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RESEARCH NOTES ON AGRICULTURAL CAPITAL FORMATION
AND TECHNOLOGICAL CHANGE

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These notes report on preliminary findings of a continuing research project. The data and conclusions are tentative and formal reference to them should be cleared with the authors.

I - Objectives

When one studies the process of economic growth it becomes important to consider the capacity of the economy to accumulate capital. New capital investments which increase the economy's productive capacity are essential for continued economic growth. One important source of this capital is the savings capacity of the agricultural sector which may provide capital for its own continued growth and even finance investments in the non-agricultural sector. Modernization of agriculture, which requires an increase in the use of capital in the form of new technologies relative to the use of traditional factors like land and labor may in fact require a net inflow of capital to finance this modernization. A study of this capacity to generate savings in a modernizing agriculture is therefore appropriate to further understand agriculture's changing capital needs.

The main purpose of this project is to investigate the savings potential generated on selected farms in the State of São Paulo. The main hypothesis to be tested is that the introduction of new technology especially modern inputs has dramatically changed the savings-investment picture on farms in São Paulo.

The specific objectives are:

- 1) To determine the functional relationship between consumption and income for different farm sizes;
- 2) To describe the investment patterns of farms at different income levels;
- 3) To measure the potential for rural savings on farms.

II - Data Source

Interviews with 383 farmers in ten municipios of the Ribeirão Preto region, State of São Paulo, completed in July, 1970 supply the basic data for this study. This research note reports the results of one M.S. thesis just completed at ESAIQ (School of Agriculture of University of São Paulo) which analyzed the data from 130 farms in the three municipios of Guairá, Jardinópolis and Salles de Oliveira, all specialized in annual crop production. Additional analysis will be completed utilizing all ten municipios plus Itapetininga - a municipio with many small farmers and more traditional than those of Ribeirão Preto.

III - Methodology

The research methodology of this project is by design similar to the consumption-savings study of Rio Grande do Sul farms by Rask and Denny so as to facilitate the eventual comparison of the results for São Paulo with those from other states where the same analyses are underway. Linear and logarithmic functions were adjusted to the São Paulo data for the total sample of 130 farms and for three size strata classified by level of income.

The following variables were considered in the analysis:

Dependent

$Y =$ Consumption expenditures including all family expenditures, measured in cruzeiros, on food, clothing, durable goods, education, health, recreation, and other expenditures during the agricultural year 1969/70.

Independent

$X_1 =$ Net cash income, measured in cruzeiros, including all cash farm and non-farm income less the cash operating expenses paid during the year.

- X_2 = Agricultural and non-agricultural assets including the cruzeiro value of all real assets owned by the farmer such as land, buildings, machinery and animals, plus non-agricultural investments owned or held at the beginning of the agricultural year.
- X_3 = Liquid assets including the cruzeiro value of crop inventory, cash on hand and accounts receivable at the beginning of the year.
- X_4 = Own consumption consisting of the cruzeiro value for all agricultural and livestock products grown on the farm which were used for family consumption.
- X_5 = Family size is the total number of persons in the owner's household without regard for age, sex or relationship who are dependent upon the farm for their livelihood.
- X_6 = Education consists of the number of years of schooling completed by the owner.
- X_7 = Total new credit obtained is value of all loans and time purchases obtained during the agricultural year.
- X_8 = Non-agricultural investments include the cruzeiro value of all non-agricultural investments in buildings, stocks, bonds, etc. made during the agricultural year.

Net credit flow is the difference between total new credit received during the year, and principal repayments made on existing debts. This variable was not used in the multiple regression analysis but was necessary for the residual savings calculations.

The above variables are approximately the same as those of the Denney-Rask research although some changes were made in order to permit use of the log function and to test the influence of some new variables on consumption. The consumption, net cash income, home consumption, family size and education variables are the same as the Denney-Rask research. Non-agricultural assets was added to the value of farm assets to test the relationship between asset ownership, a proxy for permanent income, and consumption. A new variable, liquid assets, was created to test the importance of liquidity level on current consumption. Finally a non-agricultural investments variable was defined to determine its influence on consumption.

sumption. Age of the operator was excluded from this analysis because of its high correlation with family size and the lack of a clear cut economic rationale for its inclusion.

The mean values of these variables for the surveyed São Paulo (SP) crop farms in 1970 and the Rio Grande do Sul (RS) farms in 1965 are shown in Table 1. Large differences exist for nearly all variables between the São Paulo farms and those of Rio Grande do Sul even when the latter have been adjusted for inflation. Consumption, net cash income and total physical assets are substantially higher for São Paulo than for Rio Grande do Sul farms. Home consumption on São Paulo farms which is less than for the RS farms is consistent with the hypothesis that modernizing agriculture is more highly dependent upon the market for sale and purchase of goods. A higher total consumption and smaller family size results in a much greater consumption per capita on São Paulo farms. São Paulo farmers have an average of 1.8 more years of schooling than RS farmers. Net credit flow on the other hand is nearly 50% greater for RS crop farms than for the São Paulo crop farms - a difference which could be even greater today given the emphasis on wheat production in the municipios studied in RS.

Further analysis and interpretation of this data is limited by the fact that we are comparing São Paulo crop farms in 1969 with those of RS in 1965. Adjusting the data for inflation just partially compensates for this since the RS crop farms have undoubtedly progressed economically between 1965 and 1969. Once the 1969 data are available for RS, a more interesting analysis can be made.

The multiple regression results for the SP and RS data are quite different in several respects even though many of the same variables were used. Linear and log functions were adjusted for the SP data as opposed to only a linear function for the RS data. The log function was added because it does not assume a constant marginal propensity to consume; this characteristic makes it more consistent with our economic theory.

Three variables - net cash income, total assets, and family size - were significant at the 5% level for the total sample of São Paulo farms using the log function. The same variables plus education and credit obtained were

significant in the linear function although its R^2 was lower^{1/}. Net cash income was significant but had a negative sign in the linear model. The other variables tested - liquid assets, home consumption, and non-agricultural investments - were not significant in either model.

Table 1. A Comparison of Mean Values of Defined Variables for Surveyed Farms in São Paulo, 1969 and Rio Grande do Sul, 1965.

<u>Variable</u>	São Paulo	Rio Grande do Sul, 1965 ^{a/}	
	Crop Farms 1969	<u>Total sample</u>	<u>Crop Farms</u>
Consumption	Cr\$ 10,506	Cr\$2,847	Cr\$ 5,768
Net cash income	34,437	6,862	26,941
Total physical assets	382,681	107,382	266,370
Liquid assets	18,017	NA	NA
Home consumption	1,272	1,851	2,042
Family size	5.17	6.3	6.0
Education in years	5.16	3.4	NA
Age in years	NA	45.5	NA
Non-agricultural investments	8,150	NA	NA
New credit received	NA	3,022	29,822
Net credit flow	14,891	1,716	21,885
Principal payments	NA	1,307	21,112

Sources: Lenildo F. Silva, Consumo e Poupança: Uma Análise a Nível de Proprietários Agrícolas da Região de Ribeirão Preto, Estado de São Paulo. Unpublished M.S. thesis, Department of Applied Social Sciences, ESAIQ/University of São Paulo, 1972.

Evert W. Denney, An Analysis of Income, Consumption and Savings Potential at the Farm Level in Southern Brazil. Unpublished M.S. thesis, Department of Agricultural Economics & Rural Sociology, Ohio State University, 1970.

^{a/} The data for Rio Grande do Sul have been inflated to cruzeiros of 1969 using general price index number two of the Getúlio Vargas Foundation.

^{1/} R^2 for the aggregate log model was 0.67 and linear model 0.59 using the São Paulo data of 1969.

Using a linear model for the RS data of 1965, the following variables were significant: total assets, new credit, family size, education above five years, age above 50 years and age from forty to forty-nine years. Net cash income and production for home consumption were not significant in the aggregate model. The R^2 of 0.56 for the RS data was just slightly inferior to that for the SP data.

Total assets and family size are the two most important variables explaining consumption on the SP and RS farms. Total assets, a proxy variable for permanent income, was the single most important variable studied. Net cash income, on the other hand, was not as important in explaining consumption expenditures; it was significant for the SP data but not for the RS data. Further analysis of the income variable is needed to determine its actual relationship with consumption.

Credit and education were significant variables in the SP and RS data when using the linear model. Agricultural credit, an important input to the production process, affects consumption indirectly via its impact on production and income; that is, more credit to finance production increases should permit higher incomes. Credit also affects consumption directly because the credit variable includes time purchases which are primarily used for purchase of consumer durables. Lastly, agricultural credit liberates savings for consumption that were previously needed to finance production.

Education, significant and positively related to consumption, is consistent with the hypothesis that better educated persons have more diverse and sophisticated consumption habits.

A comparison of the average propensity to consume between São Paulo crop farms and the RS farms indicates a lower overall average propensity to consume (0.31 to 0.42) among the former group (See Table 2). The APC varies from a high of nearly 5 to a low of 0.12 among the various income strata. It shows a distinct tendency to decrease as income increases. The APC is generally much lower among the RS farms than SP crop farms for any given income range. It becomes less than unity, the point at which savings begin,

starting with the income group of Cr\$6001-9000 on SP crop farms compared to Cr\$600-799 on RS farms^{2/}. This reconfirms our earlier analysis which showed much greater mean consumption values for SP crop farms than for RS farms.

Consumption studies of the Getúlio Vargas Foundation completed in 1962 with 480 São Paulo farm families and 222 Rio Grande do Sul farm families have a higher overall APC than that observed for our data (See Table 3). They estimated an APC of 0.66 for a sample of all SP farms in 1962, compared to 0.31 in 1969 for the interviewed SP crop farms; for RS farms they estimated an APC of 0.78 for a sample of all RS farms compared to 0.42 on the surveyed farms in 1969.

Table 2. Average Propensity to Consume by Income Groups for São Paulo and Rio Grande do Sul farms in 1969 and 1965, Respectively.

<u>São Paulo Crop Farms, 1969</u>		<u>Rio Grande do Sul Farms, 1965</u>	
<u>Income Group</u> <u>Cr\$ of 1969</u>	<u>Average Propensity</u> <u>to Consume</u>	<u>Income Group</u> <u>Cr\$ of 1965</u>	<u>Average Propensity</u> <u>to Consume</u>
Less than 2500	4.06	Less than 200	4.90
2501-4000	1.29	200-399	1.58
4001-6000	1.07	400-599	1.17
6001-9000	0.92	600-799	0.86
9001-13000	0.76	800-999	0.76
13,001-20,000	0.70	1,000-1,199	0.73
20,001-30,000	0.50	1,200-1,399	0.63
30,001-60,000	0.31	1,400-1,799	0.63
More than 60,000	0.12	1,800-2,899	0. .
Average	0.305	2,900-4,999	0.53
		5,000-11,499	0.41
		More than 11,500	0.17
		Average	0.415

Sources: Lenildo F. Silva, Consumo e Poupança: Uma Análise a Nível de Proprietários Agrícolas na Região de Ribeirão Preto, Estado de São Paulo. Unpublished M.S. thesis, Department of Applied Social Sciences, ESAIQ/University of São Paulo, 1972.

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^{2/} The income group Cr\$600-799 inflated to cruzeiros of 1969 equals Cr\$1593-2123 using general price index number two of the Getúlio Vargas Foundation.

Table 3. Average Propensity to Consume by Income Classes for São Paulo and Rio Grande do Sul Farm Families, 1962.

<u>Family Income Group</u> <u>Cr\$ of 1962</u>	<u>Average Propensity to Consume</u>	
	<u>São Paulo</u>	<u>Rio Grande do Sul</u>
Less than 100	2.41	2.73
100 to 249	1.57	1.39
250 to 499	1.14	0.99
500 to 799	0.95	0.88
800 to 1,199	0.82	0.83
1,200 or more	0.39	0.46
Total	0.66	0.78

Source: Fundação Getúlio Vargas, Orçamentos Familiares Rurais, São Paulo e Rio Grande do Sul, Instituto Brasileiro de Economia, Centro de Estudos Brasileiro de Economia, Centro de Estudos Agrícolas, Rio de Janeiro, Janeiro e Junho, 1971.

The APC apparently has decreased on both groups of farms during the time periods studied. Much of this decrease in the APC however is due to the use of different population frames; the OSU sample in RS and SP has been concentrated in selected regions, usually the more developed ones, and represents a more prosperous agriculture than the Getúlio Vargas Foundation studies which sampled a cross-section of all farms in each state. The OSU sample includes just land owners whereas the Getúlio Vargas Foundation studies included landowners, renters, employees and administrators. The lack of an estimated rental value for the family dwelling in the OSU data also accounts for part of this lower APC. Inclusion of this item would increase the APC by about 7-10%, using the weighting of the Getúlio Vargas Foundation study. Given these differences one cannot affirm that the APC decreased during the time period analyzed, although this is indeed what one would expect since the cross-section analysis by income groups shows a definite tendency for the APC to decrease as incomes rise (See Tables 2 & 3). Thus, savings capacity on these farms has probably increased significantly in recent years, thereby contributing importantly to farm capital formation.

The marginal propensity to consume (MPC) was calculated for all SP crop farms and for three sub-groups classified by income level. The estimated MPC consistent with the hypothesized relationship did show a tendency to decline as

incomes increased. This declining MPC is also consistent with the decreasing APC observed in Tables 2 & 3. Additional analysis will be conducted using all the São Paulo farm data to further test this relationship. If in fact further analysis shows that the MPC continues to decline as incomes increase, we know that the marginal propensity to save is increasing and that farms are able to accumulate more capital internally as incomes grow.

Savings Potential

Savings potential for purposes of this research note can be defined as the cash income left after paying consumption and depreciation expenditures. Residual savings is defined as the cash income left after paying consumption, depreciation and new agricultural capital investments during the period.

Four stages of savings potential are defined and illustrated in Figure 1.

Stage I

In the first stage income is not sufficient to pay consumption expenditures, farms must dis-save and/or decapitalize to pay consumption expenditures.

Stage II

Income is sufficient to meet consumption needs but not to maintain capital stock.

Stage III

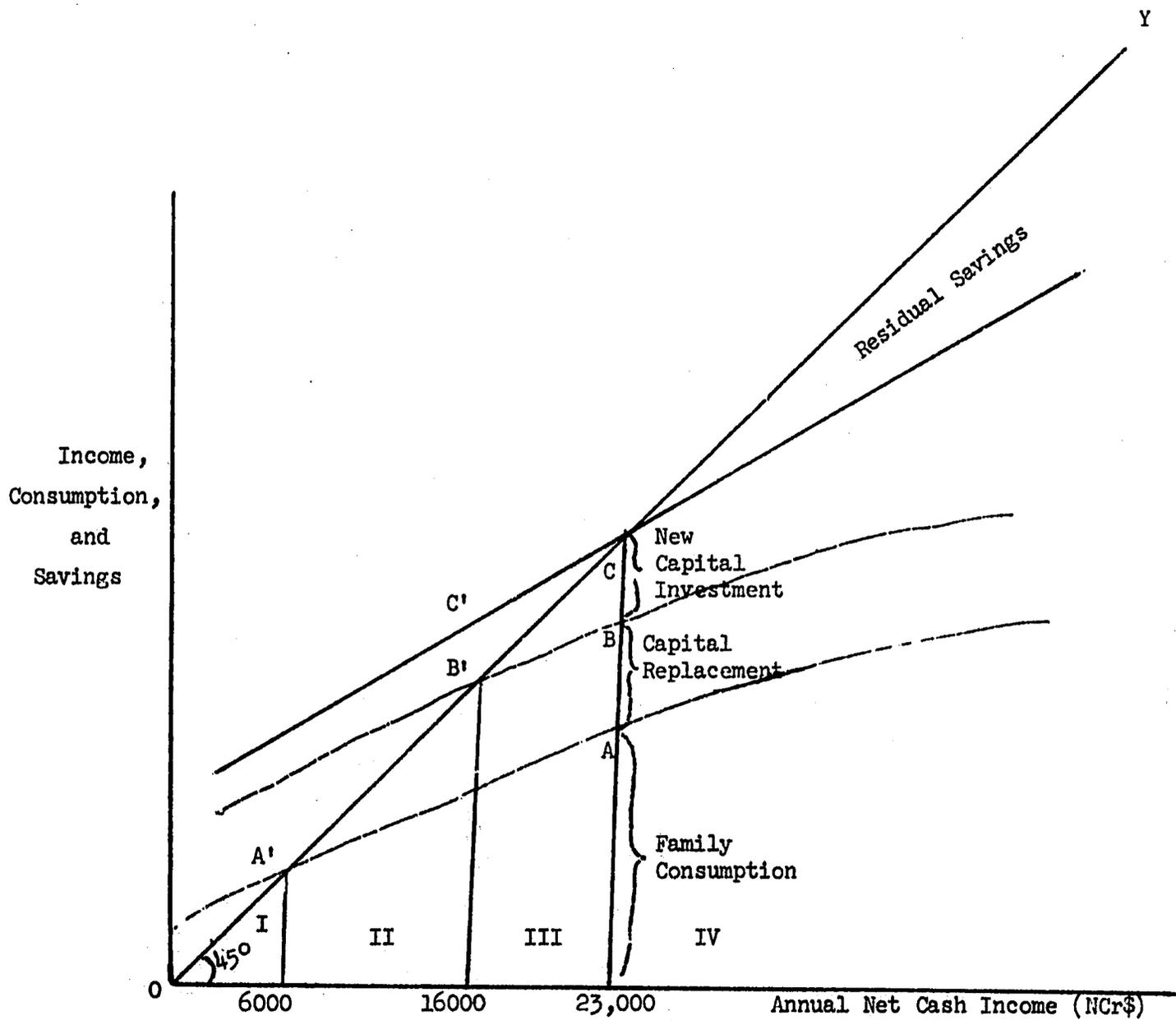
Income is sufficient to meet consumption needs, maintain capital stock, and provide additional funds for on-farm investments.

Stage IV

Farms have savings in excess of consumption, capital maintenance and new farm investments.

São Paulo crop farms were stratified into nine income groups of ascending order to analyze their savings potential (See Table 4). Farms in the first two income groups, 58% of the total, did not have income sufficient to pay consumption expenditures during the year studied. Farms in the next three income groups did not have sufficient income to meet consumption and capital maintenance expenditures. They represent 24% of the total. All farms in the

Fig. 1 - Summary illustration of savings potential on farms in São Paulo, Brazil - 1965.



- A'A = Family Consumption Expenditure Line
- B'B = Replacement Cost Line to Maintain Existing Capital Stock
- C'C = Net New Capital Investment Line
- AC = Total Capital Investment
- OY = Income Line

Table 4. Mean Values of Net Cash Income, Consumption, Capital Replacement, Savings Potential, New Capital Investments, Residual Savings and Net Credit Flow by Income Groups on Surveyed Crop Farms, São Paulo, Agricultural Year 1969/70

Income Group	Nº of observations	Net Cash Income	Consumption	Capital ^{1/} Replacement	Savings Potential	New agri ^{2/} cultural investment	Residual Savings	Net credit flow	Residual savir plus net credit flow
Less than Cr\$2500	20	1,570.4	6,376.8	3,569.0	-8,375.4	-1,942.3	-10,002.1	9,290.4	-711.7
2500 - 4000	14	3,271.4	4,225.3	1,700.1	-2,653.9	-1,559.4	-2,794.6	1,661.0	-1,133.6
4001 - 6000	14	5,104.0	5,447.2	2,151.6	-2,494.8	5,765.7	-10,411.8	10,734.1	322.3
6001 - 9000	14	7,354.1	6,794.4	4,322.5	-3,762.8	7,231.1	-15,316.4	3,282.8	-12,033.6
9001 - 13000	12	11,175.8	8,493.1	3,927.0	-1,244.3	3,388.5	-8,559.8	8,638.5	78.7
13001 - 20,000	14	16,220.6	11,387.2	4,200.3	641.1	1,994.4	-5,553.6	7,825.1	2,271.5
20,001 - 30,000	15	25,501.3	12,701.8	7,130.3	5,669.2	4,282.2	-5,743.3	11,772.1	6,028.8
30,001 - 60,000	15	46,975.8	14,677.9	9,487.2	22,810.7	18,729.0	-5,649.4	10,656.4	5,007.0
More than 60,000	12	231,394.0	27,970.5	25,329.4	178,094.1	94,868.3	57,896.4	81,741.8	20,616.7

^{1/} Capital replacement was estimated using the "normal" annual depreciation rates of 10% for machinery and equipment 20% for work animals and 5% for buildings and improvements.

^{2/} New agricultural investment was calculated as the difference between total capital purchases less depreciation on existing capital.

first five income groups, 62% of total, were therefore decapitalizing during the year analyzed; their net cash income was not sufficient to meet consumption plus capital maintenance expenditures. On the other hand, 38% of the farms were in Stage III or IV, that is, savings were sufficient to permit new on-farm investments. These farms had income sufficient to make new investments to increase their productive capacity during the year. Among the crop farms studied, a fairly large amount, 29%, were in Stage IV, that is, savings were generated in excess of on-farm investment needs. These farms were mobilizing capital that could be applied to other sectors of the economy.

The net credit flow is largest for those farms with positive residual savings. It is interesting to note that those farms had the least need for external capital resources during the year studied.

Table 5. Percentage Distribution of São Paulo Crop Farms and Rio Grande do Sul Farms According to their Savings Potential in 1969 and 1965, Respectively

<u>Stage</u>	<u>Percent of SP Farms</u>	<u>Percent of RS Farms</u>
Stage I	38%	15%
Stage II	24	10
Stage III	9	60
Stage IV	<u>29</u>	<u>15</u>
Total	100%	100%

The percentage distribution of surveyed SP crop farms among these four stages is quite different from that observed on the farms studied in RS in 1965 (See Table 5). It is very evident that SP had many more farms in Stages I and II than did RS, the stages in which income is not sufficient to meet consumption and capital replacement costs. On the other hand, RS had many more farms than SP in Stage III, where income is sufficient to meet consumption, capital maintenance and provide additional funds for on-farm investments. Finally, SP had more farms in Stage IV, with savings capacity in excess of on-farm investments than did RS in 1965.

Future Research

Since this first study only analyzed the data for the SP crop farms future analysis will be conducted with all the surveyed farms in SP to further define the income-consumption-saving relationship. In addition, it is hoped that similar analysis can be conducted using the 1969 data from RS and other states to facilitate a comparison of these relationships by states and type of farming.