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9. ABSTRACT

This paper analyzes the impact of various price policies on production of wheat and competing farm outputs in Southern Brazil. This is done with the help of a programming model that includes alternative production technologies. The model simulates the impact of varying prices and resource availabilities. Among the policy conclusions reached through this analysis: (1) At current support prices, an intensive double-cropping pattern, with wheat followed by soybeans, is the most profitable; at these price levels a transition from extensive livestock production to intensive double-cropping will continue. (2) A reduction in the domestic support price of wheat to the world price level will make it unprofitable for wheat producers to produce wheat. (3) Unless beef productivity is raised by conversion to improved pasture, it cannot compete with a wheat-soybean double-cropping system, even when support prices decline. (4) Increasing the relative price of beef with increasing beef yields would require increases of 250-300% before beef would become a competitive enterprise; such price increases would require a domestic price support program several times as costly as the current wheat price support program.

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PRODUCTION RESPONSE TO TECHNOLOGICAL  
AND PRICE CHANGES: A STUDY OF  
WHEAT AND CATTLE FARMING IN SOUTHERN BRAZIL

by

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June 23, 1971

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Production Response to Technological  
and Price Changes: A Study of  
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1. Introduction

The purpose of this paper is to analyze the impact of various price policies on the production of wheat and competing farm outputs in Southern Brazil. This is done explicitly with the help of a programming model that includes alternative production technologies and is formulated to simulate the impact of varying prices and resource availabilities.

The importance of such a study is twofold. First, the region under consideration is among the few areas in the world that have seen a tremendous increase in total agricultural productive capacity (i.e. agricultural capital formation) and the resultant increases in total output and productivity.\*\* This has come about through rapid mechanization, changes in cropping patterns, and increases in the use of non-farm inputs such as fertilizers, seeds and credit. Besides their primary impact on production and on farm resource use, these changes are of special interest because of their secondary impacts upon regional employment, income growth and distribution and on the demand for non-farm inputs and on investments in agricultural infrastructure. In this broader context it is an important

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\* We would like to thank Professor Norman Rask who initiated this study and without whose help this paper would not be possible. We would also like to thank Professors John H. Sitterley and Dale Adams for their many helpful suggestions.

\*\* The present report is part of a larger study of wheat programs and production in Southern Brazil. This is also one of a series of studies undertaken by the Department of Agricultural Economics and Rural Sociology of The Ohio State University, to analyze the role of capital formation and technology in developing agriculture, under contract to U.S.A.I.D.

case study in agricultural transformation and its role in stimulating national development. Second, and the greater topical importance of the study lies in the need to analyze the impact of these new technologies in the context of the Brazilian program to increase self-sufficiency in wheat. The program initiated in 1962/63 centers around a government policy to purchase wheat at a fixed price assured to stimulate production and stabilize the market for wheat.\* The policy, designed to reduce Brazil's reliance on foreign supplies was institutionalized in 1967 by establishing the Bank of Brazil as official purchaser of wheat. The price subsidy program has also been tied to a credit policy that has subsidized the use of purchased inputs such as certified seeds, fertilizers and farm machinery. The combined impact of these programs has been to substantially increase both the area under cultivation and the production of wheat. As wheat production has become relatively profitable, farmers have shifted out of the traditional extensive livestock enterprises to the intensive cultivation of wheat.\*\*

The specific impacts of this program can be seen from Table I, which shows that:

- 1) The area under wheat cultivation has increased nearly fivefold between 1962/63 and 1969/70.
- 2) The domestic production of wheat has increased nearly sixfold between 1964/65 and 1969/70.

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\* We are indebted for information in this section to a working paper by Richard L. Meyer: "Brazil's Program for Increased Self-Sufficiency in Wheat", Dept. of Agricultural Economics, The Ohio State University(mimeo)

\*\* In the State of Rio Grande do Sul, 60-70% of the new wheat producers on large farms are renters attracted by the new profitability, who have rented land previously used primarily for livestock grazing.

**Table 1. Cultivated Area, Domestic Production, Imports and Domestic Prices of Wheat in Brazil (1962/63 to 1970/71)**

YEAR	AREA (In 1000 Hectares)	Domestic Production (In 1000 Metric Tons)	Imports (In 1000 Metric Tons)	Domestic Production As a % of Total	Nominal Domestic Price (Cr \$/M. Ton)	Real Domestic Price (Cr \$/M. Ton)
1962/63	258.22	303.40	2175.0	12.24	40.79	266.6
1963/64	302.12	115.72	2609.0	4.25	64.54	254.9
1964/65	300.54	250.45	1876.0	11.78	119.71	237.0
1965/66	354.68	256.75	2379.0	9.74	195.36	271.7
1966/67	384.96	333.52	2434.0	12.05	260.18	255.1
1967/68	561.99	405.75	2611.0	13.45	307.44	242.1
1968/69	845.69	765.08	2362.0	24.47	366.92	246.3
1969/70	1299.52	1303.43	1799.9*	42.0*	450.00	248.6
1970/71	1810.00*	1784.00	1785.0*	50.0*	490.00	219.3

\*Estimated

- Sources:**
- 1) Area, Production and Prices from Anuario Estatístico Do Trigo, 1969/70 Page 1, Ministério da Agricultura do Brasil.
  - 2) Imports: Richard L. Meyer: "Brazil's Program for Increased Self-Sufficiency in Wheat" (mimeo).
  - 3) Index of wholesale agricultural prices used as deflator from Conjuntura Economica, Vol. 24, No. 8, 1970, page 134.

3) The total imports of wheat around the 2-2.5 million metric ton range from 1962/63 to 1968/69 show a substantial decline in the last two years.

4) The percentage of total domestic requirements provided by domestic production have increased from an average of about 10% in 1962-1967 period to an estimated 50% in 1970/71.

5) The domestic price of wheat has been stabilized in real terms. The nominal price of wheat, about twice the world price, however, has increased nearly eightfold during this period to keep up with inflationary trends in the economy.

The broader impacts, however, have included a rapid transformation of the agricultural sector in Southern Brazil through the adoption of mechanized wheat farming, and the increased use of non-farm inputs such as inorganic fertilizers, lime and improved seeds. The increasing purchase of non-farm inputs has been heavily subsidized through the extension of credit on favorable terms for machinery and other modern inputs. In response to the increased commercialization of agriculture in the region, agri-businesses and the public sector have responded by increasing investments in the marketing, financial and transportation infrastructure.

The Brazilian program to stimulate wheat production is a successful example of the use of selective price and credit policies on a regional basis. This has been done mainly by changing the relative profitability as well as the resource availabilities to farmers in a selective manner, which through their secondary effects have had sectoral and intersectoral consequences, the former by altering the pattern of production and resource use and the latter by increasing the flow of capital

resources to agriculture in the region. In addition the program has been carried out without substantial foreign assistance and provides an important case study for the efficiency of selective domestic policy instruments.

In view of the increased availability and adoption of new technologies, not only for wheat, but for other commodities, and in view of the goal on the part of the Brazilian government, to reduce the level of domestic wheat prices to world prices in the long run, the relevant policy questions that this study attempts to ask are:

What would be the impact on production, resource use and adoption of new technologies of:

- 1) Changes in the domestic price of wheat?
- 2) Changes in the relative price of their outputs, particularly beef?
- 3) Changes in the interest rates on credit for modern inputs?

The next section describes the area and data sources, the third section gives a brief summary of the methodology, the fourth section discusses some model results and the final section draws some tentative policy conclusions on the basis of these results.

## 2. Area of Study

The data for this study are from the state of Rio Grande do Sul in Southern Brazil which accounts for over 90% of the total domestic wheat production in Brazil. Three municipios-Carazinho, Nao-Me-Toque and Sao Borja-the first two from the plateau region called the Planalto Medio where there has been a recent transition from traditional to mechanized cropping and the third from the lowland region where there

has been a transition from traditional range livestock farming on natural pasture to mechanized cropping and livestock farming on improved pasture, were chosen for study.\* Detailed data with regard to input use, credit and cash flows, labor use yields and cropping patterns were obtained from some 430 farms in these municipios, and input-output coefficients and resource availabilities calculated. Though, the farms in the region range in size from 5 to 10,000 hectares in a few cases, the model farm size was between 100 to 500 hectares.\*\* From the sample selected, a representative farm situation was developed for a farm with 200 hectares of cropping area, and using the "average" resource availability and resource used in the sample.\*\*\*

For this representative farm data were constructed for two technologies: one representing the current average input use and yield structure and another representing a high input use and yield structure. The latter

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\*The improved pasture as distinct from natural pasture, involves fencing, the use of improved seeds and fertilizers and the consequent increase in the number of animals per hectare.

\*\*Farms with 60% or more of their gross income from the sale of wheat and having at least one tractor were designated as mechanized wheat farms and those with 60% or more of their gross income from livestock sales were designated as cattle farms and were chosen for the study. A further study accounting for differences in farm size is being undertaken.

\*\*\*This size is also used as a representative farm size in the region by the association of the cooperatives of wheat growers in Brazil (Federacao das Cooperativas Triticolas do Sul, Ltda.-FECOTRIGO) and was chosen for purposes of comparison. Also according to data from the Ministry of Agriculture (Comissao Central de Levantamento e Fiscalizacao das Safras Triticolas) the average cropping area of mechanized wheat was 162 hectares in 1969/70.

differs from the former in its increased use of modern inputs like certified seeds, fertilizers, insecticides and pesticides (modern inputs) and improved cultural practices including the better timing of operations to reflect a higher management input with consequent improved yields. This was done specially with the view to analyze the separable impact under these varying situations.

### 3. Model Summary

The linear programming model developed in this study included (1) a technology matrix representing the input-output structure of farm production (under two technologies), sales, investment and financial activities, (2) a constraint structure representing physical and financial resource limitations and (3) an objective function measuring the expected net returns from crop sales, the cost of purchased inputs and an investment charge based on simple depreciation for investment and (4) exogenously given input and output prices.\*

The model incorporated the production and sale of wheat, soybeans (following and independent of wheat), corn, rice, beef cattle (raised and fattened on both natural and improved pasture\*\*) and hogs. Intermediate activities allowed for the use of corn and pasture for livestock production and the conversion of natural to improved pasture. Investments were allowed in tractors and combines which provided available machine capacities. The farm was allowed to purchase non-farm inputs including labor, corn for

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\* A detailed description of the model is available in J.J. de C. Engler: "Alternative Enterprise Combinations Under Various Price Policies on Wheat and Cattle Farms in Southern Brazil," unpublished Ph.D. Dissertation, The Ohio State University, 1971.

\*\* Two types of improved pasture were considered: summer (semi-perennial) and winter (annual) pasture.

livestock and borrow for modern inputs and equipment and other uses at differential rates.\* On farm resources include available land of various qualities and family labor.

The specific constraints defining the limitations on the choice of outputs included land (cultivable, irrigated, convertible pasture and natural pasture), labor (family and hired), cash available (estimated from the average balance on hand at the end of the year plus off-farm cash incomes) and credit limitations on credit for general operating expenses (estimated at 60% of gross sales), for modern inputs (equal to the value of investment goods actually purchased).\*\* The exogenous variables include input and output prices and interest rates.

The model is estimated for current (1970 /71) input and output prices and credit policies to determine resource use and cropping patterns. These results are discussed below.

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- \* Three borrowing activities incorporate borrowing i) for general operating expenses (at 17% nominal rate), ii) for equipment purchases (at 15% nominal rate) and for modern variable inputs (at a 7% nominal rate). Rates of interest based on data from Central Bank of Brazil: Manual do Credito Rural, (mimeo), 1970. The high subsidy at negative real rates of interest (nominal) prices increased nearly ninefold between 1963 and 1970) for modern inputs is clearly evident.
- \*\* These credit constraints define the current credit policies being followed in Brazil and are one of the policy variables analyzed in the model.

#### 4. Empirical Results

The central focus of the model was an analysis of the impact of changing the domestic support price of wheat from the current (1970/71) level to the level of world prices, on such factors as production and resource use for various levels of productivity representing different levels of technology. The empirical results therefore concentrate on this important policy issue.

At current (1970/71) input and output prices, all available cultivable land is planted to wheat followed by soybeans in a double cropping pattern. A comparison of these model results with the current situation in the wheat regions of Rio Grande do Sul confirms this, since there has been a dramatic shift from traditional beef cattle production to wheat. The wheat-soybean combination was found to be the most profitable land use under varying assumptions, for both high and current levels of productivity, and with or without a charge for the use of family labor.\* (See Table 2)

The net returns per hectare vary from Cr \$ 217 to Cr \$ 359 at current levels of productivity and from Cr \$ 237 to Cr \$ 380 at high levels of productivity depending upon whether family labor and fixed costs of investment purchases are included or not.

Given these current conditions, what is the expected impact of changing the support price of wheat? This question was analyzed with respect to both short-run and long-run changes in support prices, since farms that are already producing wheat and have mechanized equipment can be expected to react differently in the short run than those farms that are not in wheat production or would have to invest in mechanized equipment

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\* Since model results showed considerable stability with regard to whether a charge for family labor was included or not, the charge was excluded for further analysis.

TABLE 2

OPTIMUM ENTERPRISE COMBINATION AND NET RETURNS  
FOR THE REPRESENTATIVE FARM UNDER TWO  
LEVELS OF PRODUCTIVITY

Wheat Region, Rio Grande do Sul, Brazil, 1970/71

Situation*	Net Returns Per Hectare	L A N D U S E			L I V E S T O C K
		Wheat (P <sub>1</sub> )	Soybeans Follow- ing Wheat (P <sub>2</sub> )	Natural Pasture (P <sub>6</sub> )	Beef Using Natural Pasture (P <sub>9</sub> )
	Cr \$/Ha	H E C T A R E S			C O W U N I T S
CURRENT LEVEL OF PRODUCTIVITY					
Ia	226.69	150	150	50	20
Ib	359.43	150	150	50	20
IIa	217.09	150	150	50	20
IIb	349.89	150	150	50	20
HIGH LEVEL OF PRODUCTIVITY					
Ia	247.12	150	150	50	25
Ib	379.86	150	150	50	25
IIa	237.38	150	150	50	25
IIb	370.13	150	150	50	25

- \*Situations :
- Ia. No charge for family labor and fixed cost is charged on the investment on mechanized equipment.
  - Ib. No charge for family labor and fixed cost is not charged on the investment on mechanized equipment.
  - IIa. Family labor is charged and fixed cost is charged on the investment on mechanized equipment.
  - IIb. Family labor is charged and fixed cost is not charged on the investment on mechanized equipment.

Note: The annual fixed cost for owning mechanized equipment includes depreciation and interest, and is equal to 20 percent of the purchase price of the equipment.

to make the transition. In order to better understand these differences the price response analysis considered explicitly the long-term prospects for present and potential wheat producers (by including the capital costs of machine purchases and replacements) and the short run prospects for present wheat producers (by including only variable costs for machine operations) under current and high productivity conditions.

#### 4.1. Wheat Production Response

The production response to changes in the support price of wheat at various productivity levels are given in Table 3, which gives both the short run response of present producers and the long run response of both present and potential wheat producers. Since a decrease of 49% in the current domestic support price is required to bring it in line with the international price (US \$50 per metric ton or CR. \$ 25. per 100 kilograms at the current exchange rate), the analysis was confined to decreases in the support price of wheat.

For farmers currently producing wheat, in the short run and at current levels of productivity wheat support prices can be decreased about 39% before any reduction in the wheat acreage occurs. Any further reductions cause a rapid shift in land use from a wheat-soybean combination to soybeans independent of and in competition with wheat. Since the net returns over variable costs for soybeans are greater than for livestock, even with improved pasture, beef production does not increase. Similar short run results are evident for high productivity levels for all enterprises, except that the margin of decrease before wheat production changes is smaller due to the increased relative profitability of soybeans.

Table 3. Wheat Production Response to Changes in the Support Price of Wheat at Various Levels of Productivity: Wheat Region, Rio Grande Do Sul, Brazil, 1970/71

Wheat Support Price (Cr. \$ per 100 kg)	% Decrease in Price	Net Returns Per Hectare (Cr. \$/Ha)	% Decrease in Production	Elasticity of Production w.r.t Price**
Current Productivity Levels - Short Run				
49.0*	-	359.48	-	-
30.0	-39.0	222.91	-8.66	0.22
29.0	-41.0	217.13	-26.00	0.63
28.0	-43.0	215.27	-92.66	2.16
27.0	-45.0	215.25	-100.00	2.22
Current Productivity Levels - Long Run				
49.0*	-	226.69	-	-
41.0	-16.0	169.49	-40.66	2.54
28.0	-43.0	117.22	-53.32	1.24
25.0	-49.0	108.37	-100.00	2.04
High Productivity Levels - Short Run				
49.0*	-	379.86	-	-
31.0	-37.0	221.24	-26.0	0.70
30.0	-39.0	216.45	-67.3	1.73
29.0	-41.0	215.92	-100.0	2.44
High Productivity Levels - Long Run				
49.0*	-	247.12	-	-
40.0	-18.0	169.51	-40.7	2.26
37.0	-24.0	155.90	-100.0	4.16

\* 1970/71 support price for wheat.

\*\* Measured from 1970/71 support price and output levels.

The crucial policy implications of course are that a reduction of wheat support prices to the level of world prices would reduce the returns from wheat below variable costs, so that wheat will not be grown, and current producers of wheat will have a strong incentive to shift their land use to soybeans. This is so in the short run for those current producers who have the required equipment for wheat production at both the current and high levels of productivity.

In the long run, and for farmers operating at current levels of productivity the price decrease before there is a substantial drop in wheat production is limited to 16%, at this point soybeans begin to replace wheat while beef even under improved pasture remains uncompetitive. At high levels of productivity, even though the margin of price decrease possible before reduction in wheat production does not change, the full double cropping of wheat and soybeans does not provide enough returns to cover the cost of the additional equipment required by this intensive land use. Instead a decrease in the order of 24% will make wheat and soybean in any combination less profitable than beef production using improved pasture. At this price all cultivable land is used for improved pasture and if support prices were to drop to this level, the long run transition will be from extensive cattle grazing to beef production on improved pasture rather than to mixed cropping of wheat and soybeans.

It is evident that the current increases in wheat production in Brazil have been the direct outcome of a policy of wheat price supports and are highly dependent upon them. Their continuation can be expected to bring more beef producers, producing on extensive grazing land into wheat production in combination with soybeans. This intensive land use would require mechanization and would continue to be the most profitable enterprise

alternative. Attempts to reduce the domestic support price of wheat would lead to a transition into soybean production at current levels of productivity and into intensive beef production on improved pasture at high levels of productivity in the long run.

As would be expected the net returns per hectare decline as support prices are reduced, the extent of the decline varying upon conditions. A 30% price reduction results in a 38% reduction in the net returns per hectare in the short run, while a 16% price reduction results in a 25% reduction in the net returns per hectare in the long run at current productivity levels. At higher productivity levels a 37% price reduction reduces net returns per hectare by 42% in the short run and a 18% price reduction reduces them by 32% in the long run. Therefore, depending upon productivity, wheat prices can be reduced between 35-40% in the short run and 15-20% in the long run without affecting the production of wheat. However, such changes can only be brought about by substantially reducing the profit margins and farm incomes of both current and potential wheat producers.

#### 4.2 Beef Production Response

The analysis also shows that in general, unless the productivity of beef production is raised, by conversion from extensive to improved pasture, beef production is not likely to displace the current pattern of land use devoted to wheat and soybeans. A related question considered therefore was the possibility of increasing the relative price of beef. The results of this analysis are shown in Table 4 for both the short run response of current producers and the long run response of current and prospective producers, at different levels of productivity. For those

**Table 4. Beef Production Response to Changes in the Price of Beef at Various Levels of Productivity. Wheat Region, Rio Grande Do Sul, Brazil, 1970/71**

Beef Prices (Cr. \$ per 100 kg. of live weight of steer)	% Increase in Price	Net Returns Per Hectare (Cr\$/Ha)	% Increase in Production	Elasticity of Production w.r.t. Price**
Current Productivity Levels - Short Run				
120.0*	-	359.43	-	-
384.0	220.0	394.21	70.0	0.32
386.4	222.0	345.15	195.0	0.88
391.2	226.0	347.79	260.0	1.15
396.0	230.0	401.86	565.0	2.46
Current Productivity Levels - Long Run				
120.0*	-	226.69	-	-
302.0	152.0	252.73	565.0	3.72
High Productivity Levels - Short Run				
120.0*	-	247.12	-	-
187.0	56.0	391.15	88.0	1.57
194.4	62.0	396.39	352.0	5.67
196.0	64.0	401.37	612.0	9.56
199.0	66.0	407.37	780.0	11.82
High Productivity Levels - Long Run				
120.0*	-	247.12	-	-
156.0	30.0	253.67	780.0	26.0

\* 1970/71 beef prices.

\*\* Measured from 1970/71 price and output levels.

already in wheat production an increase of 220% in the price of beef is required before beef production is increased, though if beef productivity was increased a change of only 56% in beef prices would increase beef production. The elasticity of production with respect to beef prices at high levels of productivity is fairly high for both the short and long run. Therefore, if beef production is to be made competitive, either beef productivity will have to be raised and production converted to improved pasture or the price increases would have to be very large, requiring a beef subsidy program that would be far more costly than the current wheat subsidy program.

As expected, increased beef prices would increase the returns per hectare, but in the short run a 230% increase in prices increases these returns by only 12% at current productivity levels and a 66% increase in prices increases returns by 65% at high productivity levels. In the long run a 152% increase in price increases returns by 11% at current levels of productivity and a 30% increase in price results in a mere 2% increase in returns at high levels of productivity.

#### 4.3 Additional Parametric Results

An additional line of inquiry focused on the impact of changes in wheat support prices on the use of labor, and capital resources.

An analysis of labor use (Table 5) showed that for farms with the wheat-soybean combination in the current pattern of land use 52-57% of the total annual family labor was employed for crop enterprise, the rest being either unemployed or having to seek other employment. There is, however, a marked seasonal pattern to labor use with scarcity during the months of May and June when wheat is planted and November and December when wheat is harvested and land prepared for soybean planting. During

**Table 5. Changes in Family Labor Use in Response to Changes in Wheat Prices for Various Levels of Productivity. (By Seasons) Wheat Region, Rio Grande do Sul, Brazil, 1970/71**

Wheat Price (Cr. \$ per 100 kg.)	Percentage Family Labor Used (By Season)						TOTAL
	I May-June	II July-Aug	III Sept-Oct	IV Nov-Dec	V Jan-Feb	VI Mar-Apr	
Current Productivity Levels - Short Run							
49.0	109.9	4.1	4.1	136.4	4.1	57.0	52.6
30.0	100.0	4.1	14.9	124.0	4.1	57.0	50.7
29.0	80.9	4.1	35.6	100.0	4.1	57.0	46.9
28.0	5.4	4.1	117.4	5.8	4.1	57.0	32.3
27.0	4.1	4.0	118.8	4.1	4.1	57.0	32.0
E over price range	2.14	0	-61.8	2.16	0	0	0.87
Current Productivity Levels - Long Run							
49.0	109.9	4.1	4.1	136.4	4.1	57.0	52.6
41.0	64.1	4.1	53.7	79.1	4.1	57.0	43.7
28.0	50.0	4.1	69.1	61.4	4.1	57.0	40.9
25.0	4.1	4.1	69.1	38.5	4.1	57.0	29.5
E over price range	1.96	0	-32.1	1.46	0	0	0.89
High Productivity Levels - Short Run							
49.0	128.6	5.3	5.3	137.4	5.3	58.1	56.6
31.0	93.6	5.3	42.6	100.0	5.3	58.1	50.8
30.0	40.1	5.3	100.0	42.6	5.3	58.1	41.9
29.0	5.3	5.3	137.4	5.3	5.3	58.1	36.1
E over price range	2.3	0	-61.4	2.4	0	0	0.9
High Productivity Levels - Long Run							
49.0	128.6	5.3	5.3	137.4	5.3	58.1	56.6
40.0	95.0	25.0	82.3	100.0	25.0	77.9	67.5
37.0	64.8	50.0	64.8	64.8	64.8	100.0	76.5
E over price range	2.1	-75.2	-47.2	2.2	-47.2	-3.0	-1.46

these months labor has to be hired to supplement family labor. In other months, however, (July through October, January, and February) family labor is gainfully employed for only about 5% of the time. Thus seasonal unemployment and scarcity of labor characterize the current pattern of production.

When wheat support prices are reduced and soybeans become profitable there is a structural shift in labor use. To begin with total labor use declines, but labor requirements in September-October increase substantially and additional labor is hired during the soybean planting period, but employment declines sharply in the months of May, June, November and December.

In the long run transition at high productivity levels from wheat to livestock the situation is different in that total employment increases with 76.5% of the family labor employed and through employment does decline in the periods of wheat planting and harvesting, livestock offers greater round the year employment. Even then only about two thirds of the family labor force is employed in most of the months.

An analysis of the impact of wheat price changes on working capital and credit use (Table 6) shows that at current input and output prices and land use patterns at current productivity levels the average working capital use per hectare is Cr \$ 243 of which Cr \$ 167 is borrowed for purchase of modern inputs and Cr \$ 26 for other operating expenses. The figures at high productivity levels are Cr \$ 330, Cr \$ 232 and Cr \$ 48 for the same items respectively.

When wheat support prices are reduced, total working capital use

Table 6. Changes in Working Capital and Credit Use Per Hectare in Response to Changes in Wheat Prices for Various Levels of Production. Wheat Region, Rio Grande do Sul, Brazil, 1970/71.

Wheat Price (In Cr. \$ per 100 kg.)	Credit for Modern Inputs.	Credit for Operating Expenses	Total Working Capital
	(In Cr. \$ per Hectare)		
Current Productivity Levels - Short Run			
49.0*	166.70	26.24	242.95
30.0	160.25	23.05	233.30
29.0	147.78	17.58	215.36
28.0	98.74	0.0	148.74
27.0	97.68	0.0	147.68
Current Productivity Levels - Long Run			
49.0*	166.70	26.24	242.95
41.0	136.95	13.56	200.56
28.0	127.69	10.12	187.80
25.0	65.12	0.0	115.92
High Productivity Levels - Short Run			
49.0*	231.82	48.23	330.04
31.0	212.36	37.72	300.08
30.0	182.51	25.22	257.73
29.0	163.05	18.40	231.45
High Productivity Levels - Long Run			
49.0*	231.82	48.23	330.04
40.0	208.09	41.03	299.12
37.0	76.25	0.0	126.25

\* 1970/71 support price for wheat.

declines also but in the short run the elasticities of cash use with respect to price declines are less than unity. (Table 7). Only in the long run as transition occurs from wheat to soybean production at current productivity levels and to livestock production at high productivity levels do these elasticities exceed unity. Therefore, both total cash use and borrowing for modern inputs are not too sensitive to changes in the price of wheat in the short run, though borrowing for operating expenses, due to a decline in the number of mechanized equipment used, are more sensitive.

Additional parametric analysis on the cost of credit revealed that at current input and wheat prices the internal rate of return to credit use exceeds 37%, since borrowing for modern inputs or operating expenses showed no decline at these high rates. This suggests that credit is probably underpriced and that interest rates could be raised substantially without affecting the borrowing levels given current conditions.

##### 5. Policy Conclusions

The important policy conclusions based on the analysis in this study can be summarized as follows:

- 1) At current support prices an intensive double cropping pattern with wheat followed by soybeans is the most profitable and it can be expected that at these price levels a transition from extensive livestock production to intensive double cropping will continue, at current levels of productivity.
- 2) A reduction in the domestic support price of wheat to the world price level will make it unprofitable for

Table 7. Percentage Changes in the Use of Working Capital and Credit in Response to Changes in Wheat Prices for Various Levels of Productivity. Wheat Region, Rio Grande do Sul, Brazil 1970/71

Wheat Prices		Percentage Change In			Elasticity of Cash Use w.r.t Wheat Price. **
Price (Cr. \$/100 kg)	% Change in Price	Credit for Modern Inputs	Credit for Operating Expenses	Total Working Capital	
Current Productivity Levels - Short Run					
49.0*	-	-	-	-	-
30.0	-39.0	-3.87	-12.15	-3.97	0.10
29.0	-41.0	-11.35	-33.02	-11.28	0.28
28.0	-43.0	-40.76	-100.0	-38.78	0.90
27.0	-45.0	-41.40	-	-39.21	0.87
Current Productivity Levels - Long Run					
49.0*	-	-	-	-	-
41.0	-16.0	-17.84	-48.33	-17.46	1.09
28.0	-43.0	-23.41	-61.44	-22.69	0.53
25.0	-49.0	-60.47	-100.0	-52.59	1.07
High Productivity Levels - Short Run					
49.0*	-	-	-	-	-
31.0	-37.0	-8.39	-21.77	-9.08	0.25
30.0	-39.0	-21.27	-47.71	-21.90	0.56
29.0	-41.0	-29.66	-61.84	-29.87	0.73
High Productivity Levels - Long Run					
49.0*	-	-	-	-	-
40.0	-18.0	-10.24	-14.9	-9.37	0.52
37.0	-24.0	-67.11	-100.0	-61.74	2.57

\* 1970/71 support price for wheat.

\*\* Measured from 1970/71 support price and output levels.

both current wheat producers in the short run and current and potential wheat producers in the long run to produce wheat.

- 3) Although wheat prices can be reduced between 35-40% in the short run and between 15-20% in the long run without affecting the production of wheat, such changes would substantially reduce the net returns per hectare and the farm incomes of current and potential wheat producers.
- 4) Unless beef productivity is raised by conversion to improved pasture it cannot compete successfully with a wheat-soybean double cropping system, even when support prices decline. In the case of productivity increases a regional transition from extensive livestock production to production with improved winter and summer pasture can be expected.
- 5) Increasing the relative price of beef without increasing beef yields would require increases in the range of 250-300% before beef becomes a competitive enterprise. Such price increases would require a domestic price support program several times as costly as the current wheat program.
- 6) The double cropping of wheat and soybeans that is currently most profitable results in a high degree of seasonality in the demand for labor, leading to both seasonal unemployment and scarcity. A shift to soybean production results in a structural change in labor use but

does not reduce the problem of seasonal demand and unemployment.

- 7) Livestock production under improved summer and winter pastures is characterized by greater round the year employment and reduced seasonality in the pattern of demand for labor.
- 8) Total demand for working capital and credit is insensitive to short run changes in wheat prices, but the demand declines somewhat in the long run.
- 9) The internal rate of return suggests that credit is a substantially underpriced resource, and interest rates could be raised substantially without affecting the interest rate of borrowing.

6. Further Research

The following items should be included in an agenda for further research:

- 1) The possibility of reducing the wheat support prices and the substitution of livestock production on improved pasture should be more fully investigated. These alternatives should include the investigation of export possibilities of Brazilian beef to earn foreign exchange to import total Brazilian wheat requirements.
- 2) Since it is evident that at current levels of productivity domestic wheat prices cannot be substantially reduced and still maintain production, the feasibility of increasing wheat yields should be investigated.
- 3) Since the current analysis is for a representative farm size and since the farm size issue is of some importance in Southern Brazil the analysis could be extended to include

various farm sizes to see the differential impact of price changes.

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