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Technological Change and Agricultural Credit: The Case of Southern Brazil

A Research Proposal

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TECHNOLOGICAL CHANGE AND AGRICULTURAL CREDIT: THE CASE OF SOUTHERN BRAZIL

A Research Proposal

Objective:

The objective of this study is to examine the role of institutional credit in the process of technological change in agriculture with particular reference to southern Brazil. Main emphasis will be placed on the role of credit in (1) accelerating the adoption of new technology, (2) in facilitating the structural and enterprise adjustments in response to changes in the market conditions and (3) on how credit policy should be formulated so as to gain maximum returns from scarce credit resources.

Justification:

Agricultural credit could be an instrument of growth as well as stagnation. To supply credit to farmers when they are, in fact, not in a position to make productive use of it is to waste scarce capital resources. Conversely, not to provide capital when lack of it constitutes the major bottleneck to fixed and operating capital investments is to let the opportunity go to waste and leave agriculture in a state of stagnation. There exists a tremendous diversity within agriculture in less developed countries; therefore, identification of the existence of profitable investment opportunities should be based on empirical evidence from farm level studies rather than on broad generalizations regarding geographical areas or farm types. The impact of technological

change will depend upon how fast the farmers apply improved technical inputs and adopt improved practices on their farms. Availability of credit may act as a lubricant and accelerate this process. Sometimes credit rationing among different types of farms, rather than aggregate credit shortage in the country, may be the problem. Judicious rationing should depend upon estimates of the marginal productivities of modern inputs (bought with credit) on different types of farms. Thus, a study of the role of credit in fostering technological change appears rather vital.

Problem and Hypotheses:

Technological changes such as mechanization, use of chemical fertilizers, improved seed, and insecticides, have been taking place in Brazilian agriculture very rapidly since the early 1950's. Various government programs, like support prices for certain commodities, provision of credit for the purchase of agricultural machinery and other farm inputs, have helped speed up this process. Preliminary analysis of 1965 survey data has shown that there have been significant structural changes on certain types of farms and consequent productivity gains (see Appendix A, Tables 1, 2, and 3). It is hypothesized that credit supplied by the banking institutions has been instrumental in making the above possible. It is also observed that there are untapped potentialities on certain types of farms, and it is hypothesized that shortage of credit might be holding up further progress on those farms. (See Appendix B, Tables 4 and 5, and also Appendix C for the regression model used and the variables chosen to test the second hypothesis).

The general hypothesis to be tested in this study is that institutional credit is a necessary condition for rapid application of many new technological inputs. To be able to test this hypothesis, the analysis may have to be extended in breadth as well as in depth. This implies that the study may cover a larger number of farm types and that several secondary hypotheses stemming from the general hypothesis may have to be looked at.

Subsidiary hypotheses proposed to be tested:

1. Institutional credit has played a significant role in the process of capital formation (historically) on the selected farms.

2. Adoption of modern technology results in increased productivity of inputs.

3. The level of use of technological inputs and operating costs in general on the sample farms is directly related to the availability of institutional credit.

4. There is no significant correlation between institutional credit and consumption expenditures.

5. Capital expenditures on the farms are directly related to the extent of borrowing from institutional sources.

6. The present credit rationing followed by banking institutions is responsible for less than optimum utilization of technological inputs.

Tools of Analysis:

These hypotheses will be examined with the help of tabular presentation by type of farm, size of farm, by borrower-non-borrower classification, and by the level of adoption of modern technology. This analysis will give average results. In addition, regression technique (single stage least squares or other appropriate form) will be used to test some of the hypotheses.

Hypothesis 1: Historical data on asset acquisition and mode of financing will be analyzed in a tabular form to bring out the role of institutional credit in this process.

Hypothesis 2: An index of adoption will be developed (i.e., for example, average level of fertilizer use or average level of 'crop inputs' could be used on crop farms as a criterion) to classify farms into different groups. Tabular presentation of resource productivity will be attempted. Regression analysis will be used to see whether there are significant differences between the categories of farms with respect to (a) level of production function and (b) slope of the production function. The choice of the stat. model is a very important step. It should be able to allow for 'scale effects' as well as 'interaction effects'. It may also be better to consider certain variables as a whole package rather than to disaggregate them.

Questions which arise are:

(a) How to provide for economies of scale in a production function? Cobb-Douglas production function vs. a quadratic function? (In the preliminary analysis, a simple linear stat. model gave better results than a log-linear model).

(b) How does the use of dummy variables help in this case?

Hypotheses 3, 4, and 5: A distinction between expenditures (investment) on capital stock and working capital is sought to be drawn in hypotheses 3 and 5, the former representing working capital and the latter, capital stock. In addition to tabular presentation, credit (i.e., institutional credit + time purchase, institutional credit alone, and outstanding debt) is proposed to be regressed against other independent variables among which working capital, expenditures on capital

stock and household living expenses will be important.

As we are getting data at two periods of time (1965 and 1970) on resurveyed farms, it is proposed that hypotheses 3 and 5 will be tested for the contribution of credit to the changes in the two types of capital expenditures over time.

Hypothesis 6: A test of this hypothesis will depend upon the results obtained on the earlier hypotheses. This, in fact, is not a hypothesis in itself, but a conclusion leading to policy implications.

Data Sources:

This study mainly draws upon the data provided by two surveys (one in 1965 and another completed in early 1970) carried out in southern Brazil and covering the states of Rio Grande do Sul, Santa Catarina, and São Paulo. Detailed data on assets, input-output, income expenditure and borrowing are available on 953 farms from 1965 survey. In addition, 1970 survey will provide data on the historical account regarding asset acquisition, major improvements on land and buildings and the sources of finances for the capital expenditures. A large number of the farms surveyed in 1965 are being resurveyed. These data will enable a detailed analysis and comparison of the productivity of inputs, growth of the farms and the role of credit in this process and modernization of farms not only between various types and sizes of farms, but also on the same farms between two points of time.

Appendix A: Range Livestock and Mechanized Crop Farms Compared

A comparison is made between traditional range livestock farms and modern mechanized crop farms choosing 31 of the former from the municipio of Alegrete and 25 of the latter from the municipio of Carazinho, both in the state of Rio Grande do Sul. The assumption here is that a transformation has taken place from the former type of farming to the latter, but not on the same farms.

Table 1: Land, Labor, and Power Resources Utilization per Farm
56 Farms -- Southern Brazil -- 1965

Items	Mechanized Crop Farms	Range Livestock Farms
Total land operated (hectares)	382	370
Owned	206	273
Rented	176	106
Cultivated[a]	224	10
Total labor units[b]	4.3	2.9
Family labor	2.2	1.9
Hired labor	2.1	1.0
Total Power units[c]	21	20
Mechanical	21	1
Animal	0	19
Number of Farms	25	31

[a]Includes improved pasture.

[b]One labor unit equals one full-time worker or 300 days of temporary labor.

[c]One power unit equals one horse, two oxen, or five horsepower of mechanical power.

Table 2 Capital Assets, Operating Expenses and Credit Use Per Farm[1/]
56 Farms - Southern Brazil - 1965

Item	Mechanized crop farms				Range livestock farms			
	Asset value	New purchases	New credit	Outstanding liabilities	Asset value	New purchases	New credit	Liabilities
	(U.S. dollar equivalents)							
Land & buildings[2/]	$18,470	$ 622	$ 163	$ 143	$25,204	$ 410	$ 92	$ 62
Livestock	3,833	221	82	55	10,567	210	13	20
Machinery and equipment	14,770	2,506	849	879	362	17	0	0
Total Assets	37,073	3,349	1,094	1,077	36,133	637	105	82
Operating expenses	-----	8,550	5,576	5,938[3/]	-----	1,295	24	18
Total	$37,073	$11,899	$6,670	$7,015	$36,133	$1,932	$129	$100

1/In addition to the loans for agricultural purposes, new credit for personal and other uses amounts to an average of $34. per farm for the mechanized crop farms and $293. per farm for the extensive livestock. In addition, average interest rates for all new loans were 13.8 percent and 24.4 percent for mechanized crop and extensive crop farms respectively.

2/Value of rented land not included.

3/At the time of interview, wheat harvest was just terminating and current operating loans had not yet been retired. This value also includes some carry over credit from the previous year.

Table 3: Measures of Output and Income per Farm
56 Farms -- Southern Brazil -- 1965

Item	Mechanized Crop Farms	Range Livestock Farms
	(Value in U. S. dollar equivalents)	
Gross output	$14,019	$2,283
Marketable output	13,604	1,904
Operating expenses	8,550	1,295
Net farm income	4,326	931
Net farm income/capital assets	.12	.03

Appendix B: Results of Regression Analysis, Level of Operating Expenses and Credit Availability

A linear stat. model is used for purposes of computing the marginal value product for crop inputs. The same model is sought to be fitted by type of farming. Type of farming is decided on the basis of contribution of enterprise to total gross annual income. The sample of mechanized crop farms used in the regression analysis includes 13 more farms in addition to the sample considered in the comparison between range livestock farms and mechanized crop farms in Appendix A.

Results of the regression analysis are presented in Table 4. Levels of operating expenses and credit availability are presented in Table 5.

Table 4: Reg. Coeff., Std. dev., and Adj. R^2 for "crop inputs" by Type of Farm -- Southern Brazil -- 1965

Type of farm	Number of observations	Mean Level of input use[a]	Reg. coef.	Std. Dev.	Adj. R^2
Mechanized crop	38	16.67	0.57	0.365	0.8406
Extensive crop	36	4.29	1.79	0.360	0.5728
General crop	109	6.34	2.31	0.471	0.5316
General farm	71	4.09	1.80	0.365	0.8827
Dairy	47	2.74	4.42	1.292	0.6300
Hog	216	1.87	-does not enter the equation-		

[a]in U. S. Dollar Equivalents

Table 5: Operating Expenses and Credit Availability per Hectare by Type of Farm -- Southern Brazil -- 1965

Farm Type	Operating crop cost	Credit available
	(Value in U. S. dollar equivalents)	
Mechanized crop	32.0	24.8
Extensive crop	6.8	3.2
General crop	8.4	2.8
General farm	4.9	3.6
Dairy	3.7	0.7
Hog	3.4	1.6

Appendix C: Stat. Model and Variables Considered by Farm Type

A linear stat. model of the following type is used to compute marginal value product of crop inputs in Appendix B.

$$y = a + b_i x_i$$

Where:

y = Value of gross output

x_1= Land cultivated (in hectares)

x_2= Land under improved pasture (in hectares)

x_3= Land under permanent pasture (in hectares)

x_4= Land equivalents (in hectares)

x_5= Family labor (in man equivalents)

x_6= Hired labor (in man equivalents)

x_7= Wages paid to hired labor (in NCr $)

x_8= Value of production livestock (in NCr $)

x_9= Value of work stock (in NCr $)

x_{10}= Livestock expenses (in NCr $)

x_{11}= Value of tractor and ocher equipment (in NCr $)

x_{12}= Crop costs (in NCr $)

x_{13}= Machinery expenses (in NCr $)

x_{14}= Manual equipment and other equipment

But the actual selection of variables (i.e., variables free to enter the equation) differed slightly between farm types. The list of variables free to enter along with the final form of the model (i.e., cut off point at significant F ratio level) are given on the next page.

1. Mechanized Crop Farms

$$y = f(x_1, x_5, x_7, x_8, x_9, x_{11}, x_{12}, x_{13}, \text{ and } x_{14})$$

$$= 258.813 + 105.320x_1 + 0.573x_{12} + 1.802x_{14}$$

2. Extensive Crops

$$y = f(x_4, x_5, x_6, x_8, x_9, x_{10}, x_{11}, \text{ and } x_{14})$$

$$= 469.336 + 0.415x_8 + 2.192x_9 + 1.786x_{12}$$

3. General Crops

$$y = f(x_1, x_2, x_3, x_5, x_7, x_8, x_{10}, x_{11}, \text{ and } x_{12})$$

$$= 530.412 + 163.543x_5 + 3.196x_{10} + 0.481x_{11} + 2.309x_{12}$$

4. Dairy Farms

$$y = f(x_1, x_2, x_3, x_5, x_7, x_8, x_9, x_{10}, x_{11}, \text{ and } x_{12})$$

$$= 351.095 + 0.512x_8 + 4.424x_{12}$$

5. Hog Farms

$$y = f(x_4, x_5, x_7, x_8, x_9, x_{10}, x_{11}, \text{ and } x_{12})$$

$$= 555.300 + 33.217x_4 + 2.687x_7 + -.362x_8 + 1.163x_{10} + 0.145x_{11}$$

(crop expenses (x_{12}) does not enter the equation)