CAPITAL FORMATION AT THE FARM LEVEL IN SAO PAULO BRAZIL--1970

THESIS

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By

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DEDICATION

To Beth,

with thanks and love.

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CHAPTER 1

INTRODUCTION

A. Purpose of the Study

Economists have no difficulty in the identification of developed countries, nor do they disagree on the characteristics of a less developed country. However, the combination of factors necessary for the transformation of a country from a low level of development to a high level is still not understood very well.

Among all the factors of production, and consequently of development, capital is considered by many to be the most important. Although the importance of capital can not be disputed, the exact definition and the specific components of capital are not clearly understood. The traditional textbook definition identifies capital as, "a good or knowledge which can be reused in the production process." Thus defined, capital can be considered as the lasting factors of production. This would tend to indicate that an evaluation of capital must be strongly correlated with an evaluation of the productive process.

The difficulty encountered in the study of capital is not the identification of capital, once accumulated, nor the identification of the lack of capital, but the identification of the factors which account for the formation of capital.

Agricultural production is basic to the progress of both developed and less developed countries. In most less developed countries it is relatively more important because it often constitutes the greatest share of the productive capacity of the country. The role of agriculture and the need for its analysis is being stressed with increasing urgency. The lack of research at the farm level in less developed countries has prevented the understanding and analysis necessary to arrive at relevant macroeconomic policies pertaining to the dovetailing of the agricultural sector into the total economic development process. It is hoped that this study will be one more small step in the direction of tying the agricultural sector into the total economic picture of Brazil.

B. The Capital Formation Process

Capital formation is the residue of the production process. Each successful production period should end by contributing to the aggregate reusable factors which are basic to the production process.

1. The Factors of Capital Accumulation

Many different processes must be considered within a single period of economic activity resulting in output, income, and investment generation. Although they are mutually interrelated in such a way that income can be considered a function of output and investment a function of income, there are some particular factors accountable for the generation of income independently of output, and for the generation of investment independently of income. The independent income generating factors are: conditions of factor prices, marketing conditions, the taxing system, and output pricing policies. The independent investment generating factors are: consumption patterns, interest rate structure, and credit conditions. All of these factors, together with the production factors, generate capital stock at the end of each period, which is added to the existing capital stock. This additive process is what is called capital formation. Thus capital formation can be considered as a function of the three basic generating processes: output (production), income, and investments.

The stock of capital accumulated in any one period will be the main factor explaining the efficiency of the three economic processes in the next period of time. Part of this stock is converted into capital flow in the

form of production investments for the following period. Thus the development process takes the form of a group of interrelationships as schematically pictured in Figure 1.

2. The Relationship of Capital Formation and Growth

For a less developed economy to escape from the catches of under-development the capital accumulated in one production period should contribute to the expansion of the production process during each ensuing period at an increasing rate. Then after accumulating an adequate base of capital the economy would achieve the so-called "take off" stage of development. Beyond this stage, economic growth would be relatively easy

If capital formation is thought of as the capacity to produce goods and services then it in essence represents economic growth. As capital is accumulated throughout each production period it determines the growth pattern of a country, or sector. The production of each succeeding period depends upon the base amount of capital accumulated plus the amount added at the end of the last period.

Underdeveloped countries can be categorized as having capital formation occur with constant marginal returns. The individual components of these economies can be visualized as growing upward in the form of individual but

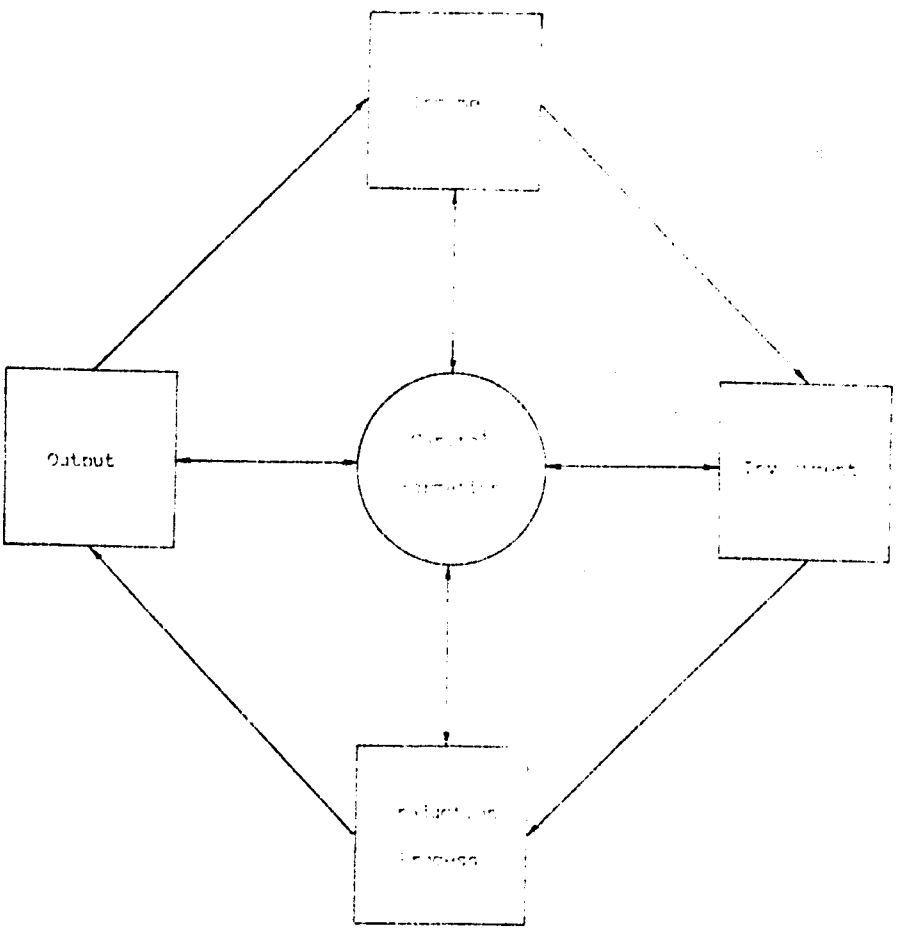


Figure 1. The Interaction of Output, Income, Investment and the Production Process in Capital Formation

interconnected cylinders (Figure 2). Their economies are stagnant and development can only be accomplished with some outside impetus.

Once an economy has been started along the road to development it frequently finds itself with resources which are not fully utilized. These countries realize increasing marginal returns with each successive production period being greater than the previous. Diagrammatically this can be presented as a cone with the point end representing earlier production periods (Figure 3).

The final stage of development, as represented by capital formation, is that of the developed countries. Decreasing returns to scale are being realized in the production process of these countries. This capital formation can be visualized as taking the form of an inverted cone, or pyramid (see Figure 3).

This suggests that capital can be used as the pivotal tool for measuring the economic performance and stage of a country in the development process. Disadjustments and disturbances in one or all of the economic processes result in a discouraging low level of capital accumulation. This scarcity of capital also causes low levels of production, the stagnation of income, and the absence of investment. Thus capital becomes the point of departure

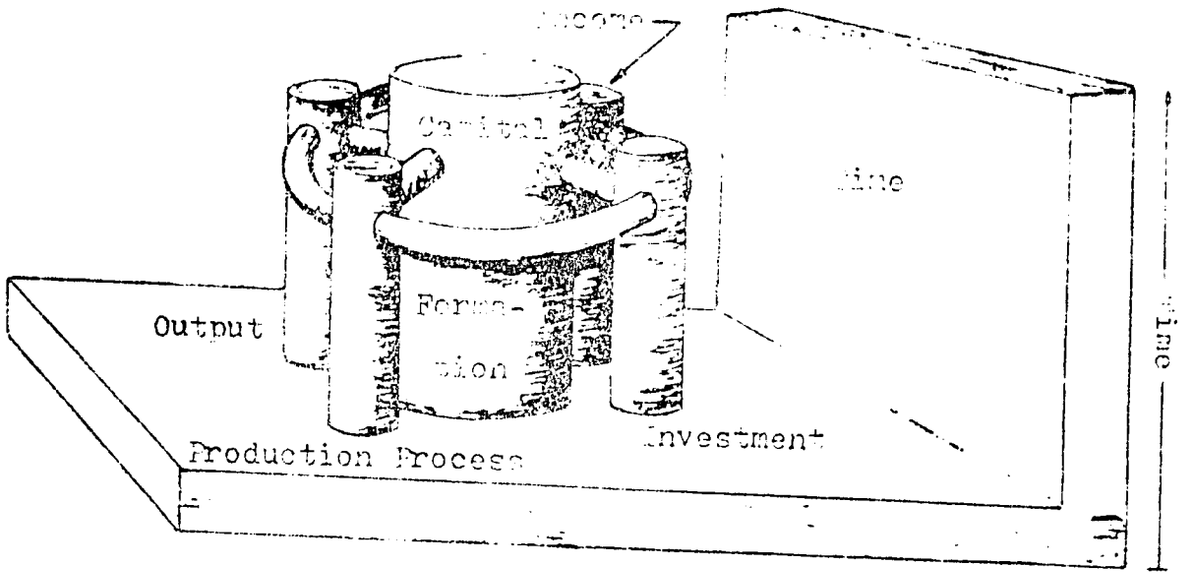


Figure 2. Diagramatic Presentation of the Interaction of Output, Income, Investment, and the Production Process toward Capital Formation in Underdeveloped Countries showing the Growth Pattern

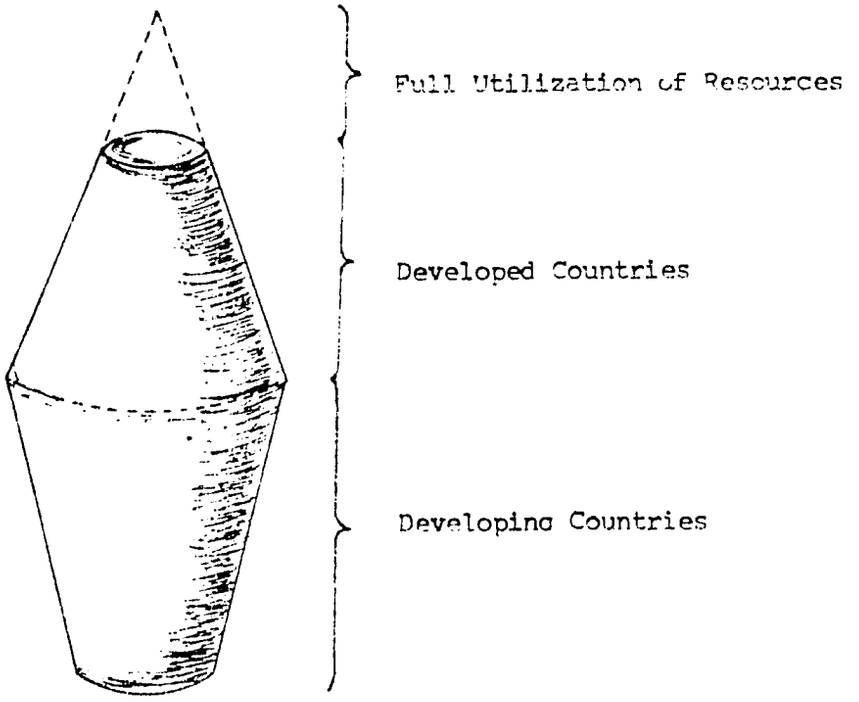


Figure 3. The Growth Pattern for Output, Income, Investment, the Production Process and/or Capital Formation for Different Stages of Economic Development

for unfolding the total picture of the developmental inefficiencies of an economy and the common background for making comparisons among countries or among sectors within an economy.

C. Objectives

While the overall objective of this research project is to better understand the role of capital formation in the development process, this study has as its specific objectives:

1. To compare the forms in which capital is accumulated according to size and type of farming.
2. To determine the amount of capital accumulated according to size and type of farming.
3. To identify the principal factors accountable for the accumulation of capital according to size and type of farming in a given area of the State of Sao Paulo, Brazil.
4. To analyze the efficiency of selected factors contributing to the basic forms of capital accumulation.
5. To arrive at a set of recommendations which can be used by policy makers.

CHAPTER II

BACKGROUND

A. The Area Studied

The data analyzed in this study are only a part of a large body of data being generated under a broad Capital Formation and Technological Change project in Brazil. Data have been collected in the States of Rio Grande do Sul, Santa Catarina, Minas Gerais and Sao Paulo.

Of course, it would be very difficult to include farms from all of these States into one representative sample. Indeed a state the size of Sao Paulo has many heterogeneous aspects in its agricultural sector. For this reason, this study will concentrate on one comparatively homogeneous region in the northeastern part of the State. The region is known as the DIRA (Divisao Integral Regional Agricola) of Ribeirao Preto.

1. Geographic Location

Brazil is the largest country in South America and the fifth in the world in land area. The country extends from the temperate zone of the southern hemisphere to the tropical zone of the equator (Map 1). Within these boundaries reside more than 80 million people.

Map 1. States and Territories of Brazil

The State of Sao Paulo is located in the south-central part of the country. The state lies at the hub of both the agricultural and industrial complex of the country. It is bordered by the states of Minas Gerais, Matto Grosso, Parana, and Guanabara. It also enjoys the facilities of the Atlantic Ocean along its eastern border (see Map 2).

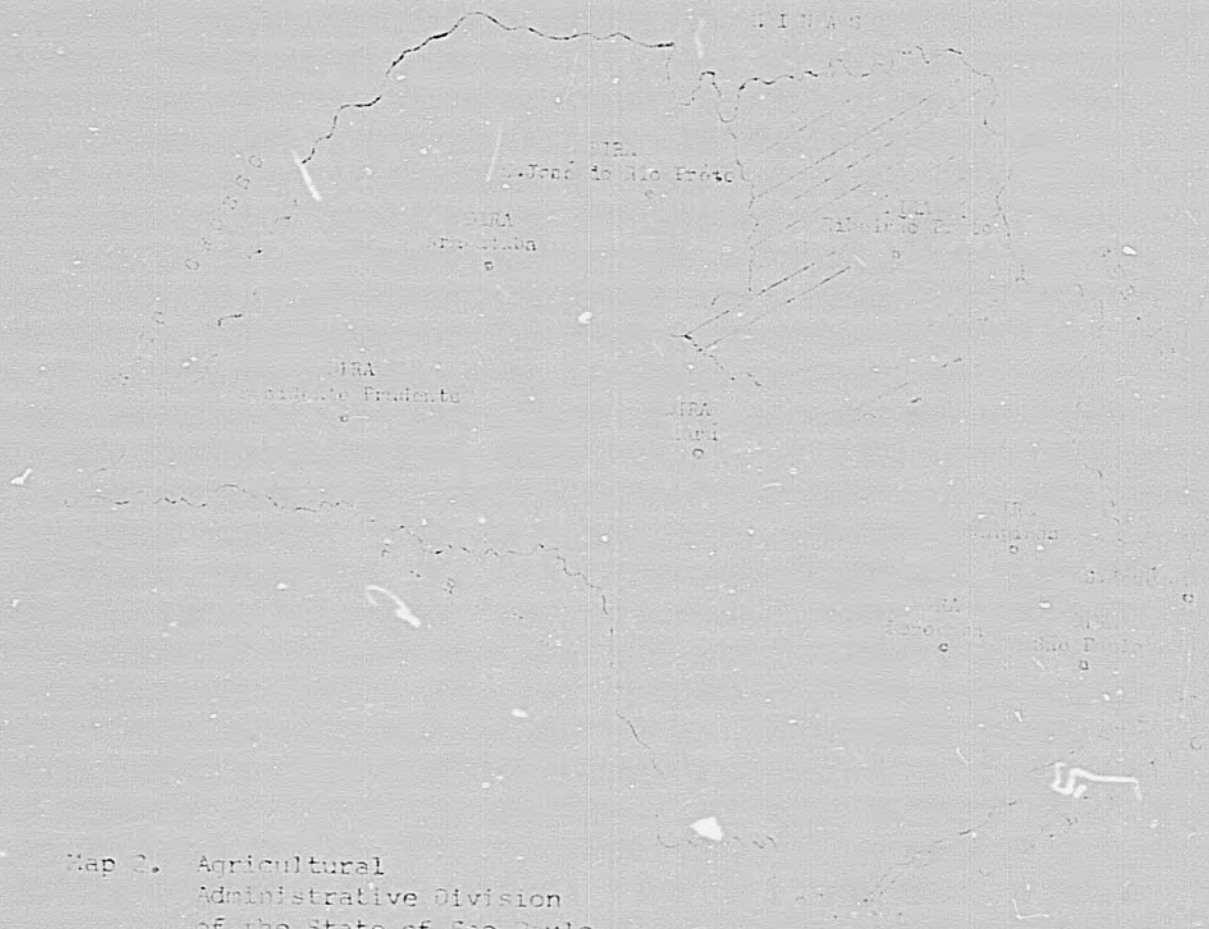
Within its 247,896 sq. km. (24.7 million hectares) reside nearly one-fourth (18 million) of Brazil's total population of 80 million. Of the state's population approximately seven million are residents of the capital city of Sao Paulo.

The DIRA of Ribeirao Preto is located in the northeastern corner of the state and bordered to the east and north by the State of Minas Gerais (see Map 2). The DIRA consists of 80 municipios and encompasses approximately 3.6 million hectares or about one-eighth of the land area in the state.

The region has adequate communication media with the major marketing and political centers of the country via air, rail, or road.

Natural Characteristics

The general climate of the area studied is sub-tropical with a wet summer and dry winter. Annual rainfall varies from 1,100 to 1,700 mm. The month of



Map 2. Agricultural
Administrative Division
of the State of São Paulo

January receives the most precipitation, about ten times the amount during July. The principal climatic variations within the area are caused by the difference in elevation of the surrounding hills, as the valley bisects by cutting northwesterly through the DIRA.[1] Temperature varies between 16° and 22°C. with July being the coldest month. Frost is very rare and occurs only at higher elevations.

The topography varies from flat to hilly with altitudes of 500 to 1,000 meters above sea level. Approximately 50 percent of the soil in the region is terra roxa legitima--the soil which is most famous for its capability in the production of coffee and sugar cane.

3. The Role of Agriculture[2]

Sao Paulo is the most industrialized state of Brazil. About one-half of the state income comes from the industrial sector; in the rest of the country the industrial income is less than one fourth of the total income. Agricultural income represents only one eighth of Sao

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[1] Kelso L. Wessel and William Nelson, Methodology and General Data Description: Farm Level Capital Formation in Sao Paulo, Brazil, Studies in Agricultural Capital and Technology, Economics and Sociology Occasional Paper No. 47, Columbus, 1971.

[2] The information for this section comes originally from: Desenvolvimento da Agricultura Paulista, published by the Instituto de Economia Agricola, Sao Paulo, 2 vol., March, 1971.

Paulo's income, while in the rest of Brazil the agricultural income is one fifth of the total. The rate of growth of agricultural output is 2.4 percent annually, of the industrial sector 9 percent annually, and of the services sector 5.9 percent. Agricultural output has been increasing more rapidly in the rest of the country (4.7 percent), while industry and services have grown at rates of 7 percent and 6.2 percent, respectively.

The per-capita income for the agricultural sector of Sao Paulo presents good prospective trends. Although it still represents only 62 percent of the industrial per-capita income of the state, it has increased 50 percent during the last 10 years, whereas the non-agricultural per-capita income has remained stagnant over the same period. These figures emphasize the fact that migration of the rural labor force to the urban centers is beneficial for the workers remaining in agriculture. However, the industrial sector of the state is not capable of overcoming the pressure the rural migrants add to the natural growth of the population in the cities.

Agriculture in the state of Sao Paulo is not only the most important of all other sectors of the national economy but is increasing in importance. Two decades ago agriculture in the state accounted for 26 percent of the gross national product. Today the state's agriculture

accounts for 35 percent of the GNP. In 1967 the value of agricultural output in the State of Sao Paulo was 1.66 times that of the second ranking state and 1.75 times that of the third most agriculturally productive state.

The state of Sao Paulo is a leading producer of all the principal crops of Brazil. The six most important crops are: corn, coffee, rice, peanuts, sugar cane, and cotton. The state also ranks first in the production of several other products such as: potatoes, oranges, and tomatoes.

Within the state of Sao Paulo the DIRA of Ribeirao Preto is the most important in the production of agricultural products. It is a major producer of all the most important crops in the state as well as the country.

B. Related Studies on Agricultural Capital Formation

1. The Concept of Capital

It is commonplace to assert that there are as many definitions of capital as authors writing about capital. The trouble arises not because capital is a vague undetectable reality in the economic activity, but because of the difficulty of identifying the borders. Capital is a pervasive entity, which makes it difficult to separate from other important elements of economic production, especially human labor. "Capital, and the

application of science to industry, are immensely productive," says Mrs. Joan Robinson.[3] But there is by no means unanimity in defining this impressive reality. Joseph A. Schumpeter has reviewed the trials of many authors attempting to reach a definition of capital, and arrived at the conclusion that too much time has been spent on trying to solve problems by hunting for the definition of words.[4]

However, when the central core of a study is something as vital as capital it is necessary to arrive at a common understanding of the basic terms being used before analysis can occur. Both Shukla and Adams have arrived at criteria by which capital can be identified. Shukla looks for some common criteria of "rational consistency" to avoid a total arbitrariness in defining capital. Adams thinks that the definition should meet "pragmatic criteria, . . . should be useful in making policy decisions."[5]

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[3] Joan Robinson, An Essay on Marxian Economics, New York: Macmillan, 1966, p. 19.

[4] Joseph A. Schumpeter, History of Economic Analysis, New York: Oxford University Press, 1955, p. 898.

[5] Tara Shukla, Capital Formation in Indian Agriculture, Bombay, India: Vora & Co., 1965; and 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, March, 1971.

For Shukla, the features that must be looked at in identifying capital are: a) transferability from stock into services, b) transferability from one point of time to another, c) productiveness, or productive capacity. The pragmatic approach of Adams comes surprisingly close to the theoretical one of Shukla. Adams identifies the following characteristics: a) capital has to be created by man, b) it has to be productive, c) its nature is of the order of a stock rather than pure flow, and d) it has to be related to the process of originating savings and investments.

Trying to combine the two approaches, it appears that the following definition of capital can be used as a satisfactory ground of common understanding of the concept of capital at a rather general level: "Capital is a stock of man-created goods used over time in the production process through its ability to be saved from consumption and converted into services."

In an unpublished paper presented in a seminar at the Department of Agricultural Economics and Rural Sociology, The Ohio State University, in Columbus, February, 1971, Adams presented a framework which has been adopted for this thesis. Four major divisions of that work are: 1) a summary of the evolution and role of capital in the history of economic thinking, 2) a brief discussion on the definition of capital, 3) a sketch of the relationships

between capital and technology, and 4) a statement of the major policy questions and research issues on rural capital formation.[6]

There are some very deep and wide theoretical studies on issues related to capital and its role in Economics. The books of Irving Fisher, The Nature of Capital and Income (1906), and of Joan Robinson, The Accumulation of Capital (1956), are but two examples. This review of literature will be related to more empirical questions.

2. Aggregate Level

Developed Countries. The basic research, and necessary point of departure, for studies on farm capital is a book by Alvin Tostlebe.[7] He studied the long-term trends in U.S. agriculture from 1870 to 1950. The objectives were to identify the circumstances inducing investment in farm assets, variations of investment from one period to another, and the sources which provided financing. Basic sources of information were the published reports of the Bureau of the Census and the Bureau of Agricultural Economics. The

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[6] Adams, op.cit.

[7] Alvin Tostlebe, Capital in Agriculture: Its Formation and Financing Since 1870, Princeton, N.J.: Princeton University Press, 1957.

data were developed and analyzed by type-of-farming regions. Ten different agricultural regions were defined according to the principal factors determining capital formation. Tostlebe also formulated a series of prospective trends of the formation and financing of farm capital.

The most important findings of this study were:

1) The gross agricultural output of the country rose about 400 percent in 80 years. In this process capital and labor played very different roles. While the labor force at the end of the period was about the same as in 1870, the value of physical capital (land included) increased about three times.

2) Of the total increase in agricultural capital, 65 percent was accountable to land, 15 percent to buildings, 4 percent to implements and machinery, 10 percent to livestock, and about 6 percent to crop inventories.

3) The bulk of financial needs was met mainly out of gross farm income, 90 percent during the decade of 1940-49.

Other studies on farm capital in other developed countries are more general. Andrew W. Ashby reports that the most relevant trends of British agriculture from

1930 to 1954 were: a decrease in the proportion of tenant-managed farms, an increase in the share of capital invested by tenants, and an increase in the share of machinery and implements in the composition of farm capital.[8]

The mechanisms of capital supplies to agriculture in Denmark since the eighteenth century have been studied by Skovgaard. The agrarian reform implemented at the end of that century is reported and its consequences in the present affluent situation of the Danish agriculture are stressed.[9]

Ciarocca states that: "The income of Italian agriculture is insufficient to supply more than a very small part of its capital needs."[10] The historic, sociological, and legal factors of this situation are analyzed.

Less Developed Countries. The basic research in this section is the impressive work of Tara Shukla on Indian farm capital formation.[11] She

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[8]Andrew W. Ashby, "Capital Formation and Use in United Kingdom Agriculture", International Journal of Agrarian Affairs, July, 1957, pp. 267-273.

[9]K. Skovgaard, "Capital Formation and Use in Danish Agriculture", International Journal of Agrarian Affairs, July, 1957, pp. 209-222.

[10]V. Ciarocca, "Capital and Credit in Agriculture: Italy (I)", International Journal of Agrarian Affairs, Vol. 2, No. 4, January, 1958, pp. 309-317.

[11]Shukla, op.cit.

criteria of rational consistency will serve the practical purpose of identifying any good as capital: 1) transferability from stock to assets, 2) transferability in time, and 3) productiveness.

Then Shukla discussed whether the magnitude of capital to be measured should be the stock or the flow of goods, whether the units of measure should refer to the cost of producing capital or to the contribution of capital to output, how within two points of time comparable measures can be performed, and how depreciation of capital goods can be estimated.

She hypothesized that shifts in supply would depend on changes of either income or technology; and shifts in demand would depend on the supply of labor and/or expectations regarding the future. Another hypothesis was related to capital formation in less developed agricultural sectors. Capital should keep pace with labor, due to shifts in the saving function, and the uncertainties regarding the future should be reflected by a change in the composition of assets from less durable goods (i.e., fertilizer) to more durable goods (i.e., land).

Shukla concluded:

> The stock of capital in agriculture in India, has tended to grow over the forty year period under study. The accumulation of capital has, however, not been at an even pace nor at a fairly high rate to enable the agricultural output to grow significantly. The overall growth of stock of capital is barely enough to keep pace with the rising tide of labor supply. The rate of capital accumulation has fluctuated, it would seem, in response to changes in the return to capital, being very low during the period of rigid control on prices, production and distribution of output and somewhat larger during the period when technology seems to respond to incentives, technological changes, and income levels. Low income levels by themselves would not explain fully the low levels of investments.
>
> In the context of underdeveloped economy such as that of India, probably the accumulation of capital seems to get the major incentive from the increase in labour supply. For this, a relationship of low substitution or complementarity between capital and labour seems to be responsible. This would happen when the technique of production remains more or less unchanged.
>
> We can also conclude that, due to a lack of major technological change, the traditional forms of capital have dominated. Irrigation, a major land substitute, has, however, helped in relieving the pressure of labour and land, and land itself has increased to some extent. The new forms of capital assets have tended to increase at a rather rapid rate only during the last decade.[12]

Ragnar Nurkse discusses some theoretical problems involved in the capital formation theory of less developed

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[12] Shukla, op.cit., p. 232-233.

countries at the aggregate level.[13] He defends the balanced growth approach; in fact, he set the stage for the studies by W. A. Lewis and the followers of the school of dualistic economy, which stresses the need for the domestic building up of capital.

Natan Rosenberg thinks the central point of analysis in a theory of economic development is to understand why the market structure of underdeveloped countries fails to induce a convenient level of private investments.[14] Thus, he is supporting one of Nurkse's ideas in the context of balanced growth. For him economists have focused on the wrong issues when studying capital formation in less developed countries.

Richard W. Hooley contends that current aggregate level estimation procedures in the determination of capital built up in less developed countries are inaccurate and often downward baised.[15]

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[13] Ragnar Nurkse, Problems of Capital Formation in Underdeveloped Countries and Patterns of Trade and Development, New York: Oxford University Press, 1967.

[14] Natan Rosenberg, "Capital Formation in Underdeveloped Countries", The American Economic Review, Vol. 50, No. 4, September, 1960, pp. 706-715.

[15] Richard W. Hooley, "The Measurement of Capital Formation in Underdeveloped Countries", The Review of Economics and Statistics, May, 1967, pp. 199-208.

3. Farm Level

Less Developed Countries. In an anthropological study of a Malayan village, focusing mainly on savings and capital formation, Swift found out that most of the savings in the village were held in jewelry or livestock. Very little working capital was held for the production of the major crop, rubber. He concluded that productive investments in the village were increasing very slowly.[16]

In 1957, Robert D. Stevens interviewed about 170 Lebanese farmers in 11 different villages. The main objective was to calculate the capital base and to find the variables related to differences in this capital base, as well as data related to credit use and institutional savings. The villages studied had begun the transition from a strictly agricultural economy to a partly industrialized community. Price elasticity of the supply and demand for capital was believed to increase as the state of economic development improved.[17]

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[16] Michael G. Swift, "The Accumulation of Capital in a Peasant Economy", Economic Development and Cultural Change, Vol. 5, No. 3, April, 1957, pp. 325-337.

[17] Robert D. Stevens, "Capital Formation and Agriculture in Some Lebanese Villages", unpublished Ph.D. dissertation, Department of Agricultural Economics, Cornell University, February, 1959.

The major conclusions of the study were: a) land value represented 90 percent of the capital base of all farms, b) the average value of tools and equipment per unit of land was $4.00 as opposed to $53.00 for farms in Bryden, N.Y. in 1947, although the average value of capital per unit of land was the same as on New York farms ($304), c) the marginal propensity to save rose with the farm size, d) land tenure security was important in explaining credit use, e) the supply of capital was stronger than the demand for it, and f) money that could be available for savings investment was hoarded.

Using 1963 farm records, Hsing-Yin Chen researched the structure and productivity of farm capital with a sample of 277 Taiwanese farms.[18] The amount and degree of capitalization of the sample was slightly higher than for the average Taiwanese farm. A production function using least squares regression was estimated to measure elasticity coefficients of production and marginal productivity of input factors.

In relation to farm capital structure, the relevant findings of this study were: a) fixed farm assets had a

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[18] Hsing-Yin Chen, "Structure and Productivity of Capital in the Agriculture of Taiwan and Their Policy Implications to Agricultural Finance", unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1967.

greater share in the total farm capital value than financial assets, b) internal sources of financing represented 95 percent of all financial sources of capital, c) there were low returns on investments in farm assets, and d) capital investment per farm was low but capital investment per unit of land was more than 10 times the corresponding figure for U.S. farmers. In relation to capital productivity, Chen found: a) investment in farm operating expenses was highly productive but investment in farm assets was not productive enough to cover interest costs, b) buildings, fixtures, and farm machinery were the less productive farm assets, and c) only wages of hired labor were unproductive operating expenditures.

Brazil. A study in the southernmost states of Brazil, Santa Catarina and Rio Grande do Sul, in 1965, concentrated on an analysis of income, consumption, and investment patterns on farms of various types and sizes.[19] Three major conclusions were reached through this research: a) there are important differences of income, consumption, and investment patterns between different types of farming;

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[19] Norman Rask, "Analysis of Capital Formation and Utilization in Less Developed Countries: Terminal Report for Research Project", unpublished paper, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1969.

b) as farm size increases the level of farm cash receipts and the level of net farm income per hectare decreases; and c) the level of borrowing as well as the saving potential per unit of land remains constant.

The second study analyzes the resource productivity of the same farms.[20] Martin found that: a) diminishing average returns to land are evident as size of farm increases; b) land is an important factor of production for types of farming classified as range livestock, mechanized crop, and dairy production; c) land acreage per unit of labor increased 42 times from the smallest to the largest farm; d) crop expenses are the most universal capital flow item, followed by livestock expenses; e) labor expenses appear profitable only on farms above 20 hectares, beyond this size farm surplus family labor was no longer in evidence; f) machinery expenses did not prove to be an explanatory variable for output; and g) capital stock was an explanatory variable for almost all types of farming, but it did not show much variation between types of farming and less between sizes.

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[20]Larry J. Martin, "Returns to Capital Inputs on Crop Farms in Southern Brazil", unpublished M.S. thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1967.

A third study, by Bernard L. Erven, analyzed the impact of selective price and credit policies on the use of new inputs and mechanization at the farm level.[21] It was found that: a) for purposes of credit and price policies the diversity of agriculture within one region has to be considered; b) a package program of mechanization and other complementary technological inputs induced major structural and productivity changes.

Another study concentrated on the management performance and productivity of capital resource under different levels of management of hog farms.[22] It was found that the superior managers had slightly larger farms, used greater total quantities of capital and used it more intensively.[23]

Bodepudi P. Rao studied the use of credit on farms.[24] Rao's work, though drawing its sample from the same major

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[21] Bernard L. Erven, "An Economic Analysis of Agricultural Credit Use and Policy Problems--Rio Grande do Sul, Brazil", unpublished Ph.D. dissertation, Department of Agricultural Economics, The University of Wisconsin, 1967.

[22] Donald E. Sorensen, "Capital Productivity and Management Performance in Small Farm Agriculture in Southern Brazil", unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1968.

[23] Rask, op.cit., p. 99.

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

study analyzed by Rask, used a wider sub-sample, representing more major types of farming and wider ranges in the sizes of farms than either of the related studies.

He concluded that the per hectare income (output), both gross and net, was highly correlated negatively with the size of the land holding and that there was a definite tendency for total farm land to be more productive, the smaller the establishment.[25]

In summary, the previous studies indicate that there is a need in Southern Brazil, and especially on small farms, for further investment of capital in operating expenses. There appears to be a difference between various types and sizes of farms with respect to productivity of resources, availability of institutional credit, intensity of capital investment, and degree of under-utilization of capital.

More recently, Joseph L. Tommy evaluated the capital accumulated on a sample of 289 small and medium sized farms in Southern Brazil.[26] Three general objectives were pursued: a) calculating and analyzing the capital base of

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[25] Ibid., p. 37.

[26] Joseph Lissa Tommy, "Credit Use and Capital Formation on Small to Medium Sized Farms in Southern Brazil--1965-1969", unpublished M.S. thesis, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1971.

the farms for two points of time, 1965 and 1969; b) analyzing the credit use during both periods; and c) identifying those characteristics of farms which are most closely associated with changes in capital base and in credit use. The data were obtained from two different studies during 1965-66 and again in 1969-70.

The most relevant findings of this study were that: a) farm capital grew in value by 14 percent from 1965 to 1969 and the value of land and buildings made up a major part of this increase; b) capital invertment in machinery also increased substantially; c) use of credit and an increase in the capital base were closely related; d) institutional credit use of the farms increased as rapidly as the national average; e) neither farm size, type of farm, nor regional location was sufficient to explain the use of credit, but credit use was strongly related to the previous loan experience of the borrowers.

William C. Nelson studied the use of fertilizer on some of the farms from the same sample as used for this thesis, and found that the use of additional fertilizer was generally not profitable in the region.[27]

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[27] William C. Nelson, "An Economic Analysis of Fertilizer Utilization in Brazil", unpublished Ph.D. dissertation, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1971.

José Valdeci Biserra studied the output/factor ratio in the production of corn in two municipios of the DIRA of Ribeirao Preto, taking his data from the same sample as Nelson and the author of this thesis. He concluded that corn farmers in that area were operating on a sound business and market oriented basis. Constant returns to scale and excess investment in labor were suggested by the analysis.[28]

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[28] José Valdeci Biserra, Analise de Relações Fator-Produto na Cultura do Milho em Jardinópolis e Guaira, Estado de Sao Paulo, Ano Agricola 1969/70, dissertaçao para titulo de Mestre, ESALQ, Piracicaba, Sao Paulo, 1971.

CHAPTER III

METHODOLOGY AND PROCEDURE

A. The Sample

As previously indicated, this study is part of a major research effort on rural capital formation and technological change by The Ohio State University with the main focus on Brazil. Selection of the area, sampling, interviewing, and general organization of the project were completed prior to the conception of this thesis. A brief description is presented here of the sampling technique. (For a more detailed description of the sampling technique see Wessel and Nelson.)[29]

1. Selection of Sample Area

The importance of agriculture within the state of San Paulo and within the Brazilian economy determined the selection of this state for the project. Also, the fact that there are data from two other southern states, Santa Catarina and Rio Grande do Sul, made Sao Paulo the missing link in the understanding of agriculture in southern Brazil.

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[29] Wessel, op.cit., pp. 14-22.

Ten municipios located in the DIRA of Ribeirao Preto were included in the sampling frame: Altinopolis, Barretos, Batatais, Colombia, Guaira, Jardinopolis, Pontal, Ribeirao Preto, Sertaozinho, and Sales de Oliveira (see Map 3). These municipios represent the following characteristics:

1) In each, the farms tend to be specialized in one or a few enterprises: Altinopolis and Batatais--coffee and dairy; Barretos and Colombia--beef cattle; Guaira, Jardinopolis, Ribeirao Preto, and Sales de Oliveira--one or more annual crops; Pontal and Sertaozinho--sugar cane.

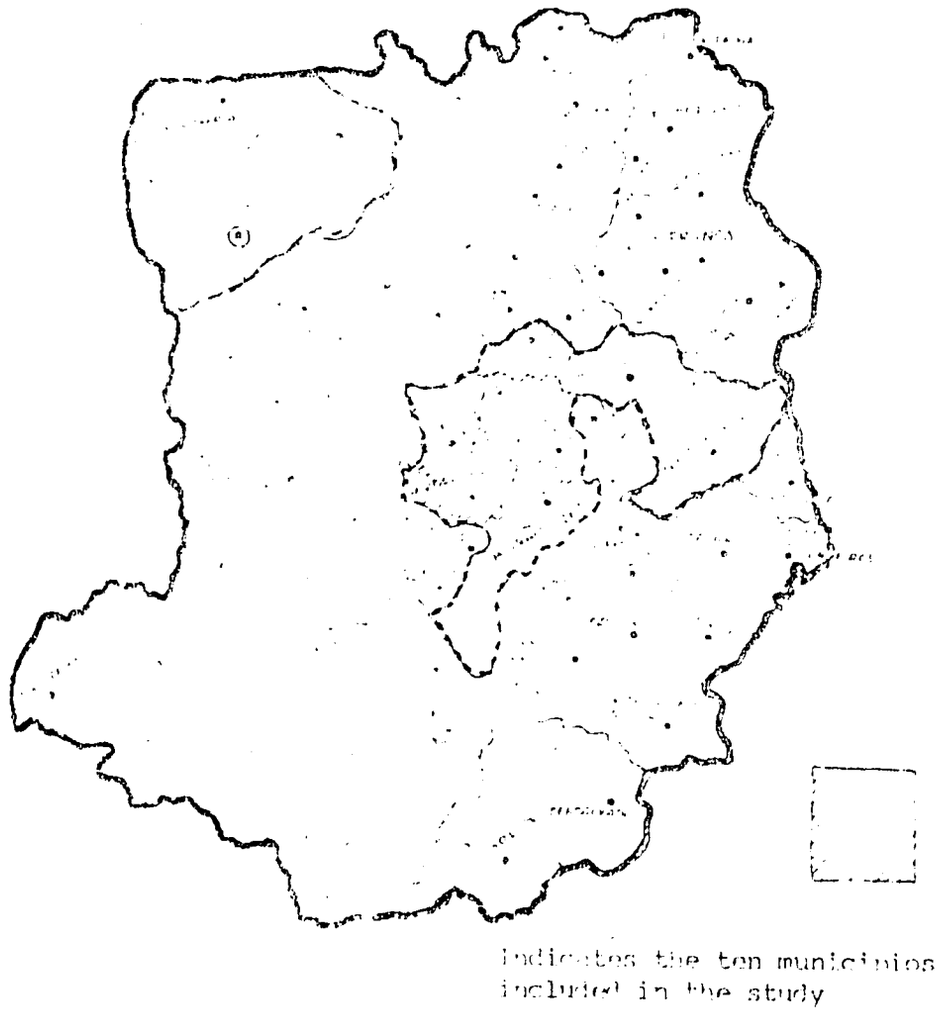
2) The other major crops grown within the state were also cultivated in one or more municipios (i.e. cotton, rice, potatoes, etc.).

3) Each of the municipios had an active agricultural extension agent, a privilege afforded by only 50 of the 80 municipios in the DIRA. Furthermore, all of these agents were willing to actively cooperate during the fieldwork phase of the project.

4) Most of the farmers in these ten municipios could be easily contacted by locating the interview team in only three different towns.

5) Farms of similar enterprises were very homogeneous regarding soil type, soil quality, and topography.

6) There appeared to be an adequate range of capital formation within each type of farming.



Map 3. Location of the Municipios Included in the Study within the DIRA of Ribeirao Preto

2. Drawing of Observations

It was decided that the sample should allow for stratification by farming enterprise and by size of operation. Therefore, the sampling procedure was based upon the following criteria:

1) The sample should be random without bias toward either traditional or progressive farms.

2) The farms should be owner operated.

3) More than 50 percent of the land area should be under cultivation. This would eliminate land held for speculation.

4) Incorporated farms or operators principally engaged in non-farming enterprises (i.e. sugar mills, pinga factories, etc.) should be excluded from the sample.

5) Farms smaller than 10 hectares were excluded because it was felt that they were not representative of viable farming operations. Farms larger than 3,000 hectares were discarded because they were expected to include most of the non-farming enterprises and absentee ownership.

6) The farms had to be utilized for specialized enterprises.

The files of IBRA (Instituto Brasileiro de Reforma Agraria) were used as the roll of the total farms population. After eliminating farms which did not fulfill the above criteria, a sample of farms were randomly

selected from the roll. Approximately 43 percent of these farms were devoted to annual crops production, 35 percent to perennial crops production, and 22 percent to livestock production.

Approximately 344 of the 549 farms were not accurately described by the IBRA cards. During the fieldwork it was discovered that they did not meet the original selection criteria and were eliminated from the sample. To replace them another 178 farms were drawn; however, the selection process did not always adhere to the original criteria as the fieldwork progressed. The final sample included 383 farms.

The final sample did approximate the desired stratification according to the characteristics of size and enterprise specialization. Some renter-operator farms were included in the final sample.

B. Data Organization

1. Complete Data Bank

The interviewing schedules were completed during July, 1970, at the end of the harvest season for all crops grown in the area except coffee and sugar cane. Production data for these two crops corresponds to the 1969 harvest rather than the 1970 harvest which was just beginning for both crops.

A detailed interview schedule, covering all areas of economic interest, was completed by each of the 383 operators in the ten municipios. The responses were checked, in the field, for internal consistency, error and clarity. Some operators were recontacted as many as three times before their responses were definitely filed.

The responses were coded and recorded on approximately 28,000 IBM cards as well as magnetic tapes. The data were checked again for consistency and accuracy against the original questionnaires. This process was completed by September, 1971, by the Departments of Agricultural Economics and Rural Sociology at OSU and ESALQ.

Each observation was given an identification number which allows their classification by types of land-tenure arrangement (10 types), land area (5 strata sizes), type of farming (9 different enterprise specialities), and municipios (10).

2. Restratification of Farms

Because the strata for both size and type of farming for the original data bank were determined a priori more representative strata were developed for the present

analysis. First, the observations were stratified according to the following five types of farming:

I. Annual Crops--more than 50 percent of the value of farm output came from either cotton, rice, corn, or soybeans.

II. Perennial Crops--more than 50 percent of the value of farm output came from either sugar cane or coffee.

III. Livestock--more than 50 percent of the value of farm output came from livestock.

IV. General Crops--the conditions for neither I or II were satisfied but more than 90 percent of the value of farm output came from crops.

V. Mixed Farming--all other farms, meaning farms which had both livestock and crops but neither predominated.

Secondly, observations within each of the above types of farming were divided into three strata--small, medium or large--such that each size stratum within each type of farming contained approximately one third of the number of observations in that type (Table 1). Stratification by size within each type of farming became necessary when it was realized that a farm which was considered large for general crops would be considered a small farm in the municipios where beef cattle predominated.

Table 1. Range of Values of Land Area in Each of the Sizes of Farms According to Type of Farming

Type of Farming	Size of Farm*		
	Small	Medium	Large
	(hectares)		
I. Annual Crops	10 - 46	47 - 137	138 - 3,312
II. Perennial Crops	12 - 31	32 - 101	102 - 720
III. Livestock	17 - 106	107 - 274	275 - 1,860
IV. General Crops	12 - 58	59 - 206	207 - 2,616
V. Mixed Farming	14 - 101	102 - 322	323 - 2,316

*Range of hectares for each size group when the total number of observations in each type of farming were equally divided into three sizes.

With the exception of general crop farms, the two-way stratification by size and type of farming permitted a more homogeneous and equal grouping of the farms. In addition, each of the 15 cells in the two-way classification table contained a nearly equal number of the sample observations (Tables 2, 3, & 4). This would also facilitate the use of various statistical tests to determine whether there was a significant difference by size of farm or type of farming for various economic factors of capital formation.

C. Terminology and Computations

Every attempt has been made to use only the accepted terminology of farm management. However, because of the nature of farming in Brazil some exceptions had to be made.

1. Terminology

Value of land owned. Includes land being operated, land occupied by buildings, and idle land.

Value of permanent constructions. Includes both residential buildings and non-residential buildings, and other constructions such as farm roads, bridges, telephone and electrical installation, fences, wells, etc.

Table 2. Distribution of Sample Observations According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Total
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(Number of Farms)					
Small	33	26	28	10	30	127
Medium	30	25	29	12	31	127
Large	33	25	30	11	30	129
Total	96	76	87	33	91	383

d.f. = 14

χ^2 = 34 , significant at 0.002 level

Table 3. Proportionate Distribution of Sample Observations According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Total
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(percentages)					
Small	8.7	6.8	7.3	2.6	7.8	33.2
Medium	7.8	6.5	7.6	3.1	8.4	33.4
Large	8.6	6.5	7.8	2.9	7.6	33.4
Total	25.1	19.8	22.7	8.6	23.8	100.0

Table 4. Relative Distribution of Observations in Each Size Group According to Type of Farming, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Total
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(percentages)					
Small	25.98	20.47	22.05	7.87	23.62	100
Medium	23.44	19.53	22.66	9.37	25.00	100
Large	25.78	19.53	23.44	8.59	22.66	100
Average for all Farm Sizes	25	20	23	9	24	100

Value of land improvements. Includes the value of labor and material used for land reclamation and clearance, irrigation and flood control systems, establishment of perennial pastures, etc. It also includes outlays for the establishment and maintenance of orchards, vineyards, timber tracts, coffee plantation, etc. until they become productive--if they take more than one year to become productive.

Capital value of land rented in. Does not necessarily represent the market value of the land. It is assumed that renting in land for farming is not normally a better investment than farming land which is owned. If the costs of renting in were zero, then renting in land could be considered as an investment which would be as profitable as using owned land. In this case the capital value of the rented in land would be its market value. Anytime the costs per hectare are higher than the returns, renting in would be a liability to the farmer and would have a negative capital value.

The capital value per hectare of land rented in was determined by using the following formula:

$$C_I = L_I(1 - \frac{R_I}{O})$$

where:

C_I = capital value of land rented in

L_I = market value of land rented in

R_I = payment for land rented in

O = average gross returns from land operated .

Capital value of land rented out. When receipts per hectare for land rented out are greater than the returns which the owner could obtain by farming the land personally then renting out is a positive investment. However, if the cash inflow from renting out land is less than that which personal management could obtain, renting out land is a net capital loss.

Determination of the capital value per hectare of land rented out was made by using:

$$C_O = L_O(1 - \frac{R_O}{O})$$

where:

C_O = capital value of land rented out

L_O = market value of land rented out

R_O = receipts from land rented out

O = average gross returns from land operated .

Present value of machinery and equipment. The present market price of all farm machinery and equipment as estimated by the farmer. This includes both mobile and stationary farm equipment and machinery.

Value of livestock on hand. The value of all breeding stock, draught animals, dairy cattle, beef cattle, birds, etc. which were kept for either their utility or production. Only livestock owned at the time of the interview were included.

Value of standing crops. Estimate made by the farmer of the value of the expected output of crops in the field and not harvested at the time of the interview.

Value of crops in storage. Expected receipts if crops in storage were sold at the market price.

Gross farm capitalization. Represents the amount of physical and financial assets which the farm operator has at his disposal for use in the productive process.

Net farm capitalization. Represents the amount of capital the farmer has accumulated exclusive of outstanding credit obligations.

2. Composition of Accumulated Capital

The following items were included in the computation of gross farm capitalization and net farm capital.

(1) Value of land owned.

(2) Value of buildings.

(3) Value of improvements to land and buildings.

(4) Capital value of land rented in.

(5) Capital value of land rented out.

(6) Net capital value of rented land. (4-5)

(7) Present value of machinery and equipment.

(8) Value of livestock on hand.

(9) Productive capital. (1+2+3+6+7+8)

(10) Value of standing crops.

(11) Value of crops in storage.

(12) Convertible capital. (10+11)

(13) Capital assets. (9+12)

(14) Cash on hand.

(15) Bank deposits.

(16) Gross farm capitalization. (13+14+15)

(17) Outstanding credit.

(18) Net farm capitalization. (16-17)

3. Determinants of Capital Accumulation

To be productive and grow, a farm has to either generate internally its capital or obtain it from an outside source. If the outside source of capital is credit the farm must generate sufficient capital to repay the loan and still grow. If the outside funds are from a non-repayable source the productive growth capacity of the farm must be considered in a completely different context.

This study is mostly restricted to the internal generation of capital. Calculation of farm output and farm income involved the following procedure:

Value of production.

(1) Annual crops.

(2) Perennial crops.

(3) Total crop output. (1+2)

(4) Ending livestock inventory.

(5) Beginning livestock inventory.

(6) Purchases of livestock.

(7) Animal products.

(8) Livestock consumed and paid in kind.

(9) Livestock sold.

(10) Total livestock output. (4-5-6+7+8+9)

(11) Total farm output. (3+10)

(12) Other farm income.

Farm expenditures.

(13) Variable crop expenses.

(14) Marketing costs.

(15) Wages.

(16) Machinery operating expenses.

(17) Crops used for feed.

(18) Crops used for seed.

(19) Livestock consumed by workers.

(20) Livestock products consumed by workers.

(21) General farm expenses.

(22) Total farm expenditures. (13+14+15+16+17+18+19+20+21)

Farm income.

(23) Net farm income. (11+12-22

4. Labor and Land

All labor has been converted to man-equivalents. One man-equivalent (m-e) is considered to be one male adult working 300 days per year (full-time on the farm). All other family members, as well as full-time and part-time laborers have been converted to man-equivalents using the following scale:

(1) boys between ages 10-14 = 0.5
(2) girls " " 15-17 = 0.5
(3) women " " 18-60 = 0.8
(4) men " " 14-60 = 1.0
(5) men older than 60 years = 0.8

Because land was rented in as well as rented out and not all land had the same productive capacity the following classifications were used:

(1) Owned land--land titled in the name of the operator or his family.

(2) Land rented in--land rented from other landlords.

(3) Land rented out--land rented to tenants.

(4) Operated land. (1+2-3)

(5) Non-improved pasture--land unsuitable for tillage.

(6) Idle land.

(7) Land suitable for cultivation. (4-5-6)

D. Analytical Procedure

1. Tabular Classification

The basic premise of this research project has been that capital formation, to be useful for policy makers, must be studied within the framework of both type of farming and size of farm. To facilitate the analysis and to provide a basis for comparison, the 383 observations were divided into five types of farming according to the major source of income for the farm. Secondly, because an economically viable farming operation varies in size

among the five types of farming, each type was divided equally into thirds. This permitted a comparison of small, medium, and large farms in each of five types of farming with approximately the same number of observations in each of the 15 cells.

Based upon previous research and a priori knowledge several factors which were considered to be contributors to capital formation were analyzed using the above cross-tabulation. The basic hypothesis was that factors such as labor, capital investment, income, etc. would vary according to size and type of farm. For each of the variables studied four sets of average values have been calculated: (1) an average for each of the fifteen size-type combinations, (2) an average for each of the five types of farming, (3) an average for each of the size groups, and (4) the general average for all 383 farms.

Once the average values of the productivity factors was calculated for each of the fifteen cells a X^2-test was used to see if there existed a significant difference between the values. If a significant variation was found it tended to indicate

whether that factor was more important in a given size-type combination of farming.[30]

To complete the cross-tabular analysis a series of efficiency ratios were calculated. The ratios were determined by calculating the average $\frac{\sum X_{ij}}{\sum Y_{ij}}$, where X_{ij} was the cell value in one table and Y_{ij} was the corresponding cell value in the other table. In most of the ratios capital investment was used as the numerator (X) and various other factors of production (i.e. labor) as the denominator (Y). A comparison of these ratios for the fifteen size-type combinations of farming should identify those farms which are using their factors of production most efficiently.

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[30] The null hypothesis is that the values in every cell of the table under consideration have come from identical populations. This hypothesis is tested by applying the formula:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{k} \frac{(O_{ij}-E_{ij})^2}{E_{ij}}$$

where: O_{ij} = Observed values of cases categorized in i-th row or j-th column
E_{ij} = Expected values under the null hypothesis to be categorized in i-th row or j-th column
k = number of columns
r = number of rows .

Hypothesis to be tested:

H_0: $\chi^2 = 0$

H_1: $\chi^2 \neq 0$.

2. Rank Correlation

To establish whether any relationship existed between the different factors of production and the size-type combinations of farming a rank ordering of the combinations was tested. This test involved ranking each of the fifteen cells for two different factors. The Spearman rank correlation coefficient was then used to see if the size-type combinations had the same order of rank for both factors of production.

The Spearman coefficient, also called rho, measures the relationship between two rank orders in such a way that a +1 indicates a similar rank order, whereas a -1 indicates an opposite rank order of the two factors. A Spearman coefficient of zero would indicate that the rank order of the two factors was not correlated.[31]

E. Hypotheses

The following hypotheses are set forth for testing in this thesis:

1) Total capital accumulated per hectare will increase as the size of farm decreases for all types of farming except livestock.

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[31] Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences, New York: McGraw-Hill Book Co., 1956, p. 202; also see pp. 202-213, and 284.

2) Net income per hectare will be greater as the size of farm decreases for all types of farming except livestock.

3) More capital will have been accumulated on those size-type combinations of farms which have a higher labor/land ratio.

4) Land constitutes the greatest proportion of capital investment.

CHAPTER IV

ANALYSIS

The basic analytic framework of this chapter will be the distribution of the sample observations according to factors contributing to capital formation into a two-way classification of size and type of farm.

A. Descriptive Analysis of Farming Operation

When the 383 farms were distributed according to size there was a strong skewness to the left. The average farm in the sample consisted of 249 hectares; however, the average small and medium sized farms in all five types of farming contained fewer hectares than this (Table 5). As expected, those farms sustaining livestock or mixed farming (livestock and crops) tended to be larger than those supporting crop enterprises.

Contrary to popular opinion, the average hectares in perennial crop farms (sugar cane and coffee) were the smallest of all types of farming in each of the three size groups. This probably reflects the fact that the production of coffee in the State of Sao Paulo has

Table 5. Average Amount of Land Operated According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(Hectares)					
Small	23	21	54	30	34	37
Medium	77	69	181	119	181	120
Large	424	304	704	687	301	569
Average for All Sizes	178	130	320	281	344	249

d.f. = 14

χ^2 = 4,261 , significant at 0.001 level

diminished considerably during the past two decades. Also sugar cane farms could have been smaller because of two factors: 1) cane is a cash crop which fits easily into the small farmer's operation, and 2) USINA's were excluded from the sample; therefore those operators who were large enough to have their own sugar mill were excluded from the sample.

Because large farms consisted of more hectares, they also contained more land suitable for cultivation (Table 6). However, there was very little difference between the ratio of cultivated land to operated land between sizes for all types of farms (Table 7). Approximately one-third of the land on all farms was suitable for cultivation.

In absolute terms the larger farms utilized more labor than the smaller farms. Even the smallest classification of farms used the equivalence of more than two full-time men--one full-time man was considered to be 300 man-days of labor (Table 8). The smaller farms in all types of farming used labor more intensively in the cultivation of their land. Small perennial crop farms used an annual average of 53 man-days per hectare; whereas large perennial crop farms used only 11 man-days per hectare. Large livestock and mixed farms used labor less intensively than any of the other size-type combinations--

Table 6. Average Amount of Land Suitable for Cultivation According to Type of Farming and Size of Farm, São Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Livestock	General Crops	Mixed Farming	
	(hectares)					
Small	7	8	16	10	11	10
Medium	26	24	38	40	43	34
Large	151	98	232	219	201	178
Average for All Sizes	62	43	98	91	84	74

d.f. = 14

χ^2 = 1,124 , significant at 0.001 level

Table 7. Relationship of Land Suitable for Cultivation to Land Operated, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Livestock	General Crops	Mixed Farming	
	(percentages)					
Small	30	38	30	33	20	27
Medium	34	35	22	34	24	26
Large	36	32	33	32	25	31
Average for All Sizes	35	33	31	32	24	30

d.f. = 14

χ^2 = 13 , not significant

Table 8. Average Amounts of Labor Used on Farms According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(man-days per year)					
Small	777	1,147	837	1,082	1,285	1,010
Medium	1,661	2,427	1,469	2,359	2,432	2,021
Large	3,827	3,355	2,609	4,373	4,338	3,646
Average for All Sizes	2,102	2,294	1,659	2,643	2,682	2,224

d.f. = 14

χ^2 = 906,521 , significant at 0.001 level

only five man-days per hectare (Table 9). Of course it must be remembered that this was available labor rather than applied: therefore, there may have been some disguised unemployment on the smaller farms. This possibility seems very unlikely since the same proportion of land was cultivatable on all size-type combinations.

The 383 farms in the sample had an average capital investment of Cr$ 507,533 (Table 10). A considerable amount of variation was found between the small and large farms in all types of farming. The large farms had approximately 10 times as much gross capital investment as the small farms. Large livestock, general crops and mixed farms had an average of more than one million cruzeiros invested in capital. Small annual crop farms had the least capital investment with an average of only Cr$ 52,472 per farm.

Gross capital investment is only one criterion for comparing capital formation on farms. Because land constitutes a major proportion of capital investment a number of ratios were calculated in order to determine the efficiency of capital formation. Also, the ratios tend to indicate which factors of production are more closely related to capital formation according to size-type combinations of farms.

Table 9. Relationship of Amount of Labor Used to Amount of Land Operated According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(man-days per year/hectare)					
Small	34	53	16	36	24	27
Medium	22	35	8	20	13	16
Large	9	11	4	6	5	6
Average for All Sizes	12	18	5	9	8	9

d.f. = 14

χ^2 = 144 , significant at 0.001 level

Table 10. Average Gross Farm Capitalization According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(cruzeiros)					
Small	52,472	96,636	123,642	111,916	170,415	109,746
Medium	166,135	294,707	310,726	317,921	341,870	281,705
Large	833,969	908,243	1,178,170	1,469,327	1,431,240	1,121,487
Average for All Sizes	356,631	428,766	549,633	665,699	653,037	507,533

d.f. = 14

χ^2 = 683 , significant at 0.001 level

The farms in the sample had anaverage of Cr$ 2,038 capital investment per hectare of land operated (Table 11). The capital investment per hectare was greater on perennial crop farms than for any other type of farming for all three size groups. As was expected, livestock farms had less capital investment per hectare than any other type of farming. This low capitalization ratio was very pronounced for medium and large livestock farms; however, small livestock farms had about the same capital/land ratio as small annual crop farms.

As indicated previously, the larger a farm the less labor tended to be used per hectare of land. Therefore, because larger farms tended to have a greater capital investment, one would expect for the capital/labor ratio to be greater on larger farms. This was the situation for all types of farming. In fact, in each type of farming, excepting mixed farms, the large farms had a capital/labor ratio of approximately three times that found for the small farms (Table 12). Because land constituted such a large proportion of capital investment the livestock farms represented a greater capital/labor ratio for all sizes of farms. Small cattlemen had about Cr$ 44,000 invested per man and large operators had approximately Cr$ 99,000. The annual crop farmer had less capital investment per man than all other types

Table 11. Ratio of Gross Capital Investment to Land Operated, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(Cr$/ha)					
Small	2,281	4,602	2,290	3,730	3,156	2,966
Medium	2,158	4,271	1,717	2,672	1,[illegible]89	2,184
Large	1,967	2,998	1,674	2,139	1,787	1,974
Average for All Sizes	2,003	3,298	1,728	2,369	1,898	2,038

d.f. = 14

χ^2 = 461 , significant at 0.001 level

Table 12. Ratio of Capital Investment to Labor, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(Cr$/man-equivalent)*					
Small	20,259	25,275	44,316	31,030	39,786	32,598
Medium	30,006	36,428	63,457	40,482	42,171	41,796
Large	65,375	81,214	135,474	100,300	98,979	93,213
Average for All Sizes	50,999	56,072	99,391	75,562	73,051	68,462

*One full-time man-equivalent is considered to be one man employed 300 days per year.

d.f. = 14

χ^2 = 263 , significant at 0.001 level

of farms for all size groups. Average capital invested per man-equivalent was Cr$ 68,462 (exchange ratio: $1.00 = Cr$ 4.49) which represented a sizable investment.

The average value of total farm output ranged from Cr$ 8,004 for small annual crop farms to Cr$ 321,191 for large general crop farms. The average value of total farm output for all farms was Cr$ 70,629 (Table 13). In all cases there was more than a doubling of the value of output on medium farms as compared with small farms and again on large farms as compared with medium farms.

General crop farmers appeared to be the only ones who were able to realize increasing returns to scale. Gross output per hectare increased as the size of the farm increased. In all other types of farming, output per hectare decreased when the size of operation became larger (Table 14). The most dramatic decrease in productivity was on livestock farms, the type of farming in which one would expect increasing returns to scale. Large livestock farms had an output per hectare of only Cr$ 209 as compared to Cr$ 378 for small operators. The next most significant decrease in productivity was on perennial crop farms. Large farms realized 43 percent less output per hectare than small farms. Both livestock and perennial crop farms are two types which would be expected to be subject to increasing returns to scale because of the nature of the product.

Table 13. Average Value of Total Farm Output According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(cruzeiros)					
Small	8,004	10,434*	20,436	12,207	18,609	14,107
Medium	25,053	35,386	39,190	50,441	55,721	40,106
Large	133,088	85,933	147,217	321,463	188,319	156,139
Average for All Sizes	56,326	43,918	69,872	129,191	87,196	70,628

*One observation was eliminated because of inconsistent data.

d.f. = 14

χ^2 = 1,412 , significant at 0.001 level

Table 14. Relationship of Gross Farm Output to Land Operated, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(cruzeiros/hectare)					
Small	348	497	378	419	345	371
Medium	325	513	216	424	309	312
Large	314	283	209	467	235	275
Average for All Sizes	316	338	220	460	253	284

d.f. = 14

χ^2 = 36 , significant at 0.002 level

Gross output per hectare is a fairly good indicator of the productive capacity of a farm but it does not reflect the capital formation capacity of the farm. To analyze the latter, net farm income is a better measure. The 383 farms in the sample had an average net farm income of Cr$ 28,617 (Table 15). If this income were evenly distributed among all the farm operators they would have had a respectable income. However, several farmers in some of the size-type groups had a negative farm income. There were a sufficient number of negative incomes among large perennial crop farmers to result in a negative average value for the group as a whole.

Net farm income ranged from Cr$ 1,029 on small general crop farms to Cr$ 93,801 on large livestock farms (see Table 15). Both small and large cattlemen realized more net farm income than any of the other types of farmers; however, in the medium sized group, mixed farming netted the most farm income.

If net farm income is related to land operated, the average farm included in the sample returned Cr$ 131 per hectare. None of the types of farming resulted in more net income per hectare as more land was operated, with the exception of mixed farming between small and medium farms (Table 16). This increase in net income per hectare is very unusual because between the same

Table 15. Average Net Farm Income According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(cruzeiros)					
Small	3,235	3,187	13,249	1,029	5,735	5,871
Medium	9,887	10,598	24,534	18,993	27,147	18,445
Large	49,460	-7,575[a]	99,801	64,350	78,564	60,848[c]
Average for All Sizes	21,203	2,070[b]	46,861	28,668	37,039	28,617[d]

[a] 11 of the 25 observations had negative values; the average value for 14 observations showing positive values = 36,167

[b] average value when large farms with negative values are discarded = 13,125

[c] average value when perennial crop farms with negative values are discarded = 66,557

[d] average value when large perennial crop farms with negative values are discarded = 31,336

d.f. = 14

X^2 = 52 , significant at 0.001 level

Table 16. Relationship of Net Farm Income to Amount of Land Operated According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(cruzeiros/hectare)					
Small	141	152	245	190	106	159
Medium	128	154	135	160	150	143
Large	117	-25	142	94	98	107
Average for All Sizes	119	16	147	102	108	216

d.f. = 14

χ^2 = 33 , significant at 0.002 level

two size groups gross output per hectare decreased significantly (see Table 14). This tends to indicate the possibility of either gross output being under-reported or farm expenses being over-reported.

As was also noted in Table 14, gross output per hectare tended to increase with size on general crop farms. However, net income per hectare of large farms was only 50 percent of that found for small farms. This would tend to indicate an excessive amount of farm expenses on large general crop farms. A part of this could be explained by a larger capital investment in machinery and equipment on the large farms. However, this would be contrary to most development strategies.

If net farm income per man-equivalent is calculated it can be seen that approximately one-half of the size-type groups are not returning even the minimum Brazilian wage rate to labor. With the exception of livestock, none of the small farm groups provided sufficient net income for labor to earn the minimum wage. The same was true for perennial crop farms of all sizes (Table 17).

Closer examination of Table 17 will indicate how individual goals and the goals of the total society might be in conflict. With the exception of perennial crop farms, all types of farming returned more net income per man-equivalent as the size of operation increased. This

Table 17. Relationship of Net Farm Income to Amount of Labor Used According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming										Average for All Types	
	Annual Crops		Perennial Crops		Live-stock		General Crops		Mixed Farming			
	Daily	Yearly	Daily	Yearly	Daily	Yearly	Daily	Yearly	Daily	Yearly	Daily	Yearly
	(Cr$/man-equivalent)											
Small	4.16	1,249	2.78	834	15.83	4,749	.95	285	4.46	1,339	5.81	1,744
Medium	5.95	1,786	4.36	1,310	16.70	5,010	8.05	2,415	11.16	3,349	9.12	2,737
Large	13.92	3,877	-2.23	-677	38.25	11,475	14.71	4,415	18.11	5,433	16.69	5,007
Average of All Sizes	10.09	3,026	.90	270	28.25	8,474	10.85	3,254	13.81	4,143	12.86	3,860

d.f. = 14

χ^2 = 13 , not significant

means that an individual operator would attempt to become larger if he wished to obtain a greater return on his time. Considering the fact that few of the large farms operated with solely family labor and that most farm laborers receive no more than the minimum wage rate, the farm operator obtained an even greater return on his management efforts.

This conflicts with the total society which wants to get the most productivity from its resources possible. Brazil has a tremendous surplus of labor in the rural area; therefore, since the returns to land is greater on small farms the country would prefer more small farms which would utilize the excessive rural labor. However, the individual farmer wants to become bigger so he will get a higher return on his invested time.

If the ratio of gross farm capital to farm output is compared for the different size-type groups it can be seen that the amount of capital investment required to produce one cruzeiro varies considerably (Table 18). The average for all farms was Cr$ 7.00 of capital investment to produce Cr$ 1.00 of farm output; however, the range was from 11:1 for large perennial crop farms to 5:1 for general crop farms.

Table 18. Amount of Gross Farm Capitalization Required to Generate One Cruzeiro of Farm Output According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average For All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(cruzeiros)					
Small	7	9	6	9	9	8
Medium	7	8	8	6	6	7
Large	6	11	8	5	9	7
Average for All Sizes	6	10	8	5	7	7

d.f. = 14

χ^2 = 5 , not significant

Another relationship which is sometimes helpful in evaluating productivity is the gross capital investment required to produce one cruzeiro of net farm income. Because of negative net incomes in some size-type combinations of farms this relationship is not always meaningful. In general it took Cr$ 16.60 of capital investment to produce one cruzeiro of net farm income annually (Table 19). Livestock farms tended to require less and perennial crop farms more capital investment to produce a given level of net income.

B. The Composition of Capital

In analyzing the proportional composition of capital (Table 20), initially the intention will be of confirming or interpreting what the analysis so far has discovered. In the last part particular findings of the capital composition will be presented.

(1) The proportion of the values of land-related or non-land-related capital items for perennial crop and annual crop types of farming is according to expectations (see Table 18). Land value plus livestock value plus cash constitute between 87 and 88 percent of the total value of gross farm capitalization in annual crops, but only between 81 and 82 percent in perennial crops. But value of machinery and equipment plus convertible capital

Table 19. Amount of Gross Farm Capitalization Required to Generate One Cruzeiro of Net Farm Income According to Type of Farming and Size of Farm, Sao Paulo, Brazil, 1970

Size of Farm	Type of Farming					Average for All Types
	Annual Crops	Perennial Crops	Live-stock	General Crops	Mixed Farming	
	(cruzeiros)					
Small	16	30	9	109	30	19
Medium	17	28	13	17	12	15
Large	17	-120	12	23	18	18
Average for All Sizes	17	---*	12	26	18	18

*This value is extremely large because of the number of large farms reporting negative values.

d.f. = 14

χ^2 = 1,855 , significant at 0.001 level

Table 20. Average Proportionate Composition of Gross Farm Capital Investments According to Value of Capital Components, Type of Farming, and Size of Farm, Sao Paulo, Brazil, 1970

Type of Farming	Size of Farm	Capital Components						Capital Investment
		Net Rent	Owned Land	Machinery & Equipment	Live-stock	Convertible Capital	Financial Capital	
		(percentages)*						
Annual Crops	Small	2	78	8	4	5	1	100
	Medium	12	70	9	[illegible]	3	3	100
	Large	11	67	13	[illegible]	1	2	100
	All Sizes	[illegible]	[illegible]	10	[illegible]	[illegible]	[illegible]	100
Perennial Crops	Small	[illegible]	[illegible]	10	[illegible]	[illegible]	[illegible]	100
	Medium	[illegible]	72	12	[illegible]	[illegible]	[illegible]	100
	Large	[illegible]	71	11	[illegible]	[illegible]	[illegible]	100
	All Sizes	[illegible]	71	11	[illegible]	[illegible]	[illegible]	100
Livestock	Small	[illegible]	[illegible]	10	16	[illegible]	[illegible]	100
	Medium	[illegible]	69	[illegible]	18	3	[illegible]	100
	Large	[illegible]	[illegible]	5	18	1	[illegible]	100
	All Sizes	[illegible]	[illegible]	8	17	[illegible]	[illegible]	100
General Crops	Small	14	[illegible]	11	1	[illegible]	[illegible]	100
	Medium	10	[illegible]	12	2	2	[illegible]	100
	Large	16	[illegible]	14	[illegible]	[illegible]	0	100
	All Sizes	16	[illegible]	12	[illegible]	[illegible]	[illegible]	100
Mixed Farming	Small	[illegible]	[illegible]	10	[illegible]	[illegible]	1	100
	Medium	[illegible]	[illegible]	10	[illegible]	[illegible]	[illegible]	100
	Large	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100
	All Sizes	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100
All Types	Small	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100
	Medium	[illegible]	70	10	[illegible]	4	[illegible]	100
	Large	[illegible]	[illegible]	10	[illegible]	[illegible]	[illegible]	100
	All Sizes	[illegible]	70	10	[illegible]	4	[illegible]	100

*In some cases the figures do not total 100 percent due to rounding off.

(mainly in the form of standing crops) constitute between 18 and 19 percent of gross farm capitalization in perennial crops, and only between 12 and 13 percent in annual crops. Because of the stressing of non-land capital items, annual crops, a labor-related type of farming, ranks close to the bottom of all types in the generation of gross farm capitalization per unit of land (see Table 11). And because of the opposite tendency, perennial crops (also labor-related farming), rank at the top in capital generation per unit of land.

(2) Between types of farming the differences in the composition of gross farm capitalization are larger then between sizes of farms. Value of land and value of machinery and equipment are the main components widening the relative differences between types. It is also according to what was expected. If in the preceding section size was the main determinant, in opposition to type, of the amount of capital generated per unit of land (see Table 11), now it is found out that type of farming determines more clearly the quality, the kind of capital items that are being accumulated.

(3) Large farms tend to accumulate more livestock, and less machinery and equipment, than other size groups of farms, which makes the use of labor in large farms less needed than in other size groups.

(4) Capital accumulation appears to be positively related to the proportion of machinery and equipment in the composition of capital, and inversely related to the proportion of livestock, but net income generation is directly related to the proportion of livestock in capital composition, and inversely related to the proportion of machinery and equipment. This is evidenced when the average composition of perennial crops and general crops as representatives of high accumulating farms is shown in contrast to the composition of livestock and annual crops as representatives of top-ranking farmings in the generation of net income. Assuming that this reflects the choices of the farmers given the constraints of resources available, it can be thought that in Ribeirao Preto the equipment and machinery available is rather expensive or low-returning, due to a poor technological level, and that it pays more to engage in an operation demanding a minimal amount of tools and being land-related, as the case of cattle farming is.

One observation related to this fact is that in the area studied the determinants of net income generation out of capital stock are exogenous to the generation of gross output. That may imply that either capital stock has a weak relationship to net income or that the generators of capital are different from the generators of net income.

C. Rank Order Comparison of Size-Type Combinations

The analysis thus far has been based mainly upon comparisons of general averages, type averages, size averages, and between smallest and largest size-type averages. No attempt has been made to compare all 15 size-type categories for the different factors of capital formation. A simple way of viewing these category relationships is through the use of rank coefficients of correlation.

Basically the Spearman rank correlation coefficient is used to test the rank order of two measures of the same factor, or two factors used to measure the same relationship. Therefore, the rank order of the averages for the size-type combinations of the previous section will be compared for different pairings of the factors contributing to capital formation.

Eighteen different pairings of factors associated with capital formation were tested using the Spearman rank coefficient (Table 21). In the following analysis the numbers in parentheses refer to the paired test number from Table 21.

Table 21. Spearman Rank Coefficients of Correlation between Average Values of the Factors Included in Size-Type Combination Analysis, Sao Paulo, Brazil, 1970

Paired Test Number	Variables Compared			Coefficient of Rank Correlation[a]
1	Land	and	Labor	0.21
2	"	"	Gross Capitalization	0.27
3	"	"	Farm Output	0.25
4	"	"	Net Farm Income	0.67
5	Labor	"	Gross Capitalization	0.94
6	"	"	Farm Output	0.35
7	"	"	Net Farm Income	0.36
8	Gross Capitalization	"	Farm Output	0.93
9	" "	"	Net Farm Income	0.75
10	" "	"	Labor/Land Ratio	-0.14*
11	Farm Output	"	Net Farm Income	0.94
12	" "	"	Capital/Land Ratio	-0.53**
13	" "	"	Capital/Labor Ratio	0.61
14	" "	"	Labor/Land Ratio	-0.74
15	Net Farm Income	"	Capital/Land Ratio	-0.69
16	" " "	"	Capital/Labor Ratio	0.73
17	" " "	"	Labor/Land Ratio	-0.96
18	Capital/Land Ratio	"	Capital/Labor Ratio	-0.52**

[a]significant at the 0.01 level, unless otherwise specified

*non-significant **significant at the 0.05 level

Gross farm capitalization appears to be strongly related to both land and labor (2 and 5), with labor being more strongly correlated. However, capitalization appeared to have no correlation with the ratio labor used per hectare (10). And the ratio of capital/land was inversely related to the ratio of capital/labor (18). This tends to imply that labor and land are good substitutes in the capital formation process.

In the production process, capital tends to be a stronger individual determinant than the other two factors. Capital and labor appear to complement each other in the production process (13), as well as capital and land (12). Land alone shows a similar correlation with output (3) as labor (1). But, the ratio of labor/land has opposite correlation with output (14) which tends to indicate that they are substitutes in the production process.

Land, labor and capital are all positively correlated with net farm income (4, 7 and 9); but the correlation is not as strong as with output (2, 6 and 8). Farm income was negatively correlated with the capital/land ratio (15) and was even more negatively correlated with the labor/land ratio (17). This tends to suggest that capital and land are substitutes in the generation of income, and that capital and labor are mildly complementary.

The ratio of labor to land shows strong negative correlation with net income (17) which would suggest that they are good substitutes.

The above analysis tends to indicate that capital available for farming is invested in labor extensive operations (i.e. crop farms) whereas the most efficient production takes place when land is substituted for both labor and capital (i.e. in cattle related farming). As a result, the most profitable enterprises are less efficient in the accumulation of capital. This can constitute a bottleneck in the agricultural development of the area because the capital-saving economy is failing to lay down a solid base for expansion.

CHAPTER V

CONCLUSIONS

1. General Framework

For purposes of this thesis, capital formation has been defined as residue from the production process. Capital is accumulated from one production period to another through the interaction of capital generating factors. The three basic generators are: output, income, and investment.

Capital formation is the underlying pillar of economic growth and development. The underdeveloped countries remain as such because their growth pattern of output, income, investments, and the production process is at a constant rate which does not lead to an increasing rate of capital formation. Consequently the economies are relatively static.

To facilitate the analysis the sample observations were stratified first according to the principal type of farming (i.e. enterprise contributing most to farm output) and secondly according to size of farming operation. To eliminate an excessive number of size-type combinations the observations in each type of farming were divided

equally into small, medium, and large operations. The equal division within each type of farming was used because it was felt that a small operation was more relative within a type of farming than between types of farming.

The 383 sample observations were divided into 15 homogeneous groups according to size and type of farming operation. All of the analysis was based upon a comparison of the average of these 15 groups. It was hypothesized that the size of operation and type of farming were basic to all factors contributing to capital formation. The 15 size-type combinations could be arrayed so the average amount of land operated within each cell increased as one moved from the upper-right to the lower-right corner of the table.

Calculations were made for the individual averages, for each of the 15 size-type combinations, of capital investment, available labor, farm output and net farm income. Theoretically, an array of these four generators of capital should have had the same pattern as that found for land operated. This would have implied that capital formation was taking place in the region at an optional rate for both the individual and the society. Such was not always the case found; in fact, it appeared as if the individual and the society were at polar ends with respect to the use of some resources.

2. Objectives and Hypotheses

Objectives. The overall objective of this thesis has been to provide a descriptive analysis of the role of capital formation in the development process. More specifically the study was to:

1. Compare the forms in which capital is being accumulated according to size and type of farming in a given area of Sao Paulo, Brazil.
2. Determine the amount of capital accumulated according to size and type of farming.
3. Identify the principal factors of capital formation according to size and type of farming.
4. Analyze the efficiency of selected factors contributing to capital formation.
5. Make policy recommendations.

The results of the analysis pertaining to each of the objectives are briefly summarized.

First objective: The average amount of land operated varied considerably between types of farms. However, the proportion of land suitable for cultivation was approximately the same for all sizes and types of farms.

As was expected, the total amount of labor used increased as the size of farm increased for all types of farms. However, the inverse was true of the amount of labor used per hectare. In all types of farming, small farms used labor at least four times as intensively as large farms. Among types of farms, perennial crop farms used labor more intensively than any other type.

As farms increased in size and became more extensive in their type of operation they tended to have a greater value of farm output. Of the small farms, livestock farms tended to have more farm output (Cr$ 20,400); whereas, for large operators, the general crop farms had the greatest farm output (Cr$ 321,463).[32]

Total net farm income followed the same general pattern as gross farm output, except the livestock farmers appeared to realize a greater net income.

Both gross farm output and net farm income were less favorable on large farms than on small farms when compared on a per hectare basis. Perennial crop farms showed the greatest output per hectare for small and medium size farms. The average value of gross output was more on larger general crop farms than on perennial crop farms. On a per hectare basis, livestock farms showed the greatest net farm income.

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[32]Rate of exchange: US$ 1.00 = Cr$ 4.49.

Second objective: Among small and medium farmers, gross capital accumulation was greatest on mixed farms. However, large general crop farms had the greatest gross farm capitalization (Cr$ 1,469,000).

When capital investment per hectare was compared, it was found that small farms in all types of farming had a greater relative investment in capital. Livestock and annual crop farmers had the least amount of capital investment per hectare. Perennial crop farmers had the most capital invested per hectare.

Capital investment per man-equivalent (M-E) increased as size of farm increased and as the type of farming became more extensive. Small annual crop farms had a capital/M-E investment of Cr$ 20,259 whereas large livestock farms had a capital/M-E investment of Cr$ 135,474.

Third objective: In Sao Paulo, land was found to be the most preferred form of capital accumulation. This is consistent with that for other less developed countries,[33] and also in developed countries.[34] In Sao Paulo, land was a greater proportion of capital investment

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[33] Stevens, op.cit., p. 27.

[34] Tostlebe, op.cit., p. 20.

on small farms than large farms for all types of farming. In no case did land account for more than 78 percent of total capital investment, which was considerably less than found on Lebanese farms in 1957.[35]

Machinery and equipment was the second most important component of capital accumulation (3 to 13 percent) except on livestock farms. Livestock, stored and standing crops, and cash constituted the balance of capital.

Because capital formation was defined as residue from the production process, labor and farm output were also considered as factors of capital accumulation.

Fourth objective: Both output and income were positively related to capital accumulation. Land and labor were also highly correlated with capital investment. However, the capital/land ratio was negatively correlated with net farm income and the labor/land ratio showed no relationship with farm income.

Hypotheses. Four hypotheses were set forth for testing in this thesis:

1) Total capital accumulated per hectare increases as size of farm decreases for all types of farming except livestock.

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[35]Stevens, op.cit., p. 27.

2) Net farm income per hectare increases as size of farm decreases for all types of farming except livestock.

3) More capital is accumulated on those size-type combinations of farms which have a higher labor/land ratio.

4) Land constitutes the greatest proportion of capital investment.

As stated in the first hypothesis, it was felt that capital accumulation per hectare on livestock farms would increase as size increased. This was not confirmed. The capital/land ratio was greater on small livestock farms than on medium farms which in turn was less than on large farms. For the other types of farming the capital/land ratio increased as size decreased.

Net farm income per hectare increased as size of operation decreased for all types of farming. Therefore, the second hypothesis, which stated that this would not hold for livestock farms, was not completely confirmed.

The third hypothesis was negated in its entirety. Capital accumulation showed very little correlation with the labor/land ratio (the rank correlation coefficient between the two variables was only -0.14). This tends

to indicate that capital was being substituted for labor as the size of operation became larger.

Land was found to be the most important factor in capital accumulated as stated in the fourth hypothesis.

3. Farming Comparisons: by Size and Type

Small farms: This size group tended to have less labor and capital and also generated less total farm output and net income. However, they tended to use more labor and capital per hectare farmed and also produced more output and income per hectare. The exception to this was livestock farms which tended to have more output per hectare as farms became larger. These findings are consistent with those of Martin and Rao (see pp. 29-31).

Medium size farms: With the exception of medium size, perennial-crop farms, this group was almost consistently mid-way in the efficiency of generating capital, output, and income as well as in the use of labor.

Large farms: Large farms used more labor, had the largest accumulation of capital, generated the most farm output, and resulted in the greatest net farm income. However, large farms were inefficient in the use of both capital and labor in the generation of either farm output or farm income. These results are consistent with those found by Rask, Rao and Martin (see pp. 28-31).

There tended to be more variation between types of farming with respect to the factors of capital formation than there was between sizes of operation.

Annual crops: This group tended to rank close to the average of all farms with respect to most of the factors of capital accumulation. The larger farms tended to be more efficient generators of capital than the smaller farms (this agrees with Valdeci, p. 33).

Perennial crops: These farms had the most capital accumulated per hectare. Their capital investment per unit of labor tended to be low. Both output per hectare and income per hectare were high--except for the large farms. For some unexplainable reason, a greater proportion of the large, perennial crop farms showed negative net incomes than for any other size-type combination.

Livestock farms: This group of farms had more labor, capital, and land. The labor/land, the capital/land, and the capital/labor ratios were all relatively low. They had a very unfavorable output/land ratio. The income/land ratio for medium operations was low, but was most favorable for small and large farms. Livestock farms showed the best returns to management of any type farming included in the study. These farms required less capital to generate each cruzeiro of net

income than any other type, but medium and large operations required a substantial capital investment per cruzeiro of farm output generated.

General crops: This type of farming was high in capital investment per hectare, and in output per hectare. The large farms showed a fairly good return to management but the small ones did not. Income per hectare was good for all sizes.

Mixed farming: Showed no strong tendency, except both medium and large operations tended to provide a better than average return to management as measured by the farm income/labor ratio.

4. Policy Recommendations

One of Brazil's most urgent problems is that of labor--surplus labor in agriculture, disguised unemployment and unemployment. The problem affects a large proportion of the urban and rural population. As a result more than one-half of the Brazilian population must be satisfied with receiving an income which provides for little more than their subsistence. For these persons, a lack of adequate employment means a lack of opportunity for improving their condition.

At the root of the employment problem is the necessity of using more labor in the production process. The entrepreneur realizes that his profits will be

increased if he substituted mechanization for unskilled labor. This study tends to indicate this process occuring in agriculture. Larger farms used relatively less of both capital and labor per hectare, but, considerably less labor. The gross output as well as the net income per hectare on larger farms was less than on smaller farms.

The following recommendations are proposed as a partial solution to some of Brazil's agricultural problems.

1) A reduction in the size of the average farming operation will tend to absorb more labor and also result in more capital formation.
2) Product pricing policies should allow the farmers higher levels of net income per hectare and per worker, thus encouraging an increase in production. Annual crops, mainly oriented for the internal market of the state and the country, can be more easily affected by product price policies than perennial crops--coffee, sugar cane--which are oriented heavily toward export production and dependent on international prices.
3) The present policies of credit and fertilizer diffusion should be maintained, or rather

adjusted following the recommendations of studies like the ones by Nelson and Tommy, but the emphasis of agricultural strategy should not be placed on these complementary techniques instead of other more direct programs. Credit strategy could be particularly helpful toward small farms. These farms, being the most successful from a social and an individual point of view, should be rewarded and encouraged in a particular way. It seems, therefore, that some discrimination on the terms of credit in favor of small farms within every type of farming would be justified and rewarding in terms of production.

4) Finally, specific strategies for particular types of farming in the area are strongly needed. It seems that annual crop farming would be the first to benefit from the entire package of policies delineated above, since they are now the type showing the least imbalance between production and capitalization processes. For that reason, no particular measure is presented here with respect to this type. For perennial crops

and general crops the gap between high production and low net income has to be filled through policies lowering the amount of operational costs. Credit programs allowing the farmers to substitute ownership of land for rented-in land are strongly recommended. For livestock farming a very different problem esists; it is the low level of production, in spite of the highly rewarding income returns, which qualifies these farms as the least socially and most individually oriented enterprises. Special programs for substituting technological practices for traditional forms of livestock raising have to be implemented; also the farmers should be provided adequate instruction and financial protection in adopting new technologies. Regarding mixed farming, no special policy is suggested since this type of farming offers poor prospects from both social and individual points of view. A negative policy discouraging this type of farming must be recommended in order that these farms become categorized under livestock or one of the crop-related types of farming.

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