ANALYSIS OF FACTORS ASSOCIATED WITH FIXED AND OPERATING CAPITAL AT THE FARM-LEVEL: SÃO PAULO, BRAZIL

A Thesis

Presented in Partial Fulfillment of the Requirements for the Degree Master of Science

by

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1973

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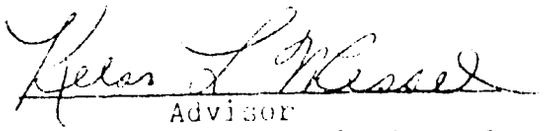

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TITLE OF THESIS Analysis of Factors Associated with Fixed and Operating Capital at the Farm-Level: São Paulo, Brazil

Summarize in fifty words or less the purpose and principal conclusions of your thesis

The purpose of this study was to identify differences among farms in the region of Ribeirão Prêto in São Paulo, Brazil, with respect to input usages and input productivities and to identify factors associated with fixed and operating capital. The study showed that there were significant differences among farms and that these differences were largely explained by the farm types, farm sizes, and by the impact of various policies. Internal and external infusion of funds appeared to be influencing the capital structure of the farms.

Adviser's Signature

ACKNOWLEDGEMENTS

My M.S. program in the United States would not have been possible without the support of the Commission for Educational Exchange between the United States of America and Brazil which provided a travel grant for me to participate in the Fulbright Program. Therefore, I wish to express my deep appreciation to the administrative staff of the Fulbright Commission in Brazil.

A very important part of my program was the financial and logistical support provided by the Department of Agricultural Economics and Rural Sociology of the Ohio State University. Special gratitude is expressed to Dr. David Boyne, Chairman, and to the Graduate Committee of the Department.

Sincere appreciation goes to my advisor, Dr. Kelso Wessel, for his assistance and guidance throughout my M.S. program. His advice and counsel were extremely helpful at all times.

Appreciation is also extended to other faculty members of the Department for their helpful guidance, suggestions, and constructive criticism throughout my graduate program. Among these people are Dr. Terrence Glover, Dr. Francis Walker, Dr. Norman Rask, Dr. Dale Adams, Dr. David Francis, and Dr. Bernie Erven.

Special thanks is extended to Mrs. Elizabeth Howard and her staff at the statistical laboratory for their help in the preparation of the data.

My colleagues at the Department of Agricultural Economics were also most helpful in the data preparation, and particular thanks are extended to Mrs. Zilda Paes de Barros Mattos, Dr. Iby Arvaratti Pedroso, and Douglas Reber Dunkel.

Last but not the least, my gratitude is extended:

. . .to my Aunt Doracy for her encouragement and continuous assistance with the mail from Brazil.

. . .to my parents and my wife Thelma for their continued support and the real source of motivation for my endeavours.

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CHAPTER I

INTRODUCTION

A strong economy usually implies a viable and progressive agricultural sector. For the agricultural sector to develop, however, investment in modern techniques of production must be made. Skills of farmers must be increased, changes in the land distribution system may be needed and changes in resource allocation may be required. These are all very important considerations when government policies are introduced aiming at developing the agricultural sector and improving its technical efficiency.

Decision makers in Brazil are becoming increasingly convinced that Brazil's economic expansion is limited by low agricultural productivity and growth; accordingly, this sector is now receiving more attention in policy formulation at various levels of government. The present agricultural goals of the Brazilian government reflect a development strategy for increasing agricultural growth and productivity which requires massive investment in productive inputs.

THE PROBLEM

Accelerating the capital formation process at the farm-level is one of the key problems that arises in expanding agricultural production.

The process of capital formation can be stimulated from internally generated funds, external infusion of funds or labor investments in the farm. Farms in developing agriculture are very diverse; often displaying significant differences in resource endowment, e.g. quality of labor, type of capital, etc. These differences therefore lead to varying rates of ability and/or incentives to accept capital changes as well as to take less or more advantage of internal or external sources for capital formation. Obviously, policy can have a major impact on the speed and the manner that capital formation occurs at the farm level. Unfortunately, very little is known about this process and the manner in which the individual farmer, under different resource situations, will react. This problem has been emphasized by Adams who states:[1]

> Very little is known about the extent of rural capital buildup, what factors determine its growth, what forms capital takes, how technical change affects capital accumulation, and how rural capital relates to firm, sector, and overall growth.

The recent Brazilian experience indicates that farm-level capital formation is related with farm size, enterprise specialization and with existing agricultural policies. When analyzing agricultural problems in Brazil

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[1]Dale W. Adams, "Rural Capital Formation and Technology: Concepts and Research Issues", Occasional Paper No. 29, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1971, p. 1.

one needs to especially understand the diversity which exists among farms due to the size of the land holding as well as the type of farming.

There have been studies which have shown that various sized farm units have not shared equally in the growth that has taken place in many developing countries.[2] Small family farms usually do not share the results of economic growth, especially when small and large farms are both operating within the same region.[3] It is acknowledged that this situation exists not only in the area selected for this study, the Ribeirão Prêto region of São Paulo, but in other parts of the country as well. While agricultural output has expanded in Brazil, it has been a selective process with the most rapid increases occurring on the larger farms. Agricultural policies apparently have been such that larger farms are the most likely to benefit. Policies such as highly subsidized credit for modern inputs, minimum prices considerably above world prices for certain crops, and highly favorable financing arrangements for the acquisition

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[2]Dale W. Adams and E. Walter Coward, Jr., "Small Farmer Development Strategies: A Seminar Report", The Agricultural Development Council, July, 1972.

[3]Norman Rask, "The Differential Impact of Growth Policy on the Small Farmer of Southern Brazil", Purdue Workshop on Empirical Studies of Small Farm Agriculture in Developing Nations, Purdue University, West Lafayette, Indiana, November 13-15, 1972.

of machinery and for pasture improvement have been given as examples of these policy tools.[4]

A recent study in the region of Ribeirão Preto indicated that major capital investments have occurred on farms in the decade of the 1960's.[5] A major portion of these investments have been made by the large crop farmers and it appears that major capital irvestments on these farms are related to certain policy incentives. Other than these general indicators (e.g. policy, size, and type), little is known about the specific factors that may have been associated with the high level of capitalization on some farms in the region.

Two additional steps need to be taken to better understand the relationship between varying farm level resource situations and the nature, speed and degree of farm level capitalization. This understanding is especially needed to guide policies that attempt to stimulate this process. The first is the identification of factors that are associated with capitalization. The second is the identification of investment profitability factors through marginal analysis. This study is concerned with the first.

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[4] Iby A. Pedroso, "Resource Accumulation and Economies of Scale in Agriculture - The Case of São Paulo, Brazil", unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1973, p. 3.

[5] Iby A. Pedroso, op. cit., pp. 49-64.

THE OBJECTIVES

The general objective of this study is to identify and measure the impact of various factors associated with fixed and with operating capital on farms in the Ribeirão Preto region of São Paulo, Brazil.

Specifically, this research study has the following objectives:

1. To describe the sample farms and identify major factors that may be related to differences in levels of capital investment.

2. To determine how these selected factors are associated with variations in fixed and operating capital by farm size and type in the area.

3. To arrive at recommendations for policies which might be better suited for each size-type of farming and the overall agricultural production of the region under investigation.

THE HYPOTHESES

The first part of this study presents a description of the sample farms in which the following hypothesis is tested:

1. There are significant differences among the farms in the sample with respect to levels of input usages and also input productivities.

The second part of the study utilizes the econometric tools of regression analysis to test the following central hypothesis:

2. Fixed and Operating Capital are each a function of net farm income, non-farm income, amount of land used, credit, labor, level of commercialization, age, and the educational level of the farm operator. Education enters at two and three levels as a set of shift variables affecting all the other factors in each size-type group of farms.

CHAPTER II

REVIEW OF LITERATURE

The literature on capital formation is extensive. Despite the considerable number of studies focusing on capital formation, however, very little attention has been given to farm-level capital formation.[1]

Various obstacles and limitations on capital formation in underdeveloped countries have been identified. One central question which has been regularly asked is why is the rate of capital formation so low in most underdeveloped countries.[2] The question is answered in terms of factors accounting for low incomes and those accounting for weak inducements to invest. The unattractiveness and the unprofitable nature attached to productive investment in underdeveloped countries; low rates of saving; widespread preference for the acquisition of assets which fail to enhance productive capacity; and preference for investment in land are often cited as reasons. More recently it has been argued that savings and capital formation by farmers in developing countries depends substantially on profitable

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[1] Dale W. Adams, "Rural Capital Formation and Technology: Concepts and Research Issues", Occasional Paper No. 29, The Ohio State University, 1971, p. 1.

[2] Nathan Rosenberg, "Capital Formation in Underdeveloped Countries", The American Economic Review, Vol. 50, September, 1960, pp. 706-715.

investment opportunities.[3] Misallocation of the small volume of resources which are devoted to investment purposes, poor management, and the propensity to engage in short term speculative ventures, are also barriers to capital formation.

CAPITAL AND GROWTH

Capital can be treated as a major factor associated with economic growth but it must be made clear that if capital is available without, at the same time, providing an adequate and fruitful framework for its use, it will not be utilized properly and therefore wasted.[4] There is a difference between additional capital investment involving poor management and traditional technology, and additional capital investment involving new technology. In the former case one may find capital being underutilized or even wasted, whereas in the second case, this is less likely to happen.

Another point is that over capitalization may have little direct bearing on output and consequently on the farmer's net income. Investment in physical capital, for

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[3]Yujiro Hayami and V. W. Ruttan, Agricultural Development: An International Perspective, (Baltimore, Maryland: The John Hopkins Press, 1971), p. 271.

[4]Arthur W. Lewis, The Theory of Economic Growth, (Illinois: Richard D. Irwin, Inc., 1955), p. 201.

example, assumes meaning only within a given technological and institutional framework.[5]

In studying the determinants of capital formation, it must be emphasized that capital may be only a partial answer to improved farm income:[6]

> The answer to improved farm income does not lie with a greater use of capital in existing patterns. Rather it depends (to the extent that it is a capital problem) upon a capital base being used by management capable of higher productivities and in large enough combinations to return a desirable income in the presence of low average returns. An integral need is a reduction in the number of and an increase in the capacity of farm workers. Considerations other than capital, such as power in the market place, healthy economy, agricultural public policy, etc., are crucial to farm income improvement.

It has been found that the rate of capital accumulation at the farm level partially depends on the allocation of net income between consumption and/or re-investment in the farm.[7] Net income is considered the most important component of capital accumulation. This study presents a model of

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[5] S. G. Madiman, "Institutional Structure and Capital Formation", Indian Journal of Agricultural Economics, Vol. 20, No. 1, January-March 1965, pp. 167-169.

[6] R. G. F. Spitze, "Determinants of Capital Formation--Conceptual and Factual Considerations", in Capital and Credit Needs in a Changing Agriculture, (Ames, Iowa: Iowa State University Press, 1961), pp. 19-35.

[7] V. Gilchrist, "Projecting Capital Accumulation for the Agricultural Firm-Household", Canadian Journal of Agricultural Economics, Vol. 14, No. 1, 1966, pp. 51-60.

capital projections for a particular farm in which the relationship between total input capital and net income is considered critical. The more stable this relationship is the higher the probability of making correct projections of capital growth. The effect of income taxes, family size, off-farm income, and level of management on capital accumulation are left for further analysis.

It is generally acknowledged that the expansion of the farm's productive capacity is possible if substantial amounts of credit are made available to farmers thus allowing them to increase their level of physical and operating capital. Considerable attention has been given to the impact of credit on the process of capital formation and many studies have examined the relationship between credit and capital use. One study, for example, attempted to explain agricultural capital formation in terms of borrowed funds and components of capital according to size-groups of farm holdings.[8] Farm capital was grouped into homogeneous components such as fixed, operating, and human capital; the relationship between each component of capital and borrowed funds was then examined using regression analysis.

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[8] Baldev Singh, "Capital Formation and Borrowed Funds", paper presented at the Seminar on "Economic Development with Special Emphasis on Agricultural Development", Punjab University, Chandigarh, January 15-17, 1970.

The conclusion was that credit represented a significant source of funds for capital formation.

A model of capital accumulation at the farm-level has been proposed in which the proportion of retained net earnings and borrowed funds are the most important variables. This model showed that the rate of change of capital with respect to the retention ratio (proportion of net revenue and borrowed funds retained for expansion) is dependent upon a growth function defined by the study, which relates the rate of growth to the amount of funds available for expansion.[9]

From studies of agricultural production in Southern Brazil, it is clear that increased investment in capital have not necessarily been the answer to increasing production and productivity. Low marginal returns to capital have been found in several production function analyses. For example, in Southern Brazil, the estimation of crop productivity and its change was analyzed. Sample farmers were subdivided into three groups: 1) those who owned machinery, 2) those who rented machinery, and 3) those who used no mechanized equipment for their crop enterprise. In the first group, the marginal returns to capital was found to

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[9] A. N. Halter, "Models of Farm Growth", Journal of Farm Economics, December, 1966, pp. 1503-1509.

be less than one. This was the lowest among the three groups. However, the marginal return to capital in the other groups was found to be sufficiently high so that increased use of machinery services could be expected to increase the value of output by more than the cost of additional inputs. From this it can be concluded that increased investment in inputs alone is not the solution to increasing crop production. The study indicates that farmers also need better management, more information and a more efficient utilization of resources if any benefit is to be expected from capital formation.[10]

Both small and large farms in the Ribeirão Preto DIRA, specializing in perennial crops have been found to have extremely low value of marginal product for capital.[11] One possible reason for the near zero value of marginal product for capital on the larger farms was, according to the study, an over-investment in capital items which may have been due to the accessibility of highly subsidized credit in the region.

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[10] A. M. Steitieh, "Input Productivity and Productivity Change of the Crop Enterprise in Southern Brazil", unpublished Ph.D. dissertation, The Ohio State University, 1971.

[11] Iby A. Pedroso, "Resource Accumulation and Economies of Scale in Agriculture - The Case of São Paulo, Brazil", unpublished Ph.D. dissertation, The Ohio State University, 1973, p. 91.

Previous analysis, also using data from the same sample of farms included in this study, found that output was positively related to capital accumulation but the capital/land ratio was negatively correlated with net farm income.[12]

Apparently, in certain areas of Brazil capital seems to be made available without providing an adequate and fruitful framework for its use. In the Brazilian case, increased investment in inputs by farmers may not be the only answer to improving farm income. It is possible that poor management, poor education, and over-investment may be crucial factors limiting the efficient use of capital.

Several studies have been done concerning the agricultural production process of Southern Brazil in which capital inputs have been analyzed as well as their impact on production. Although these studies are not closely associated with the scope of this thesis, they provide conclusions which facilitate an overall understanding of how farm capital relates to production as well as of how agriculture has been progressing in Brazil.

Management performance and productivity of capital resources among swine farms under different levels of

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[12]Ivan Garcia, "Capital Formation at the Farm-Level in São Paulo, Brazil", unpublished M.S. thesis, The Ohio State University, 1972, p. 93.

management in Southern Brazil were found to be better on the larger farms where more capital was being used.[13]

There is a need, especially on small farms, for a greater investment of capital in operating expenses. This has been emphasized by relating the differences among types and sizes of farms as to resource productivity levels, availability of institutional credit, intensity of capital investment, and degree of under-utilization of capital.[14]

Research on 289 farms in Southern Brazil has shown that farm capital increased by 14 percent from 1965 to 1969; the value of land and physical capital made up a major part of this increase. It was found that the use of credit and an increase in the farm capital portfolio may be closely associated. However, neither size nor type of farm, according to this study, were sufficient to explain the use of credit.[15]

An investigation has been done to determine the impact of a substantial rate of capital investment in mechanized

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[13]Donald M. Sorenson, "Capital Productivity and Management Performance in Small Farm Agriculture in Southern Brazil", unpublished Ph.D. dissertation, The Ohio State University, 1968.

[14]Bodepudi P. Rao, "The Economics of Agricultural Credit-Use in Southern Brazil", unpublished Ph.D. dissertation, The Ohio State University, 1970.

[15]Joseph L. Tommy, "Credit Use and Capital Formation on Small to Medium Sized Farms in Southern Brazil--1965-1969", unpublished M.S. thesis, The Ohio State University, 1971.

power and equipment of farms in Southern Brazil under three situations:[16] (1) mechanization accompanied by farm size increases; (2) mechanization accompanied by enterprise change; and (3) mechanization in which neither enterprise nor farm size changes are apparent. Conclusions reached from the study indicate, in all cases, that mechanized farms had a substantially greater investment in operating capital per unit of output.

Another study showed that small farms in Southern Brazil are not keeping pace with the rate of growth of larger farms. Exception could be made, according to the results, to a limited number of small farmers dealing with selected enterprises and assured markets.[17]

Research pertaining to credit policies indicates that only a few small borrowers have benefited from the recent large increase in agricultural credit in Brazil. Returns to credit used on large farms may be rather low and farmers who have access to credit sources tend to use larger amounts of credit. Banks appear to be uninterested in making loans

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[16] Norman Rask and J. Stitzlein, "Mecanização Agrícola no Sul do Brasil - Seu Impacto no Nível de Emprêgo, na Produtividade e no Custo de Produção", paper presented at Seminar on the Influence of Agricultural Policy on Capital Formation, Ministry of Agriculture, EAPA/SUPLAN, Brasilia, Brazil, February 29 to March 1, 1972.

[17] Norman Rask, "Technological Change and the Traditional Small Farmer of Rio Grande do Sul--Brazil", Occasional Paper No. 85, The Ohio State University, June, 1972.

to small farmers. It has been suggested that raising the real rates of interest charged on bank loans could lead to a more efficient allocation of resources at the farm-level.[18]

FACTORS INFLUENCING CAPITAL FORMATION

Knowledge about the means for increasing the capital base of farmers is of primary importance in the agricultural development process. Agricultural development always requires the use of additional capital investment on farms. The question is: "How can this additional capital be generated?" Credit often constitutes an important element in helping farmers accelerate the capital accumulation process and technological change. Availability of credit may act as a lubricant and facilitate technological change. But the amount of credit farmers use will depend on a number of factors, the essential ones being the terms and conditions imposed by the credit system, size and characteristics of the farm operation, the farmers' repayment capacity, and whether inputs bought with the credit funds bring returns which are profitable. Distortions in the credit policies adopted by developing countries can introduce bottlenecks in the credit distribution system. The evidence from Latin America, particularly Brazil, suggests that by holding

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[18] Fernando C. Peres and Dale W. Adams, "Resultados da Recente Política de Crédito Rural no Brasil", presented at Seminar on the Influence of Agricultural Policy on Capital Formation, Ministry of Agriculture, EAPA/SUPLAN, Brasilia, Brazil, February 29 to March 1, 1972.

interest rates down governments have kept the private banking system and the credit markets from providing substantial amounts of credit to agriculture.[19] One definite outcome of subsidized credit policies is that it dampens the incentive to save and build up resources for entrance into more efficient production alternatives. Another consideration is that lower interest rates stimulate the demand for credit by farmers regardless of their farm size. On the supply side, cost of services, repayment guarantees and bankers preferences are the factors that will ultimately determine whether equitable distribution occurs.[20]

Introduction of new agricultural inputs into the agricultural sector may lead to the formation of more capital. Farmers increase their operating capital by purchasing hybrid seed and fertilizer. The increased yields may lead to an increase in fixed capital through additional requirements for storage facilities, application equipment, and other complementary inputs. Also the formation of human capital at the farm-level would occur if farm owners had to improve

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[19] Dale W. Adams, "Agricultural Credit in Latin America: External Funding Policy", Occasional Paper No. 9, Department of Agricultural Economics and Rural Sociology, The Ohio State University, April 15, 1971, p. 1.

[20] Norman Rask, "The Differential Impact of Growth Policy on the Small Farmer of Southern Brazil", Purdue Workshop on Empirical Studies of Small Farm Agriculture in Developing Nations, Purdue University, West Lafayette, Indiana, November 13-15, 1972.

their management skills to more profitably utilize the new agricultural inputs. A final result of the introduction of new agricultural inputs can be the generation of social capital or social overhead investment in the form of education, extension services, marketing cooperatives, credit services, and other community infrastructure investments.[21]

The agricultural sector can become more productive if the capital formation process at the farm-level is accelerated. But to do this agricultural productivity must be increased. Increased productivity is the core of economic growth, and is probably one of the best gauges of economic performance.[22] The low level of technical efficiency of Brazilian agriculture has prevented the agricultural sector from giving its maximum contribution to the development of the economy. This problem is summarized in the following statement.[23]

> Had the efforts been made to raise the level of productivity in the agricultural sector, and had trade policy been such as to capture the gains from this increase in

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[21] William C. Nelson, "An Economic Analysis of the Factors Influencing the Utilization of Fertilizer in Southern Brazil", Occasional Paper No. 3, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1969, p. 2.

[22] Theodore N. Beckman and William R. Davidson, Marketing, (New York: The Ronald Press Company, 1962), pp. 788-791.

[23] Edward G. Schuh, The Agricultural Development of Brazil, (New York: Praeger, 1970), p. 439.

productivity, the development of the total economy might have proceeded at a much more rapid rate.

Increasing agricultural productivity is an important part of increasing the satisfactions of rural living, since without it most rural family incomes cannot rise. The extent to which increased agricultural productivity will increase the satisfactions of rural living depends on how the rewards of the increased production are divided among land owners, tenants, farm laborers, and urban consumers.[24]

Land and labor are the basic agricultural resources in most developing countries. Although the quantity and quality of these resources are very diverse, their productivity is fundamental to the economic well being of farmers. Increasing the productivity of these two resources helps farmers increase their total production and income.[25] Without an adequate capital base to allow farmers access to new technology higher levels of productivity can not be reached. In part, productivity improvement is possible if a substantial amount of credit is available to farmers thus allowing them to increase their level of fixed and operating capital.

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[24] A. T. Mosher, "Projects of Integrated Rural Development", Agricultural Development Council, New York, 1970, p. 2.

[25] Raymond P. Christensen and Harold T. Yee, "The Rose of Agricultural Productivity in Economic Development", Journal of Farm Economics, XLVI No. 5, December, 1964, pp. 1051-1052.

Another factor closely associated with farm capital accumulation is managerial ability and the application of technology in the farming operation. However, it has always been difficult to measure the managerial capacity of farmers and its impact on the production process.[26] Yotopoulos states that **entrepreneurship** is a crucial factor of production but is very elusive and difficult to submit to quantification.[27] In a study concerning agricultural development alternatives in the Bolivian Lowlands, management was a difficult factor to quantify, in the farm production analysis, but education was found to be one of the major contributors to management capability.[28] The adoption of new technology and the use of new inputs may depend on the level of education of the farm people who are to use them.[29]

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[26]Earl O. Heady et. al., Resource Productivity, Returns to Scale, and Farm Size, (Ames, Iowa: Iowa State College Press, 1956), p. 19.

[27]Pan A. Yotopoulos, Allocative Efficiency in Economic Development, (Athens, Greece: Center of Planning and Economic Research, 1967), p. 60.

[28]Kelso L. Wessel, "An Economic Assessment of Pioneer Settlement in the Bolivian Lowlands", unpublished Ph.D. dissertation, Cornell University, 1968, pp. 171, 173, 207.

[29]Yujiro Hayami and V. W. Ruttan, op. cit., p. 2.

CHAPTER III

METHODOLOGY

Farm size and farm type may influence the optimum allocation of farm resources. Use of credit and non-farm income may also have an impact on the resource allocation process. This study takes into account these variables in the economic analysis of the farms.

DESCRIPTIVE CHARACTERISTICS ACCORDING TO FARM TYPE AND SIZE

The major hypothesis tested in this section was:

"There are significant differences among the farms in the sample with respect to levels of input usage and also input productivities."

The descriptive characteristics of the farms were included under seven groups of selected factors: 1) Gross Investment and Output Factors; 2) Production Ratios; 3) Labor Related Factors; 4) Age and Schooling; 5) Credit Use; 6) Non-Farm Income; and 7) Capital Intensity.

The factors included in the first group, i.e. Gross Investment and Output Factors, were (1) amount of land used; (2) value of total assets;[1] (3) value of gross farm output; and (4) net farm income. Production Ratios included (1) value of farm output per hectare; (2) net farm income per

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[1] Total Assets refer to the aggregate value of: (1) total land and building inventory; (2) livestock inventory; and (3) farm machinery and equipment inventory measured in Cr$.

hectare; (3) rate of capital turnover, i.e. gross farm output per cruzeiro[2] of total assets; and (4) net output ratio, i.e. productive net cash income per cruzeiro of total assets. Labor Related Factors included (1) labor intensity which was expressed in terms of total man-equivalents[3] per hectare of land used; (2) average returns to labor, expressed in terms of gross farm output per man-equivalent; (3) ratio of net farm income to labor, expressed in terms of net farm income per man-equivalent; and (4) capital-labor ratio, i.e. the ratio of total assets to total man-equivalents of labor available on farm. Age and Schooling were based on the age and years of schooling of the farm operator. Credit Use was measured as the sum of loans in force, weighted by the proportion of the year it was unpaid.[4] Non-Farm Income included income received for off-farm work, expenses paid by someone other than the farm operator, and other non-agricultural net income. Capital Intensity was measured in terms of two ratios: (1) flow of

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[2]Rate of Exchange: US$1.00 = CR$4.49(at the time the data were collected).

[3]Total man-equivalents is the total potential productive labor available from the active members of the farm family, plus hired labor used on the farm, measured in man-equivalents. One man-equivalent of labor is one male adult (age 18-59) working 300 days on the farm.

[4]For more details about the way Credit Use was measured, see definition of credit on page 38.

fixed capital per hectare of land used, and (2) flow of operating capital per hectare of land used.

An analysis of variance and an F-test or t-test for difference of means were used to determine whether groups of farms differed when stratified according to farm size and type. The analysis takes into account the variation within and also between sub-groups of farms.[5]

To test for significant difference among the mean values, an F-test was performed. The null hypothesis tested was:

$$H_o: \quad \bar{X}_1 = \bar{X}_2 = \ldots = \bar{X}_k$$

and the alternative hypothesis:

$$H_A: \quad \bar{X}_1 \neq \bar{X}_2 \neq \ldots \neq \bar{X}_k$$

where $\bar{X}_1$, $\bar{X}_2$, ... , $\bar{X}_k$ are the mean values for different farm-size or farm-type groups.

The F-test of the mean values was computed as follows:

$$\text{F-ratio} = \frac{S_b \div (k - 1)}{S_w \div (N - k)}$$

Where:

S_b = Between sum of squares.

S_w = Within sum of squares.

N = Total number of observations in all groups.

k = The number of different groups.

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[5] For details on the variance analysis performed in this study see Wilfrid J. Dixon and Frank J. Massey, Introduction to Statistical Analysis, (New York: McGraw-Hill, 1957).

Additional analysis was also done to compare one particular mean value with another specific mean value. In this case a standard t-test was performed. The null hypothesis tested was:

$$H_o: \quad \bar{X}_{1_i} - \bar{X}_{2_i} = 0$$

and the alternative hypothesis:

$$H_A: \quad \bar{X}_{1_i} - \bar{X}_{2_i} \neq 0$$

where $\bar{X}_{1_i}$ and $\bar{X}_{2_i}$ were the mean values for two farm-size groups or two farm-type groups.

The standard t-test of the mean values was computed as follows:[6]

$$t\,[(n_1 + n_2)] - 2 = \frac{\bar{X}_{1_i} - \bar{X}_{2_i}}{\sqrt{\frac{S_{1_i}^2}{n_1 - 1} + \frac{S_{2_i}^2}{n_2 - 1}}},$$

where:

$\bar{X}_{1_i} - \bar{X}_{2_i}$ = difference between the group means.

n_1 and n_2 = number of observations in each group.

$S_{1_i}^2$ and $S_{2_i}^2$ = variance within each group.

$(n_1 + n_2 - 2)$ = number of degrees of freedom.

$i = 1, 2.$

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[6]For computation of this test statistic see Hubert Blalock, Jr., Social Statistics, (New York: McGraw-Hill, 1972), pp. 224-228.

BASIC REGRESSION MODEL

Multiple regression models are frequently used in economics to describe relationships that include more than one explanatory variable. In production functions, output is typically a function of several inputs; in consumption models, the dependent variable may be affected by income, past consumption pattern, desirable wealth, as well as other factors. In demand functions the price of the product, the price of substitutes, and income are the traditional explanatory variables.[7]

Although this study does not attempt to derive a demand for capital, part of the underlying theory of derived demand for inputs is found in the functional relationships between selected factors and fixed or operating capital on farms.

Fixed capital in this study was analyzed as a set of heterogeneous components made up of various factors such as buildings, equipment, and livestock. Therefore, fixed capital is viewed from a broad standpoint instead of considering only one specific input such as tractors, livestock, or any other specific capital factor. A derived demand function with the traditional explanatory variables described above would be difficult to define and the scope of

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[7]Jan Kmenta, Elements of Econometrics, (New York: MacMillan Company, 1971), p. 347.

this study did not deal in depth with these complexities. The aim of this study was to identify major quantitative and qualitative variables which are associated with the two forms of farm capital, i.e. the flow from the aggregation of fixed inputs and of operating capital. To do this, seven variables have been included in the functional analysis: net farm income, non-farm income, credit, amount of land used, labor, level of commercialization, and age of farmer. An eighth explanatory factor, level of education, entered the equation in the form of dummy variable.[8]

Multiple regression analysis was used to determine which of the selected factors were associated with capital within each of the three specific farm types and according to two combined farm-size groups within each farm type.

The results of the statistical analysis were derived from a set of regression equations through the use of least squares estimation, assuming that the error term was normally distributed with the mean equal to zero and the variance constant.

The basic regression equation was:

$$\text{MODEL (A)} \quad Y_A = a + b_1X_1 + b_2X_2 + \ldots + b_iX_i + u \qquad i = 1,\ldots,7$$

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[8] The rationale underlying each one of these factors is discussed in the "Definition of Variables" section in this Chapter.

Where:

Y_A = dependent variable

a = the vertical intercept or level of the function

b_i = the regression coefficients for the independent variables

X_i = the independent variables

u = the error term

First a linear econometric model with seven independent variables was fitted. In addition to the seven quantitative independent variables cited above, education entered the model as one or two dummy variables, in separate regression equations. These were defined as dichotomous and trichotomous dummy variables. A dichotomy was represented by only one binary or dummy variable, and a trichotomy was represented by two dummy variables.[9]

The values assigned to the dummy variables were:

dichotomy	D	trichotomy	D_1	D_2
Educated farmer	1	Highly educated farmer	1	0
Less educated farmer	0	Moderately educated farmer	0	1
		Less educated farmer	0	0

The dummy variables were introduced to the constant term and to each of the seven independent variables.

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[9] Jan Kmenta, op. cit., pp. 411-415; J. Johnston, Econometric Methods, (New York: McGraw-Hill, 1972), pp. 180-186.

In the dichotomous case the function becomes:

$$\text{MODEL } (B_1) \quad Y_{B_1} = a + (b_1 + b_8 D)\ X_1 + (b_2 + b_9 D)\ X_2 + (b_3 + b_{10} D)\ X_3 + (b_4 + b_{11} D)\ X_4 + (b_5 + b_{12} D)\ X_5 + (b_6 + b_{13} D)\ X_6 + (b_7 + b_{14} D)\ X_7 + S_1 D + u$$

and upon expansion:

$$Y_{B_1} = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8(DX_1) + b_9(DX_2) + b_{10}(DX_3) + b_{11}(DX_4) + b_{12}(DX_5) + b_{13}(DX_6) + b_{14}(DX_7) + S_1D + u$$

In the trichotomous case, the function becomes:

$$\text{MODEL } (B_2) \quad Y_{B_2} = a + (b_1 + b_8 D_1 + b_{15} D_2)\ X_1 + (b_2 + b_9 D_1 + b_{16} D_2)\ X_2 + (b_3 + b_{10} D_1 + b_{17} D_2)\ X_3 + (b_4 + b_{11} D_1 + b_{18} D_2)\ X_4 + (b_5 + b_{12} D_1 + b_{19} D_2)\ X_5 + (b_6 + b_{13} D_1 + b_{20} D_2)\ X_6 + (b_7 + b_{14} D_1 + b_{21} D_2)\ X_7 + S_1 D_1 + S_2 D_2 + u$$

and upon expansion:

$$Y_{B_2} = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8(D_1X_1) + b_9(D_1X_2) + b_{10}(D_1X_3) + b_{11}(D_1X_4) + b_{12}(D_1X_5) + b_{13}(D_1X_6) + b_{14}(D_1X_7) + b_{15}(D_2X_1) + b_{16}(D_2X_2) + b_{17}(D_2X_3) + b_{18}(D_2X_4) + b_{19}(D_2X_5) + b_{20}(D_2X_6) + b_{21}(D_2X_7) + S_1D_1 + S_2D_2 + u$$

To test whether the sets of regression coefficients for the two or three educational levels were the same within each of the size-type combinations (i.e. L-VL Mixed, S-M Annual Crop, L-VL Annual Crop, S-M Perennial Crop, and L-VL Perennial Crop) the following hypotheses were tested (using an F-test) within each size-type combination of farms:

In both the dichotomous and trichotomous case the null hypothesis was:

$$H_o: \quad R^2_{B_i} = R^2_A$$

and the alternative hypothesis:

$$H_A: \quad R^2_{B_i} \neq R^2_A$$

Where: subscripts refer to Model (A) and (B_i). $i = 1,2$. In the case of rejection of the null hypothesis, it was concluded that education had a significant impact upon the slopes of the function. The F-test formula used was:

$$F = \frac{R^2_{B_i} - R^2_A}{1 - R^2_{B_i}} \div \frac{Q - K}{n - Q - 1} \qquad i = 1,2.$$

Where:

R^2_A = Multiple correlation coefficient for equation (A)

$R^2_{B_i}$ = Multiple correlation coefficient for equation (B_i)

n = No. of observations

K = No. of variables in equation (A)

Q = No. of variables in equation (B)

A t-test was performed to determine whether net farm income, non-farm income, and credit were related to fixed and operating capital according to level of education. The null hypothesis tested was:

$$H_o: \quad b_n + b_e = 0$$

and the alternative hypothesis:

$$H_A: \quad b_n + b_e \neq 0$$

Where:

b_n = Regression coefficient for the less educated farmers

b_e = Corresponding regression coefficient for the educated, moderately, or highly educated farmers

The test is to determine whether the sum of a regression coefficient of educated farmers added to the regression coefficient of less educated farmers significantly differs from zero. If it is significantly different from zero, then it is concluded that education has an impact upon the variable. For example, in order to determine if the relationship between the dependent variable and net farm income (X_1)

was significant for educated farmers in Model E_1, the null hypothesis tested would be:

$$H_o: \quad b_1 + b_e = 0$$

and the alternative hypothesis:

$$H_A: \quad b_1 + b_e \neq 0$$

The t-test formula used was:

$$t = \frac{b_n + b_e}{s_{b_n + b_e}}$$

Where:

$$s_{b_n + b_e} = \sqrt{s^2_{b_n} + s^2_{b_e} + 2\mathrm{Cov.}(b_n, b_e)}$$

To test the significance of the multiple correlation coefficient which gives the degree of correlation between the dependent variable and a set of explanatory variables, another F-test was used to test the null hypothesis:

$$H_o: \quad R^2 = 0$$

and the alternative hypothesis:

$$H_A: \quad R^2 \neq 0$$

The F-test formula is:

$$F = \frac{R^2}{1 - R^2} \times \frac{n - k - 1}{k}$$

Where:

R^2 = Multiple correlation coefficient

n = No. of observations

k = No. of independent variables

The relative importance of the independent variables was calculated to determine, without the influence of the unit of measurement, the relative influence of each of the independent variables upon the dependent variable. This was done by standardizing the regression coefficients using:

$$b'_i = b_i \frac{S_{x_i}}{S_y}$$

The transformed beta coefficients, (b'_i) are free of the measurement dimmensions that may have influenced the estimation of the regression coefficients (b_i); S_{x_i}, and S_y are the standard errors of the independent and dependent variables, respectively.

In order to estimate the response of capital to changes in each factor identified in the model, elasticities were computed. The computation used was:

$$E_i = b_i \frac{\overline{X}_i}{\overline{Y}}$$

This measures the change in the dependent variable (Y) resulting from a one percent change in the independent factor (X_i).

TEST OF EQUALITY BETWEEN FARM SIZE GROUPS

The sample farms included in this study have been stratified according to three farm types (perennial, annual, and mixed) and within each farm type they have been stratified according to four sizes (small, medium, large, and very large).

The test of equality between the coefficients for the same variable in two linear regressions has been used to determine whether two farm-size groups could be aggregated into one group. The equality of the regression coefficients of the two functions involved was determined with an F-test.[10] The test consists of taking the ratio of the sum of squares of the residuals of the two subsamples.

For example, where the functions representing the two subsamples are:

$$Y_{(1)} = a_1 + \alpha_1 X_{11} + \alpha_2 X_{12} + \alpha_3 X_{13} + \alpha_4 X_{14} + \alpha_5 X_{15} + \alpha_6 X_{16} + \alpha_7 X_{17} + u_1$$

$$Y_{(2)} = a_2 + b_1 X_{21} + b_2 X_{22} + b_3 X_{23} + b_4 X_{24} + b_5 X_{25} + b_6 X_{26} + b_7 X_{27} + u_2$$

Let Z_1 be a column vector of parameters to be estimated for the first subsample and let Z_2 be a column vector of parameters to be estimated for the second subsample.

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[10] Computation of this F-ratio test is explained by the following: (1) Franklin M. Fisher, "Tests of Equality Between Sets of Coefficients in Two Linear Regressions: An Expository Note", Econometrica, Vol. 38, No. 2, March, 1970, pp. 361-366; and (2) A. M. Steitieh, "Input Productivity and Productivity Change of the Crop Enterprise in Southern Brazil", unpublished Ph.D. dissertation, The Ohio State University, 1971, pp. 32-34.

$$Z_1 = \begin{bmatrix} a_1 \\ \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \\ \alpha_7 \end{bmatrix} \quad \text{and} \quad Z_2 = \begin{bmatrix} a_2 \\ b_1 \\ b_2 \\ b_3 \\ b_4 \\ b_5 \\ b_6 \\ b_7 \end{bmatrix}$$

The null hypothesis to be tested is:

$$H_o: \ Z_1 = Z_2$$

and the alternative hypothesis:

$$H_A: \ Z_1 \neq Z_2$$

If the null hypothesis is not rejected, the two functions can be written as:

$$Y_{(1)} = X_{1_i} (Z_1) + u_1$$

$$Y_{(2)} = X_{2_i} (Z_1) + u_2$$

Where X_{1_i} is an (n x 7) matrix, with (n) observations and X_{2_i} is an (m x 7) matrix, with (m) observations.

The F-ratio is determined by using:

$$F = \frac{\dfrac{SS_P - SS_{(1)} - SS_{(2)}}{K}}{\dfrac{SS_{(1)} + SS_{(2)}}{N - 2K}}$$

Where:

SS_P = Is the sum of squares of the residuals of the pooled samples with (n + m) observations.

$SS_{(1)}$ = Is the sum of squares of the residuals of the first subsample with (n) observations.

$SS_{(2)}$ = Is the sum of squares of the residuals of the second subsample with (m) observations.

K = Is the number of independent variables including the intercept.

N = Is the total number of observations or (n + m) observations.

The above F-ratio can then be tested against the critical value of $F(K, N-2K, \alpha)$.

DEFINITION OF VARIABLES

Y_1 - Fixed Capital (Cr$). The first dependent variable of the regression analysis is the annual flow of fixed capital. The annual flow of fixed capital was determined by summing four percent of the value of permanent structures (buildings, barns, etc.), plus twelve percent of the value of mechanized equipment, plus eight percent of the value of non-mechanized equipment, plus six percent of the value of average livestock inventory.[11] These capital flows are actually the assumed depreciation for the various capital

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[11] Different percentages were used to calculate the depreciation rates of each of the capital stock items with no significant impact upon the function when compared to the selected depreciation rates.

items. It is also assumed that the monetary value of capital is a good substitute for the quantitative measure of the capital items. Of importance is the fact that, since the data are available only for capital stock, a linear relationship is assumed between capital stock and capital flow and that there is proportionality of flows to stock.[12] Fixed capital is thus transformed into a flow of services assuming that the relevant concept for production is the quantity of capital services which enters the production process.[13]

Y_2 - Operating Capital (Cr$_2$). The second dependent variable of the regression equation is operating capital. This is the amount of operating capital used during the production year. It is the sum of actual cost of fertilizer, lime, seeds, herbicides, pesticides, machinery maintenance, fuel, farm taxes, labor, farm insurance, and animal expenses during the production year.

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[12] Zvi Griliches, "Estimates of the Aggregate Agricultural Production Function from Cross Sectional Data", Journal of Farm Economics, Vol. 45, 1963, pp. 419-425. Griliches used this technique to measure the capital variable in fitting an aggregate production function to U. S. agriculture; Also see Pan A. Yotopoulos, Allocative Efficiency in Economic Development, (Athens, Greece: Center of Planning and Economic Research, 1967), pp. 112-140; A. M. Steitieh, op. cit., pp. 16-18; and Evan Harold Drummond, "An Economic Analysis of the Farm Enterprise Diversification and Associated Factors in Two Regions of Minas Gerais-Brazil", unpublished Ph.D. dissertation, Purdue University, 1972.

[13] Pan A. Yotopoulos, Ibid., pp. 59, 113-115.

X_1 - Net Farm Income (Cr$). Net Farm Income is the value of gross farm output plus other agricultural income minus total farm expenditures (the sum of actual cost of fertilizer, lime, seeds, herbicides, pesticides, machinery maintenance, fuel, farm taxes, farm insurance, animal expenses during the production year, and hired labor cost).

Gross farm output includes the sum of total farm cash receipts from crops, livestock, and animal product sales, value of family and hired labor farm privileges, value of abnormal livestock losses,[14] net change in livestock inventory, and value of payments made in kind - minus livestock purchases.

Other agricultural income includes income received from land and machinery rental. For sugarcane farms income received from sales made prior to the 1969/70 production period was also included.[15]

To be productive and grow, a farm has to either generate its capital internally from its income or rely on external

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[14] The value of the abnormal loss is equal to the difference between observed livestock losses and a statistically determined concept of normal livestock loss.

[15] The harvest season for sugarcane takes place in September and sugar mills usually take more than six months to pay farmers for sugarcane purchases. This happens every year which means that sugarcane sales are always paid in the following production period. This is the reason why income from sales made prior to the 1969/70 production period has been counted for farms producing sugarcane.

sources. Farmers are expected to accelerate the process of capital formation as a result of an increase in net income. Also, use of new technology is enhanced as the income of the farmer increases. Therefore, a positive relationship is expected between this variable and capital flow.

X_2 - Non-Farm Income (Cr$). It includes income received for off-farm work, expenses paid by someone other than the farm operator, and other non-agricultural net income.

It is hypothesized that non-farm income constitutes a significant source of revenue for capital formation on the Ribeirão Prêto farms studied. A positive relationship between this source of income and the dependent variable is expected.

X_3 - Land Used (ha). This variable is defined as the land actively being utilized in the farming operation during the agricultural year. It is the sum of cultivated land (irrigated land + non-irrigated land + improved pasture) and natural pasture (amount of unimproved pasture land).

It is hypothesized that the more land a farmer utilizes in his farming operation the more capital he needs in the production process. A positive relationship is expected.

X_4 - Credit (Cr$). In this study credit was calculated based on a credit availability measure defined in a previous

study of credit use in one region of São Paulo.[16] Credit is defined as the sum of loans in force during the production year weighted by the proportion of the year the loan was unpaid. Four general cases were taken into account: (1) loans which were negotiated prior to the start of the production year; (2) loans which were negotiated at the beginning of the production year; (3) loans which were negotiated during the production year; and (4) loans which were negotiated at the end of the production year. For example, a loan obtained prior to the production year but running through half of the production period was counted at 50 percent of its contractual value. If negotiated at the beginning of the production period (August-September 1969) and running through July 1970 (end of production period), the loan was counted at 100 percent. Also, if the loan was negotiated during the production period and running for half of the production period, it was counted at 50 percent. Finally, if negotiated at the end of the production period, the loan was not counted (weight = 0). This procedure was followed because it is assumed that a loan available for only part of the production year does not fill as much of the credit needs as a loan available for the whole production cycle.

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[16] Gerald I. Nehman, "Small Farmer Credit Use in a Depressed Community of São Paulo, Brazil", unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1973, pp. 41-50.

Credit functions as a lubricant allowing farms to move along their production functions towards the optimal point of resource use. It is hypothesized that credit has a positive impact on the farm's level of both fixed and operating capital.

X_5 - Age of Farmer (Yrs.). This variable is defined as the actual age, in years, of the farmer.

The hypothesized relationship is that older farmers have had more time to accumulate wealth; therefore, a positive relationship is expected between this variable and capital.

X_6 - Labor (M.E.). This variable represents the total potential productive labor available from the active members of the farm family, plus hired labor used on the farm, measured in man-equivalents. One man-equivalent of labor is one male adult (age 18-59) working 300 days on the farm. The inclusion of this variable in the function permits the determination of the association between labor and fixed capital as well as between labor and operating capital. It is hypothesized that the amount of labor available on the farm constitutes a significant factor in explaining variations in the level of farm capital.

X_7 - Level of Farm Commercialization (%). It is defined as the ratio of value of farm products marketed to the value of gross farm output.

This ratio is an attempt to quantify the level of market participation. The rationalization regarding this variable is that farms will capitalize more as their participation in the market increases. It is hypothesized that farms which market a relatively high proportion of their production will have the highest level of capital; therefore, a positive relationship between this variable and capital is expected.

Level of Education (dummy variable). This study not only attempts to determine the relationship between capital and education but attempts to find out if the relationship between fixed and operating capital and each of the input factors is independent of the farmer's level of education. To do this, education has been incorporated in the analysis as a dummy variable which permits the impact of the independent factors on the dependent variable to be determined for different levels of education.

The level of education for large and very large farmers has been defined as follows: (1) highly educated: those farmers who have completed nine years or more of education; i.e. have completed ginásio.[17] (2) moderately educated: the farmers with four to eight years of education;

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[17] Ginásio is roughly equivalent to United States junior high school.

i.e. most of primário[18] completed or half-way through ginásio, and (3) less educated: those who have not had any formal education or completed less than four years of primário.

Small farmers usually have less years of schooling; therefore, their education was divided into two levels: (1) educated and (2) less educated. Educated refers to four years or more of schooling and less educated refers to less than four years of schooling.

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[18] Primário is roughly equivalent to United States grade school.

CHAPTER IV

SAMPLE DESIGN

This chapter explains the geographic, climatic, and agricultural setting of the sample farms. It also explains how the data were collected and how the sample farms were stratified according to size and type.

AREA OF STUDY[1]

This study concentrates on one region of São Paulo which comprises the DIRA (Divisão Integral Regional Agrícola) of Ribeirão Prêto. The DIRA consists of 30 municípios[2] and encompasses approximately 3.6 million hectares or about one-eighth of the land area in the state.

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[1] For more information about the area see the following research studies: (1) Kelso L. Wessel and William C. Nelson, "Methodology and General Data Description: Farm Level Capital Formation in São Paulo, Brazil", Occasional Paper No. 47, December, 1971; (2) Lêda Ferroco et. al., Aspectos Econômicos da Agricultura na Região de Ribeirão Prêto, Ano Agrícola 1969-70, ESALQ, Piracicaba, November, 1971; (3) William C. Nelson, "An Economic Analysis of Fertilizer Utilization in Brazil", unpublished Ph.D. dissertation, The Ohio State University, 1971, pp. 47-53; (4) Solon J. Guerrero, "Structural and Individual Components of Change in a Brazilian Agricultural Situation", unpublished Ph.D. dissertation, The Ohio State University, 1973, pp. 44-57; (5) Ivan Garcia-Barenco, "Capital Formation at the Farm-Level in São Paulo--1970", unpublished M.S. thesis, The Ohio State University, 1972, pp. 10-15; and (6) José Valdeci Siserra, "Análise de Relações Fator-Produto na Agricultura de São Paulo, Ano Agrícola 1969/70", unpublished M.S. thesis, ESALQ, Piracicaba, 1971, pp. 7-11.

[2] A município is approximately the same political-physical entity as a county in the United States.

It is located in the north-eastern corner of the state and is bordered on both the east and the north by the state of Minas Gerais (Map 1). Geographically and economically, the DIRA of Ribeirão Prêto is located in the heartland of agriculture in both the state and the country.

Among all the DIRAs of São Paulo, the DIRA of Ribeirão Prêto stands out as being the most important in the production of agricultural products. The DIRA of Ribeirão Prêto is a major producer of all the most important crops in the state as well as the country (Table 1). The DIRA ranks first, within the state, in the production of cotton, coffee, soybeans, oranges and tomatoes. It ranks second in the production of corn and rice and third in the production of coffee and peanuts. Aside from high levels of agricultural production within the state, the Ribeirão Prêto region is provided with an adequate communication media with the major agricultural markets and political centers of the country by air, rail, or road.

Three main factors were decisive in the choosing of this area: (1) there is sufficient farm diversity in the region which allows an evaluation of agricultural policy impact on various resources and enterprise situations; (2) the area constitutes a representative sample of the major agricultural systems in São Paulo; and (3) agricultural production is growing rapidly within the region.

Map 1. Location of Dira of Ribeirão Prêto Within State of São Paulo

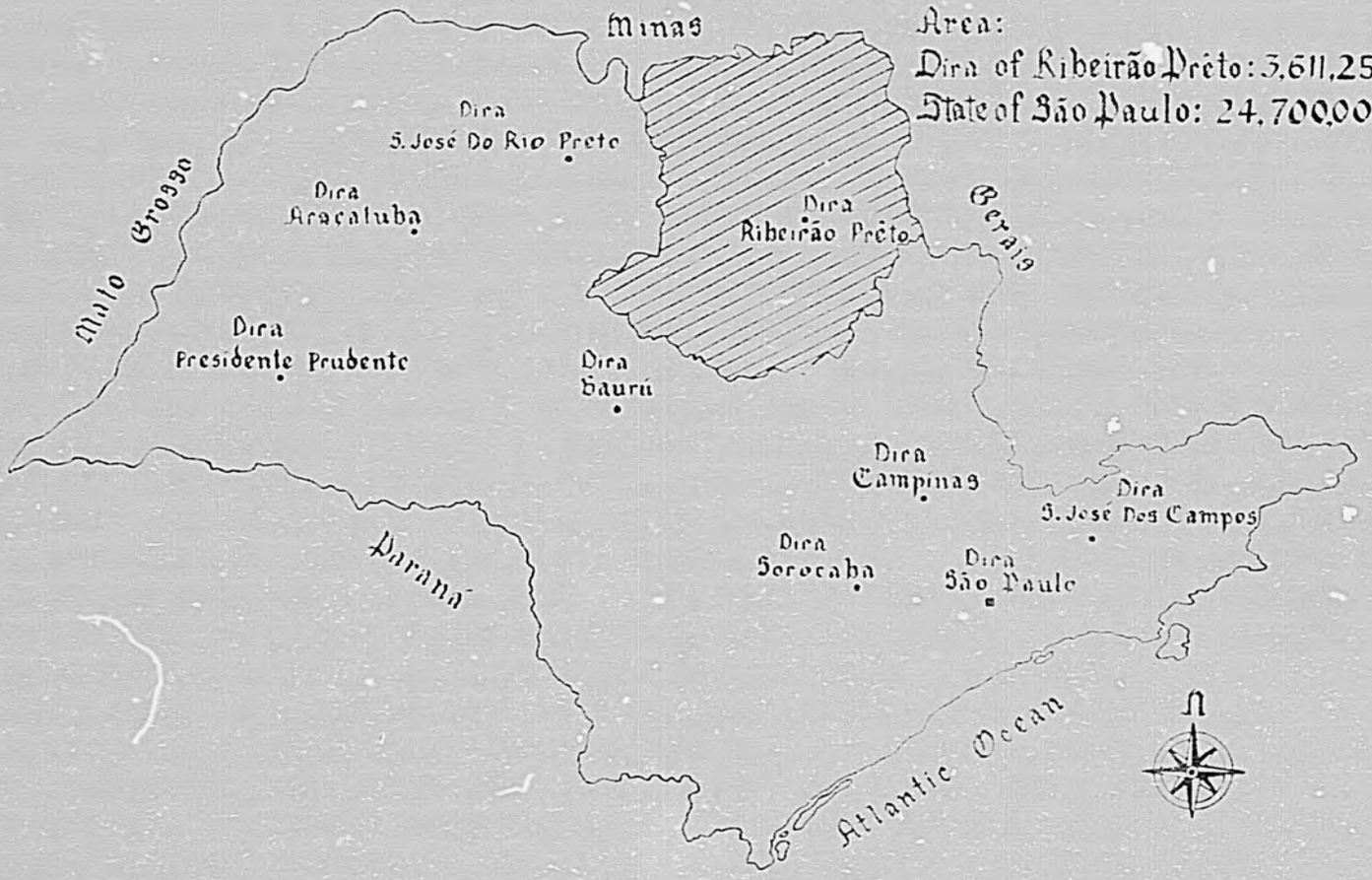

Table 1

Area and Production of Selected Agricultural Products in the State of São Paulo and Ribeirão Prêto Region, 1970

Crops	Sao Paulo			Ribeirao Preto		
	Area (Ha.)	Production (Tons)	Rank Within Brazil[a] (in Area)	Area (Ha.)	Production (Tons)	Rank Within Sao Paulo[b] (in Area)
Beans	230,933	125,237	7	16,238	5,820	4
Coffee	762,325	732,000	2	64,400	33,000	3
Corn	1,317,595	2,114,931	3	271,863	390,000	2
Cotton	469,767	551,493	1	76,690	115,050	1
Lemons	1,930[c]	2,570[d]	-	638	963,000[d]	6
Peanuts	479,193	565,772	1	33,928	40,700	3
Oranges	82,996	6,305,544	1	13,954[c]	585,320	1
Rice	709,017	774,097	4	181,330	132,000	2
Soybeans	47,121	61,010	3	42,471	54,600	1
Sugarcane	495,704	25,887,374	1	197,327	9,354,000	1
Tomatoes	18,400	381,000	1	9,183	126,500	1

[a] There are 22 states within Brazil.

[b] There are nine DIRA regions within the state.

[c] 1,000 plants/hectare.

[d] Boxes of 40 kg.

Source: (1) Anuário Estatístico do Brasil, Instituto Brasileiro de Estatística, (IBGE), Rio de Janeiro, 1970, and (2) Anuário Estatístico de São Paulo, Secretaria de Economia e Plane jamento, Departmento de Estatística, São Paulo, 1970.

Also, of importance is the fact pointed out by Pedroso[3] that Brazilian agricultural policies do affect this region. There are minimum prices for practically all crops grown, as well as, highly subsidized credit for machinery, fertilizer, pasture improvement, and other modern inputs.

Table 2 provides a brief profile of the 9 municípios, out of a total of 80 in the DIRA, which were included in the survey. The selection of farms was made on the basis of statistical information from IBRA[4] (Instituto Brasileiro de Reforma Agrária) and upon the advise of extension personnel working in the region. Sample selection and interviewing of farmers were carried out by a team from the Escola Superior de Agricultura Luiz de Queiroz (ESALQ) and The Ohio State University.

As far as natural characteristics of the area are concerned, the following are important: (1) climate in the region is subtropical with rainy summers and dry winters; (2) the area has 1,100 to 1,700 mm of annual rainfall, with

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[3]Iby A. Pedroso, "Resource Accumulation and Economies of Scale in Agriculture - The Case of São Paulo, Brazil", unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1973, p. 12.

[4]IBRA (Instituto Brasileiro de Reforma Agrária) maintains a file which has a summary of the data for each farm in the State. The summary includes the following information: size and address of property, farmer's name, address of farmer's residence if he does not live at the farm, how the property is being utilized, what is cultivated, amount of pasture, livestock inventory, etc.

Table 2

Size, Population, Population Density and Type of Farming in Nine Selected Municípios of the DIRA of Ribeirão Prêto, State of São Paulo, 1970

Municipios	Area (Sq.Km.)	Total Population	Population Density (People/Sq.Km.)	Major Enterprise
Altinópolis	943	11,110	11.5	Annual Crops
Batatais	835	29,600	35.0	Perennial Crops
Barretos	1,527	66,096	43.0	Livestock
Colombia	702	4,212	6.0	Livestock
Guaíra	1,201	27,147	22.5	Annual Crops
Jardinópolis	552	17,212	31.0	Annual Crops
Pontal	394	13,777	35.0	Perennial Crops
Sertãozinho	405	31,235	74.5	Perennial Crops
Sales de Oliveiro	293	7,112	24.3	Annual Crops

Source: Anuário Estatístico do Brasil, 1971.

the most precipitation during the first two months of the year; (3) the temperature varies between 16° and 22°C; and (4) the topography varies from flat to hilly, mostly favorable to agriculture, with altitudes of 300 to 1,000 meters above sea-level.

Concerning the state of São Paulo, it is important to know that its agriculture is not only the most important of all other states in the national economy but is increasing in importance. The state covers 247,6[illegible] sq.km. (24.7 million hectares) and nearly one-fifth (20 million) of Brazil's population is located there. São Paulo is best known for its industrial development which has greatly benefited the agriculture of southern Brazil. This conclusion is shared by Nicholls who states:[5]

> The generally high levels of farm labor productivity and production techniques in the agriculture of the south of Brazil are readily explained by its more favorable location relative to Brazil's generating centers of industrial-urban development, particularly the city of São Paulo.

About one half of the state income is from the industrial sector, compared to less than one-fourth for the rest of the country. Agricultural production constitutes one-eighth of the total gross product within the state, and on a national

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[5] William H. Nicholls, "Agriculture and Economic Development of Brazil", article in Modern Brazil, (Gainesville, Florida: University of Florida Press, 1971), p. 245.

basis, São Paulo's agricultural production has contributed 26 to 35 percent of the gross national agricultural income during the last two decades.[6] Currently the State of São Paulo accounts for one-fifth of the Brazilian gross national income.

SOURCE OF DATA

The data used in this study correspond to the agricultural year 1969/70. The data was collected through a farm survey completed during July, 1970. This was the end of the 1969/70 harvest season for all crops grown in the region except coffee and sugarcane.[7]

The files of IBRA (Instituto Brasileiro de Reforma Agrária) were used as the roll of the total farm population. The sampling procedure for selecting farms was carried out according to the following criteria: (1) more than 50 percent of the land area should be under cultivation; (2) more than 50 percent of the land operated should be utilized for specialized enterprises; and (3) more than 50 percent of the farms should be owner operated.

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[6]For more information about the role of São Paulo's agriculture in Brazil, see Instituto de Economia Agrícola, Desenvolvimento da Agricultura Paulista, São Paulo, February, 1972, pp. 24-28.

[7]For complete details on how the data were collected see: Kelso L. Wessel and William C. Nelson, "Methodology and General Data Description: Farm Level Capital Formation in São Paulo, Brazil", Occasional Paper No. 47, Department of Agricultural Economics and Rural Sociology, December, 1971.

The questionnaire used in the survey was pretested and revised before the interviewing began. The field work was supervised by a team of O.S.U. and USALQ professors and 15 students from USALQ did the interviewing. All farmers interviewed were precontacted by extension agents so interviewing would be facilitated. Before a completed questionnaire was accepted, it was checked for internal consistency, error, and clarity. There were cases that required as many as three recontacts before the questionnaire was completed satisfactorily.

The 382 farms included in the original sample were stratified according to size and farm type.[3] According to the farm-size and farm-type stratification used for the original stratification, only two small farms and only nine medium farms were found in the respective crop-fed livestock groups. In the natural-pasture livestock group, there was only one medium size farm (Table 3). Since the present study is based on farm type-size groups, the number of farms in these three strata were not sufficient to allow statistical analysis. Therefore, these twelve farms have been excluded and only 370 farms are included in the present study.

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[3] The definition of farm size and type for this study is given on page 54.

In addition, the natural-pasture livestock and crop-fed livestock farms have been grouped together because they both have more than 50 percent of their income generated by livestock sales. The difference between these two farm types is limited strictly to the land use ratio (L.U.R.)[9] Therefore, it was assumed that grouping these two farm types together would not affect the analysis. The aggregation of these two farm-type groups in this study resulted in a Mixed farming group (Table 4).

DATA PREPARATION

A new stratification was developed for the sample farms obtained in the original survey. This new stratification is consistent with the other data collected in Brazil for the "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's" conducted under a research contract between USAID and the Department of Agricultural Economics and Rural Sociology at U.S.U. A Summary Data Set has been prepared where, in certain cases, a reformulation of selected variables has taken place, such as type of enterprise and farm size. In order to prepare this Summary Data Set, the original data were rechecked for consistency and accuracy against the original questionnaires. This process was completed in March, 1973.

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[9] Ratio of Cultivated Land to Land Used (Cultivated Land = Crop Land + Improved Pasture; Land Used = Cultivated Land + Natural Pasture).

Table 3

Original Stratification of Sample Observations by Farm Size and Type, DIRA of Ribeirão Prêto, Brazil, 1970

Farm Type	Farm Size (Small)	(Medium)	(Large)	(V.Large)	Total
Natural Pasture Livestock	-	1	9	5	15
Crop Fed Livestock	2	9	36	41	88
Annual Crop	27	41	74	57	199
Perennial Crop	16	22	28	14	80
Total	45	73	147	117	382

Table 4

Re-Stratification, for Present Study, of Sample Farms by Size and Type, DIRA of Ribeirão Prêto, Brazil, 1970

Farm Type	Farm Size (Small)	(Medium)	(Large)	(V.Large)	Total
Mixed	-	-	45	46	91
Annual Crop	27	41	74	57	199
Perennial Crop	16	22	28	14	80
Total	43	63	147	117	370

The Summary Data Set consists of seven parts, or seven cards, for each farm interviewed. The cards provide complete information on the composition of gross farm output, land, labor, fixed capital, variable capital, consumption, and capital improvement investments.

The farm-size and farm-type stratification as defined in the Summary Data Set are used for this study. The four size groups defined are based on the amount of land used (cultivated land + natural pasture).

The four groups according to size are as follows:

Size Group	Hectares
Small	0.0 - 19.9
Medium	20.0 - 49.9
Large	50.0 - 199.9
Very Large	200.0 +

Farm type was determined on the basis of a land use ratio (L.U.R.) and the relative importance of various farm types measured in terms of income share. The land use ratio (L.U.R.) equals the quotient of cultivated land divided by total land used (cultivated land plus natural pasture land). Based on these quotients four farm types are defined:

Farm Type		Farm Type Characteristics
(I) Natural Pasture Livestock	if	L.U.R. $<$ .25 and more than 50% of farm income is generated by livestock sales.

(II) Crop Fed Livestock	if	L.U.R. $\geq$ .25 and more than 50% of farm income is generated by livestock sales.
(III) Annual Crop[10]	if	L.U.R. $\geq$.[illegible] and more than 50% of farm income is generated by annual crop sales.
(IV) Perennial Crop[11]	if	L.U.R. $\geq$ .25 and more than 50% of farm income is generated by perennial crop sales.

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[10] Refers to cotton, corn, rice, or soybeans.

[11] Refers to coffee or sugarcane.

CHAPTER V

DESCRIPTIVE FARM CHARACTERISTICS ACCORDING TO FARM TYPE AND SIZE

This chapter includes a description of selected factors and a comparison of these among farms according to size and type.

Specifically, the major hypothesis tested in this chapter is that there are significant differences among the farms in the sample with respect to levels of input usages and also input productivities.

The comparison was done according to seven groups of selected factors: 1)Gross Investment and Output Factors; 2)Production Ratios; 3)Labor Related Factors; 4)Age and Schooling; 5)Credit Use; 6)Non-Farm Income; and 7)Capital Intensity.

The comparisons of relative factors (e.g. farm output per hectare) in this chapter are based on the equal weighting of each farm. Therefore, if the average gross farm output (from Table 7) is divided by the average amount of land used (from Table 5) the obtained value will not equal the values presented in the analysis of the ratios, e.g. gross farm output per hectare. The same interpretation applies for all measures involving ratios.

GROSS INVESTMENT AND OUTPUT FACTORS

Amount of Land Used

With respect to amount of land used, by definition, the very large farms in all three farm types had considerably

more hectares of land being used in the farming operation as compared to the other size groups. Comparison of size across different farm types indicates that perennial crop farms used relatively less land than either annual or mixed farms. Mixed farms tended to have more hectares of land used than either of the other two farm types (Table 5).

Value of Total Assets

A sharp increase in the value of total assets occurred as the farm size became larger (Table 6). This was true for all three farm types, as expected, since value of land owned was included in the definition of total assets. Except for small farms, no significant difference was found among the mean values for total assets across farm types (Table 6). The higher value of total assets in the very large mixed farm group was due to land.

Value of Gross Farm Output

Gross farm output increased as the farm size increased in all farm types. With respect to farm type, output was found to be larger among perennial crop farms (Table 7). The statistical tests for difference of means indicated that, except for medium sized farms, a considerable degree of variation existed in gross farm output according to farm type. Mixed farms had the lowest values of farm output in all size groups. The values of gross farm output tended to be the highest among perennial farms, despite the fact that they

Table 5

Total Land Used, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Hectares)						
Mixed			114	720	5.25		.01
Annual	13	33	110	545		49.73	.01
Perennial	15	31	97	371		154.48	.01
T-Value	1.34	.89					
F-Value			1.36	2.27			
Level of Significance	.18	**	.25	.10			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

Table 6

Value of Total Assets, According to Type and Size of Farm
DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
			(Cruzeiros)				
Mixed			204,779	953,856	6.13		.01
Annual	29,182	73,939	229,171	825,362		56.97	.01
Perennial	36,182	73,300	299,530	762,221		11.52	.01
T-Value	1.48	.06					
F-Value			.80	.69			
Level of Significance	.14	**	**	**			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

Table 7

Value of Gross Farm Output, According to Type and Size of Farm
DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros)						
Mixed			21,269	129,917	5.78		.01
Annual	4,997	14,601	54,183	175,450		19.82	.01
Perennial	8,946	16,827	42,553	227,534		34.58	.01
T-Value	2.74	.88					
F-Value			11.44	1.77			
Level of Significance	.01	**	.01	.17			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

used less land than either annual or mixed farms (see Table 5).

Net Farm Income

Similar to gross farm output, net farm income increased sharply for all types of farming as the farm size increased. The variation across farm types was significant for all farm sizes (Table 8). Again, perennial crop farms had the largest average net farm income with the exception of the large size group where the large annual crop farms had the greatest.

PRODUCTION RATIOS

The two average productivity ratios included in this section were defined as gross output per hectare and net farm income per hectare. The first ratio indicates the gross productivity of land being used in the production process. The second ratio, net farm income to land used, indicates the residual that each hectare of land gives to the farmer, after total operating expenses (hired labor expenses inclusive) are covered. The rate of capital turnover and the net output ratio have also been included in this section.

Value of Farm Output Per Hectare

Significant variation was found in the value of output per hectare among size-type groups (Table 9). This ratio also varied significantly within each farm type but did not

Table 8

Net Farm Income, According to Type and Size of Farm,
DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros)						
Mixed			11,086	70,476	3.25		.01
Annual	2,701	5,342	19,613	40,256		3.59	.01
Perennial	4,799	8,597	10,628	93,767		9.90	.01
T-Value	1.56	1.76					
F-Value			.12	1.56			
Level of Significance	.12	.08	.02	.21			

*See Table 4 in Chapter IV for number of farms in each size-type group.

Table 9

Value of Farm Output Per Hectare, According to Type and Size of Farm
DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros/Ha)						
Mixed			193	245	1.24		.22
Annual	383	447	496	311		3.76	.01
Perennial	630	542	434	590		1.69	.18
T-Value	2.32	1.41					
F-Value			11.65	12.15			
Level of Significance	.02	.16	.01	.01			

*See Table 4 in Chapter IV for number of farms in each size-type group.

tend to increase as the farm size increased. Comparing the ratios across farm types, the perennial crop farms had greater average land productivity, which seems to indicate that they are more intensive users of land than either annual or mixed farms. In fact, the nature of perennial crops appear to be more land intensive which also requires more labor and higher levels of operating capital per hectare (see Tables 14 and 23).

Net Farm Income Per Hectare

The second ratio, net farm income per hectare of land used, also showed significant variation according to both farm size and farm type. The ratios for annual and perennial crop farms tend to indicate that the residual provided to the farmer from each hectare of land used is greater on small and medium sized farms (Table 10). Similar to the results found with the former ratio, perennial crop farms, as a whole, were found to have the highest ratios. Large perennial crop farms had the second lowest ratio relative to all farm groups but this could be due to the very high level of operating expenses found in the farm size-type group as it will be shown in the capital intensity analysis later.

Capital Turnover

The rate of capital turnover is a partial measure of the efficiency of the use of capital invested. It indicates

Table 10

Net Farm Income Per Hectare, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros/Ha)						
Mixed			104	124	.50		**
Annual	197	172	185	62		6.05	.01
Perennial	347	269	99	220		2.59	.06
T-Value	1.39	1.77					
F-Value			4.14	3.33			
Level of Significance	.17	.08	.02	.04			

*See Table 4 in Chapter IV for number of farms in each size-type group.
**Not significant.

the value of gross farm output as a percentage of total assets (fixed capital) for a given production year.[1]

With the exception of small perennial and very large annual farms, larger farms tended to have higher rates of capital turnover (Table 11). With respect to farm type, perennial crop farms tended to have the highest rates of fixed capital turnover. Large and very large mixed farms tended to require five to eight years for the average farmer to produce an amount equal in value to his total investment. Among annual crop farms, it was found that an average farmer produces an amount equal in value to his total investment in approximately three to five years whereas perennial crop farmers required only two to four years to recoup their fixed capital investment (Table 12).

Net Output Ratio

The net output ratio is the ratio of net farm income to value of total productive assets. This ratio indicates the percentage return realized on all fixed resources owned during a given production period. The obtained values for this ratio varied significantly according to farm type but it did not increase as farm size increased (Table 13). Among mixed farms the very large group realized higher

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[1]Total assets refer to the aggregate value of: (1) total land and building inventory; (2) livestock inventory; and (3) farm machinery and equipment inventory. Operating capital is not included in this definition of total assets.

Table 11

Rate of Capital Turnover, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Percentages)						
Mixed			12	19	1.34		.18
Annual	18	22	35	22		3.70	.01
Perennial	32	28	27	43		1.10	**
T-Value	1.93	1.73					
F-Value			7.04	4.04			
Level of Significance	.05	.09	.01	.14			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

Table 12

Average Number of Years Required to Cover Fixed Capital Investments According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Rate of Capital Turnover	Average Number of Years Required to Cover Fixed Capital Investments	Rank
	(%)		
MIXED			
Large	12	8.3	10
Very Large	19	5.3	8
ANNUAL			
Small	18	5.4	9
Medium	22	4.5	6
Large	35	2.9	2
Very Large	22	4.6	7
PERENNIAL			
Small	32	3.1	3
Medium	28	3.5	4
Large	27	3.8	5
Very Large	43	2.3	1

Table 13

Net Output Ratio, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Percentages)						
Mixed			6	11	1.16		.25
Annual	10	8	14	5		3.92	.01
Perennial	19	13	6	14		1.66	.16
T-Value	1.36	1.64					
F-Value			3.73	1.98			
Level of Significance	.18	.10	.03	.14			

*See Table 4 in Chapter IV for number of farms in each size-type group.

productive returns; among annual crop farms, the small and large groups had higher returns; and among perennial crop farms the small and very large groups realized the highest returns. As a whole, perennial crop farms tended to realize higher productive returns on all fixed resources owned than either mixed or annual crop farms.

LABOR RELATED FACTORS

In this section three measures have been taken into account: 1) labor intensity which is the ratio of man-equivalents of available farm labor to hectares of land used; 2) average returns to labor; and 3) the ratio of net farm income to labor used (expressed in man-equivalents) in the farm operation.

Labor Intensity

With respect to labor intensity, the results indicate that labor intensity decreased as farm size increased (Table 14). This is an expected result since it is known that smaller farms are much more labor intensive than larger farms in most developing countries. In Brazil this is particularly true because of small farms being characterized as having extended families living on them.

Perennial crop farms tended to be more labor intensive than either annual or mixed farms. This is a logical result since the nature of this type of enterprise (coffee and sugarcane) requires a greater amount of labor for both plant-

Table 14

Labor Intensity, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(M.E/Ha)						
Mixed			.04	.03	1.87		.06
Annual	.18	.12	.08	.05		31.70	.01
Perennial	.18	.15	.10	.09		7.70	.01
T-Value	.10	1.57					
F-Value			23.54	29.22			
Level of Significance	**	.12	.01	.01			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

ing and harvesting. Mixed farms used impressively less labor per hectare than the other farm type groups. This is another logical result since natural pasture livestock farms as well as crop-fed livestock farms have extensive amounts of pasture land which do not require so much labor input. The statistical tests indicate that the variation in labor intensity is significant according to both farm size and type.

Average Returns to Labor

The second measure chosen to analyze labor was the ratio of gross farm output to total available man-equivalents of farm labor. Available farm labor represents the total potential productive labor available from the active members of the farm family, plus hired labor used on the farm, expressed in man-equivalents. This ratio constitutes the measure for the average returns to labor. The results presented in Table 15 strongly suggest that the average returns to labor increase as the farm size increases. This was found to be true in all three farm types and was more dramatic for mixed farms.

The reason why the ratio of gross farm output to labor increases as the farm size increases is largely explained by two factors: (1) redundant family labor on smaller farms and (2) substitution of machinery for labor on larger farms. The high capital-labor ratios among larger farms (Table 17) also suggests that labor substitution among larger farms is occurring.

Table 15

Average Returns to Labor, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros/M.E.)						
Mixed			6,955	22,664	2.67		.01
Annual	2,900	5,226	8,637	9,176		2.08	.10
Perennial	3,969	3,904	5,180	7,766		5.09	.01
T-Value	1.34	.66					
F-Value			.70	4.14			
Level of Significance	.18	**	**	.02			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

Ratio of Net Farm Income to Labor

The measure net farm income per man-equivalent presented somewhat different results as compared to average returns to labor. Among mixed and annual crop farms the ratio increased as the farm size increased but this trend did not exist among perennial crop farms. Medium and large perennial crop farms had lower income-labor ratios than the small or very large farm groups; the very large group had the highest income-labor ratio (Table 16). This tends to indicate that, except for perennial crop farms, the larger the farming operation the greater the net farm income per unit of labor.

Capital-Labor Ratio

The capital-labor ratio tends to increase as the farm size increases (Table 17)[2] This is an expected result since substitution of mechanization for labor is occurring on larger farms.

AGE AND SCHOOLING

Managerial capacity can be influenced by many factors. This study takes into account two variables which may affect the managerial capacity of the farm operator as well as

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[2]The capital-labor ratio is equal to the value of total assets divided by total man-equivalents of labor available on farm.

Table 16

Net Farm Income-Labor Ratio, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros/M.E.)						
Mixed			4,057	15,773	2.33		.02
Annual	1,658	2,276	2,939	3,172		.63	**
Perennial	2,200	1,634	1,411	3,126		1.16	**
T-Value	.75	.35					
F-Value			5.31	4.79			
Level of Significance	**	**	.01	.01			

*See Table 2 in Chapter IV for number of farms in each size-type group.

**Not significant.

Table 17

Ranking of Size-Type of Farms According to Capital-Labor Ratio, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*			
	Small	Medium	Large	Very Large
	(Cruzeiro/M.E.)			
Mixed			74,478 (2)	148,408 (1)
Annual	21,379 (8)	28,074 (7)	34,847 (4)	55,254 (3)
Perennial	17,412 (10)	17,980 (9)	31,757 (5)	30,981 (6)

*See Table 4 in Chapter IV for number of farms in each size-type group.

( ) = Rank

capital usage: age and years of schooling. The relationship between these two variables and capital formation is left for the regression analysis in the next chapter.

Age

Farm operators of mixed and annual crop farms did not show significant differences in age across farm sizes. The average age of perennial crop farmers varied significantly according to size of farm (Table 18). Among perennial-crop farm operators, the results indicate that operators of larger farms tended to be younger. For mixed and annual crop farms, age of operator was found to be approximately the same regardless of the farm size.

Education

Among mixed and annual crop farms, the operators' level of education increased as the farm size increased. The same conclusion cannot be drawn for the perennial crop farms where small farm operators had more years of schooling than medium size farm operators, and large size farm operators had more years of schooling than very large farm operators (Table 19). However, the general trend was that larger farm operators had more years of schooling. It must be pointed out that Ribeirão Prêto is one of the most developed agricultural regions of Brazil, and yet, the level of education among farmers does not appear to be high especially among small and medium farmers. The averages for the small and medium sized

Table 18

Age of Farm Operator, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
			(Yrs.)				
Mixed			51	50	.37		**
Annual	46	47	48	46		.50	**
Perennial	53	53	48	44		2.25	.09
T-Value	2.00	1.95					
F-Value			.99	1.95			
Level of Significance	.05	.05	**	.14			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

Table 19

Years of schooling of Farm Operator, According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
			(Yrs.)				
Mixed			5.7	7.4	1.61		.11
Annual	2.9	3.9	4.2	7.2		0.13	.01
Perennial	3.7	2.2	0.3	5.3		3.96	.01
T-Value	.73	1.66					
F-Value			2.66	.95			
Level of Significance	**	.10	.07	**			

*See Table 4 in Chapter IV for number of farms in each size group.
**Not significant.

farm operators indicates that these farmers had not finished curso primário.[3] The data for the larger farm operators indicate that an average farmer in the region had completed curso primário but had not finished ginásio.[4]

CREDIT USE

To measure the amount of credit that was used in the production year, the sum of loans in force weighted by the proportion of the year it was unpaid has been taken into account and measured for each farm size-type group.[5] The analysis indicates that credit was used more as the farm size increased within each type of farming. Except for small farms, annual crop farmers used more credit for all size groups than either mixed or perennial crop farmers (Table 20).

If one examines the amount of credit used during 1969/70 on farms in the Ribeirão Prêto area it is found that three of the type-size farm groups had an amount of credit outstanding which exceeded their net farm income, i.e. large and very large annual crop farms and large perennial crop farms. The most credit was used by the very large annual crop farms.

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[3] curso primário is roughly equivalent to U.S. grade school.

[4] ginásio is roughly equivalent to U.S. junior high school.

[5] For more details about the way credit use was measured, see definition of credit on page 38.

Table 20

Credit Use[a], According to Type and Size of Farm, DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros)						
Mixed			10,246	35,565	3.21		.01
Annual	798	3,716	25,299	108,342		14.67	.01
Perennial	1,665	4,790	14,347	42,822		13.40	.01
T-Value	1.42	.76					
F-Value			7.97	4.79			
Level of Significance	.16	**	.01	.01			

[a] In this study credit is the sum of loans in force weighted by the proportion of the year it was unpaid (see definition, page 36).

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

These farms had an average credit use of Cr$ 108,342 with an average net income of Cr$ 40,256. Thus, outstanding credit for annual crop farms, averaging over 500 hectares in size was 2 1/2 times their net income. If credit is compared with the value of total assets it can be seen that the most intensive users of credit - very large annual crop farmers - had an amount of credit which corresponded to 13 percent of the value of their fixed assets.

Small crop farmers used relatively less credit. Small annual and perennial crop farmers had credit use in 1969/70 amounting to only two and three percent, respectively, of the total investment in capital assets. As will be shown in the regression chapter, with respect to small and medium crop farms, credit appears to be having a significant impact but only on the level of operating capital.

NON-FARM INCOME

As farm size increases non-farm income also increases (Table 21). The mean value of non-farm income for each of the small farm groups was found to be almost the same as the mean value of net farm income (see Table 8). Among medium and very large sized groups, non-farm income was less than net farm income. The value of non-farm income for the perennial large farms was higher than the net farm income for this same group. As a whole, non-farm earnings appear to be an important source of income for some farmers in Ribeirão

Table 21

Non-Farm Income, According to Type and size of Farm
DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros)						
Mixed			9,870	11,539	1.10		.27
Annual	2,639	3,594	3,935	22,342		1.49	.22
Perennial	4,466	4,665	13,631	56,431		4.64	.01
T-Value	1.16	.59					
F-Value			5.65	1.57			
Level of Significance	.25	**	.01	.21			

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

Prêto. It could be that both the production process and the level of farm investment are affected by this exogeneous variable.

CAPITAL INTENSITY

In order to measure the level of capital intensity among farms, two ratios have been taken into account: 1) fixed capital per hectare, and 2) operating capital per hectare.

Fixed Capital per Hectare

Fixed capital per hectare tended to increase as the farm size increased; however, very large crop farms tended to have less fixed capital invested per hectare than large farms (Table 22). Perennial crop farms tended to have more fixed capital per hectare than the two other farm types.

Operating Capital per Hectare

The ratio of operating capital per hectare suggests that perennial crop farms tended to invest more in operating capital on a per hectare basis than the other types of farming (Table 23). Also medium sized farms tended to have a higher level of operating capital per hectare than the other farm size groups. Another trend that can be detected is that, excluding the ratios for small farms, as the farm size increases the ratio of operating capital per hectare decreases.

Table 22

Fixed Capital[a] Per Hectare, According to Type and Size of Farm
DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros/Ha)						
Mixed			37	62	1.67		.09
Annual	42	64	72	53		.56	**
Perennial	67	81	185	75		.50	**
T-Value	1.61	1.03					
F-Value			2.21	.36			
Level of Significance	.11	**	.11				

[a] See definition of fixed capital page 35.

*See Table 4 in Chapter IV for number of farms in each size-type group.

**Not significant.

Table 23

Operating Capital[a] Per Hectare, According to Type and Size of Farm
DIRA of Ribeirão Prêto, São Paulo, 1970

Type of Farm	Farm Size*				Statistical Test for Difference of Means		
	Small	Medium	Large	Very Large	T-Value	F-Value	Level of Significance
	(Cruzeiros/Ha)						
Mixed			81	78	.22		**
Annual	148	214	190	184		2.08	.10
Perennial	200	284	216	208		1.34	.26
T-Value	1.57	1.52					
F-Value			26.74	19.66			
Level of Significance	.12	.13	.01	.01			

[a] See definition of Operating Capital page 36.
*See Table 4 in Chapter IV for number of farms in each size-type group.
**Not significant.

SUMMARY

Three broad categories of characteristics can be identified from the analysis: those related to level of output and income; those related to inputs, specifically focusing on capital and labor; and those related to management. In addition to these, one policy variable - credit - has been taken into account.

With respect to output and income, some specific trends have been detected. Mixed farms had the lowest values of gross output in all size groups. Perennial crop farms had the highest values of gross farm output, despite the fact that they used less land than either annual or mixed farms. Similar to gross farm output, net farm income increased sharply for all types of farming as the farm size increased.

Non-farm income appears to be an important source of income for some farmers in Ribeirão Prêto. The mean value of non-farm income for large perennial crop farms was higher than the mean value for net farm income for this same group. Among the small farm groups, the mean values of non-farm income were found to be almost the same as the mean values of net farm income.

With respect to output per hectare, this ratio did not tend to increase as the farm size increased. Comparing this ratio across farm types, the perennial crop farms had greater

returns per hectare, which seems to indicate that they are more intensive users of land than either annual or mixed farms. The ratio of net farm income per hectare showed that the residual provided to the farmer from each hectare of land used tended to be greater for perennial crop farms.

On an income-output basis there are some generalizations which can be made: (1) the perennial crop enterprise appears to be more profitable than either annual cropping or mixed farming; (2) mixed farming appears to be the least profitable type of farming; and (3) non-farm income may constitute an important source of income for some farms in the region.

On the input side some specific trends were found concerning input usage. Fixed capital per hectare tended to increase as the farm size increased; however, very large crop farms tended to have less fixed capital invested on a per hectare basis than either large or medium farms. Comparing this ratio across farm types, it was found that fixed capital investment per hectare on mixed farms was low compared to annual or perennial crop farms. Perennial crop farms had the highest level of investment per hectare. Concerning the ratio of operating capital per hectare, perennial crop farms also tended to have the highest ratios and the lowest were found for the mixed farms. Comparing this ratio across farm sizes, it was found that the ratio tended to increase from small to medium farms but it declined as farms became larger.

Based on the rates of capital turnover for fixed assets, perennial crop farms required the least number of years (2-3 yrs.) to recoup their investment as compared to annual crop farms (3-5 yrs.) or mixed farms (5-6 yrs.). The net output ratio indicated that perennial crop farms tended to realize higher productive returns on all fixed resources owned than either annual crop farms or mixed farms. The latter had the lowest returns.

With respect to the labor input, the results indicate that labor intensity decreased as farm size increased. Perennial crop farms used the greatest amount of labor on a per hectare basis as compared to annual or mixed farms. The latter used the least amount. The ratio of gross farm output to labor, i.e. average labor productivity, increased as the farm size increased for all three farm types. The ratio of net farm income to labor followed a similar trend among mixed and annual crop farms but not among perennial crop farms. Finally, the capital-labor ratio increased consistently as the farm size increased among all three farm types.

The generalizations which can be made on the input side are that (1) perennial crop farms tend to have the highest levels of capitalization and mixed farms the lowest; (2) perennial crop farms require greater amounts of labor per hectare on their farming operation and mixed farms the least; and (3) farms specializing in perennial crops

require the least amount of time to recoup their capital investment on fixed assets and mixed farms the longest period of time.

The third broad category of characteristics is related to management. It includes age and schooling. The age comparisons indicate that among perennial crop farms, operators of larger farms tended to be younger. Among mixed and annual crop farms, age of farm operator was approximately the same regardless of the farm size. Comparing the mean values found for age and the mean values found for fixed capital per hectare, the hypothesis that the level of capitalization is higher among older farmers cannot be substantiated. The schooling comparisons indicate that among mixed and annual crop farms the farmers' level of education increased. However, this trend was not found among perennial crop farms where small farmers had more years of schooling than medium size farmers, and large size farmers had more years of schooling than very large farmers. Ribeirão Prêto is one of the most developed agricultural regions in the country but the educational level of farmers does not appear to be very high, especially among small and medium farmers. Very large farmers had an average of 6.6 years of education; large farmers had an average of 5.4 years; and small and medium farmers had an average of about 3 years of education.

The generalization that can be made concerning education is that larger farmers tend to be considerably better

educated than smaller farmers in the region of Ribeirão Prêto. It should be noted that the level of educational attainment of farmers may be a contributor to varying rates of ability to accept capital changes as well as to take less or more advantage of internal or external sources for capital formation.

The analysis of credit use among farmers indicates that more credit is used as the farm size increases within each type of farming. Annual crop farmers used more credit than either mixed or perennial crop farmers. Three of the ten type-size farm groups had an amount of credit outstanding which exceeded their net farm income; they were the large and very large annual crop farms and the very large perennial crop farms.

With respect to farm type, the low ratios found for mixed farms, i.e. natural pasture and crop-fed livestock farms, can be explained by the nature of this farm enterprise. Natural pasture and crop-fed livestock farms rely largely on extensive amounts of pasture and not so much on cropping. This obviously requires less capital, less labor, and less tillage. The result is a non-intensive type of farming operation. Annual cropping, i.e. corn, cotton, rice, or soybeans, requires more tillage and mechanization. It is logical that more credit should go to annual crop farms considering their need for more mechanization as required by the nature of their enterprise

specialization. Finally, the higher capital and labor intensity ratios found among farms specializing in perennial crops, i.e. coffee and sugarcane, reflect that this type of farming has been very responsive to existing agricultural policies and more output has been obtained. In the case of coffee, government policies include minimum prices and highly subsidized and long term credit for new planting. In the case of sugarcane, policies have included production quota allotments, minimum prices and subsidized credit for farm consolidation.[6]

Based on the findings presented in this Chapter, it is apparent that across farm sizes and types: (1) perennial crop farms are the most intensely operated and mixed farms the least; (2) credit is concentrated on larger farms, particularly the annual crop farms; and (3) the major differences among farms can be largely explained by three factors: farm type, farm size, and policy. The hypothesis that there are significant differences among the farms in the sample with respect to levels of input usages and also input productivities across farm types and sizes is supported.

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[6]A more detailed discussion about these policies is presented in a study by Iby A. Pedroso, "Resource Accumulation and Economies of Scale in Agriculture - The Case of Sao Paulo, Brazil", unpublished Ph.D. dissertation, The Ohio State University, 1973, pp. 12, 13.

CHAPTER VI

REGRESSION ANALYSIS

This chapter uses multiple regression to analyze the relationship of selected factors with either fixed or operating capital for the sample farms.

The central hypothesis tested was that fixed and operating capital were each a function of net farm income, non-farm income, amount of land used, credit, age of farmer, available labor, level of commercialization, and the educational level of the farmer. Level of education entered the regression as a dummy variable, in separate regression equations and was introduced to both the constant term and to each of the other seven original independent variables. This was done to determine whether the relationship between either fixed or operating capital and each of the input factors was independent of the farmer's level of education (see Chapter III, p.27).

Before performing the regression analysis a test of equality between farm-size groups was done for both annual and perennial crop farms. These farms were divided into two groups by size, one composed of the small and medium farms (up to 49.9 hectares) and the other composed of the large and very large farms (50 or more hectares). The test of equality between sets of coefficients in two linear regressions was used to determine whether the two groups of farms had different functions (see Chapter III, p. 32, for computation procedure of this test).

The results clearly indicate that the group composed of small and medium farms had a different function than the group composed of large and very large farms. This happened for both annual and perennial crop farms and for both fixed and operating capital functions. The test between the S-M and L-VL groups[1] for the fixed and operating capital functions presented the following result:

F-test values for different functions.

Type of Capital	Type of Farming	
	Annual	Perennial
Fixed	2.52*	10.19*
Operating	7.56*	4.84*

*Significant at the .01 level.

As indicated in Chapter IV, mixed farms in this study refer to the aggregation of the natural pasture livestock and the crop-fed livestock farms. The very small number of observations for the small and medium size farms in this group was not sufficient to allow statistical analysis; therefore, the analysis of the mixed farms was limited to only one group composed of the large and very large farms.

[1] S-M refers to the small and medium sized farms grouped together; L-VL refers to the large and very large farms grouped together.

It must be pointed out that had the total number of sample farms been larger this study would have analyzed separately each of the four farm-size groups previously defined (see Chapter IV, Table 4).

A regression analysis was performed for each of the farm-type groups defined: mixed, annual, and perennial crop farms. For each of these groups the following analysis was first performed: (1) fixed capital was analyzed as a function of seven independent variables; (2) operating capital was analyzed as a function of the same seven independent variables. In the second part, the impact of education upon the regression equations was analyzed by: (a) performing an F-test to determine whether farmers with different levels of education would have different functions for fixed or operating capital; and (b) performing a t-test to determine whether net farm income (X_1), non-farm income (X_2), and credit (X_4) were significantly related to fixed or operating capital according to the different levels of education (as defined in Chapter III, p. 41).

MIXED FARMS

Fixed Capital

The analysis of the flow of fixed capital among mixed farms yielded the following:

$$\hat{Y} = \underset{(236)}{-11,116} + \underset{(.050)}{.235X_1} + \underset{(.227)}{.141X_2} + \underset{(7.91)}{1.743X_3} + \underset{(.124)}{.176X_4}$$

$$+ \underset{(314)}{285X_5} + \underset{(622)}{315X_6} - \underset{(706)}{29.6X_7} \qquad R^2 = .26$$

Where:

$\hat{Y}$ = estimated fixed capital flow (Cr$ 1,000) for mixed farms

X_1 = net farm income (Cr$ 1,000)

X_2 = non-farm income (Cr$ 1,000)

X_3 = land used (hectares)

X_4 = credit (Cr$ 1,000)

X_5 = age (years)

X_6 = labor (man-equivalents)

X_7 = level of commercialization (index)

( ) = standard deviation of the regression coefficient

The coefficient of determination indicates that only 26 percent of the variation in the flow of fixed capital can be explained by the factors included in the regression model. The regression coefficients for net farm income and credit were found to be significant and positively associated with fixed capital at the 1 percent and 20 percent level, respectively. The coefficient of net farm income indicates that the flow of fixed capital is likely to increase by approximately Cr$ 235 for every Cr$ 1,000 increase in net income. The beta weight for net farm income was the highest indicating that net farm income had the most influence on fixed capital formation (App. Table 1). Credit was the second most important variable associated with fixed capital (App. Table 1). The regression coefficient indicates that for every Cr$ 1,000 increase in credit fixed capital flow would tend to increase approximately Cr$ 176.

An elasticity coefficient is an estimate of the relative change in the flow of fixed capital associated with a one percent change in an independent variable at the mean value of the variable. According to the results presented in Appendix Table 3, the elasticity coefficients indicate that a one percent increase in the age of the average farmer will result in the flow of fixed capital increasing by more than the same one percent increase in net income or in credit. However, age was associated with the dependent variable at a low level of significance (0.20); therefore, the elasticity coefficients for net farm income and credit can be more useful in drawing conclusions since these two variables do affect the level of fixed capital at a higher confidence level. A given one percent increase in either average level of net farm income or in credit, will increase fixed capital flow by more than a similar increase in non-farm income, land, or labor.

Multicollinearity was found to be insignificant between pairs of independent variables included in the regression models for mixed farms (App. Table 2).

Operating Capital

The model for operating capital among mixed farms yielded the following results:

$$\hat{Y} = \underset{(308)}{2313} + \underset{(.021)}{.042X_1} + \underset{(.094)}{.026X_2} + \underset{(3.3)}{12.9X_3} + \underset{(.051)}{.224X_4} - \underset{(130)}{236X_5}$$

$$+ \underset{(256)}{1,986X_6} + \underset{(34.8)}{37.4X_7} \qquad R^2 = .72$$

Where:

$\hat{Y}$ = estimated operating capital (Cr$ 1,000) for mixed farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The regression results indicate that 72 percent of the variation in operating capital can be explained by the factors included in the model. Five out of the seven variables were found to be significantly associated with the dependent variable. Labor (X_6) was significant and positively associated with operating capital at the one percent level of confidence (App. Table 1). The standardized regression coefficients indicate that labor (X_6) was the independent variable contributing most to the formation of operating capital.

Credit (X_4) was also found to be significantly associated with variations in operating capital. The regression coefficient for this variable indicates that operating capital would increase by approximately Cr$ 224 with every Cr$ 1,000 increase in credit. According to the regression coefficients, credit has a greater impact on operating capital than on fixed capital (App. Table 1).

Land (X_3) was also positively and significantly associated with operating capital. The regression coefficient of this variable indicates that operating capital will tend to increase with increases in the amount of land used in the farming operation. Net farm income (X_1) was significantly

associated with operating capital at the five percent level. The positive relationship between this variable and operating capital suggests that, among mixed farms, an increase in operating capital would be associated with an increase in net farm income. The impact of net farm income on operating capital was much less than on fixed capital. This tends to indicate that among mixed farms operating capital is less responsive to net farm income than fixed capital.

The analysis of elasticity coefficients indicates that a one percent increase of labor utilized on the farm increases operating capital relatively more than a one percentage increase in credit (X_4), land (X_3), or net farm income (X_1). The elasticity coefficient for age (X_5) indicates that as the farmer becomes older the level of operating capital decreases (App. Table 3). The opposite was found for fixed capital.

Level of Education

Both fixed and operating capital were analyzed according to three different levels of education. To do this dummy variables representing different levels of education were introduced to the constant term and to each of the independent variables (App. Table 4). To test the hypothesis that all regression coefficients were the same, for each of the three levels of education under consideration, an F-test was used (see Chapter III, page 29). The results for mixed farms were:

Fixed Capital:

$$F = 0.609 \text{ (not significant)}$$

Operating Capital:

$$F = 6.338 \text{ (significant at .01 level)}$$

this indicates that level of education does not explain variations in fixed capital but it does for operating capital.

1) Fixed Capital. Although the overall effect of education on the fixed capital function was not found to be significant, a t-test was performed to determine how level of education affected the responsiveness of fixed capital to net farm income, non-farm income, and credit. The test indicates that fixed capital was more responsive to net farm income among highly educated farmers than among moderately or less educated ones. The regression coefficient for net farm income was greater among highly educated farmers than either moderately or less educated farmers (Table 24).

Non-farm income was positively but not significantly related to fixed capital among less educated farmers and negatively but not significantly associated with fixed capital among moderately and highly educated farmers (Table 24).

Credit was positively and significantly associated with fixed capital only among highly educated farmers (Table 24). This means that the more educated a farmer the greater impact credit has on fixed capital.

Table 24

The Impact of Net Farm Income, Non-Farm Income, and Credit upon Fixed and Operating Capital According to Level of Education. Large and Very Large Mixed Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education of Farmers					
	Less Educated (0-3 yrs.)		Moderately Educated (4-8 yrs.)		Highly Educated (9 or more yrs.)	
	Regression Coefficient	T-Test	Regression Coefficient	T-Test	Regression Coefficient	T-Test
FIXED CAPITAL						
Net Farm Income	.121	.690	-.024	.079	.240	3.693***
Non-Farm Income	.104	.238	-.097	.119	-.037	.092
Credit	.224	.570	.059	.139	.662	2.012**
OPERATING CAPITAL						
Net Farm Income	.346	7.115***	-.075	.934	.021	.808
Non-Farm Income	-.179	1.462*	-.110	.467	.143	1.284*
Credit	.387	3.549***	.159	3.533***	.534	6.010***

Source: Appendix Table 4.

*Significant at .20 level.

**Significant at .05 level.

***Significant at .01 level.

2) Operating Capital. Net farm income was positively and significantly associated with operating capital among educated farmers. Similar to what was found in the fixed capital equation, the relationship between net farm income and operating capital was negative, but not at a significant level, among moderately educated farmers (Table 24). It is important to observe that the magnitude of the regression coefficient for less educated farmers is greater than that for either moderately or highly educated farmers. This tends to indicate that operating capital is more responsive to increases in net farm income among the less educated farmers.

Non-farm income was positively and significantly associated with operating capital only among highly educated farmers. This result indicates that operating capital is positively affected by non-farm income only among highly educated farmers (Table 24).

Credit was positively and significantly associated with operating capital at all levels of education. However, the impact of credit on the dependent variable was greater among highly educated farmers (Table 24).

ANNUAL CROP FARMS

Fixed Capital

S-M Group. For the S-M annual crop farms, the results obtained in the analysis of fixed capital were:

$$\hat{Y} = \underset{(317)}{-2061} + \underset{(.033)}{.094X_1} + \underset{(.037)}{.064X_2} + \underset{(19.4)}{34.7X_3} + \underset{(.063)}{.030X_4} + \underset{(15.8)}{10.9X_5} + \underset{(109)}{213X_6} + \underset{(7.8)}{9.55X_7} \qquad R^2 = .46$$

Where:

$\hat{Y}$ = estimated fixed capital (Cr$ 1,000) for S-M annual crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The coefficient of determination indicates that 46 percent of the variation in the flow of fixed capital can be explained by the independent variables included in the model (App. Table 5).

The standardized regression coefficients indicate that net farm income (X_1) was the independent variable accounting for most of the variation in fixed capital. This variable was positively associated with the dependent variable and significant at the 1 percent level. The positive relationship between net farm income and fixed capital indicates that an increase in net farm income among S-M farms would result in an increase in the flow of fixed capital.

The second most important variable found in the analysis was land (X_3) whose regression coefficient was significantly and positively associated with fixed capital at the 5 percent level of significance. The elasticity coefficient of this variable shows that a one percent increase in land would increase the fixed capital flow relatively more than a one percent increase in either of the other independent factors.

Other significantly associated independent variables, in order of importance were: labor (X_6), non-farm income (X_2), and level of commercialization (X_7). All these variables were positively associated with the dependent variable.

The positive association between the flow of fixed capital and labor (X_6) among S-M annual crop farms tends to indicate that these farms absorb more labor as they become more capital intensive.

Non-farm income (X_2) had a significant impact on fixed capital investment which tends to indicate that it may constitute a source of revenue for capital formation on these farms.

Level of commercialization (X_7), which measures the level of market participation of the farms, was positively associated with fixed capital, but only at the 20 percent level of confidence.

L-VL Group. The model for fixed capital yielded the following result:

$$\hat{Y} = \underset{(595)}{-15,091} + \underset{(.05)^1}{.015X_1} - \underset{(.05)^2}{.022X_2} - \underset{(11.3)^3}{2.17X_3} + \underset{(.04)^4}{.108X_4}$$

$$+ \underset{(211)^5}{.415X_5} + \underset{(229)^6}{.261X_6} + \underset{(161)^7}{0.9X_7} \qquad R^2 = .33$$

Where:

$\hat{Y}$ = estimated fixed capital flow (Cr$ 1,000) for L-VL annaul crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The coefficient of determination indicates that 33 percent of the variation in fixed capital was explained by the seven variables. Credit (X_4) and age (X_5) were the only variables found to be significantly associated with variations in fixed capital flow at the 1 percent and 5 percent level, respectively. This is the only model in which credit was associated with fixed capital at the 1 percent level of significance (App. Table 9). In the descriptive analysis (Chapter V) it was found that credit was used mostly by the large and very large annual crop farmers; therefore, this result was expected. The regression coefficient for age indicates that older farmers tend to have a greater investment in fixed capital than younger farmers. The elasticity coefficient for age was the highest (App. Table 11) but, according to the standardized regression coefficients (App. Table 9), credit was the variable which explained the most variation in fixed capital.

Operating Capital

S-M Group. The regression equation for operating capital among these farms was:

$$\hat{Y} = \underset{(230)}{-3{,}602} - \underset{(.08)}{.089X_1} + \underset{(.09)}{.065X_2} + \underset{(45)}{197X_3} + \underset{(.15)}{.406X_4} + \underset{(36)}{14X_5}$$

$$+ \underset{(251)}{200X_6} + \underset{(17)}{19.5X_7} \qquad R^2 = .61$$

Where:

$\hat{Y}$ = estimated operating capital (Cr. 1,000) for S-M annual crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The coefficient of determination indicates that 61 percent of the variation in operating capital can be explained by the independent variables included in the model. In this equation the regression coefficients of land (X_3) and credit (X_4) were significant at the 1 percent level (App. Table 5). All the coefficients had the expected sign except net farm income (X_1) which was negatively but not significantly associated with operating capital. This tends to indicate that an increase in operating capital does not result from an increase in net farm income. From the standardized regression coefficients it can also be seen that net farm income is relatively unimportant in explaining changes in operating capital. According to both the standardized regression coefficient and the elasticity coeffcient, land has the greatest impact on the level of operating capital among S-M annual crop farms (App. Tables 5 and 7). The regression coefficient of credit indicates that operating capital is likely to increase by approximately Cr$ 408 for every Cr$ 1,000 increase in credit. It should be remembered that the same was not found to be true for the fixed capital analysis.

L-VL Group. The regression analysis for operating capital was the following:

$$\hat{Y} = \underset{(223)}{-30{,}952} + \underset{(.06)}{.162X_1} - \underset{(.06)}{.295X_2} + \underset{(13)}{75X_3} + \underset{(.04)}{.556X_4} - \underset{(250)}{54X_5}$$

$$+ \underset{(271)}{313X_6} + \underset{(191)}{303X_7} \qquad R^2 = .91$$

Where:

$\hat{Y}$ = estimated operating capital (Cr$ 1,000) for L-VL annual crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

Ninety-one percent of the variation in operating capital was explained by the seven independent variables included in the model. Net farm income (X_1), non-farm income (X_2), land (X_3), and credit (X_4) were significant at the 1 percent level. Labor (X_6) was significant at the 20 percent level and age (X_5) was found not significantly associated with the dependent variable (App. Table 9). The beta coefficients for the independent variables indicate that credit (X_4) was the most important variable associated with operating capital. For every Cr$ 1,000 increase in credit, operating capital is likely to increase by Cr$ 556. Although credit also has an impact on fixed capital, its impact on operating capital is five times as great (App. Table 9).

Non-farm income (X_2) was negatively associated with operating capital at the 1 percent level of confidence. This indicates that non-farm income does not constitute source of revenue for operating capital among L-VL annual crop farms in Ribeirao Preto. However, it should be remembered that among S-M farms the inverse was found to

be true, i.e. non-farm income was positively associated with both fixed and operating capital (App. Table 5). It appears from these results that even though non-farm income has no positive impact on operating capital among L-VL farms, it does seem to be an important source of revenue for capital formation among S-M annual crop farms.

The positive relationship of level of commercialization to operating capital tends to indicate that as the farm participates more in the agricultural market, increases in operating capital can be expected. This indicates that more market articulated farms are likely to have higher operating costs. Consequently, it is likely that the demand for agricultural credit will also tend to be greater among market oriented farms.

Level of Education

S-M Group. Fixed and operating capital were analyzed according to two different levels of education. The first level comprised farmers with less than 4 years of education, namely less educated farmers and the second level of education comprised farmers with more than 4 years of education, namely educated farmers. A dummy variable representing the two levels of education was introduced to both the constant term and to each of the independent variables (App. Table 6).

In order to test the hypothesis that all regression coefficients were the same for each of the two levels of

education under consideration an F-test was used (see Chapter III, page 29). The results for S-I annual crop farms were:

Fixed Capital:

$$F = 2.425 \text{ (significant at .05 level)}$$

Operating Capital:

$$F = 1.366 \text{ (not significant)}$$

The above results indicate that level of education does not explain variation in operating capital. However, the F-test performed for the fixed capital function indicates that variation in fixed capital can be explained by the farmer's level of education. This means that level of education influences the investment in fixed inputs among S-I farmers.

1) Fixed Capital. A t-test was performed to determine how responsive fixed capital was to net farm income, non-farm income, and credit, depending upon the farmer's level of education. The results indicate that fixed capital was more responsive to net farm income among farmers with more than 4 years of education (Table 25).

Non-farm income was positively associated with fixed capital at the .01 level among farmers with less than 4 years of education. A negative but not significant relationship was found between both variables among farmers with more than 4 years of schooling. This indicates that the more educated

Table 25

The Impact of Net Farm Income, Non-Farm Income, and Credit upon Fixed and Operating Capital According to Level of Education. Small and Medium Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education of Farmers			
	Less Educated (0-3 yrs.)		Educated (4 or more yrs.)	
	Regression Coefficient	T-Test	Regression Coefficient	T-Test
FIXED CAPITAL				
Net Farm Income	.068	1.560	.105	1.985**
Non-Farm Income	.196	3.410***	-.021	.420
Credit	-.068	.821	.222	1.819*
OPERATING CAPITAL				
Net Farm Income	-.141	1.320	-.140	1.093
Non-Farm Income	.071	.508	.018	.144
Credit	.037	.182	.640	3.766***

Source: Appendix Table 8.

*Significant at .10 level.

**Significant at .05 level.

***Significant at .01 level.

the S-M crop farmer is the less the impact non-farm income has on his fixed capital flow (Table 25).

Credit was positively and significantly associated with fixed capital at the .10 level only among farmers with more than 4 years of education. This means that the more educated a S-M farmer is the greater impact credit has on fixed capital (Table 25).

2) Operating Capital. Although the overall effect of education on the operating capital function was not found to be significant, the t-tests indicate that net farm income was negatively and significantly associated with operating capital among less educated farmers (Table 25).

Non-farm income was positively but not significantly related to operating capital at both levels of education (Table 25).

Credit was positively associated with operating capital at both levels of education; however, a significant association was found only among farmers with more than 4 years of education. The magnitude of the regression coefficient increased sharply among farmers with more than 4 years of education (Table 25). This again means that the more educated a S-M farmer the greater impact credit has on operating capital.

L-VL Group. The fixed and operating capital functions were analyzed according to three levels of education (see page 41.

In order to test the hypothesis that all regression coefficients were the same for each of the three levels of education under consideration the F-test (see page 29). was used. The results for L-VL annual crop farms were:

Fixed Capital:

$$F = 2.047 \text{ (significant at .05 level)}$$

Operating Capital:

$$F = 5.050 \text{ (significant at .01 level)}$$

The above indicates that level of education influences the investment in both fixed and operating capital.

A t-test analysis was performed to determine how responsive fixed and operating capital were to net farm income, non-farm income, and credit.

1) Fixed Capital. Net farm income was positively associated with fixed capital at all three levels of education. However, only among moderately educated farmers (4-6 years of education) net farm income was significantly associated with the dependent variable (Table 26).

Non-farm income was positively but not significantly associated with fixed capital among less educated farmers. A negative relationship between this variable and fixed capital was found among moderately and highly educated farmers, i.e. among farmers with more than 4 years of schooling; however, the relationship was significant only among moderately educated farmers (Table 26).

Table 26

The Impact of Net Farm Income, Non-Farm Income, and Credit upon Fixed and Operating Capital According to Level of Education. Large and Very Large Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education of Farmers					
	Less Educated (0-3 yrs.)		Moderately Educated (4-8 yrs.)		Highly Educated (9 yrs. or more)	
	Regression Coefficient	T-Test	Regression Coefficient	T-Test	Regression Coefficient	T-Test
FIXED CAPITAL						
Net Farm Income	.114	.473	.274	1.647*	.026	.426
Non-Farm Income	.032	.116	-.287	2.210**	-.106	.568
Credit	.075	.369	.039	.722	.247	4.491***
OPERATING CAPITAL						
Net Farm Income	-.310	1.259	-.140	.413	.187	3.224***
Non-Farm Income	-.265	.947	-.224	1.671*	-.333	1.753*
Credit	.549	2.649***	.391	6.962***	.485	8.083***

Source: Appendix Table 12.

*Significant at .10 level.

**Significant at .15 level.

***Significant at .01 level.

Credit was positively associated with fixed capital at all three levels of education; however, a significant association between credit and fixed capital was found only among highly educated farmers, i.e. farmers with 9 years of education or more (Table 26).

2) Operating Capital. With respect to operating capital it was found that this variable was negatively associated with net farm income among less and moderately educated farmers, i.e. farmers with less than 9 years of education. However, the regression coefficient for highly educated farmers was positive and significant at the .01 level indicating that an increase in operating capital can be associated with an increase in net farm income among farmers with 9 years of education or more (Table 26).

Non-farm income was negatively associated with operating capital at all three levels of education but the relationship was significant only among moderately and highly educated farmers. This suggests that non-farm income has no positive impact on operating capital on L-VL annual crop farms (Table 26).

Credit was positively and significantly associated with operating capital at high statistical levels at all three levels of education. However, the magnitude of the regression coefficient was greater among farmers with less than 4 years of education. The fact that credit is highly associated with operating capital on the L-VL annual crop farms is an

expected result since this farm group was the greatest user of credit according to the descriptive analysis of Chapter V.

PERENNIAL CROP FARMS

Fixed Capital

S-M Group. The analysis of the flow of fixed capital among these farms yielded the following:

$$\hat{Y} = \underset{(752)}{-2{,}478} + \underset{(.06)}{.081X_1} + \underset{(.05)}{.112X_2} + \underset{(38)}{71X_3} + \underset{(.07)}{.061X_4} - \underset{(28)}{8.7X_5} - \underset{(139)}{47X_6} + \underset{(21)}{23X_7} \qquad R^2 = .46$$

Where:

$\hat{Y}$ = estimated fixed capital flow (Cr$ 1,000) for S-M perennial crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The regression results indicate that 46 percent of the variation in the flow of fixed capital is explained by the independent factors included in the model.

Net farm income (X_1), non-farm income (X_2), and land used (X_3) had the greatest level of association with fixed capital on the S-M perennial crop farms. These three variables were positively associated with the dependent variable. Net farm income (X_1) was significantly associated with fixed capital at the .20 level. Non-farm income (X_2) and land used (X_3) were significantly associated with the dependent variable at the 5 and 10 percent level, respectively. The coefficient of net farm income indicates that fixed capital is likely to

increase by approximately Cr$ 81 for every Cr$ 1,000 increase in net income. For every Cr$ 1,000 increase in non-farm income (X_2) fixed capital flow is likely to increase by approximately Cr$ 112 (App. Table 13).

Credit (X_4) was positively associated with fixed capital but not at a significant level.

The standardized regression coefficients indicate that non-farm income (X_2) was the independent variable accounting for most of the variation in fixed capital (App. Table 13). This tends to indicate that non-farm income constitutes a major factor contributing to the formation of fixed capital among the S-M perennial crop farms.

The second most important variable found in the analysis was land used (X_3). The positive relationship between this variable and fixed capital indicates that an increase in the amount of land used in the agricultural operation is associated with an increase in capital investment.

Net farm income (X_1) ranked third in importance according to the standardized regression coefficients. This variable was positively and significantly associated with fixed capital at the .10 level of confidence. It appears that the positive impact of net farm income on the fixed capital structure of S-M perennial crop farms is not as great as the impact of non-farm earnings (App. Table 13).

Level of commercialization(X_7) was positively related with fixed capital at a lesser level of significance but its elasticity

coefficient was the highest as indicated in Appendix Table 15. A given percent increase at the average level of commercialization will increase the flow of fixed capital more than the same percent increase in net farm income, non-farm income, or land used.

L-VL Group. The model for fixed capital flow among L-VL farms yielded the following results:

$$\hat{Y} = \underset{(1,765)}{440,455} + \underset{(.11)}{.043X_1} + \underset{(.11)}{.019X_2} + \underset{(00)}{06X_3} - \underset{(.23)}{.041X_4} - \underset{(560)}{129X_5}$$

$$- \underset{(682)}{263X_6} - \underset{(524)}{4,533X_7} \qquad R^2 = .71$$

Where:

$\hat{Y}$ = estimated fixed capital flow (Cr. 1,000) for L-VL perennial crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The coefficient of determination indicates that 71 percent of the variation in the dependent variable was explained by the independent variables included in the model (App. Table 17). However, only two variables were significantly associated with the dependent variable: land used (X_3) and level of commercialization (X_7). The regression coefficient of land used (X_3) carried a positive sign and was significantly associated with fixed capital at the 5 percent level of confidence. Level of commercialization (X_7) was negatively and significantly associated with fixed capital. However, the reason for the negative sign of the regression coefficient

for level of commercialization was due to the fact that perennial crop sales tend to be fixed among L-VL perennial crop farms. As indicated in Chapter III, level of commercialization was defined as the ratio of perennial crop sales to gross output. Most perennial crop farms also had annual crop sales which did not enter the ratio thus causing an underestimation of the level of commercialization among this farm group. Therefore, the results concerning level of commercialization for L-VL perennial crop farms are inconclusive.

<u>Operating Capital</u>

<u>S-M Group</u>. The regression results for these farms were the following:

$$\hat{Y} = \underset{(431)}{-\,2{,}133} + \underset{(.11)}{.130X_1} + \underset{(.06)}{.22X_2} + \underset{(69)}{55X_3} + \underset{(.13)}{.589X_4} - \underset{(51)}{65X_5}$$

$$+ \underset{(253)}{833X_6} + \underset{(39)}{52X_7} \qquad R^2 = .84$$

Where:

$\hat{Y}$ = estimated operating capital (Cr$ 1,000) for S-M perennial crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The regression results indicate that 84 percent of the variation in operating capital is explained by the variables included in the model.

Credit (X_4) and labor (X_6) were positively and significantly associated with operating capital at the 1 percent level of significance. The standardized regression

coefficients also indicate that these two variables are the most important factors associated with variations in operating capital (App. Table 13).

Additionally significantly associated variables, in order of association were: non-farm income (X_2), age (X_5), and level of commercialization (X_7). Net farm income (X_1) was positively related to operating capital at the .20 level (App. Table 13).

The elasticity coefficients indicate that a given percent increase at the average level of commercialization (X_7) will increase the level of operating capital more than the same percent increase in any other variable (App. Table 15).

L-VL Group. The model for operating capital among these farms yielded the following:

$$\hat{Y} = \underset{(618)}{28,454} + \underset{(.05)}{.041X_1} - \underset{(.05)}{.045X_2} + \underset{(32)}{116X_3} + \underset{(.11)}{.20X_4} - \underset{(263)}{316X_5} + \underset{(316)}{305X_6} - \underset{(243)}{86X_7} \qquad R^2 = .78$$

where:

$\hat{Y}$ = estimated operating capital (Cr$ 1,000) for L-VL perennial crop farms

X_1, X_2, X_3, X_4, X_5, X_6, and X_7 are explained on page 96.

The coefficient of determination indicates that 78 percent of the variation in operating capital among L-VL perennial crop farms is explained by the independent factors of the model.

Land used (X_3) and credit (X_4) were positively and significantly associated with operating capital at the .01 and .05 level of significance, respectively (App. Table 17).

The standardized regression coefficients indicate that land (X_3) had the highest relative importance among all independent variables. Credit (X_4) ranked second in relative importance, according to the standardized regression coefficients (App. Table 17).

The elasticity coefficients indicate that a given percent increase at the average amount of land used (X_3) will result in the flow of fixed and operating capital increasing by more than the same percent increase in any other variable included in the model. This indicates that land appears to be a very important variable in explaining variations in both fixed and operating capital among L-VL perennial crop farms (App. Table 19).

Level of Education

S-M Group. Fixed and operating capital were analyzed according to two levels of education. Farmers with more than 4 years of education and farmers with less than 4 years of education.

The F-test, used to test the hypothesis that all regression coefficients were the same for each of the two levels of education, yielded the following:

Fixed Capital:

F = 0.580 (not significant)

Operating Capital:

F = 3.071 (significant at .05 level)

The above indicates that variations in the level of fixed capital is independent of the farmers' level of education. The same was not true for the operating capital function since the F-test shows that level of education explains significant variation in the level of operating capital.

1) Fixed Capital. Although the overall effect of education on the fixed capital function was not significant, a t-test was performed to determine how responsive fixed capital was to net farm income (X_1), non-farm income (X_2), and credit (X_4).

The test results indicate that fixed capital was more responsive to net farm income among less educated farmers, i.e. farmers with less than 4 years of education. The magnitude of the regression coefficient for net farm income was much greater among less educated farmers as indicated in Table 27.

Similar to net farm income, non-farm income was positively associated with fixed capital at both levels of education but only among less educated farmers was the association significant at the .05 level. The magnitude of the regression coefficient for non-farm income was greater among less educated farmers (Table 27).

Table 27

The Impact of Net Farm Income, Non-Farm Income, and Credit upon Fixed and Operating Capital According to Level of Education. Small and Medium Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education of Farmers			
	Less Educated (0-3 yrs.)		Educated (4 or more yrs.)	
	Regression Coefficient	F-test	Regression Coefficient	F-test
FIXED CAPITAL				
Net Farm Income	.157	1.920*	.007	.036
Non-Farm Income	.114	2.171**	.033	.191
Credit	.193	1.809**	.005	.023
OPERATING CAPITAL				
Net Farm Income	-.149	1.322	.164	.699
Non-Farm Income	.220	3.033***	-.063	.264
Credit	.262	1.730*	.564	1.925*

Source: Appendix Table 16.

*Significant at .10 level.

**Significant at .05 level.

***Significant at .01 level.

Credit was positively associated with fixed capital at both levels of education; however, a significant relationship between fixed capital and credit was found only among farmers with less than 4 years of education. This indicates that, although credit is having a positive impact on the fixed capital structure of all S-M perennial crop farms, a significant impact is being verified only on farms owned by less educated farmers (Table 27).

2) Operating Capital. Net farm income was positively but not significantly associated with operating capital among farmers with more than 4 years of education (Table 27). A negative and significant relationship at the .20 level was found between net farm income and operating capital among less educated farmers.

Non-farm income was positively and significantly associated with operating capital at the .01 level but only among less educated farmers. No significant relationship was found between this variable and operating capital among farmers with more than 4 years of education (Table 27).

Credit had a positive and significant impact on operating capital at both levels of education at the .10 level; however, the magnitude of the regression coefficient was greater among farmers with more than 4 years of education as indicated in Table 27. This means that the more educated a S-M perennial crop farmer is the greater impact credit has on operating capital.

L-VL Group. Three levels of education had been defined for large and very large farmers; however, due to the small number of observations for the L-VL perennial crop group, only two educational levels were introduced in the equation in the form of dummy variable.

The F-test used to test the hypothesis that all regression coefficients were the same for each of the two levels of education resulted as follows:

Fixed Capital:

$F = 0.533$ (not significant)

Operating Capital:

$F = 1.687$ (not significant)

The above results indicate that the fixed and operating capital functions do not change depending upon the farmers' level of education. This indicates that the overall effect of education on both forms of capital is not significant.

1) Fixed Capital. Although the overall effect of education did not affect the fixed capital function, a t-test was applied to find out if the relationship between fixed capital and net farm income was independent of the level of education. The result showed no significant difference in the relationship between fixed capital and net farm income depending upon education. The same result was also found for non-farm income and credit. It should also be remembered that, according to Appendix Table 17,

net farm income (X_1), non-farm income (X_2), and credit (X_4) had no significant impact on fixed capital. The analysis now shows that even if you disaggregate the sample according to levels of education, the impact of the three variables on fixed capital is still insignificant (Table 28).

2) Operating Capital. Similar to the fixed capital function, the overall effect of education on operating capital was also non-significant.

The t-test analysis for net farm income indicates that a positive and significant relationship exists between this variable and operating capital but only among less educated farmers (Table 28).

Non-farm income was negatively and significantly associated with operating capital only among less educated farmers. No significant association was found between this variable and operating capital among educated farmers (Table 28).

Credit was positively and significantly associated with operating capital at both levels of education but the magnitude of the regression coefficient was considerably greater among farmers with less than 4 years of education (Table 28).

Table 28

The Impact of Net Farm Income, Non-Farm Income, and Credit Upon Fixed and Operating Capital According to Level of Education. Large and Very Large Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education of Farmers			
	Less Educated (0-3 yrs.)		Educated (4 or more yrs.)	
	Regression Coefficient	F-Test	Regression Coefficient	F-Test
FIXED CAPITAL				
Net Farm Income	.083	.327	.006	.046
Non-Farm Income	-.040	.058	.008	.063
Credit	-.014	.024	-.071	.261
OPERATING CAPITAL				
Net Farm Income	.247	2.471**	.002	.036
Non-Farm Income	-.740	2.746**	-.026	.212
Credit	.369	1.784*	.115	1.406*

Source: Appendix Table 20.

*Significant at .20 level.

**Significant at .05 level.

SUMMARY

With respect to the second objective of this study, the following central hypothesis was tested: fixed and operating capital are each a function of net farm income, non-farm income, amount of land used, credit, labor, level of commercialization, and age of farmer. Level of education also entered the function in the form of dummy variables and were introduced to both the constant term and to the independent variables so the impact of different levels of education on the independent factors for either fixed or operating capital could be determined.

The findings regarding this hypothesis were as follows:

Mixed Farms

Because of the very small number of observations for the small-medium farm size group, mixed farms were analyzed as one single group including only the large and very large farms.

Fixed Capital. It was found that fixed capital on mixed farms could be increased by increasing net farm income and credit. However, it is the net farm income that has the greatest impact on the fixed capital structure of these farms.

Operating Capital. It was found that labor was the factor contributing most to variation in the level of operating capital. This means that an increase in the amount of labor utilized on mixed farms would be accompanied by an

increase in the level of operating capital. Credit was the second most important factor contributing to the formation of operating capital. The impact of this variable on operating capital was greater than on fixed capital. Land and net farm income were also found to have a positive impact on the level of operating capital among mixed crop farms.

Level of Education. Education did not have a significant impact on the fixed capital function, according to the F-test; however, it was found that fixed capital was more responsive to net farm income and to credit among highly educated farmers. Non-farm income was negatively but not significantly associated with fixed capital among educated farmers.

When education entered the operating capital function it was found that net farm income was positively and significantly associated with operating capital among less educated farmers. Non-farm income was positively and significantly associated with operating capital but only among highly educated farmers. Credit had a significant and positive association with operating capital at all levels of education with highly educated farmers more responsive.

Annual Crop Farms

Fixed Capital on S-A Farms. Net farm income was the most important factor associated with investment in fixed

capital. The positive relationship between net income and fixed capital indicates that an increase in net income is accompanied by an increase in the flow of fixed capital among these farms. Fixed capital can also be expected to increase among these farms by increasing the amount of land used in the production process and increasing labor. The analysis suggested that non-farm income also contributes to the formation of fixed capital among S-I farms and it also indicated that as S-I farms become more commercialized fixed capital tends to increase.

Operating Capital on S-I Farms. Land and credit were the most important factors positively associated with operating capital. It should be pointed out that credit was found to have no significant impact on fixed capital among these farms, but according to the analysis, it does tend to be a major contributor to increases in operating capital. The analysis has also indicated that by increasing the farms' level of commercialization operating capital can also be expected to increase.

Level of Education on S-I Farms. Education was an important factor in explaining variations in fixed capital. Fixed capital among educated farmers was more responsive to increases in net farm income than among less educated farmers. Non-farm income was positively and significantly associated with fixed capital only among farmers with less than 4 years of education. Credit had a positive and significant

association with variations in both fixed and operating capital with educated farmers more responsive.

Fixed Capital on L-VL Farms. Credit was the most significant factor associated with variation in fixed capital. This is an expected result since, according to the descriptive analysis in Chapter V, large and very large annual crop farmers were found to be the greatest users of credit. The farmers' age was the second most significant factor positively associated with fixed capital which means that older farmers tend to have higher levels of capital investment.

Operating Capital on L-VL Farms. Credit was the most important variable found to be positively and significantly associated with operating capital. This is again consistent with previous findings in Chapter V which indicated that L-VL annual crop farms were the greatest users of credit. Non-farm income was the second most important variable associated with the dependent variable but the relationship was negative meaning that non-farm income does not contribute to operating capital among L-VL annual crop farms. Additional significantly associated variables, in order of importance, were land, net farm income, and level of commercialization.

Level of Education on L-VL Farms. Education was an important factor associated with variations in both fixed

and operating capital. Net farm income was positively and significantly associated with fixed capital only among farmers with more than 3 but less than 5 years of education, i.e. moderately educated farmers. Non-farm income was positively associated with fixed capital only among moderately educated farmers. Credit had a positive and significant association with fixed capital but only among farmers with more than 4 years of education. Net farm income had a positive and significant relationship with operating capital but only among highly educated farmers. Non-farm income was negatively associated with operating capital at all three levels of education but the relationship was significant only among farmers with more than 4 years of education. Credit was positively and significantly associated with operating capital at all three levels of education but the responsiveness of operating capital to credit was greater among less educated farmers.

Perennial Crop Farms

Fixed Capital on S-E Farms. Non-farm income was the factor accounting for most of the variation in fixed capital. This result strongly indicates that non-farm income may constitute a major source of revenue for the formation of fixed capital among S-E perennial crop farms. Land was the second most significant variable associated with fixed capital indicating that if more land is used for production the

S-M perennial crop farms also tend to have more capital available. Net farm income ranked third in importance indicating that it does not have such a great influence on the formation of fixed capital as non-farm income does. Level of commercialization was also significant at a lesser level of significance.

Operating Capital on S-M Farms. Credit was the most significant factor positively associated with operating capital. It should be pointed out at this point that credit had no significant impact on the fixed capital structure of either S-M perennial or annual crop farms. Other significantly associated variables, in order of importance, were: labor, non-farm income, age of farmer, and net farm income.

Level of Education on S-M Farms. Education did not have a significant impact on the fixed capital function, according to the F-test; however, it was found that fixed capital was more responsive to net farm income among farmers with less than 4 years of education. Non-farm income was significantly and positively associated with fixed capital only among farmers with less than 4 years of education. Credit was positively associated with fixed capital at both levels of education; however, only among less educated farmers was the relationship significant. This indicates that the degree of responsiveness of fixed capital to credit is greater among farmers with less than 4 years of education.

With respect to operating capital, education was an important factor for explaining variations in this variable which was significantly and negatively associated with net farm income among less educated farmers. Non-farm income, on the other hand, was positively and significantly associated with operating capital but only among less educated farmers. Credit had the most significant association with operating capital among educated farmers, i.e. farmers with more than 4 years of education.

Fixed Capital on L-VL Farms. It was found that land used was the most significant factor accounting for increases in fixed capital. Net farm income and credit did not account for significant variation in fixed capital. Large and very large perennial crop farms had the highest level of non-farm income according to the findings of the descriptive analysis in Chapter V but, surprisingly, this variable did not have a significant impact on the fixed capital structure of these farms. This can be explained by the fact that the very high mean value for non-farm income among L-VL perennial crop farms might have been due to only a few L-VL farms having very high levels of non-farm income.

Operating Capital on L-VL Farms. Land and credit accounted for most of the variation in operating capital among these farms. Land was also the variable contributing most for the formation of fixed capital. This tends to indicate that capitalization among L-VL perennial crop farms

is closely associated with the size of the land holding. On the other hand, capitalization on L-VL mixed and annual crop farms was not found to be closely associated with the amount of land used in the production process.

Level of Education on L-VL Farms. The functions for fixed and operating capital did not vary when education entered the equation; therefore, it can be concluded that education has no effect on either fixed or operating capital formation on the L-VL perennial crop farms. Net farm income, non-farm income, and credit when analyzed according to level of education also showed no significant impact on fixed capital.

With respect to operating capital, a positive and significant relationship was found between this variable and net farm income but only among farmers with less than 4 years of education. Non-farm income was negatively and significantly associated with operating capital but only among farmers with less than 4 years of education. Credit was positively and significantly associated with operating capital at both levels of education but, according to the magnitude of the regression coefficient, operating capital appeared to be more responsive to credit among less educated farmers.

Table 29 gives a summary of significant variables associated with fixed and operating capital according to farm type-size stratification. The Table also shows the impact of education as a shift factor according to type of capital.

TABLE 29. Summary of Significant Variables Associated with Fixed or Operating Capital According to Farm Type-Size Stratification. Also, Impact of Education as a Shift Factor, DIRA of Ribeirão Prêto, São Paulo, 1970.

Farm Size-Type	Type of Capital		Impact of education on three factors according to type of capital*	
	Fixed	Operating	Fixed	Operating
	(Significant variables - in descending order of importance)			
Mixed (L-VL)	net farm income credit	labor credit land net farm income age**	net farm income (+) credit (+)	credit (+) non-farm income (+) net farm income (-)
Annual crop (S-M)	net farm income land labor non-farm income commercialization	land credit	net farm income (+) credit (+) non-farm income (-)	credit (+) net farm income (-)**
Annual crop (L-VL)	credit age	credit non-farm income** land net farm income commercialization	net farm income (+) credit (+) non-farm income (+)**	net farm income (+) credit (-) non-farm income (+)**
Perennial crop (S-M)	non-farm income land net farm income	credit labor non-farm income age** net farm income	credit (-) non-farm income (-) net farm income (-)	credit (+) non-farm income (-) net farm income (-)**
Perennial crop (L-VL)	land	land credit		credit (-) net farm income (-) non-farm income (-)**

*Symbols in ( ) indicate impact of education:
(+) more important for more educated group
(-) more important for less educated group

**Regression coefficient was negatively associated with the dependent variable.

CHAPTER VII

CONCLUSIONS, POLICY IMPLICATIONS, AND FUTURE RESEARCH

The primary objectives of this study were: 1) to describe the sample farms and identify major factors that may be related to differences in levels of capital investment; 2) to determine how these selected factors are associated with variations in fixed and operating capital by farm size and type in the area; and 3) to arrive at recommendations for policies which might be better suited for each size-type of farming and the overall agricultural production of the region under investigation.

CONCLUSIONS

From the findings of the descriptive analysis in Chapter V, it is apparent that farms specializing in perennial crops (i.e. coffee and sugarcane) are obtaining higher profits relative to farms specializing in annual crops (i.e. corn, cotton, rice, or soybeans) or mixed farming (i.e. natural pasture and crop-fed livestock). The perennial crop farms also had higher capital and labor intensity ratios indicating that they were more intensive users of land and capital compared to the other farm types. Favorable agricultural policies were considered to be one of the major reasons why perennial crop farms were the most intensely operated farms in the region. Coffee producing farms have

benefited from policies such as minimum prices and highly subsidized and long term credit for new plantings. Sugarcane producing farms have benefited from minimum prices, production quota allotments, and subsidized credit for farm consolidation.

The low capital and labor intensity ratios found among mixed farms were consistent with the nature of this farm type. Mixed farms were defined in this study as the aggregation of natural pasture and crop-fed livestock farms. Both of these types of farms rely largely on extensive amounts of pasture with little emphasis on crops. Obviously, the need for capital and labor inputs on these farms cannot be as dramatic as in the case of crop farms.

Another major finding of the descriptive analysis was that credit has been concentrated on larger crop farms, especially the annual crop farms. This was interpreted as a logical result of policies which stressed mechanization and use of other purchased inputs on annual crop farms.

Based on the above major findings, the hypothesis that there are significant differences among the farms studied with respect to levels of input usages and input productivities across farm types and farm sizes was accepted. The differences were largely explained by the nature of the farm types, by the size of the land holding, and by the impact of various policies in the region.

Multiple regression was used to determine how selected variables were associated with variations in fixed and operating capital. The specific conclusions drawn from this analysis were as follows:

Mixed Farms

Net farm income and credit were the factors explaining most of the variation in the level of fixed and operating capital of these farms. The results tend to indicate that as these farms increase their net farm receipts, increased investment in both forms of capital may occur. The analysis concerning credit showed that both fixed and operating capital are significantly related with the amount of borrowed funds used by these farms. It can be concluded that internal and external infusion of funds are affecting the capital formation process of mixed farms. Increases in two other factors of production, i.e. land and labor, were significantly associated with the amount of operating capital used on mixed farms but not with the flow of fixed capital such as buildings, machinery, and livestock.

Annual Crop Farms

The small and medium sized annual crop farms were the first ones to be analyzed within the annual crop farm group. The results indicated that net farm income was a major factor associated with increases in the fixed capital structure of these farms. Credit, on the other hand, showed no association

with investments in fixed capital items among these farms but it did appear to be related with the level of operating capital. This tends to indicate that most of the borrowed funds used by the small and medium annual crop farms tend to affect primarily their level of operating capital. The amount of land used in the farming operation was related to both forms of capital although it appeared to have a closer association with the level of operating capital. Therefore, it is apparent that if small and medium sized annual crop farms increase their land holdings a need for more operating capital may occur.

Among large and very large annual crop farms, credit was the principal factor associated with both fixed and operating capital. This result is consistent with the findings of the descriptive analysis where it was found that the large and very large annual crop farms were the greatest users of credit. From this it can be concluded that considerable investment in mechanization has occurred among these farms. Another logical conclusion is that the impact of credit on the capital formation process of the region is more dramatic on larger farms which specialize in annual crops, i.e. corn, cotton, rice, or soybeans. It should be noted that the kind of mechanical technology which has been developed in the region relies considerably on large equipment. Obviously, investment in large equipment requires

large sums of money. Lacking inputs which could be more suited to small and medium sized farming operation may help to explain why credit did not appear to be significantly related with the fixed capital structure of small and medium sized crop farms.

Perennial Crop Farms

Similar to what was found among small and medium sized annual crop farms, credit had no significant relationship with the fixed capital structure of the small and medium perennial crop farms. Most of the credit used on these farms appeared to be related only with the operating capital used. Non-farm income was the principal factor associated with fixed capital among these farms which tends to indicate that farmers with higher off-farm earnings tend to invest more in fixed capital inputs.

Credit was significantly related with only the level of operating capital in the large and very large perennial crop farms. However, the analysis indicated that the major factor associated with both fixed and operating capital was the amount of land used in the production process. As was pointed out previously, policies oriented to perennial crops have included highly subsidized credit for farm consolidation. Consequently, land may have become a crucial factor among large and very large perennial crop farms. It seems logical to conclude that perennial crop farmers may be willing to increase their land holding in response to existing

agricultural policies. This conclusion helps to explain why land appears to be such an important variable associated with the level of fixed and operating capital among large and very large perennial crop farms.

Level of Education

The general conclusions concerning education are as follows:

1. Investments in fixed capital on mixed and annual crop farms are more responsive to net farm income among farmers with more than four years of education.

2. Fixed capital is responsive to non-farm income but only among small and medium annual and perennial crop farms owned by farmers with less than four years of education.

3. With respect to fixed capital inputs, the contribution of credit to capital formation of mixed and annual crop farms is considerably greater among farmers with more than four years of education; therefore, it can be concluded that the impact of credit on the productive capacity of these farms is greater among farmers with higher educational attainment.

4. The impact of credit on the operating capital of the farms studied is significant at all levels of education except on the small and medium crop farms where credit is significant only among educated farmers. The degree of responsiveness of operating capital to credit on the mixed

and small and medium crop farms is greater among more educated farmers. On the large and very large crop farms operating capital is more closely related to credit use among less educated farmers.

The above conclusions lead to the acceptance of the hypothesis that the intensity of capital use among the farms studied is associated with the educational attainment of the farmer.

POLICY IMPLICATIONS

The data used in this study were based on the 1969/70 production year only. Thus, the interpretation of any statement or policy recommendation is conditioned by this limitation.

The descriptive analysis of Chapter V indicates that there exists significant differences in capital use among farms according to type and size. Policy makers in Brazil must take into account the size and type of farming operation when formulating agricultural policies. Policies which may be appropriate for large farms may not be beneficial for small farms. Specific strategies for specific types of farming, taking into account the farm size, are strongly recommended for the Ribeirão Prêto region. It is also important that research be done according to farm size and type in order to determine the reasons for different responses to changes in agricultural policy and how the capital formation pattern is affected.

The significant relationship between net farm income and fixed capital (i.e. machinery, buildings, and livestock) among mixed, small, and medium crop farms point to the need of instituting product price policies which will benefit the level of farm income of these farms if substantial increases in their productive capacity are to occur. The greater the difference in the farmer's net income the greater the potential for farms to absorb new technology through the acquisition of yield increasing inputs.

The analysis indicates that credit appears to be helping the large and very large mixed as well as the large and very large annual crop farmers to improve their fixed capital structure. Income from off-farm work seems to be contributing to the improvement of small and medium farms' productive capacity but credit does not appear to be having a major impact on the process of capital formation among these farms. Various changes in policy could cause credit use to increase among these farms thus helping them to keep pace with the rate of growth of larger farms.

Agricultural growth is occurring in the Ribeirão Prêto DIRA; however, the skewed land distribution pattern of the region, the massive allocation of credit to larger crop farms, and the impact of policies in the agricultural production process of the region are mostly benefiting the larger farms. This situation may be contributing to a selective process of agricultural growth thus generating a

need for readjustment of agricultural policies so income distribution among farms can follow a more equitable pattern.

Based on the results concerning education it appears that investment in new technology through internal or external funds may be associated with the educational level of the farmer. Investment in education thus may alter the agro-economic environment by helping farmers to better identify profitable investment opportunities. This indicates a possibility of instituting programs to improve the level of education of farmers who are most likely to invest in new agricultural inputs. By so doing it is likely that technological change, especially among small and medium farmers, and the productivity growth of Ribeirão Prêto's agriculture will be enhanced.

Studies with data for a number of years (time series data) should be carried out in order to more thoroughly examine the variables associated with fixed and operating capital.

It is also suggested that studies concentrating on the supply and demand for capital be undertaken. A supply-demand capital analysis for specific factor inputs would be appropriate to determine the major factors which incluence the farmer's investment decisions.

As pointed out in the review of literature, several analyses of resource productivity in Brazil have shown that

various farm groups have low marginal productivity for capital inputs. This present study has shown that the educational attainment of the farmer may be associated with the ability to accept capital changes as well as ability to take advantage of internal or external sources for capital formation. Therefore, it is suggested that marginal productivity analysis be conducted by stratifying farms not only according to size and enterprise specialization but also according to the educational level of the farmers. This would allow production function analysis among more homogeneous groups, which take into account the managerial ability of farmers. Studies concentrating on homogeneous farm groups would help to identify the major determinants of high or low marginal rates of return to various kinds of capital investments. An increasing need appears to exist for studies which attempt to explain the farmer's decisions to defer consumption and incentives to save. Knowing that education is associated with the farmer's level of investment leads to the conclusion that the managerial ability of the farmer may be an important variable to be taken into account in studies concentrating on the investment profitability question.

A final suggestion which stems from the findings of this study is that more research oriented toward small and medium farmers should be done. A proper research program

oriented toward smaller farmers seems to be the pre-requisite if programs and/or subsidies are to be introduced with the intention of increasing small farm production and facilitating capital formation on these farms.

APPENDIX

App. Table 1

Summary Statistics of Fixed Capital and Operating Capital Regression Equations for Large and Very Large Mixed Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Fixed Capital			Operating Capital		
	Regression Coefficient	T-Test for b=0	Beta Weight	Regression Coefficient	T-Test for b=0	Beta Weight
Intercept	-11115.905 (236.197)	47.062***	-	2313.312 (307.901)	7.513***	-
Net Farm Income(X_1)	.235 (.050)	4.703***	.477	.042 (.021)	2.047**	.128
Non-Farm Income(X_2)	.141 (.227)	.622	.063	.026 (.094)	.274	.017
Land Used(X_3)	1.743 (7.909)	.221	.024	12.894 (3.260)	3.955***	.267
Credit(X_4)	.176 (.124)	1.412	.154	.224 (.051)	4.383***	.293
Age(X_5)	285.266 (314.205)	.908	.089	-237.671 (129.526)	1.835*	-.110
Labor(X_6)	315.249 (621.770)	.507	.056	1985.883 (256.315)	7.747***	.525
Level of Commercialization(X_7)	-29.566 (705.729)	.144	-.014	87.431 (84.809)	1.031	.062
R^2	.260			.721		
F-Ratio	4.147**			30.551***		
D.F.	83			83		

( ) = standard deviation
* significant at .10 level
** significant at .05 level
*** significant at .01 level

App. Table 2

Simple Correlation Coefficients Between Pairs of Independent Variables Used to Estimate Fixed and Operating Capital, Large and Very Large Mixed Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	X_7	X_6	X_5	X_4	X_3	X_2
X_1	.16	-.09	-.13	-.03	.27	.35
X_2	.04	.06	-.09	.05	.35	
X_3	.21	.18	.04	.09		
X_4	.13	.48	-.12			
X_5	.05	-.08				
X_6	.04					

App. Table 3

Elasticity Coefficients of Factors Affecting Fixed and Operating Capital on Large and Very Large Mixed Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Models	Elasticity Coefficients						
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Fixed Capital	.51	.07	.04	.22	.77	.12	-.13
Operating Capital	.07	.01	.22	.21	-.48	.58	.30

App. Table 4

The Impact of Education, expressed as dummy variables, upon the independent variables, Large and Very Large Mixed Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education					
	Regression Coefficient			t-Statistics		
	A	B	C	A	B	C
FIXED CAPITAL						
Intercept	-9801.450			20.661***		
Net Farm Income	.121	-.145	.119	.690	.416	.639
Non-Farm Income	.104	-.200	-.141	.238	.218	.237
Land Used	.258	6.928	4.932	.022	.176	.254
Credit	.224	-.165	.436	.570	.388	.856
Age	102.959	-91.569	694.116	.159	.089	.752
Labor	-443.441	584.221	281.486	.191	.225	.108
Level of Commercialization	116.285	-265.976	-564.600	.291	.494	.612
First Dummy (D_1)	15003.422			.167		
Second Dummy (D_2)	25425.629			.376		
R^2	.354					
F-Ratio	1.593					
D.F.	67					
OPERATING CAPITAL						
Intercept	-34199.629			82.137***		
Net Farm Income	.346	-.421	-.345	7.115***	4.335***	6.282***
Non-Farm Income	-.179	.089	.323	1.482	.272	1.962**
Land Used	4.969	33.418	2.459	1.529	3.063***	.456
Credit	.367	-.228	.147	3.549***	1.936*	1.031
Age	160.906	-151.867	-543.911	.781	.533	2.123**
Labor	1864.815	-868.511	100.798	2.894***	1.234	.223
Level of Commercialization	218.410	-310.565	-3.464	1.935*	2.077**	.014
First Dummy (D_1)	27408.238			1.101		
Second Dummy (D_2)	41971.145			2.234**		
R^2	.889					
F-Ratio	23.429***					
D.F.	67					

A = poorly educated
B = moderately educated
C = highly educated

* significant at .10 level
** significant at .05 level
*** significant at .01 level

App. Table 5

Summary Statistics of Fixed Capital and Operating Capital Regression Equations for Small and Medium Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Fixed Capital			Operating Capital		
	Regression Coefficient	T-Test for b=0	Beta Weight	Regression Coefficient	T-Test for b=0	Beta Weight
Intercept	-2060.833 (316.871)	6.504**	-	-3601.496 (229.693)	15.680**	-
Net Farm Income(X_1)	.094 (.033)	2.799**	.280	-.089 (.077)	1.156	-.098
Non-Farm Income(X_2)	.064 (.037)	1.699*	.173	.065 (.085)	.760	.066
Land Used(X_4)	34.744 (19.406)	1.790*	.235	197.145 (44.454)	4.432**	.495
Credit(X_4)	.038 (.063)	.607	.079	.408 (.145)	2.820**	.311
Age(X_5)	10.045 (15.629)	.692	.070	14.382 (36.284)	.396	.034
Labor(X_6)	213.319 (109.417)	1.950*	.233	200.446 (250.814)	.799	.081
Level of Commercialization(X_7)	9.653 (7.525)	1.283	.126	19.540 (17.479)	1.118	.095
R^2	.459			.609		
F-Ratio	7.283**			13.357**		
D.F.	60			60		

( ) = Standard Deviation
* significant at .10 level
** significant at .01 level

App. Table 6

Simple Correlation Coefficients Between Pairs of Independent Variables Used to Estimate Fixed and Operating Capital on Small and Medium Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	X_7	X_6	X_5	X_4	X_3	X_2
X_1	.10	.26	.06	.12	.26	.02
X_2	-.15	-.02	-.01	.01	.24	
X_3	.17	.51	-.01	.56		
X_4	.19	.50	-.28			
X_5	-.06	-.01				
X_6	.22					

App. Table 7

Elasticity Coefficients of Factors Affecting Fixed and Operating Capital on Small and Medium Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Models	Elasticity Coefficients						
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Fixed Capital	.27	.14	.58	.06	.34	.46	.53
Operating Capital	-.07	.04	.96	.20	.13	.13	.32

App. Table 8

The Impact of Education, expressed as dummy variable, upon the independent variables, Small and Medium Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education			
	Regression Coefficient		t-Statistics	
	A	B	A	B
FIXED CAPITAL				
Intercept	-2283.620	.037	7.044***	
Net Farm Income	.066	.037	1.560*	.547
Non-Farm Income	.196	-.216	3.410***	2.639***
Land Used	50.326	-25.208	2.076**	.639
Credit	-.056	.290	.821	2.354**
Age	9.759	12.444	.583	.346
Labor	216.901	-150.676	1.508*	.707
Level of Commercialization	9.397	3.473	1.144	.205
Dummy (D)	-176.822		.069	
R^2	.606			
F-Ratio	5.347***			
D.F.	52			
OPERATING CAPITAL				
Intercept	-4665.843		19.491***	
Net Farm Income	-.141	.001	1.320*	.006
Non-Farm Income	.071	-.053	.508	.286
Land Used	294.235	214.889	4.963***	2.227**
Credit	.037	.805	.182	2.869***
Age	2.061	5.101	.051	.058
Labor	40.212	-63.306	.113	.159
Level of Commercialization	30.224	-38.204	1.520*	.876
Dummy (D)	6990.742		1.116	
R^2	.677			
F-Ratio	7.259			
D.F.	52			

A = poorly educated
B = educated

* significant at .20 level
** significant at .05 level
*** significant at .01 level

App. Table 9

Summary Statistics of Fixed Capital and Operating Capital Regression Equations for Large and Very Large Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Fixed Capital			Operating Capital		
	Regression Coefficient	T-Test for b=0	Beta Weight	Regression Coefficient	T-Test for b=0	Beta Weight
Intercept	-15091.737 (595.125)	25.359***	-	-30952.425 (222.525)	139.096***	-
Net Farm Income(X_1)	.015 (.050)	.291	.034	.162 (.059)	2.707***	.254
Non-Farm Income(X_2)	-.022 (.047)	.462	-.052	-.295 (.055)	5.344***	-.317
Land Used(X_3)	-2.167 (11.327)	.191	-.025	79.169 (13.393)	5.913***	.298
Credit(X_4)	.108 (.036)	3.006***	.455	.550 (.042)	13.031***	.906
Area(X_5)	414.925 (211.022)	1.966**	.147	-94.491 (244.519)	.218	-.006
Labor(X_6)	261.300 (229.237)	1.227	.155	313.452 (271.054)	1.156	.054
Level of Commercialization(X_7)	8.950 (161.218)	.056	.004	302.737 (190.627)	1.588*	.044
R^2	.330			.914		
F-Ratio	8.672***			189.924***		
D.F.	123			123		

( ) = standard deviation
* significant at .20 level
** significant at .05 level
*** significant at .01 level

App. Table 10

Simple Correlation Coefficients Between Pairs of Independent Variables Used to Estimate Fixed and Operating Capital, Large and Very Large Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	X_7	X_6	X_5	X_4	X_3	X_2
X_1	-.01	-.02	.03	-.05	.45	.72
X_2	.00	.15	.05	.19	.48	
X_3	.12	.67	-.07	.70		
X_4	.16	.82	-.07			
X_5	-.19	-.10				
X_6	.22					

App. Table 11

Elasticity Coefficients of Factors Affecting Fixed and Operating Capital on Large and Very Large Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Models	Elasticity Coefficients						
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Fixed Capital	.03	-.02	-.04	.43	1.26	.26	.05
Operating Capital	.08	-.06	.40	.61	-.05	.08	.48

App. Table 12

The Impact of Education, expressed as dummy variables, upon the independent variables, Large and Very Large Annual Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education					
	Regression Coefficient			t-statistics		
	A	B	C	A	B	C
FIXED CAPITAL						
Intercept	-5054.592			5.989***		
Net Farm Income	.114	.160	-.068	.473	.543	.355
Non-Farm Income	.032	-.319	-.138	.116	1.050	.355
Land Used	7.656	23.124	-10.098	.220	.487	.291
Credit	.075	-.036	.172	.362	.172	.817
Age	37.080	841.802	579.089	.106	1.630	1.516
Labor	80.859	-215.378	-421.235	.103	.186	.493
Level of Commercialization	33.747	-797.945	392.199	.182	1.723*	1.001
First Dummy (D_1)	-48760.539			1.052		
Second Dummy (D_2)	42187.750			.776		
R^2	.487					
F-Ratio	4.421***					
D.F.	107					
OPERATING CAPITAL						
Intercept	-2950.021			10.795***		
Net Farm Income	-.310	.170	.497	1.259	.563	1.554***
Non-Farm Income	-.265	.041	-.086	.947	.131	.280
Land Used	34.649	129.105	-.639	.949	2.454***	.016
Credit	.549	-.156	-.064	2.649***	.738	.296
Age	7.936	-72.340	30.291	.022	.137	.052
Labor	1757.706	-1228.905	-1402.485	2.175**	1.047	1.604
Level of Commercialization	24.514	551.299	-413.912	.113	1.163	1.032
First Dummy (D_1)	-28447.945			.0017		
Second Dummy (D_2)	-62523.168			1.1252		
R^2	.951					
F-Ratio	89.639***					
D.F.	107					

A = poorly educated
B = moderately educated
C = highly educated

* significant at .10 level
** significant at .05 level
*** significant at .01 level

Apr. Table 1[a]

Summary Statistics of Fixed Capital and Operating Capital Regression Equations for Small and Medium Perennial Crop Farms, DIRA of Ribeirão Preto, São Paulo, [illegible]

Variables	Fixed Capital			Operating Capital		
	Regression Coefficient	t-Test for b=0	Beta Weight	Regression Coefficient	t-Test for b=0	Beta Weight
Intercept	-2[illegible] (791.056)	[illegible]***	-	-[illegible] ([illegible])	-.[illegible]***	-
Net Farm Income(X_1)	.[illegible] (.060)	1.392	.[illegible]	.1[illegible] (.101)	.287	.[illegible]
Non-Farm Income(X_2)	.112 (.046)	2.[illegible]**	.[illegible]	.[illegible] (.[illegible])	[illegible]**	.[illegible]
Land Used(X_3)	71.[illegible] (37.591)	1.882*	.[illegible]	[illegible] (28.[illegible])	.[illegible]	.[illegible]
Credit(X_4)	.[illegible] (.07[illegible])	.847	.197	.5[illegible] (.1[illegible])	-.[illegible]***	.[illegible]
Area(X_5)	-3.73[illegible] (27.[illegible])	.[illegible]	-.[illegible]	[illegible] ([illegible])	[illegible]**	-.[illegible]
Labor(X_6)	-[illegible].[illegible] (139.[illegible])	.[illegible]	-.[illegible]	[illegible].1[illegible] (262.9[illegible])	[illegible]***	.[illegible]
Level of Commercialization(X_7)	[illegible].32[illegible] (22.70[illegible])	1.075	.[illegible]	.1.7[illegible] ([illegible])	1.[illegible]	.[illegible]
R^2	.[illegible]			.[illegible]		
F-ratio	[illegible].[illegible]***			[illegible].05[illegible]***		
D.F.	[illegible]			[illegible]		

( ) = standard deviation
* significant at .10 level
** significant at .05 level
*** significant at .01 level

App. Table 14

Simple Correlation Coefficients Between Pairs of Independent Variables Used to Estimate Fixed and Operating Capital, Small and Medium Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	X_7	X_6	X_5	X_4	X_3	X_2
X_1	-.17	.59	.09	.16	.35	-.39
X_2	.12	-.10	-.16	.31	.06	
X_3	.25	.49	-.08	.39		
X_4	.12	.40	-.46			
X_5	-.04	-.03				
X_6	.20					

App. Table 15

Elasticity Coefficients of Factors Affecting Fixed and Operating Capital on Small and Medium Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Models	Elasticity Coefficients						
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Fixed Capital	.29	.27	.89	.11	-.24	-.09	1.06
Operating Capital	.14	.16	.21	.32	-.70	.50	.71

App. Table 16

The Impact of Education, expressed as dummy variable, upon the independent variables, Small and Medium Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education			
	Regression Coefficient		t-Statistics	
	A	B	A	B
FIXED CAPITAL				
Intercept	-2534.671		2.258**	
Net Farm Income	.157	-.150	1.928*	.722
Non-Farm Income	.114	-.081	2.171**	.445
Land Used	35.982	29.590	.664	.140
Credit	.193	-.185	1.804*	.765
Age	-35.951	33.501	.690	.330
Labor	54.191	42.469	.189	.112
Level of Commercialization	38.940	-28.579	1.096	.496
Dummy (D)	1542.791		.229	
R^2	.554			
F-Ratio	1.621			
D.F.	22			
OPERATING CAPITAL				
Intercept	-4092.965		6.371***	
Net Farm Income	-.149	.333	1.322	1.183
Non-Farm Income	.220	-.253	3.053***	1.131
Land Used	215.214	47.697	2.862***	.174
Credit	.262	.303	1.786*	.921
Age	-9.276	-156.447	.188	1.138
Labor	-80.210	729.433	.203	1.393
Level of Commercialization	42.186	-39.096	.863	.496
Dummy (D)	7660.184		.649	
R^2	.923			
F-Ratio	17.485***			
D.F.	22			

A = poorly educated
B = educated

* significant at .10 level
** significant at .05 level
*** significant at .01 level

App. Table 17

Summary Statistics of Fixed Capital and Operating Capital Regression Equations for Large and Very Large Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Fixed Capital			Operating Capital		
	Regression Coefficient	T-Test for b=0	Beta Weight	Regression Coefficient	T-Test for b=0	Beta Weight
Intercept	440455.500 (176.800)	249.581**	-	26454.887 (817.756)	34.796**	-
Net Farm Income(X_1)	.045 (.105)	.414	.064	.041 (.048)	.833	.112
Non-Farm Income(X_2)	.019 (.112)	.174	.022	-.045 (.052)	.860	-.09
Land Used(X_3)	85.880 (43.107)	1.992*	.220	11[illegible].624 ([illegible].[illegible])	3.597**	.578
Credit(X_4)	-.041 (.228)	.183	-.022	.200 (.102)	1.960*	.201
Age(X_5)	-128.670 (568.120)	.227	-.029	-[illegible]6.005 (263.253)	.200	-.120
Labor(X_6)	-262.457 (681.826)	.385	-.069	304.782 (315.941)	.965	.151
Level of Commercialization(X_7)	-4533.172 (524.057)	8.650**	-.655	-88.041 (242.835)	.363	-.032
R^2	.709			.778		
F-Ratio	11.806**			14.781**		
D.F.	34			34		

( ) = standard deviation
* significant at .05 level
** significant at .01 level

App. Table 18

Simple Correlation Coefficients Between Pairs of Independent Variables Used to Estimate Fixed and Operating Capital, Large and Very Large Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	X_7	X_6	X_5	X_4	X_3	X_2
X_1	.27	.57	-.32	.22	.65	.53
X_2	-.01	.53	-.20	.26	.32	
X_3	.14	.80	-.16	.37		
X_4	.08	.41	-.49			
X_5	-.07	-.18				
X_6	.04					

App. Table 19

Elasticity Coefficients of Factors Affecting Fixed and Operating Capital on Large and Very Large Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Models	Elasticity Coefficients						
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Fixed Capital	.08	.03	.77	-.05	-.28	-.21	-20.16
Operating Capital	.04	-.03	.58	.13	-.39	.14	-.22

App. Table 20

The Impact of Education, expressed as dummy variable, upon the Independent Variables, Large and Very Large Perennial Crop Farms, DIRA of Ribeirão Prêto, São Paulo, 1970

Variables	Level of Education			
	Regression Coefficient		t-Statistics	
	A	B	A	B
FIXED CAPITAL				
Intercept	35204.810		4.969***	
Net Farm Income	.083	-.077	.327	.270
Non-Farm Income	-.040	.048	.056	.076
Land Used	45.663	50.165	.393	1.195
Credit	-.014	-.057	.024	.095
Age	170.397	-755.668	.112	.445
Labor	-517.151	296.934	.203	.111
Level of Commercialization	-400.765	-4351.094	.152	1.608
Dummy (D)	44578.700		1.911*	
R^2	.756			
F-Ratio	5.142***			
D.F.	28			
OPERATING CAPITAL				
Intercept	5454.700		1.369***	
Net Farm Income	.447	-.245	2.471**	2.172**
Non-Farm Income	-.740	.714	2.748**	2.664***
Land Used	211.539	-92.685	3.207***	1.223
Credit	.369	-.254	1.784*	1.040
Age	407.405	-1073.582	.963	2.597
Labor	-696.530	1162.935	.859	1.109
Level of Commercialization	-744.[illegible]	721.669	.716	.660
Dummy (D)	15439.180		.201	
R^2	.601			
F-Ratio	10.729***			
D.F.	28			

A = poorly educated
B = educated

* significant at .10 level
** significant at .05 level
*** significant at .01 level

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