1,305.50	0.00	1,837.85	35.36	92.60	532.35	652.45	0.82
1951	1,134.30	1,134.30	0.00	1,557.95	29.12	96.27	423.65	724.88	0.58
1952	1,615.50	1,615.50	0.00	2,305.00	41.83	93.70	684.50	809.58	0.85
1953	1,409.40	1,409.40	0.00	2,181.09	38.47	77.90	771.69	910.41	0.85
1954	1,685.70	1,685.70	0.00	2,557.03	43.78	65.40	871.33	1,081.40	0.81
1955	1,422.50	1,392.60	29.90	2,523.81	41.92	62.47	1,101.31	1,196.06	0.92
1956	1,440.60	940.00	500.60	2,295.57	37.09	62.47	854.97	885.57	0.97
1957	1,506.20	1,097.60	408.60	2,287.34	35.85	62.10	781.14	1,153.52	0.68
1958	1,820.20	1,423.84	396.36	2,409.19	36.67	61.73	588.99	1,446.33	0.41
1959	2,032.90	1,436.12	596.78	2,643.78	39.05	61.36	610.88	1,185.66	0.52
1960	1,881.30	1,449.32	431.98	2,594.42	37.22	62.10	713.12	1,141.01	0.62
1961	2,191.80	679.10	1,512.70	2,736.66	38.12	62.83	544.86	1,022.23	0.53
1962	2,175.60	1,346.69	828.91	2,961.22	40.02	64.30	785.62	743.46	1.06
1963	2,609.00	1,846.62	762.38	3,001.36	39.41	66.14	392.36	793.49	0.49
1964	1,876.30	404.72	1,471.58	2,519.30	32.12	63.94	643.00	733.60	0.88
1965	2,394.41	2,172.53	221.88	2,979.79	36.89	58.42	585.38	766.64	0.76
1966	2,446.02	1,804.06	641.96	3,060.67	36.73	66.13	614.66	716.98	0.86
1967	2,621.01	2,183.25	437.76	3,250.31	37.90	61.73	629.30	830.87	0.76
1968	2,355.60	1,838.73	516.87	3,211.77	36.41	62.83	856.17	970.13	0.88
1969	1,969.30	1,880.74	88.56	3,342.99	36.83	53.28	1,373.69	1,407.12	0.98
1970	1,710.52	1,439.16	271.36	3,554.78	38.42	60.26	1,844.26	1,895.25	0.97
1971	1,796.88	1,796.88	0.00	3,808.21	40.01	60.26	2,011.33	2,268.93	0.89
1972	2,945.55	2,945.55	0.00	3,928.45	40.15	91.13	982.90	2,319.96	0.42
1973	2,399.18	2,399.18	0.00	4,430.51	44.06	177.11	2,031.34	1,839.39	1.10
1974	2,443.88	2,443.88	0.00	5,302.40	51.31	170.00	2,858.53	2,471.15	1.16
1975	3,428.11	3,428.11	0.00	5,215.96	49.10	161.00	1,787.85	2,931.21	0.61

[a]Wheat only.

Sources: Col. 1 from [26]; col. 2 calculated from cols. 1 and 3; col. 3 from [53]; cols. 4 and 5 calculated from cols. 1 and 7; col. 6 from [32]; and cols. 7, 8, and 9 from [8], [11], and [25].

APPENDIX TABLE 2

Brazil: Trade, Consumption, and Production of Corn, 1950-1975

Year	Trade		Consumption		International price	Production		
	Imports	Exports	Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7	8
	1,000 metric tons		1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	0.00	11.70	6,011.85	115.66	62.96	6,023.55	4,681.83	1.29
1951	0.00	295.25	5,922.78	110.71	71.91	6,218.03	4,749.95	1.31
1952	0.00	28.42	5,878.50	106.42	74.98	5,906.92	4,864.08	1.21
1953	49.60	0.00	6,033.88	106.42	64.14	5,984.28	5,119.61	1.17
1954	0.00	11.65	6,777.14	116.05	62.70	6,788.79	5,528.34	1.23
1955	0.00	80.09	6,609.84	109.80	54.61	6,689.93	5,623.13	1.19
1956	9.70	0.00	7,009.03	113.23	56.43	6,999.33	5,997.88	1.17
1957	0.00	0.00	7,763.44	121.68	51.12	7,763.44	6,095.09	1.27
1958	0.00	0.00	7,370.09	112.18	48.23	7,370.09	5,790.35	1.27
1959	0.00	0.00	7,786.74	115.02	47.32	7,786.74	6,189.11	1.26
1960	0.00	9.93	8,662.03	124.28	44.60	8,671.95	6,681.16	1.30
1961	0.00	4.45	9,031.79	125.79	44.45	9,036.24	6,885.74	1.31
1962	5.60	0.01	9,592.88	129.63	43.82	9,587.29	7,347.88	1.30
1963	0.02	669.21	9,779.08	128.40	48.86	10,478.27	7,957.63	1.32
1964	0.00	62.32	9,345.72	119.16	48.65	9,408.04	8,105.89	1.16
1965	1.13	559.68	11,553.38	143.04	50.55	12,111.92	8,771.32	1.38
1966	4.57	627.06	10,748.96	128.98	53.30	11,371.46	8,703.17	1.31
1967	7.69	430.44	12,401.75	144.63	50.26	12,824.50	4,274.32	1.38
1968	4.59	1,237.97	11,580.26	131.27	44.50	12,813.64	9,584.75	1.34
1969	1.06	658.54	11,995.95	132.16	49.49	12,653.44	9,653.76	1.31
1970	2.11	1,470.62	12,747.50	137.78	57.00	14,216.01	9,858.11	1.44
1971	1.18	1,279.70	12,851.23	135.03	56.00	14,129.75	10,550.49	1.34
1972	2.14	172.07	14,721.51	150.45	72.00	14,891.44	10,538.94	1.41
1973	4.25	41.01	14,149.12	140.70	114.00	14,185.88	9,923.57	1.43
1974	3.33	1,108.71	15,179.33	146.87	124.00	16,284.71	10,493.01	1.55
1975	3.15	1,200.00	15,156.80	142.68	106.00	16,353.65	10,670.97	1.53

Sources: Cols. 1 and 2 from [26], 1975 figures are estimates/unofficial figures from [26]; cols. 3 and 4 calculated from cols. 1, 2, and 6; col. 5 from [6]; and cols. 6, 7, and 8 from [2] and [25], 1973-1975 figures are from [11].

APPENDIX TABLE 3

Brazil: Trade, Consumption, and Production of Rice, 1950-1975

Year	Trade		Consumption		International price	Production		
	Imports	Exports	Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7	8
	1,000 metric tons		1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	0.00	80.31	3,137.39	60.36	123.20	3,217.69	1,964.16	1.64
1951	0.00	118.12	3,063.96	57.27	131.60	3,182.08	1,967.22	1.62
1952	0.00	0.00	2,931.11	53.20	214.20	2,931.11	1,872.73	1.57
1953	9.50	2.79	3,079.09	54.30	218.40	3,072.37	2,072.34	1.48
1954	0.00	0.00	3,366.84	57.65	171.00	3,366.84	2,425.28	1.39
1955	0.00	2.48	3,734.99	62.04	141.00	3,737.47	2,511.69	1.49
1956	0.00	102.44	3,386.33	54.71	138.00	3,488.78	2,554.85	1.37
1957	0.00	0.33	4,071.72	63.82	139.00	4,072.05	2,490.17	1.64
1958	0.00	51.55	3,777.74	57.50	148.00	3,829.30	2,514.49	1.52
1959	0.00	9.82	4,091.63	60.44	133.00	4,101.45	2,682.88	1.53
1960	0.00	0.43	4,794.38	68.79	124.54	4,794.81	2,965.68	1.62
1961	0.00	150.76	5,241.72	73.00	136.06	5,392.48	3,174.04	1.70
1962	0.10	43.68	5,513.26	74.50	164.76	5,556.83	3,349.81	1.66
1963	0.01	0.00	5,740.08	75.37	143.30	5,740.07	3,721.80	1.54
1964	0.00	12.42	6,332.51	80.74	137.37	6,344.93	4,182.36	1.52
1965	0.00	236.79	7,342.86	90.91	135.27	7,579.65	4,618.90	1.64
1966	0.01	289.25	5,512.57	66.15	163.25	5,801.81	4,004.85	1.45
1967	0.01	31.88	6,760.11	78.84	211.03	6,791.99	4,291.15	1.58
1968	0.00	158.18	6,494.34	73.62	202.19	6,652.51	4,458.95	1.49
1969	0.15	70.18	6,324.26	69.67	186.68	6,394.29	4,620.70	1.38
1970	0.03	95.05	7,458.06	80.61	143.38	7,553.08	4,979.16	1.52
1971	1.51	148.83	6,445.86	67.73	128.72	6,593.18	4,764.00	1.38
1972	9.19	1.90	7,831.52	80.04	143.00	7,824.23	4,821.31	1.62
1973	10.98	33.43	7,137.68	70.98	274.00	7,160.13	4,794.83	1.49
1974	0.54	56.78	6,426.67	62.18	527.00	6,482.92	4,378.21	1.48
1975	84.95	2.56	7,619.98	71.73	374.00	7,537.59	5,198.94	1.45

Sources: Cols. 1 and 2 from [26]; cols. 3 and 4 calculated from cols. 1, 2, and 6; cols. 5 from [6]; and cols. 6, 7, and 8 from [8], [11], and [25].

APPENDIX TABLE 4

Brazil: Exports, Consumption, and Production of Soybeans, 1950-1975

Year	Exports	Consumption		International price	Production		
		Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7
	1,000 metric tons	1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	21.24	39.76	0.76	107.07	61.00	34.00	1.79
1951	39.68	38.33	0.72	119.57	78.00	60.00	1.30
1952	28.94	48.94	0.89	118.99	77.88	60.03	1.30
1953	26.12	62.11	1.10	109.80	88.23	62.98	1.40
1954	25.34	91.98	1.57	121.34	117.32	68.12	1.72
1955	51.39	55.49	0.92	97.31	106.88	73.97	1.44
1956	41.48	73.46	1.19	101.57	114.94	80.80	1.42
1957	17.40	104.10	1.63	89.17	121.50	97.45	1.25
1958	33.91	96.98	1.48	85.75	130.89	107.04	1.22
1959	42.07	109.50	1.62	87.21	151.57	114.10	1.33
1960	0.00	205.74	2.95	84.31	205.74	171.44	1.20
1961	73.27	198.22	2.76	145.09	271.49	240.92	1.13
1962	96.77	245.40	3.32	98.20	342.18	313.64	1.09
1963	33.45	289.47	3.80	106.14	322.92	339.80	0.95
1964	0.00	304.90	3.89	105.20	304.90	359.62	0.85
1965	75.29	447.89	5.55	111.01	523.18	431.83	1.21
1966	121.24	473.73	5.68	121.31	594.98	490.69	1.21
1967	304.54	411.06	4.79	109.63	715.61	612.12	1.17
1968	65.86	588.62	6.67	97.27	654.48	721.91	0.91
1969	310.15	746.46	8.22	95.27	1,056.61	906.07	1.17
1970	289.60	1,218.94	13.17	101.16	1,508.54	1,318.81	1.14
1971	213.43	1,862.94	19.57	112.90	2,076.37	1,716.00	1.21
1972	1,037.27	2,362.73	24.15	127.66	3,400.00	2,192.00	1.55
1973	1,786.14	3,225.48	32.08	290.20	5,011.61	3,615.06	1.39
1974	2,730.43	5,145.78	49.79	216.33	7,876.21	5,143.12	1.53
1975	3,333.33	6,558.96	61.74	181.25	9,892.30	5,823.73	1.70

Sources: Col. 1 from [26], 1975 figure is estimate/unofficial figure from [26]; cols. 2 and 3 are calculated from cols. 1 and 6; col. 4 from [6]; and cols. 5, 6, and 7 from [8] and [25].

APPENDIX TABLE 5

Colombia: Import, Consumption, and Production of Wheat,[a] 1950-1975

Year	Imports			Consumption		International price	Production		
	Total	Commercial	P. L. 480 Title I	Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7	8	9
	1,000 metric tons			1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	47.16	47.16	0.00	149.16	13.15	96.60	102.00	145.00	0.70
1951	32.98	32.98	0.00	162.98	14.12	96.27	130.00	175.00	0.74
1952	22.67	22.67	0.00	162.67	13.73	93.70	140.00	188.00	0.74
1953	52.90	52.90	0.00	197.90	16.34	77.90	145.00	175.00	0.83
1954	52.58	52.58	0.00	198.58	16.04	65.40	146.00	195.00	0.75
1955	90.17	67.93	22.24	237.17	18.73	62.47	147.00	182.00	0.81
1956	104.26	55.10	49.16	244.26	18.88	62.47	140.00	170.00	0.82
1957	86.23	47.65	38.58	196.23	14.83	62.10	110.00	178.00	0.62
1958	96.05	79.16	16.89	236.05	17.36	61.73	140.00	160.00	0.88
1959	86.15	11.27	74.88	231.15	16.69	61.32	145.00	166.00	0.87
1960	126.48	83.32	43.16	268.48	19.00	62.10	142.00	160.00	0.89
1961	135.29	68.96	66.33	277.29	17.44	62.83	142.00	160.00	0.89
1962	93.01	30.61	62.40	255.01	15.55	64.30	162.00	150.00	1.08
1963	158.07	128.46	29.61	248.07	14.66	66.14	40.00	113.00	0.80
1964	173.54	158.54	15.00	258.54	14.81	63.94	85.00	100.00	0.85
1965	244.29	224.21	25.08	359.29	19.94	58.42	110.00	120.00	0.92
1966	170.35	153.31	17.04	295.35	15.86	66.13	125.00	110.00	1.14
1967	228.13	200.13	28.00	308.13	16.03	61.73	80.00	68.00	1.18
1968	243.02	101.74	141.28	348.02	17.55	62.83	105.00	90.00	1.17
1969	209.19	209.19	0.00	281.19	13.74	53.28	72.00	65.00	1.11
1970	446.04	273.69	172.35	501.04	24.41	60.26	55.00	50.00	1.10
1971	412.95	370.73	42.22	457.45	21.71	60.26	45.00	44.00	1.02
1972	274.00	191.47	82.53	342.00	15.78	91.13	68.00	57.00	1.19
1973	381.11	318.92	62.20	454.11	20.39	177.11	73.00	56.00	1.30
1974	328.87	328.87	0.00	377.87	16.50	170.00	49.00	37.00	1.32
1975	300.00	300.00	0.00	345.00	14.65	161.00	45.00	35.00	1.29

[a]Wheat only.

Sources: Col. 1 from [13] and [26], 1974-75 figures are estimates/unofficial figures from [26]; col. 2 calculated from cols. 1 and 3; col. 3 from [53]; cols. 4 and 5 calculated from cols. 1 and 7; col. 6 from [32]; and cols. 7, 8, and 9 from [25], [49], and [52].

APPENDIX TABLE 6

Colombia: Trade, Consumption, and Production of Corn, 1950-1975

Year	Trade		Consumption		International price	Production		
	Imports	Exports	Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7	8
	1,000 metric tons		1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	0.90	0.10	620.80	54.74	62.96	620.00	652.00	0.95
1951	1.26	0.00	846.25	73.33	71.91	845.00	768.00	1.10
1952	0.00	1.15	926.85	78.21	74.98	928.00	844.00	1.10
1953	0.00	0.03	769.97	63.58	64.14	770.00	700.00	1.10
1954	0.50	3.21	772.29	62.38	62.70	775.00	680.00	1.14
1955	0.00	0.07	735.93	58.13	54.61	736.00	830.00	0.89
1956	0.00	0.00	748.00	57.81	56.43	748.00	828.00	0.90
1957	0.00	0.00	718.00	54.27	51.12	718.00	624.00	1.15
1958	0.07	0.00	823.07	60.52	48.23	823.00	693.00	1.19
1959	0.00	0.00	858.00	61.95	47.32	858.00	721.00	1.19
1960	0.00	0.00	866.00	61.29	44.60	866.00	715.00	1.21
1961	39.17	0.00	797.17	50.14	44.45	758.00	711.00	1.07
1962	0.00	0.00	754.00	45.98	43.82	754.00	697.00	1.08
1963	0.00	0.00	782.00	46.22	48.86	782.00	689.00	1.13
1964	20.48	0.00	978.48	56.04	48.65	958.00	772.00	1.24
1965	0.00	2.34	868.66	48.21	50.55	871.00	869.00	1.00
1966	0.00	0.51	849.49	45.62	53.30	850.00	846.00	1.00
1967	0.00	0.51	849.49	44.20	50.26	850.00	790.00	1.08
1968	10.79	2.05	894.74	45.12	44.50	886.00	818.00	1.08
1969	0.00	18.30	901.70	44.07	49.49	920.00	800.00	1.15
1970	6.58	13.00	855.58	41.67	57.00	862.00	760.00	1.13
1971	47.33	0.00	797.33	37.81	56.00	750.00	750.00	1.00
1972	0.61	0.00	625.61	28.87	72.00	625.00	625.00	1.00
1973	97.33	0.00	819.33	36.79	114.00	722.00	555.00	1.30
1974	39.20	0.31	722.89	31.57	124.00	684.00	559.00	1.22
1975	39.20	0.00	796.20	33.82	106.00	757.00	579.00	1.31

Sources: Cols. 1 and 2 from [13], col. 1, 1975 figure is estimate/unofficial figure from [26]; cols. 3 and 4 computed from cols. 1, 2, and 6; col. 5 from [6]; and cols. 6, 7, and 8 from [25] and [49].

APPENDIX TABLE 7

Colombia: Trade, Consumption, and Production of Rice, 1950-1975

Year	Trade		Consumption		International price	Production		
	Imports	Exports	Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7	8
	1,000 metric tons		1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	1.10	0.00	242.10	21.35	123.20	241.00	133.00	1.81
1951	7.36	0.00	304.36	26.37	131.60	297.00	145.00	2.05
1952	0.03	7.85	321.17	27.10	214.20	329.00	150.00	2.19
1953	0.09	13.66	258.44	21.34	218.40	272.00	153.00	1.78
1954	31.23	0.19	326.04	26.34	171.00	295.00	175.00	1.69
1955	1.07	0.00	321.07	25.36	141.00	320.00	188.00	1.70
1956	0.01	0.00	342.01	26.43	138.00	342.00	190.00	1.80
1957	10.14	0.00	360.14	27.22	139.00	350.00	190.00	1.84
1958	0.02	0.00	380.02	27.94	148.00	380.00	197.00	1.93
1959	0.07	0.00	422.07	30.47	133.00	422.00	206.00	2.05
1960	0.16	0.00	450.16	31.86	124.54	450.00	227.00	1.98
1961	39.14	0.00	513.14	32.27	136.06	474.00	237.00	2.00
1962	2.74	4.19	583.55	35.58	164.76	585.00	275.00	2.13
1963	0.05	3.14	546.91	32.32	143.30	550.00	254.00	2.17
1964	0.22	0.16	600.06	34.37	137.37	600.00	303.00	1.98
1965	0.50	0.00	672.50	37.32	135.27	672.00	375.00	1.79
1966	0.44	0.00	680.45	36.54	163.25	680.00	350.00	1.94
1967	0.30	0.00	662.30	34.46	211.03	662.00	290.00	2.28
1968	0.24	0.04	786.20	39.65	202.19	786.00	277.00	2.84
1969	0.26	15.76	678.50	33.16	186.68	694.00	351.00	1.98
1970	0.22	5.16	747.06	36.39	143.38	752.00	233.00	3.23
1971	0.09	0.32	904.77	42.90	128.72	905.00	254.00	3.56
1972	0.04	3.00	1,040.03	47.99	142.00	1,043.00	274.00	3.81
1973	0.06	20.32	1,154.75	51.85	274.00	1,175.00	291.00	4.04
1974	0.00	1.22	1,538.78	67.20	527.00	1,540.00	355.00	4.34
1975	0.00	166.00	1,780.00	75.62	374.00	1,614.00	372.00	4.34

Sources: Cols. 1 and 2 from [13] and [26], col. 2, 1975 figure is estimate/unofficial figure from [26]; cols. 3 and 4 computed from cols. 1, 2, and 6; cols. 3 and 4 computed from cols. 1, 2, and 6; col. 5 from [6]; and cols. 6, 7, and 8 from [25], [49], and [51].

APPENDIX TABLE 8

Colombia: Import, Consumption, and Production of Barley, 1950-1975

Year	Imports	Consumption		International price	Production		
		Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7
	1,000 metric tons	1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	0.00	50.00	4.41	67.00	50.00	44.00	1.14
1951	4.00	60.00	5.20	62.00	56.00	47.00	1.19
1952	7.59	68.59	5.79	70.00	61.00	51.00	1.20
1953	5.11	70.11	5.79	64.00	65.00	53.00	1.23
1954	0.69	65.69	5.31	61.00	65.00	53.00	1.23
1955	0.02	52.02	4.11	53.00	52.00	43.00	1.21
1956	0.00	70.00	5.41	55.00	70.00	54.00	1.30
1957	0.00	60.00	4.54	54.00	60.00	48.00	1.25
1958	4.77	79.77	5.87	53.00	75.00	42.00	1.79
1959	4.00	105.00	7.58	50.00	101.00	56.00	1.80
1960	0.00	106.00	7.50	49.00	106.00	56.00	1.89
1961	0.02	101.02	6.35	61.00	101.00	48.00	2.10
1962	0.00	108.00	6.59	51.00	108.00	49.00	2.20
1963	0.00	118.00	6.97	50.00	118.00	58.00	2.03
1964	2.49	112.49	6.44	56.00	110.00	58.00	1.90
1965	0.00	90.00	4.99	60.00	90.00	45.00	2.00
1966	49.54	144.54	7.76	61.00	95.00	55.00	1.73
1967	6.12	101.12	5.26	57.00	95.00	61.00	1.56
1968	23.00	98.00	4.94	53.00	75.00	47.00	1.60
1969	41.67	126.67	6.19	50.00	85.00	55.00	1.55
1970	58.97	158.97	7.74	56.00	100.00	65.00	1.54
1971	41.17	153.17	7.26	53.00	112.00	71.00	1.58
1972	0.00	106.00	4.89	68.00	106.00	69.00	1.54
1973	56.34	150.34	6.75	131.00	94.00	61.00	1.54
1974	45.19	162.19	7.08	186.00	117.00	73.00	1.60
1975	0.00	122.00	5.18	167.00	122.00	81.00	1.51

Sources: Col. 1 from [13] and [26]; cols. 2 and 3 computed from cols. 1 and 5; cols. 4 from [6]; and cols. 5, 6, and 7 from [25] and [49], 1975 figures are estimates/unofficial figures from [25].

APPENDIX TABLE 9

Peru: Import, Consumption, and Production of Wheat,[a] 1950-1975

Year	Imports			Consumption		International price	Production		
	Total	Commercial	P. L. 480 Title I	Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7	8	9
	1,000 metric tons			1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	242.60	242.60	0.00	386.41	48.30	92.60	143.81	162.39	0.89
1951	189.03	189.03	0.00	345.60	42.56	96.27	156.57	162.44	0.96
1952	232.95	232.95	0.00	395.06	47.83	93.70	162.11	170.35	0.95
1953	253.99	253.99	0.00	422.72	50.20	77.90	168.73	171.91	0.98
1954	240.72	240.72	0.00	403.22	46.89	65.40	162.50	166.29	0.98
1955	298.37	233.85	64.52	450.32	51.23	62.47	151.95	159.29	0.95
1956	285.20	273.23	11.97	408.51	45.39	62.47	123.31	139.47	0.88
1957	289.11	230.51	58.60	428.94	46.47	62.10	139.83	146.83	0.95
1958	266.52	192.70	73.82	393.81	41.54	61.73	127.29	135.15	0.94
1959	329.15	329.15	0.00	490.29	50.29	61.36	161.14	158.03	1.02
1960	349.42	308.03	41.39	502.42	50.14	62.10	153.00	154.00	0.99
1961	416.32	369.63	46.69	566.64	54.91	62.83	150.32	155.59	0.97
1962	405.04	366.52	38.52	557.87	52.48	64.30	152.83	153.80	0.99
1963	352.97	352.97	0.00	505.58	46.13	66.14	152.61	153.10	1.00
1964	383.84	348.43	35.41	526.99	46.64	63.94	143.15	149.30	0.96
1965	455.62	455.62	0.00	602.34	51.70	58.42	146.72	153.15	0.96
1966	486.13	486.13	0.00	631.13	52.55	66.13	145.00	156.71	0.93
1967	484.46	484.46	0.00	636.64	51.38	61.73	152.18	159.85	0.95
1968	624.19	624.19	0.00	743.58	58.23	62.83	119.39	143.24	0.83
1969	680.63	680.63	0.00	817.34	62.06	53.28	136.70	146.56	0.93
1970	521.76	521.76	0.00	647.13	48.11	60.26	125.37	136.23	0.92
1971	695.61	695.61	0.00	817.83	59.05	60.26	122.23	138.54	0.88
1972	617.99	617.99	0.00	757.99	53.12	91.13	140.00	139.00	1.01
1973	747.64	747.64	0.00	862.64	58.64	177.11	115.00	164.00	0.70
1974	604.65	604.65	0.00	721.65	47.63	170.00	117.00	154.00	0.76
1975	825.00	825.00	0.00	975.00	62.42	161.00	150.00	137.00	1.09

[a] Wheat only.

Sources: Col. 1 from [26] and [44], 1975 figure is estimate/unofficial figure from [26]; col. 2 is calculated from cols. 1 and 3; col. 3 from [53]; cols. 4 and 5 are calculated from cols. 1 and 7; col. 6 from [32]; and cols. 7, 8, and 9 from [25] and [44].

APPENDIX TABLE 10

Peru: Import, Consumption, and Production of Corn, 1950-1975

Year	Imports	Consumption		International price	Production		
		Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7
	1,000 metric tons	1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	0.01	266.20	33.28	62.96	266.19	188.20	1.41
1951	0.15	299.05	36.83	71.91	298.90	206.85	1.44
1952	0.03	321.35	38.90	74.98	321.31	231.03	1.39
1953	0.03	318.87	37.87	64.14	318.84	225.73	1.41
1954	1.89	305.73	35.55	62.70	303.84	321.56	1.31
1955	0.55	297.15	33.81	54.61	296.60	236.00	1.26
1956	16.63	281.88	31.32	56.43	265.24	233.87	1.13
1957	7.80	278.37	30.16	51.12	270.57	235.19	1.15
1958	28.62	322.87	34.06	48.23	294.26	238.29	1.23
1959	5.75	338.96	34.77	47.32	333.21	261.86	1.27
1960	0.84	340.84	34.02	44.60	340.00	253.00	1.34
1961	21.44	470.27	45.57	44.45	448.82	340.86	1.32
1962	9.99	469.66	44.18	43.82	459.67	330.80	1.39
1963	7.49	487.68	44.50	48.86	480.19	338.50	1.42
1964	15.67	518.25	45.86	48.65	502.58	346.94	1.45
1965	4.57	561.74	48.22	50.55	557.17	342.35	1.63
1966	6.00	587.01	48.88	53.30	581.01	354.92	1.64
1967	0.88	591.46	47.74	50.26	590.57	362.40	1.63
1968	59.13	611.67	47.90	44.50	552.54	316.14	1.75
1969	6.31	596.01	45.26	49.49	589.70	368.41	1.60
1970	1.72	616.34	45.82	57.00	614.62	382.10	1.61
1971	0.43	616.79	44.53	56.00	616.37	373.85	1.65
1972	111.00	700.00	49.05	72.00	589.00	301.00	1.96
1973	225.00	841.00	57.17	114.00	616.00	430.00	1.43
1974	273.00	745.00	49.17	124.00	472.00	320.00	1.48
1975	325.00	950.00	60.82	106.00	625.00	370.00	1.69

Sources: Col. 1 from [26] and [44], 1972-1975 figures are estimates/unofficial figures from [26]; cols. 2 and 3 are computed from cols. 1 and 5; col. 4 from [6]; and cols. 5, 6, and 7 from [25] and [44], 1975 figures are estimates/unofficial figures from [25].

APPENDIX TABLE 11

Peru: Import, Consumption, and Production of Rice, 1950-1975

Year	Imports	Consumption		International price	Production		
		Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7
	1,000 metric tons	1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	25.55	138.54	17.32	123.20	112.99	41.75	2.71
1951	26.70	233.43	28.75	131.60	206.74	51.45	4.02
1952	14.32	278.86	33.76	214.20	264.54	59.01	4.48
1953	0.02	277.26	32.93	218.40	277.25	65.84	4.21
1954	0.03	258.65	30.08	171.00	258.62	68.77	3.76
1955	0.02	248.82	28.31	141.00	248.80	62.09	4.01
1956	0.18	243.38	27.04	138.00	243.20	66.98	3.63
1957	20.24	266.57	28.88	139.00	246.33	59.74	4.12
1958	44.83	330.21	34.83	148.00	285.38	70.64	4.04
1959	0.17	249.07	25.55	133.00	248.89	70.05	3.55
1960	25.45	383.45	38.27	124.54	358.00	87.00	4.11
1961	8.66	298.57	28.93	136.06	289.91	76.60	3.78
1962	1.21	375.41	35.32	164.76	374.20	86.80	4.31
1963	0.92	270.78	24.71	143.30	269.86	72.79	3.71
1964	47.98	399.46	35.35	137.37	351.48	82.20	4.28
1965	91.91	382.43	32.83	135.27	290.52	74.92	3.88
1966	11.40	385.44	32.09	163.25	374.03	95.88	3.90
1967	59.01	520.43	42.00	211.03	461.42	106.69	4.32
1968	47.92	334.12	26.16	202.19	286.20	75.98	3.77
1969	37.31	481.75	36.58	186.68	444.43	109.86	4.05
1970	0.03	586.75	43.62	143.38	586.72	140.40	4.18
1971	0.01	591.12	42.68	128.72	591.11	147.34	4.01
1972	0.00	436.00	30.55	143.00	436.00	105.00	4.15
1973	0.00	398.00	27.71	274.00	451.00	110.00	4.10
1974	43.00	404.00	26.67	527.00	361.00	89.00	4.06
1975	78.00	578.00	37.00	374.00	500.00	117.00	4.27

Sources: Col. 1 from [26] and [44]; cols. 2 and 3 are computed from cols. 1 and 5; col. 4 from [6]; and cols. 5, 6, and 7 from [25] and [44], cols. 6 and 7, 1975 figures are estimates/unofficials figures from [25].

APPENDIX TABLE 12

Peru: Import, Consumption, and Production of Barley, 1950-1975

Year	Imports	Consumption		International price	Production		
		Total	Per capita		Total	Harvested acreage	Yield
	1	2	3	4	5	6	7
	1,000 metric tons	1,000 metric tons	kilograms per capita	dollars (U. S.) per metric ton	1,000 metric tons	1,000 hectares	metric tons per hectare
1950	0.00	219.73	27.47	67.00	219.73	185.14	1.19
1951	0.00	201.58	24.83	62.00	201.58	181.58	1.11
1952	0.00	217.18	26.29	70.00	217.18	186.34	1.17
1953	0.00	225.53	26.79	64.00	225.53	190.55	1.18
1954	0.00	225.80	26.26	61.00	225.80	194.19	1.16
1955	0.00	207.58	23.62	53.00	207.58	184.80	1.12
1956	3.50	162.77	18.09	55.00	159.27	169.12	0.94
1957	11.75	177.86	19.27	54.00	166.10	169.55	0.98
1958	3.02	199.38	21.03	53.00	196.36	174.70	1.12
1959	2.89	204.43	20.97	50.00	201.54	189.96	1.06
1960	3.00	218.00	21.76	49.00	215.00	185.00	1.16
1961	13.10	192.92	18.69	61.00	179.83	172.15	1.04
1962	12.06	196.65	18.50	51.00	184.59	179.52	1.03
1963	15.72	197.95	18.06	50.00	182.23	180.20	1.01
1964	17.61	200.51	17.74	56.00	182.89	179.40	1.02
1965	14.65	193.60	16.62	60.00	178.95	176.19	1.02
1966	13.09	167.33	13.93	61.00	154.24	178.25	0.87
1967	19.01	191.46	15.45	57.00	172.45	185.12	0.93
1968	9.60	155.45	12.17	53.00	145.86	173.47	0.84
1969	10.05	173.71	13.19	50.00	163.67	181.70	0.90
1970	14.32	184.28	13.70	56.00	169.96	186.33	0.91
1971	11.88	170.70	12.32	53.00	158.82	182.79	0.87
1972	26.11	186.11	13.04	68.00	160.00	183.00	0.87
1973	19.03	184.03	12.51	131.00	165.00	185.00	0.89
1974	19.05	187.05	12.35	186.00	168.00	190.00	0.88
1975	32.94	202.94	12.99	167.00	170.00	193.00	0.88

Sources: Col. 1 from [26] and [44], 1975 figure is estimate/unofficial figure from [26]; cols. 2 and 3 are computed from cols. 1 and 5; col. 5 from [6]; and cols. 6, 7, and 8 from [25] and [44], 1973-1975 figures are estimates/unofficial figures from [25].

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