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COMPARATIVE POLICY SIMULATIONS:

ECONOMIC DEVELOPMENT IN BRAZIL TO 1985

by

Choong Yong Ahn and Inderjit Singh

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Department of Agricultural Economics and Rural Sociology
The Ohio State University
College of Agriculture and Home Economics
2120 Fyffe Road
Columbus, Ohio 43210

CHAPTER 10

COMPARATIVE POLICY SIMULATIONS: ECONOMIC DEVELOPMENT IN BRAZIL TO 1985

Choong Yong Ahn
Inderjit Singh

1. INTRODUCTION

1. This paper traces possible future outcomes under alternative policy assumptions for the agricultural sector in the wheat regions of Southern Brazil. We do this using a recursive programming model that has already been tested by simulating regional agricultural history for the sixties Ahn [1972] and Singh and Ahn [1972]. During this decade, the region saw considerable growth in real agricultural output and a persistent transformation of the regional economy from range livestock production to intensive crop production. This transformation was made possible through a large program of price supports for wheat producers tied to subsidized credits made available for the purchase of modern capital intensive inputs. Preliminary analysis indicates that besides stimulating agricultural growth, these policies also brought about distortions in the allocation of resources, a large increase in the demand for credits and an increasing inequality in the distribution of incomes between farms of different size.[1]

2. The purpose of the current exercise is to project regional development into the 1980's under alternative policy assumptions about price supports and credits. The main focus of these projections is to determine what might happen if current policies are revised by terminating wheat price supports programs

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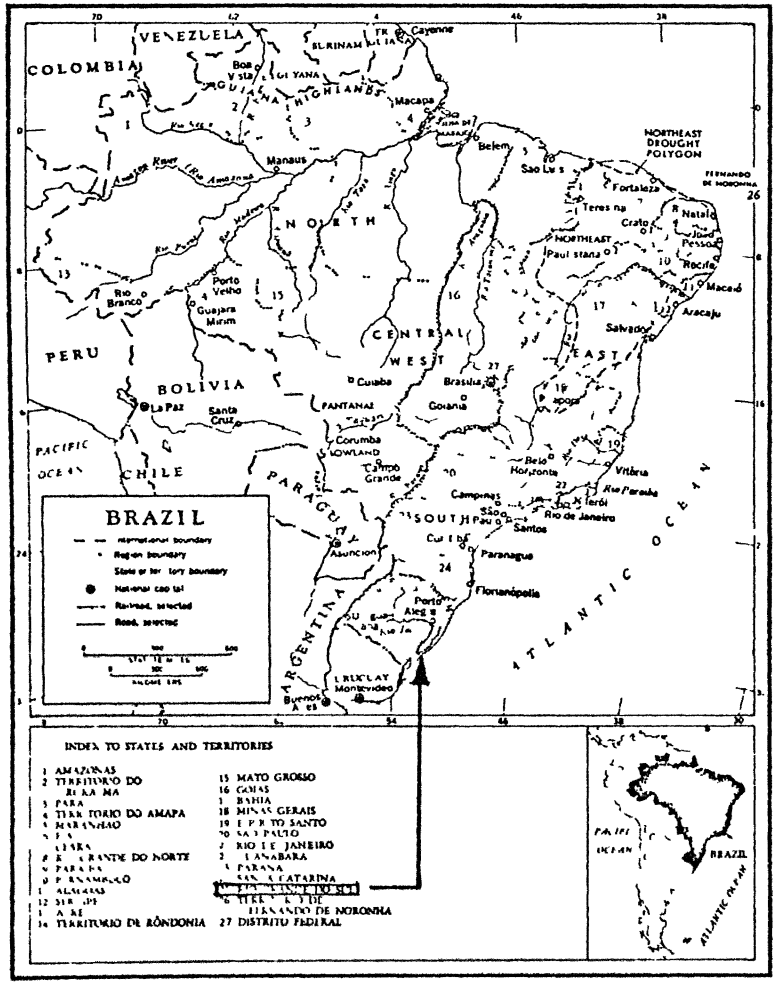
*Notes for this chapter begin on page 10-33.

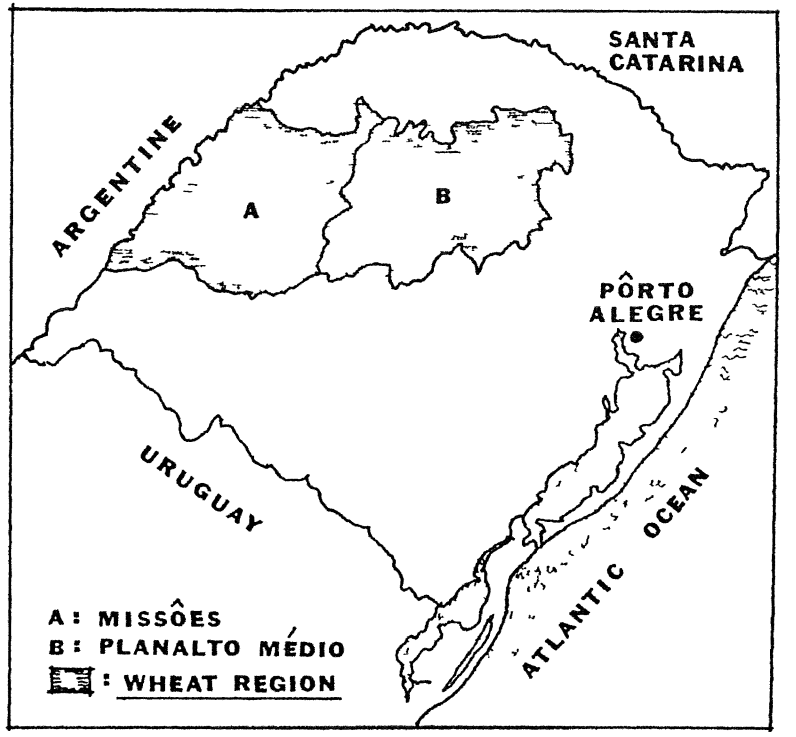
and/or credit subsidies. We hope such conditional projection will enable us to draw some tentative conclusions about the direction which future policy might take.

3. The next section briefly reviews some of the regional characteristics and recent policy developments in the region under study; section three outlines the structure of the model, section four, the policy assumptions used for projection; section five reports selected simulation results for alternative policies for the period 1970-1985; section six draws on some of these results in order to evaluate alternative policy outcomes. We conclude with a brief discussion of the complex set of factors that need to be evaluated before future policy choices are implemented.

2. THE REGION

1. The present study and model structure have been tailored to the wheat growing areas of Rio Grande do Sul in Southern Brazil shown in Figure 1. This region is fairly homogeneous with regard to climate and agricultural practices even though it covers some 5.7 million hectares of cultivated land. Contrastingly there has been a wide distribution of farm sizes as shown in Table 1 and substantial differences in resource endowments at the farm level Rask [1969], [1971]. As a result the regional process of development has been highly skewed vis a vis such factors as growth in farm incomes, factor productivities, resource use and policy impacts on farms of different size.





RIO GRANDE DO SUL

TABLE 1: FARM SIZE DISTRIBUTION IN THE WHEAT REGION OF RIO GRANDE DO SUL IN 1967

Class by Hectares	Number of Farms	Percent of Total Farm Area	Land Used (1000 Ha)	Percent of Total Land Used
0-25	65,054	67.32	753,155	13.76
26-50	15,807	16.35	541,606	9.89
51-100	7,485	7.74	506,092	9.25
101-1,000	7,558	7.82	2,112,646	38.61
1,011-10,000	729	0.77	1,557.784	28.49
Total	96,633	100.0	5,471,283	100.00

Source: Estrutura Fundiarra do Rio Grande do Sul - Instituto Brasileiro de Reforma Agraria Delegacia Regional do Rio Grande do Sul.

2. The wheat price support program was started in 1962 with the Bank of Brazil standing ready to purchase wheat at the official support price. By 1970, the domestic support price of wheat stood at a level nearly 80 percent above the U.S. export price.[2] The ratio of wheat to beef prices in the domestic market nearly doubled while, by way of contrast, the ratio declined slowly in international markets. As a result, by 1970 the domestic ratio exceeded the international price ratio by more than four times.[3]

3. The improved profitability for wheat was accompanied by large credits, tied to the purchase of modern inputs, on very liberal terms. After 1964, modern variable inputs, such as seed, nutrients and pesticides, could be purchased 100 percent on credit, at a nominal interest rate of 15 percent per annum, while farmers could obtain long-term, low-interest financing for agricultural machinery with a 25 percent down payment at a 7 percent rate of interest. Meanwhile, the wholesale price index for foodstuffs increased by an average of 60 percent annually between 1960-66 and 23 percent annually between 1967-71. Thus, in effect, due to inflation the real rate of interest on credit was negative during the entire decade.

4. This combination of policies made wheat, often double cropped with soybeans, highly profitable, and fueled a program of import substitution in wheat on a massive scale. The area under cultivation and domestic production of wheat increased nearly sevenfold, while domestic production as a percentage of total domestic requirements increased from an average of 9.5 percent for the period 1962-65 to an estimated 50 percent by 1970/71 Engler and Singh [1971, p. 13]. This increased program of self-sufficiency transformed the regional land use patterns from predominantly range livestock production to intensive crop production, accompanied by mechanization on medium and large farms.[4]

3. THE MODEL

1. The model presented here is similar to the regional models of agricultural development using recursive programming techniques pioneered by Day [1963a], further extended by Schaller and Dean [1965], Heidhues [1966], and Cigno [1969] and recently applied to agriculture in transition in the LDC's by Singh [1971] and Mudahar [1972]. These models use a single linear programming model to represent the regional aggregate of all the production plans of farms for a given period of time. Such a regional linear program is an unbiased estimate of aggregate activity levels when certain technical conditions are fulfilled.[5] As we have seen, the region under consideration here is characterized by substantial differences in farm size and resource endowments. Consequently, instead of a single regional aggregate, we group all farms in the region into three farm size groups -- small farms (less than 50 hectares), medium farms (51-300 hectares) and large farms (301-10,000

hectares) and assume that all farms within each group satisfy the required aggregation conditions. Further utilizing the decomposition principle of linear programming, the three farm group models are jointly treated in a single model of the region.[6]

2. Seven basic components are included. These are (1) a set of farm activities representing decision variables for farms within each size group; (2) an annual objective function measuring the expected revenues from crop sales, the costs of purchased inputs and annual investment charges for resource augmenting investments; (3) a technology matrix representing the traditional and modern input-output structure of cash consumption, farm production, investment, sales, purchase and financial activities; (4) "technical" constraints representing regional resource and financial limitations; (5) "behavioral" constraints representing adaptive "safety-first" limitations for protection against mistakes of cropping and investment choices, and representing drags on investment due to "learning" and "unwillingness to change"; (6) feedback functions that relate the parameters of the current programming problem to previous decisions; and (7) exogenously given input and output prices, regional supplies of land and labor resources and exogenously estimated consumption requirements by farm size and supplies of regional wage labor, credit and non-farm quasi-fixed capital goods.

3. The endogenous variables explained by the model include, by farm size, the production of crops and livestock (by technology -- traditional and modern); investment levels in farm power (tractors, harvestors and draft animals); working capital expenditures on machines, fertilizers, seeds, bone meal, concentrates, fuel, etc.; borrowings and savings levels and labor

utilization by family and wage labor categories, by individual activity, by season and by crop. The exogenous variables not explained by the model include market prices, interest rates, supplies of land and family labor by farm size, wage labor in the region and non-farm incomes. The parameters of the model include input-output coefficients by farm size, regional depreciation rates, adoption and adjustment coefficients by machine type, flexibility coefficients by crop, and the average propensity in the region to consume out of gross sales.

4. Activities distinguished by farm size include production activities (wheat, soybeans, soybean-wheat rotation, corn, each at two levels of technology (traditional and modern) and beef cattle raised on either natural or improved summer and winter pastures), purchase activities (variable cash inputs such as hired labor, seeds, fertilizers, and livestock concentrates), sales activities (wheat, soybeans, corn and beef), financial activities (include savings, borrowings, and debt repayment) and investment activities (include the purchase of capital goods, combines and draft animals and land improvement). Intermediate transfer activities allow for the use of corn and pasture for livestock production and the conversion of natural to improved pasture or crop land.

5. Constraints by farm size group include land, labor, power, and working capital supplies. Behavioral constraints defined within farm size groups are individual crop flexibility constraints. Regional constraints include farm credit, wage labor by season and behavioral constraints emitting the rate of investment in mechanical power and the adoption of modern technology.

*6. Let A be a set of production activity indexes and let C be a set of constraint indexes. Also let Q = {small, medium, large} be the set of farm size indexes. All activities are assumed to be linear, finite in number and their levels x_j, $j \in A$ measured for the regional farm size aggregates. It is convenient to decompose activity indexes into subsets associated with individual farm size groups. Thus we let $\{A_q, q \in Q\}$ be a partition of A where A_q is the set of activities associated with farm size q. Constraining factors are identified by an index $i \in C$. The technical coefficients b_{ijt}, $i \in C$, $j \in A$ are assumed constant over time and all technology is assumed to be embodied. Positive (negative) coefficients mean a given factor is a net input (output); a zero coefficient indicates a factor not involved in the activity in question. Limitation coefficients C_i, $i \in C$ are also defined for farm size aggregates and for the region as a whole; positive (negative) coefficients are associated with upper (lower) bounds on activity combinations, zero coefficients with balance constraints. We also let $\{C_q, q \in Q, C_r\}$ be a partition of C where C_q is the set of constraint indexes associated with farm size q and C_r the set of constraint indexes associated with the region as a whole.

7. The objective function to be maximized in each year is

$$(1) \qquad \varphi(x,a_t) := \Sigma_{j \in A}\, a_{jt}\, x_j = \Sigma_{j \in A_q,\, q \in Q}\, a_{jt} x_j$$

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*The remaining paragraphs in this section are technical and may be skipped by those primarily interested in the policy analysis which is taken up in section 4.

where a_{jt} is the anticipated net profit of activity j, for the period t. These represent current variable costs of the appropriate input (seeds, manure, chemical fertilizers, pesticides, animal draft, fuel, lubricants and labor costs) when j is a purchase activity, the nominal rate of interest when j is a borrowing activity, the regional time deposit rate when j is a saving activity, the expected sales price per unit of output when j is a sales activity and an investment charge estimated on a straight line depreciation basis from the current purchase price of the capital good when j is an investment activity.

(2) $$\Sigma_{j\in A_q} b_{ijt} x_j \leq c_{it}, \quad i\in C_q, \quad q\in Q.$$

The regional constraints are

(3) $$\Sigma_{j\in A} b_{ij} x_j = \Sigma_{j\in A_q, q\in Q} b_{ijt} x_j \leq c_{it}, \quad i\in C_r$$

The objective function is maximized for each year subject to constraints (2)-(3).

8. In specifying model details it is convenient to decompose activity and constraints groups further. Thus we shall use the following index sets:

Activities by farm size

P_q	production
$P_{y,q}$	final production of crop y
Y	commodity indexes
H_q	purchase
S_q	sales
F_q	financial
I_q	investment

Constraints by farm size

L_q	land and seasonal family labor
K_q	farm power capacities
E_q	intermediate goods
G_q	working capital
y^u_q, y^ℓ_q	crop flexibility

Regional coupling constraints

W	regional wage labor supplies by season
rc	regional farm credit
B	behavioral bounds on investment and adoption

10. Land is assumed to be constant, while family labor by season is assumed to grow at an exogenously given rate equal to the rate of growth of population. Hence the c_{iy}, $i \in L_q$ coefficients in (2) are exogenous variables.

11. Farm power constraints are endogenously generated. They are given by

$$\text{(5a)} \qquad \Sigma_{j \in P_q} b_{ij} x_j - b_{ik_i} x_{k_i} \leq c_{it}, \; i \in K_q$$

in which $k_i \in d_q$ is the investment activity in power source (or machine) $i \in K_q$, which states that current power utilization by production activities augmented by current investments must not exceed initial capacities. Current capacity is generated recursively by

$$\text{(5b)} \qquad c_{it} = (1-\delta_i) c_{i,t-1} + b_{ik_i} x_{k_i,t-1}, \; i \in K_q$$

which states that current capacity is previous depreciated capacity augmented by the immediately preceding year's investment.

12. Balance equations allow the production of intermediate outputs to be used for final outputs, as well as the transfers of additional capacities from investments to current capacities. These are completed endogenous and may be expressed by

$$(6) \qquad \Sigma_{j\in A_q} b_{ij} x_j \leq 0, \; i\in E_q, \; q\in Q.$$

In these constraints a positive b_{ij} means a given intermediate good is "used up" by activity j, a negative b_{ij} means one "produced" by activity j.

13. The use of working capital within each farm group is constrained in the model by current supplies augmented by current borrowings. Purchasing, savings and investments in power and machines compete for this amount. We thus have

$$(7a) \qquad \Sigma_{j\in H_q} a^o_{j,t} x_j + \Sigma_{j\in F_q} b_j x_j + \Sigma_{j\in I_q} a^o_{j,t} x_j \leq c_{wqt}$$

The coefficients $a^o_{j,t}$, $j\in H_q$ are the current unit costs of the purchased inputs (prices of seeds fertilizer fuels, lubricants, wages, etc.). The b_j coefficients are equal to +1 for savings -1 for borrowing activities so the former competes for, the latter augments working capital. The $a^o_{j,t}$, $j\in I_q$ are the currently estimated annual capital charge for investment activities based on current prices and straight-line depreciation determined by use life. The initial supply of working capital within the farm size group is determined recursively by the equation

(7b) $$c_{wqt} = (1-\gamma_q)(\Sigma_{j\in S_q} a^o_{j,t-1} x_{j,t-1} + \bar{Y}_{qt})$$

$$+\Sigma_{j\in F_q} [\text{sign } a^o_{j,t-1} + a^o_{j,t-1}]x_{j,t-1},\ q\in Q.$$

In this expression $a^o_{j,t-1}$, $j\in S_q$ is the price received for commodities sold in the previous crop year, $\bar{Y}_q$ is exogenously given off-farm income, $a^o_{j,t-1}$ is the interest received for savings and minus the interest paid on borrowing activities. Sign $a^o_{j,t-1}$ is +1 for savings, -1 for borrowing. The parameter γ_q is the marginal propensity to consume on farms in group q.

14. The production of individual commodities is bounded in each year by flexibility constraints to account for adaptive, safety-first behavior. These may be written

(8a) $$c^{\ell}_{yqt} \leq \Sigma_{j\in P_{yq}} x_j \leq c^u_{yqt}$$

where

(8b) $$c^u_{yqt} = (1 + \gamma^u_{yq}) \Sigma_{j\in P_{yq}} x_{j,t-1}$$

$$c^{\ell}_{yqt} = (1 - \gamma^{\ell}_{yq}) \Sigma_{j\in P_{qy}} x_{j,t-1}$$

where the flexibility coefficients, γ^{ℓ}_{yq} and γ^u_{yq} were parameters of the model.

15. Let us now describe the regional coupling constraints. Regional wage labor constraints are given by

(9) $$\Sigma_{j\in P_q, q\in Q} b_{ij} x_j \leq c_{it},\ i\in W$$

where c_{it} is the exogenously estimated supply of regional wage labor by season.

16. The supply of credit is assumed to be limited to the region as a whole, but allocated efficiently among farm groups within the region. Let $_{bq}$ be the borrowing activities for farm size group q. Then we have

(10a) $$\Sigma_{j \in F_{bq}} x_j \leq c_{rct}$$

where the limitation coefficient c_{rct} is generated recursively by

(10b) $$c_{rct} = \beta \Sigma_{j \in S_q, q \in Q} x_{j,t-1}.$$

The parameter β is a rule of thumb "borrowing coefficient" used by credit institutions in extending credit. Thus, the sum of regional borrowings in the current period cannot exceed a fraction of previous years gross revenues in the region.

17. Maximum potential investment bounds are defined for investment activities. These are defined by

(11a) $$\Sigma_{q \in Q} x_{j_q} \leq c_{rj_q t}, \; j_q \in I_q$$

Here x_{jq} is investment by farm size group q in the capacity associated with activity j. $c_{rj_q t}$ is the limit in year t on this investment determined by the "adjustment rule"

(11b) $$c_{rj_q t} = \rho_j [\bar{c}_{rj_q} - \Sigma_{q \in Q} c_{i_q t}]$$

where $\bar{c}_{rj_q}$ is the long run desired capacity if the given capital good were used throughout the region and where $c_{i_q t}$ is the initial capacity in farm group q of the given capital good as determined by (5b). ρ_j is the "adjustment coefficient".

18. The final set of behavioral constraints reflect friction in adopting new technology throughout the region and are given by bounds on the use of modern technology applied to individual commodities. Let N be the subset of new production activities that involve the use of new machines, seeds, and practices. Then the adoption constraints are

$$x_j \leq c_{jt}, \quad j \in N \tag{12a}$$

where the limitation coefficients are generated recursively by

$$c_{jt} = (1 + \alpha_j)x_{j,t-1}. \tag{12b}$$

19. Our description of the model is completed by returning to the objective function to describe the objective coefficients a_{jt}, $j \in A$. These are as follows. The payoff for sales activities is the current observed price

$$a_{jt} = a^o_{j,t}, \quad j \in S_q. \tag{1b}$$

Those for purchasing are the current observed prices times minus one, i.e.,

$$a_{jt} = -a^o_{jt}, \quad j \in H_q. \tag{1c}$$

$$(\text{sign } a_{jt})a_{jt} = a^o_{jt}, \quad j \in F_q. \tag{1d}$$

Financial activity coefficients are the "observed" interest rates with sign $a_{jt} = +1$ for savings and sign $a_{jt} = -1$ for borrowing. Investment activities coefficients are

$$a_{jt} = -a^o_{jt}, \quad j \in I_q \tag{1e}$$

where a^{o}_{jt} in the "observed" annual capital cost based on straight line depreciation.

4. POLICY ALTERNATIVES

1. The focus of our analysis rests on the wheat price support program and credit subsidies that continue to play a critical role in the development of the region. We use our simulation model to project possible development impacts of three policy alternatives. These alternatives are the following:

P1: Continuation of Current Policy Programs

The domestic price subsidy for wheat above and domestic prices for beef below international price levels are allowed to continue into the future on the basis of currently projected trends. A nominal rate of interest of 10 percent on borrowed capital is assumed.

P2: Increasing the Nominal Rate of Interest

Assumptions same as under (P1), except nominal interest rates at 20 percent instead of 10 percent.

P3: Introducing International Prices in Output Markets for Traded Goods

Assumptions same as under (P1), except projected international prices are assumed for final traded outputs. This consists of substituting the U.S. export prices for wheat and soybeans and the Argentine export price for beef, valued at the going exchange rate, for the respective domestic price vectors. Domestic corn prices are allowed to prevail because it is in main a non-traded good and domestic prices have not differed substantially from international levels once transportation costs have been allowed for. A nominal interest rate of 10 percent

is allowed to prevail as in (P1).

2. Policy (P1) enables us to study the longer run consequences of a situation in which, in the past the rate of inflation has exceeded 10 percent per annum and real interest rates have been negative. As it was difficult to project rates of inflation for the Brazilian economy we used a nominal rate. The real rate of interest implied by this assumption will depend upon realized rates of inflation in the future. If inflationary trends, already dramatically curbed, continue to decline in the same manner, the implied real rate of interest may be positive under these assumptions. All other domestic input and output prices are projected on the basis of current trends that would continue to prevail into the future.

3. The purpose of (P2) is to evaluate the impact of removing credit subsidies if inflationary trends continue to exceed 10 percent. This policy alternative is of special interest because an earlier analysis showed that there were serious allocative distortions in the use of credit and capital that could have been prevented had credits not been available at negative real rates of interest. There is also a growing concern that low interest rates on institutional credits have major distributive effects that may harm small farmers.[7]

4. The effect of (P3) is to drop the wheat price support program and open domestic output markets to international competition. In the past domestic beef prices have been held below the international level, wheat above. One of the effects has been the substitution of wheat-soybean production for beef cattle production. The focus of analysis then is to see if this process is reversed when output prices are allowed to fall or rise to their levels in international markets.

5. For the purpose of the comparative dynamic analysis we have projected input and output prices using the linear time trend

$$P_t = \alpha + \hat{\beta}t. \qquad (\ )$$

The coefficients were estimated from series data for all domestic input and output prices and international prices in terms of Cruzeiros. The resulting series for beef, soybeans, and wheat are presented in Table 2. The reader should note the sharp differences between domestic and international prices and the substantial price inflation projected.

TABLE 3: PROJECTED PRICES IN BRAZIL FOR THE POLICY SIMULATIONS[a]

	Domestic			International		
Year	Wheat[b]	Soybeans	Beef[c]	Wheat[d]	Soybeans[d]	Beef[e]
1971	0.5401	0.4055	1.1723	0.3163	0.5397	2.8714
1972	0.5973	0.4543	1.2642	0.3489	0.5946	3.1559
1973	0.6545	0.5031	1.3561	0.3815	0.6495	3.4403
1974	0.7116	0.5519	1.4479	0.4140	0.7044	3.7248
1975	0.7688	0.6007	1.5398	0.4466	0.7593	4.0093
1976	0.8260	0.6496	1.6316	0.4792	0.8142	4.2937
1977	0.8831	0.6984	1.7235	0.5117	0.8691	4.5782
1978	0.9403	0.7472	1.8154	0.5443	0.9240	4.8626
1979	0.9974	0.7960	1.9072	0.5769	0.9789	5.1471
1980	1.0546	0.8448	1.9991	0.6095	1.0337	5.4316
1981	1.1117	0.8936	2.0909	0.6420	1.0886	5.7160
1982	1.1689	0.9424	2.1828	0.6746	1.1435	6.0005
1983	1.2261	0.9912	2.2747	0.7072	1.1984	6.2849
1984	1.2832	1.0400	2.3665	0.7397	1.2533	6.5694
1985	1.3404	1.0888	2.4584	0.7723	1.3082	6.8539

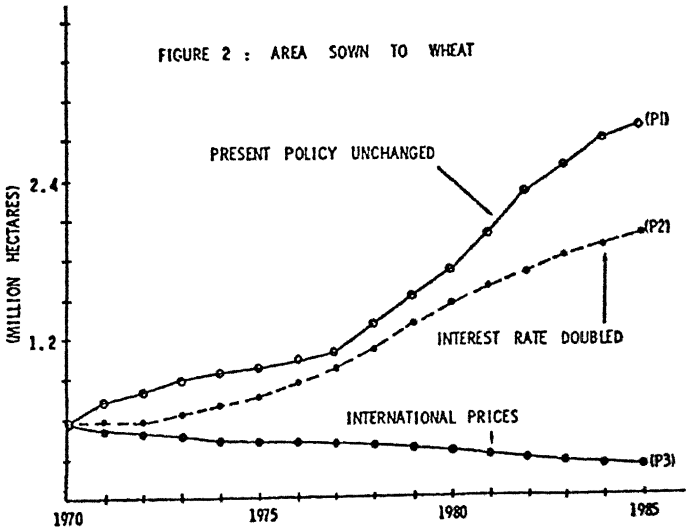
Source: Ahn (1972) and Singh and Ahn (1972).

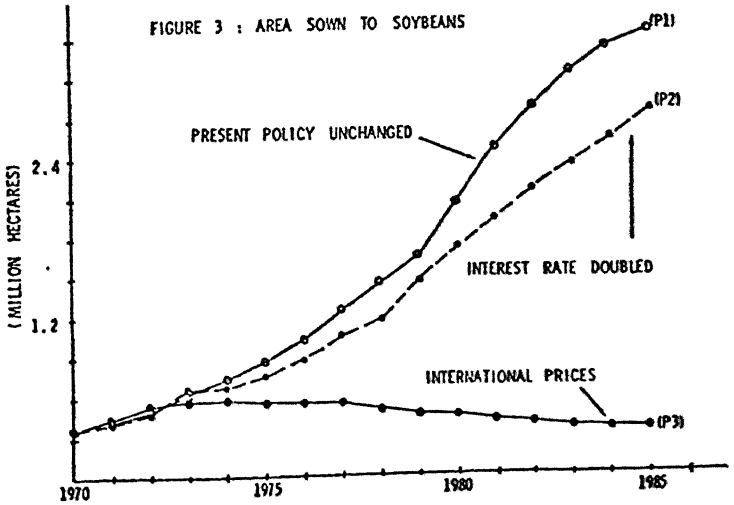
a. All prices in Cruzeiros/kilogram. b. Unmilled. c. Chilled and Frozen. d. Based on U.S. export F.O.B. prices between (1964-70). e. Based on Argentina export F.O.B. prices between (1964-70).

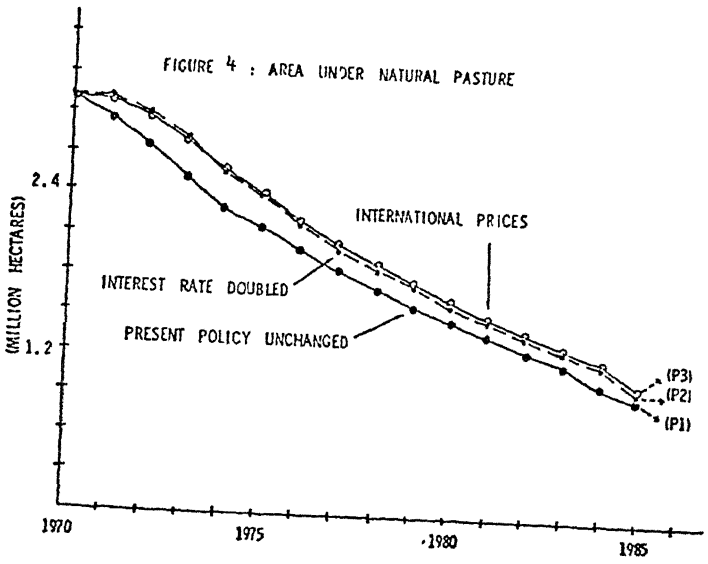
5. MODEL SIMULATIONS

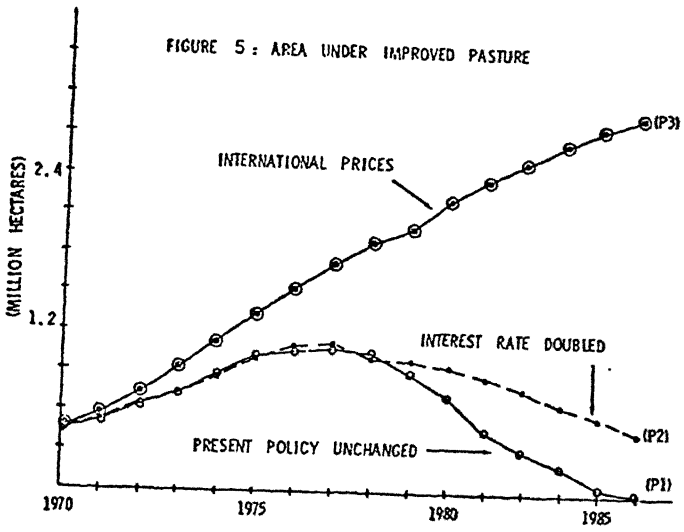
1. The highlights of the model projections which are of the most interest from a policy point of view may now be considered.[8] In the graphical displays that follow the projected time paths are identified by policy alternative, (P1)-(P3). We shall look first at land use, then output, capital use and employment, then factor productivity and farm income.

2. Model results for regional land use are shown in Figures 2-5. If current programs continue the transition from range livestock to wheat-soybean









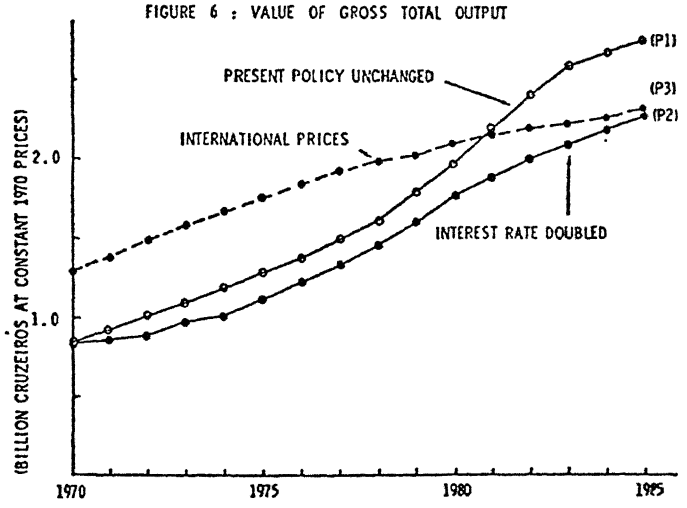
production, is projected to continue unabated. Wheat hectrage would grow from 0.6 million in 1970 to over 2.8 million by 1985, trebling domestic wheat production. Soybean hectarage shown in Figure 3 would increase even more dramatically from 0.37 million to over 3.3 million, a nearly tenfold increase in production. As illustrated in Figure 4 most of the increase in crop farming under (P1) would come through the reduction of natural pasture

lands from over 3.1 million in 1970 to about a million hectares by 1985. Beef production on improved pasture systems, shown in Figure 5, which has been increasing in the past, would continue through the mid 1970's. Thereafter it declines, as the domestic wheat/beef price ratio continues to increase, making wheat-soybean double cropping even more profitable.

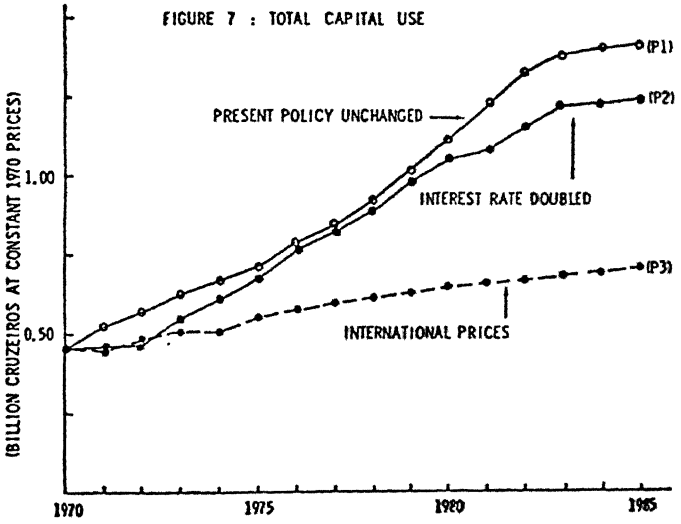
3. When the nominal interest rate is increased (P2) predicted regional land use follows a similar pattern but crops increase slower while beef production under improved pastures declines at a somewhat slower rate after 1976. This is due in large part to the impact of interest rates on the relative profitability of wheat-soybean double cropping which use larger amounts of both variable and investment capital inputs.

4. When international prices for farm outputs are introduced (P3) the model projects drastic changes in land use patterns. Wheat production instead of increasing declines to half its 1970 level, while soybean production after showing some small initial increases remains at its 1970 level. Interestingly enough the economy does not revert to range livestock production, but as beef becomes relatively profitable, the farm capital build up in tractors and harvesting equipment that has already occurred in the transition from range livestock to wheat production, becomes readily available for beef production on improved pastures. Beef production on improved pastures is expected to increase nearly tenfold using the increased area that would have been devoted to wheat production under current programs. Thus, we see that the termination of the domestic price support programs for wheat would very likely reverse the process of transformation that has characterized the region since the early sixties. Such a reversal would also have an important impact on regional output, employment and capital use.

5. Model projections under the alternative policy assumptions for the value of gross output, total capital use, investment outlays, and total credit use by farm size are shown in Figures 6 to 9. Under a continuation of current programs the value of gross output at constant 1970 prices would grow more than three-fold between 1970-85 (Figure 6). This would require

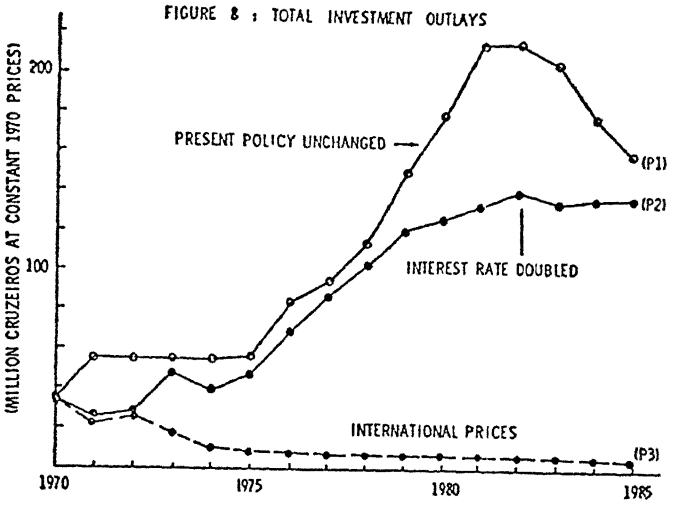


an almost three-fold increase in total capital use (Figure 7). Gross invest-



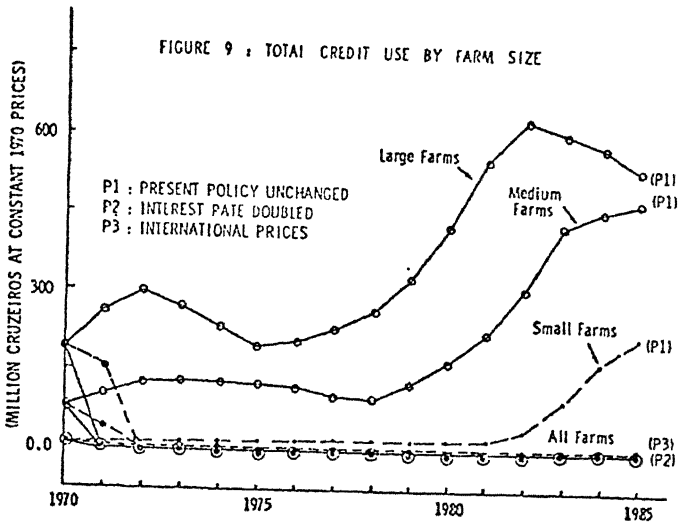
ments in farm power would increase six-fold between 1960-81, declining slowly thereafter (Figure 8). This projected trend involves a rapid

FIGURE 8 : TOTAL INVESTMENT OUTLAYS



mechanization of farm operations as large and medium farms continue to invest heavily in tractors and combines, partly to avoid seasonal labor shortages and partly to take advantage of the timeliness and efficiency provided by mechanization. After 1975 even small farms would experience seasonal labor shortages and begin to mechanize some of their operations.

6. However, it is clear that not all the impetus to mechanization would be due to seasonal labor shortages or efficiency as attended by the dampening effect of increasing interest rates on investment outlays (Figure 8). In order to finance their increased capital requirements large and medium farms would continue to rely heavily on credit (an average of 30% and 50% of the total cash requirements on medium and large farms respectively are met through short term borrowings). Small farms begin to borrow substantial amounts only after 1981 to finance partial mechanization. Total credit use in the region would increase more than six-fold if current programs continue (Figure 9).

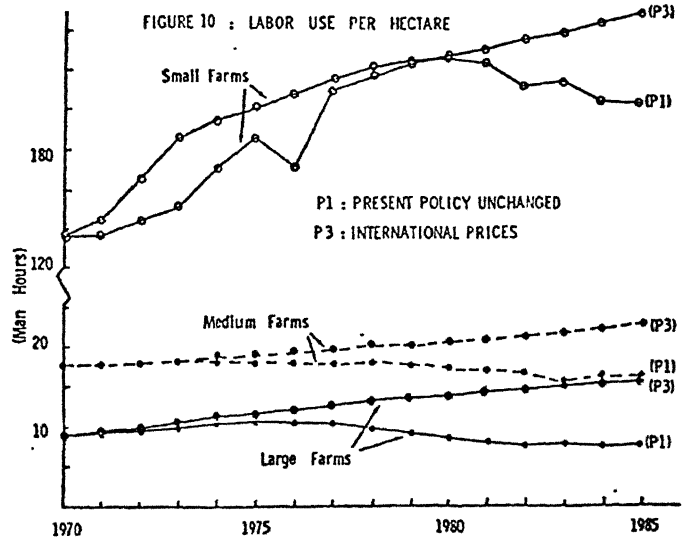


7. Raising nominal interest rates retards the growth of regional output, capital use, and gross investments and reduces the level of borrowings on all farms to zero (see run (P2) in Figures 6-9). This is no doubt a probable underestimate, but it reflects very clearly the sensitivity of short term borrowings to changes in the nominal rates of interest. This is no doubt due to the fact that the marginal efficiency of capital is highly interest elastic at current interest rates and that the rates of return to capital investments are fairly low. As long as credit at real negative rates of interest is made available to farmers and tied to the purchase of modern inputs used to produce outputs made profitable by a price support program, farmers will be more than willing to increase their indebtedness. However, as soon as the real opportunity cost of borrowing is raised, all farms begin to finance their own operations fully, cutting back their capital use at the margin.

8. But can regional growth be generated without a program of price supports and credit subsidies? The answer is in the affirmative as the substitution of international for the domestic output prices for wheat, soybeans and beef, generate the highest accumulated value for gross output in the region. This is achieved with smaller amounts of total capital use, a very small level

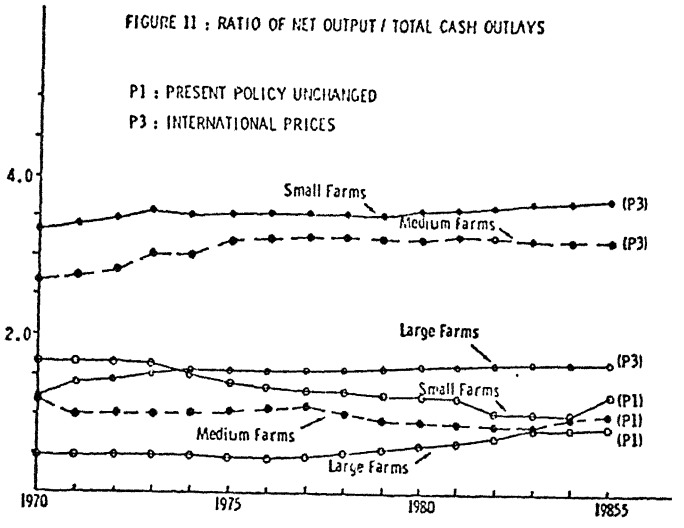
of annual gross investments and no credit use (see run (P3) in Figures 7-9). These results are possible because given domestic factor costs and yields, Brazil has a comparative advantage in beef production at prices projected to prevail in the international market.

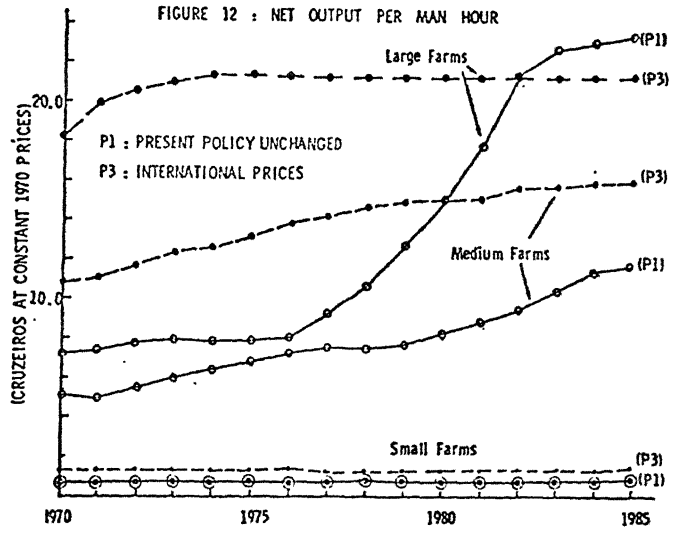
9. In addition the employment impact in the region of either keeping or removing the price supports is approximately the same. Regional employment under both programs is expected to nearly double with about 90 percent of the increased employment coming from small farms. The labor use per hectare as expected is inversely related to farm size (Figure 10). Beef



production on improved pastures compared to the double cropping of wheat-soybeans usually implies i) a higher labor use per hectare on large and medium farms because beef production is less mechanized and ii) a more stable demand for labor throughout the year as seasonal harvest and land preparation peak loads are not encountered.

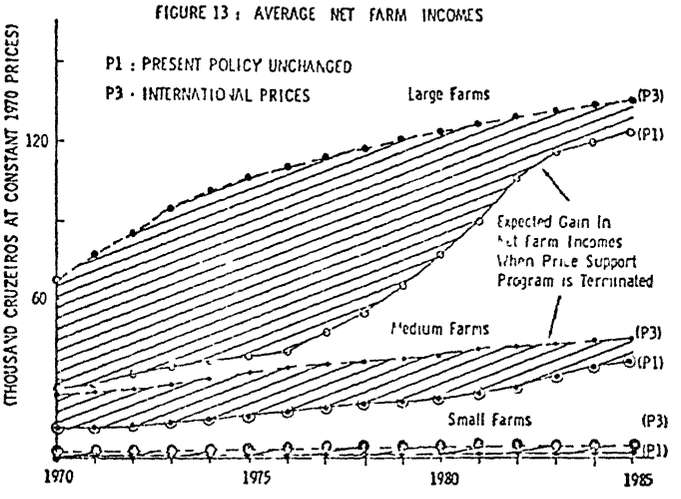
10. Both the projected ratios of net output per man hour and per unit of capital outlays are shown in Figures 11-13. They indicate that average output/capital ratios are inversely related to farm size while average output/labor ratios are directly related to farm size as expected. Both average





capital and labor productivity are higher when domestic prices are replaced by import prices for traded outputs. (Land productivity is also higher as long as value of output is higher since land is assumed to be a fixed factor).

11. Average net farm incomes (at constant 1970 prices) continue to show dramatic increases on large farms, when current programs are continued, with a nearly five-fold increase between 1970 and 1980 (Figure 13). A more moderate three-fold increase is experienced on medium farms while on small farms the increase is marginal.



12. As in the decade of the sixties, policies designed to stimulate regional growth also benefit the larger farms disproportionately and aggravate the problem of income distribution in the region. Thus in 1970 the net farm incomes on large and medium farms were 24 and 10 times higher respectively than on small farms. By 1985 large farm incomes are expected to be more than 40 times small farm incomes. In this regard a program to terminate price supports again has beneficial effects. To begin with, gains in net farm incomes are expected when price support programs are terminated (Figure 13). In addition, though income inequality increases, this increase is less rapid. Thus by 1985 net farm incomes on large farms are only 34 times those on small farms.

6. EVALUATING POLICY ALTERNATIVES

1. In comparing expected model outcomes under alternative policy assumptions we have suggested that the termination of current price support programs in favor of letting the international output prices prevail can have a variety of desirable effects. These would appear to be the following: (1) accumulated output growth is expected to be larger. (2)

Less capital is used and probably more efficiently. (3) Total credit use would be negligible, releasing credits for use elsewhere. (4) Labor, land and capital productivities are likely to be higher on all farms. (5) Employment increases are equal to those obtained under alternate programs and are likely to have less seasonal fluctuations. (6) Average net incomes on all farms are expected to be higher. (7) The increase in income inequalities is likely to be less rapid. On the basis of the model evidence, partial though it is, it would seem possible to evaluate the relative costs and benefits of alternative programs and to make tentative policy recommendations. This we now attempt to do.

2. We shall focus on a comparison between policy (P1) to continue current programs and policy (P3) to rescind price supports for wheat and allow all output prices to fall or rise to their international levels. Obviously our confidence in the following analysis must be qualified. Even though the model has incorporated some of the details of individual farm situations it is still highly aggregated. In addition the tests of model goodness, reported elsewhere, were sketchy because of limited data. Also, of course, the comparative model projections are conditional. They only tell us what might happen if assumed conditions do materialize. Given these qualifications what can we say about the relative costs and benefits of these two alternative programs?

3. To begin, there are direct costs associated with price supports and the credit subsidies that could be saved if the program (P1) was terminated and (P3) established. The direct costs of wheat price supports can be measured by multiplying the difference between the domestic and import price of wheat per hectare of output by the wheat hectarage predicted

under the program P1.[9] The estimated direct costs, discounted at ten percent per annum and at 1970 prices, are shown in Table 3.

TABLE 3: ESTIMATED DIRECT COSTS OF POLICY (P1)

Year	Wheat Hectarage P1	Discounted Direct Costs of Price Supports	Discounted Direct Costs of Credit Subsidies
	(1,000 Hectares)	(Million Cruzeiros)	(Million Cruzeiros)
1971	702.0	137.144	128.447
1972	811.4	144.106	105.040
1973	889.5	143.616	80.703
1974	933.7	137.047	55.221
1975	967.1	129.045	33.155
1976	1,071.8	130.014	23.875
1977	1,172.7	129.322	17.844
1978	1,306.5	130.979	19.348
1979	1,508.5	137.482	30.004
1980	1,742.0	144.329	46.731
1981	2,014.3	151.719	69.288
1982	2,302.1	157.633	85.283
1983	2,534.6	157.775	95.030
1984	2,702.1	152.911	94.519
1985	2,808.0	144.458	87.032
Total		2,127.580	971.520

These figures indicate that the net losses for 15 year period due to the direct costs associated price supports and credit subsidies would be 2,127.6 million Cruzeiros and 971.5 million Cruzeiros respectively not including administrative costs of the price support and credit programs.

4. As we have seen the two programs generate quite different paths for regional output. Under (P3) lower wheat prices and production are offset by higher beef prices and production. Furthermore, the domestic costs for production are different under the two programs. An appropriate measure for the indirect costs associated with the programs is the differences in the

value of net domestic output generated under the two programs. These are shown in Table 4. They show that the loss in the value of net output

TABLE 4: ESTIMATED DIFFERENCES IN INDIRECT COSTS

Year	Net Domestic Outputs P1	Net Domestic Outputs P3	Discounted Differences
	(Million Cruzeiros)		(Million Cruzeiros)
1971	391.716	910.650	-471.758
1972	437.250	988.312	-455.422
1973	478.906	1,074.255	-447.294
1974	515.296	1,144.049	-429.446
1975	547.702	1,208.503	-410.305
1976	584.815	1,268.109	-385.701
1977	645.207	1,323.207	-347.921
1978	703.421	1,373.536	-312.613
1979	773.146	1,417.473	-273.257
1980	868.366	1,462.825	-229.189
1981	977.275	1,500.886	-183.522
1982	1,096.897	1,538.558	-140.726
1983	1,229.343	1,572.393	-99.369
1984	1,308.168	1,604.353	-77.994
1985	1,375.720	1,634.361	-61.916
Total			-4,326.433

associated with the continuation of current programs is 4,326 million Cruzeiros over the fifteen year period. Adding these to the total direct costs we arrive at a measure of the total loss over the 15 year period of approximately 7 billion Cruzeiros if current programs continue.[10]

5. Another way to look at the highly successful program of price supports for wheat is to recognize that it is an attempt at import substitution. Following Krueger [1966], we can analyze the efficiency of the Brazilian "import substitution" program by using the domestic resource cost (DRC) concept. The DRC measures the opportunity costs of the domestic resources employed directly in a given industry as a fraction of the net

change in the country's trade balance that would occur were the level of that industries output contracted or expanded by one unit. Thus DRC = DC ÷ NVA where DC is the net opportunity cost of domestic resources employed per unit of output and NVA is the net international value-added per unit of output in the given industry.

6. Our estimate of DC for wheat production per hectare in 1970 is 413.22 cruzeiros.[11] The corresponding NVA in 1970 is 61.105 U.S. dollars. The DRC for wheat at the current exchange rate implies that it costs the Brazilian economy 6.63 Cruzeiros to obtain one dollars worth of value added, at 1970 international prices, through the domestic production of wheat. Comparing this with the ratio of 4.57 for the free market exchange rate between Cruzeiros and U.S. dollars, we see that the DRC for wheat is such that Brazil could have imported 1.45 times the value of imported goods for every unit of wheat produced domestically.

7. The DRC provides a measure of the loss in terms of the value of imports foregone as a result of import substitution in wheat. We have the model predictions for the total domestic resource costs for each year (DC(t)) and the value of total output at international prices. We can use the same method to calculate the losses in foreign exchange in each year as a consequence of import substitution in the wheat region. These figures are shown in Table 5. Over 15 years the losses in foreign exchange as a result of the continuation of the current program would be about 268.024 million U.S. dollars compared to policy (P3).

TABLE 5: PROJECTED DOMESTIC COSTS AND IMPORT COSTS[12]

Year	Area Sown to Wheat	Discounted Regional Domestic Costs	Discounted Equivalent Import Costs
	(1,000 Ha)	(Million U.S.$)	(Million U.S.$)
1971	576.9	52.140	35.956
1972	665.4	54.672	37.702
1973	718.1	53.638	26.989
1974	732.6	49.746	34.306
1975	740.6	45.720	31.529
1976	824.1	46.262	31.902
1977	909.3	46.404	32.001
1978	1,030.1	52.879	32.958
1979	1,239.5	52.275	36.049
1980	1,492.4	57.226	39.464
1981	1,769.0	61.659	42.520
1982	2,058.5	72.177	44.986
1983	2,293.2	66.069	45.562
1984	2,465.5	64.557	44.528
1985	2,577.9	61.378	42.326
Total		836.802	568.778

8. It would appear on the basis of the above calculations that a continuation of import substitution in wheat through a program of price supports is less desirable than an alternative program that would allow output prices in domestic markets to approach their international level. Besides a net savings in foreign exchange of U.S. $268 million during 15 years such a change in policy would result in higher net social benefits of approximately 7,425 million Cruzeiros in the region over the same period.

9. Such a change would have other desirable consequences. Growth in income inequalities would be reduced and more stable employment with seasonal peak-loads would be provided. Farm factor productivities would also be likely to rise and a more efficient use of capital encouraged. The price of wage

goods is likely to fall as the domestic price of wheat is reduced, even though beef prices may increase. Furthermore, institutional credit, a scarce factor now would be released for use in other regions and sectors.

10. In spite of these cogent reasons for terminating the price support program, one hesitates to recommend it. This is because the alternative program would mean an increasing dependence on foreign markets. The dependence would come from the need to import and domestic requirements for wheat, and the need to find export markets for beef.[13] Whereas the prospects for increasing beef exports are reasonable given the current shortage in world markets, the prospects of importing wheat to meet growing domestic demand are not so good. A reliance on international markets introduces a large element of uncertainty in the development program in any country and has to be properly taken into account. Thus the desireability of terminating wheat support programs has to be further evaluated in terms of the situation in international markets for wheat, beef and soybean.

NOTES

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1. See Ahn (1972), Ahn and Singh (1972), Singh and Ahn (1972a), (1972b). The reader may also refer to these works for various background details and related analysis that space limitations preclude attention here.

2. Since 1962 the domestic wheat price has steadily risen above the U.S. export price of wheat. For example, in 1970 the Brazilian Government fixed the domestic wheat price at U.S. $100 per metric ton, while the price for imported wheat is U.S. $58 per metric ton, see Engler (1971).

3. The international wheat and beef prices here refer to respectively the F.O.B. prices of the U.S. wheat (unmilled) export and the Argentina beef (chilled and frozen) export. For detailed time series price data see Ahn and Singh (1972).

4. For details see Rask (1971) and Engler (1971). For the pricing policy is followed for agricultural commodities in general see Knight (1971) and Smith (1969). For the detailed discussions of credit policies and their implications for agricultural development in Brazil, see Adams (1971) and Smith (1969).

5. Cf. above C2§B.B. Also Day (1963b), Cignio (1969), Buckwell and Hazell (1972).

6. In this study, the decomposition principle is used to distinguish non-aggregatable resource structure specific to each farm size groups and to establish intra-farm competition mechanism for the use of regional strategic resources rather than to partition a larger matrix to solve a mathematical programming problem. For the theory of decomposition principle see for example Lasdon (1970), and for its application to agricultural production, see DeHaen above, Chapter 6.

7. For example, simulation results showed that by 1970 large and medium farms accounted for 70 percent and 28 percent of all borrowings in the region, while small farms accounted for the remainder. During the same year the average productivity of cash outlays on small farms was eight times that on large farms. Ahn (1972), Singh and Ahn (1972).

8. The model provides data on a wide variety of expected outcomes including regional resource use, factor proportions, outputs, average factor productivities, credit use, and farm incomes all by farm size and for the region as a whole. We concentrate here on selected results in order to focus clearly on the policy choices available and their expected outcomes. For details see Ahn (1972).

9. The credit subsidy that will prevail in the future is more difficult to estimate. We need to know both the real opportunity cost of capital to farmers in the region, as well as the rate of inflation, or we need to know the difference between the rate of interest that will prevail in open financial markets and the rate charged on institutional credit. For our purpose here we assume that this latter difference will be a uniform five percent for all years up to 1985. The cost of credit subsidy is then five percent of the difference in total regional borrowings under the two programs, predicted by the model. As there were no borrowings under the second program, this reduces to five percent of the borrowings under the current program.

10. Of course a measure of true welfare losses can only be obtained if all inputs and outputs are priced at their social opportunity cost. We have already priced outputs at international prices. In addition it should be noted that those inputs that are likely to be underpriced in domestic compared to international markets -- like tractors, combines -- are used in larger amounts for wheat-soybean production than for beef production. Thus these estimates of welfare losses associated with the continuation of current programs are probably an underestimate. In addition one must include administrative costs for which we have no data.

11. For detailed cost enumeration in wheat production see Trigo: Estudo Do Custo De Producas, Safra De (1971) and (1972) published in Brazil, Ahn (1972) and Engler (1971).

12. The computational procedure for column two of Table 5:

A) Area sown to wheat times per hectare domestic costs 413.2 Curzeiros in 1970,
B) The product in A) is converted to U.S. dollars using the free market exchange rate of 4.572 Cruzeiros/U.S. dollars,
C) The quantity in B) is discounted at 10 percent per annum into the present value in 1970.

For column three we proceded as follows:

A) Area sown to wheat times per hectare gross revenue valued at the U.S. export F.O.B. price of $61.105 per metric ton in 1970.
B) The product in A) is discounted at 10 percent per annum into the present value in 1970.

13. Some estimates place the total domestic demand for wheat and beef by 1975 at 5170 and 3390 thousand metric tons respectively. (See Schuh (1970) pp. 370-371).

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