Brazilian Economic Studies

6

The Institute of Economic and Social Planning (Instituto de Planejamento Econômico e Social — IPEA) is a foundation established by the Brazilian Federal Government in 1967. Its main activities are related to economic research, planning, government budgeting and training.

IPEA is under the responsibility of a president and comprises a research institute (Instituto de Pesquisas — INPES) , a planning institute (Instituto de Planejamento — IPLAN) , a budget institute (Instituto de Programação e Orçamento — INOR) and a training center (Centro de Treinamento para o Desenvolvimento Econômico — CENDEC) .

The outcome of the work done at IPEA is regularly made available, in Portuguese, in five series of publications. In addition, IPEA issues an economic journal entitled *Pesquisa e Planejamento Econômico*.

The papers published in *Brazilian Economic Studies* refer not only to research conducted at IPEA, but also to work carried out by scholars at other Brazilian institutions.

Brazilian Economic Studies

N.º 6 — Edited by Wilson Suzigan

Agricultural commodity prices in Brazil: empirical evidence *

José Honório Accarini **

1 — Introduction

It is well known that from a dynamic perspective, distortions in a market economy's price formation mechanism can lead to problems of resource allocation among sectors and activities, and to changes in the distribution of income. Nevertheless, little has been done to examine the factors which determine the price differentials observed in the Brazilian agricultural market. The purpose of this empirical study is to examine this aspect of the agricultural market, in an attempt to identify the determinants of the differences in the prices received by rural producers for their surplus. The analysis to be developed is partial and static and is based on a market in which several forms of discrimination are present. It is assumed that price differentials are the result of the interaction of several forces, such as the farmer's control over the production of commodities and factor allocation, and the alternatives available to him for marketing his harvest. More rigorously put, an analysis will be made of equilibrium prices observed in the market: prices resulting from the supply and demand model.

Rice and beans were chosen from among the commodities analyzed, because they constitute typical domestically supplied

commodities. Soybeans and cotton will be utilized as well because they are internationally traded and are widely used in industry. Corn was selected since it occupies an intermediate position between two aforesaid commodity groups and, although it is used intensively in industry and not commonly exported, corn is occasionally responsible for increases in foreign exchange earnings.

The data used in our research were taken from a sample collected to evaluate the economic impact of rural extension services in Brazil. The sample, which applies to all the states of Brazil except São Paulo, for the agricultural year 1970-71, allows us to select a large amount of information on the characteristics of rural producers who are assisted by extension service personnel, as well as the supply and demand conditions they face.

Since the objective of this study is to analyze producers located in various states of Brazil, and since no information is available regarding the differences in climatic factors, harvest seasons, and the general supply and demand conditions affecting prices the many micro-regions, we shall utilize a distribution of percentage price differentials which is derived by comparing the prices received by the rural producer to the average price obtained in the state in which he farms. This average was calculated with data from the sample. Although this procedure implicitly takes the states' agricultural frontiers as delimitations of the differences in prices caused by the above mentioned factors, we hope to thus eliminate some of these differences. This may be a step in the right direction, since it is less probable that differences of this kind would influence prices within states than within the agricultural sector as a whole. The practical reason for this procedure was the need to obtain a sufficiently large sample to permit an empirical study of the problem, i.e. an aggregate analysis of farmers from different regions.

In the second section of this paper, we shall make a preliminary examination of the distribution of the price percentages, emphasizing some peculiarities inherent to each commodity market. In the third section, the distribution will be divided into different groups of prices received, in an attempt to explain the differences among groups, using a vector of characteristics which synthesizes the relevant economic variables. For this purpose, two types of analyses will be conducted: first, we will use a test of equality of the means of those characteristics among groups, and second, we shall conduct a discriminant analysis. Our conclusions will be presented in the final section.

2

2 — Differences among commodities

We shall initiate this part of our discussion with an extremely useful general characterization of the price distributions for the different commodities to be studied. (These distributions are presented in figure 1). After having compared the distributions, note the increasing dispersion of the percentiles when passing from commodities such as cotton and soybeans to others such as rice and beans. The second point to be observed is the bimodal pattern of the distributions for the latter two commodities.

Considering first the differences between the variances of these percentage differentials as an indication of the differences of price behavior among commodities, a possible relation immediately arises between the alternatives for the industrialization of these commodities and their participation in international trade. We find that commodities such as soybeans and cotton, which respectively presented smaller variances than the others, are industrializable and exportable. One may expect greater efficiency in the marketing of these commodities, since farmers have both greater access to information and a greater range of marketing options. In the case of rice and beans, which are not industrializable like the other two commodities, the domestic market is virtually the only option. To a certain extent, this hinders the flow of information and limits the marketing alternatives. Corn, as we have already mentioned, holds and intermediate position.

Regarding the possibilities of industrialization and external marketing of the product, there are reasons to believe that these two characteristics favor better market organization, since transaction and information costs tend to be lower. In this sense, the higher concentration of demand would also be a contributing factor, as would a greater sensitivity of demand in terms of generally well-defined types and standards. In the case of cotton, for example, we note that prices vary, in both domestic and international markets, according to the lenght and strength of the thread and the degree of impurities, as well as the origin of the product. For the farmer and the marketing agents, this makes it easier to know the market opportunities for the prices which can be obtained.

The costs tend to be greater for the less industrialized commodities which are largely restricted to the domestic market, such as rice and beans. The segmentation of production and consumption, for example, creates local and regional markets which are usually poorly integrated due to communications difficulties. Furthermore, the demand for these products is less sensitive to quality, making

Figure 1
PRICE PERCENTILE DISTRIBUTIONS

Cotton
N = 283
S = 0.16.
$\overline{X}$ = 1.00
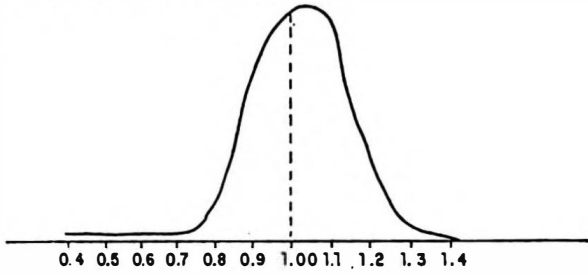
Soybeans
N = 154
S = 0.14
$\overline{X}$ = 1.00
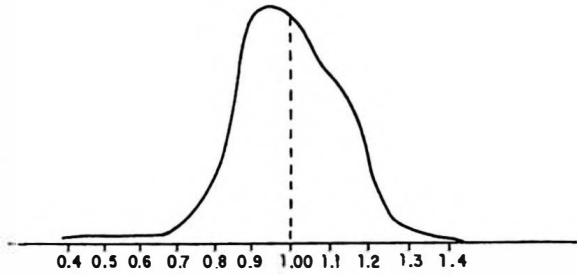
Corn
N = 464
S = 0.30
$\overline{X}$ = 1.00
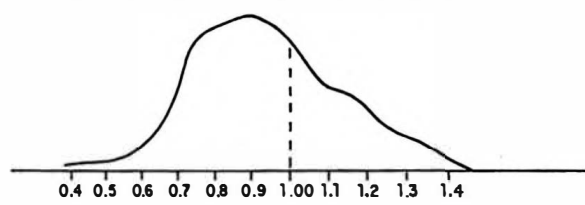
Rice
N = 404
S = 0.32
$\overline{X}$ = 0.98
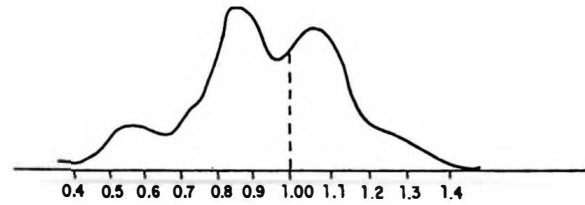
Brown Beans
N = 293
S = 0.21
$\overline{X}$ = 0.99
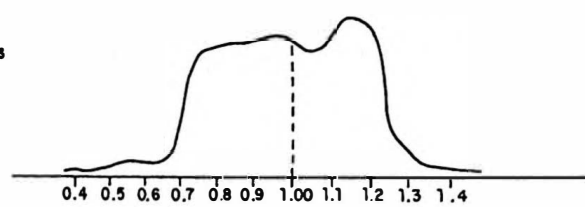
S = Standard Deviation $\overline{X}$ = Mean   N = Size of Sample

4

it more difficult for production agents to standardize the commodity, thus contributing to greater price variations.

We may therefore conclude that this aspect of dispersion is at least partially the result of the varying degrees of organization of different markets. It is necessary, however, to analyze this aspect with a certain amount of caution, since the greater or lesser equalization of prices does not necessarily reflect an advantageous situation for the farmer. In fact, he could simply be a victim of generalized exploitation by the agents to whom he sells his commodities, who benefit disproportionately from the more organized market. Consequently, it is important to know the type of commercial arrangement into which the producer enters, that is, his degree of access to the existing organizational forms, besides the form in which markets are organized. Insofar as the nature of these arrangements differs from one group of farmers to another, or depends on the particular conditions which arise from the economic relations between these groups and intermediate agents, the possibility for price differestials to arise should be greater.

In the case of cotton, for example, there exists a mixture of varieties as well as the common practice of rotating cattle breeding with the cultivation of cotton, principally in the Northeast. This allows for greater contact between the producer and the processing plants, since the plants supply him with credit for expenses and subsistence in payment for, or even in anticipation of, the commodity supplied. Furthermore, the cotton producer in the Northeast usually operates as a tenant farmer, and is thus obligated to turn over part or all of his production to the landowner as rent and, mainly, as the amortization of contracted debts. [1] Since the producer does not own land, his access to the credit market is usually limited, and he must obtain credit through the landowner or from informal suppliers.

Thus, despite the fact that the cotton market is reasonably organized due to the presence of industries which fix the sale price, the former can take little advantage of this organization. He finds himself locked into a compromise with the processor or the landowner, both of whom are able to conduct transactions in both the commodity and input markets and have a greater degree of freedom to establish commercially profitable arrangements.

Despite the fact that soybeans are both industrialized and exported, their situation must be placed in an entirely different context than cotton. Because their production is geographically very concentrated, a quite developed cooperative system emerged

[1] For additional information on this subject, see Banco do Nordeste do Brasil (1964), especially Chapters IV and V.

5

notably in Rio Grande do Sul, where cooperatives were originally created to deal with the problems of the production and marketing of wheat. (Rio Grande do Sul is the largest producer of soybeans in Brazil, followed by the state of Paraná.) From the moment in which greater rationality in the exploitation of land began to indicate the economic advantages of wheat-soybean rotation, [2] the cooperatives also began to operate with soybeans to the point where some have become specialized in this product, due to its regional importance. The cooperatives supply technical and financial assistance to their associates in soybean production and market nearly all the production surpluses. Some large conglomerates even export commodity and press it for the production of oil, bran, and other derivatives.

Thus there is an increase in the options open to the farmer for the marketing of his surpluses, and his information costs diminish. In addition, since the cooperative system exists precisely to promote his economic interests, it can obtain all the advantages that an organized market can offer him. [3]

Corn also presents some peculiarities when compared to the other commodities analysed: first it occupies first place in cultivated area (nearly 10 million hectares), and second, is directly responsible for the availability of protein foods of animal origin, such as meat, milk, and eggs, because of its large-scale use as a forage. [4]

The production and consumption of corn are thus geographically disperse; this renders a greater uniformity of prices more difficult to the extent that markets are poorly integrated and restricted to specific areas. On the other hand, the demand for corn is not very sensitive to quality, since it is seldom exported and is largely used for animal feed. It may be deducted that these features impede the operation of an efficient market information mechanism; the difficulties of creating and disseminating the standardized systems of classification necessary to improve the marketing processes contribute to the increase of information and transaction costs. This facilitates the intense participation of middlemen, since they can

[2] This rotation is viable due to the difference in the agricultural calendar of the two products. Mechanization was also a contributing factor and allowed for the shortening of the period between the wheat harvest and soil preparation for the soybeans crop, as well as the creation of varieties of wheat with a shorter growing cycle (precocious varieties).

[3] In other states, where expansion is more recent and the cooperative system less developed (as in Mato Grosso and Goiás), its marketing can be less advantageous for the farmer if there is no stimulation of structures that permit a division of forces between supply and demand, as exists, for example, in the cooperative system.

[4] In this regard, see M. A. — CFP (1974; pp. 71-74).

pass these costs on, through price arbritation, to different segments of the market.

Rice and beans appear to be in a situation similar to that of corn. Rice ranks second place in terms of cultivated area. This geographic dispersion significantly contributes to the low technological intensity used in its cultivation, [5] as does the vulnerability of rice to climatic conditions, particularly in the cultivation of *sequeiro* in the central states of the Northeast. In some regions, such as Mato Grosso, rice is considered a secondary crop, since the main activity is cattle breeding. Thus, the incorporation of new areas creates the inconvenience of locating production in areas lacking adequate infra-structure, making the marketing of surpluses more difficult. [6]

Finally, in analyzing bean cultivation, two important particularities should be noted when compared to the other crops. Bean cultivation takes place on small scale, by numerous units with a level of production, largely in conjunction with other crops. It therefore represents a small portion of the producer's total income, rendering the search for better market opportunities less important for economic success. Since the bean farmer is usually a small producer, his bargaining power vis-à-vis middlemen is limited, the middlemen constituting a small number of processor-packagers, organized entrepreneurially around the cultivation of rice, beans, and corn, because of the similarities of the services required for the marketing of each, [7] making it profitable to sell the surplus production of various commodities in one single operation.

In light of these observations, we may expect (for these three commodities), not only a large dispersion of the price percentages relative to cotton and soybeans, but also the submission of the producer to middlemen. Thus, the conditions are not met for the formation of an organized market which would be beneficial to the producer, for these commodities.

In the case of bean cultivation, the bimodal pattern or price distribution may be explained by the fact that this crop is one of the few with two annual harvests, commonly known as "dry" and "rain havests". [8] The distribution of harvesting throughout the year

[5] See Pastore, Dias, and Castro (1976).

[6] It has been noted that the expansion of the agricultural frontier in the direction of this region is, to a certain degree, illusory; the cattlemen are taking advantage of credit incentives to clear native growth and prepare the soil to plant crops during a given year, then transforming these into grazing pastures.

In this respect, see Instituto de Economia Agrícola (1971), p. 187.

[8] This fact is confirmed in the *Calendário Agrícola Nacional* (1975).

7

influences the price distribution for this crop, since demand should be very stable when compared between periods.

Such an explanation, however, would be inappropriate for rice, since, in most regions, rice is gathered between the months of March and May. In principle, this bimodal standard can be explained by the comprehensiveness of the sample, since there exists a great diversity between states with regard to forms of cultivation, varieties used, lineage, and predominant species. [9] This explanation seems to be sustained by the fact that when analyzing only the states of Minas Gerais and Goiás (two productive regions with very similar supply and demand structures, and both specialized, traditional rice producers), the bimodal structure nearly disappears, as may be observed in figure 2. It should be kept in mind that the relatively high frequency observed in the class which received between 50 and

Figure 2

RICE : DISTRIBUTION OF PRICE PERCENTILES

Rice (Brazil)
N = 404
S = 0.32
X̄ = 0.98

0.4 0.5 0.6 0.7 0.8 0.9 1.00 1.1 1.2 1.3 1.4

Rice (Minas Gerais / Goiás)
N = 143
S = 0.36
X̄ = 1.00

0.4 0.5 0.6 0.7 0.8 0.9 1.00 1.1 1.2 1.3 1.4
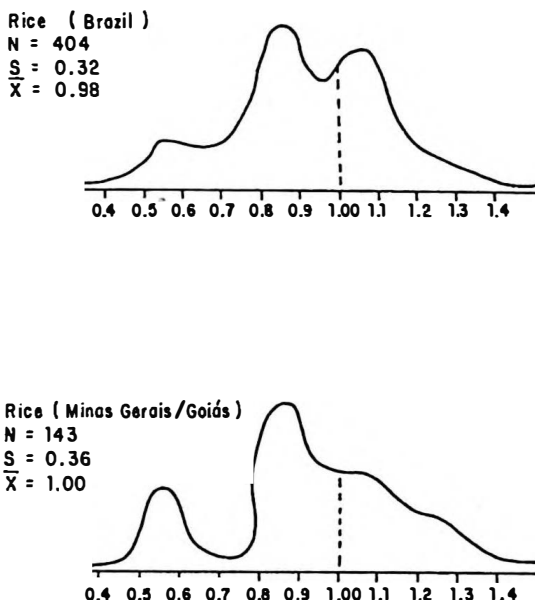
[9] The information referring to rice can be obtained in the *Calendário Agrícola Nacional* (1975).

60 percent of the average price is due to a small number of producers located in the north of Goiás who market their surpluses via middlemen for a price lower than the state's average. [10]

3 — Differences existing among the groups of producers

Having analyzed the differences between the variances associated with the distribution of price percentiles, and the factors which condition the access of the rural producer to the existing forms of market organization, in the present section we return to our main objective, that is the explanation of price differentials between groups of producers.

In the first subsection, we will discuss the problem of classifying by groups of prices received. In the second, we define some variables which can potentially explain those differences. Empirical results will be presented and discussed in the last subsection.

3.1 — The classification of producers

Two basic problems arise in establishing classification criteria. First, the number of groups to be adopted must be fixed; second, we need to establish the limits used to define each one of them. It is with regard to this point that the peculiarities of the different commodities which are inherent to the market ought to be taken into consideration.

It seems appropriate to approach the first problem as follows. First, the distribution of percentiles is divided into three groups: those which received price percentiles below, around, or above the average. [11] Second, only the growers in the extreme groups (1 and 3) are classified. The first criterion permits us to analyze the agricultural sector as a whole, whereas the second allows us to concentrate the analysis only on the producers located in the two extreme groups, which usually evoke most interest.

As to the second problem, it is important to point out that an appropriate theoretical criterion does not exist, rendering arbitrary the fixing of limits. However, we may still minimize the effects of this arbitrariness on the results, by establishing alternative criteria. For this purpose, we shall fix two limits to define the

[10] This fact, incidentally, could explain the small increase in the variance of the price percentage differentials in these two states compared to the aggregate analysis, since a smaller size sample is used.

[11] To facilitate the presentation, these groups will be denominated groups 1, 2, and 3, respectively.

9

intermediate group, since the other groups are automatically defined through the exhaustive analysis of the sample.

First we shall fix a 10 percent interval of variation for all commodities above and below the average percentile. This allows us to compare the importance of some characteristics influencing prices, using a uniform criterion. Based on this first criterion we shall subsequently attempt to increase or diminish the size (amplitude) of the interval in so as to keep approximately 50 percent of the rice, beans, and corn producers in the intermediate group along with approximately 40 percent of the cotton and soybeans producers. The percentile distributions of the latter are more concentrated around the average. The objective of this last criterion is to utilize a smaller margin of price variation for those commodities with more organized markets, thus respecting the particularities associated with these two commodities.

Since it constitutes a separate analysis within this study, the classification of rice producers in Minas Gerais and Goiás follows slightly different criteria. The limit for classifying the intermediate group will be 20 percent around the average rather than 10 percent, as in the previous cases. Second, 50 percent of the producers are classified in the intermediate group, so that we may determine to what degree the results vary, relative to the previous criteria. For each commodity, table 1 presents the intervals used to classify producers in the intermediate group, as well as the absolute frequency in each group.

Table 1

Classificacion of Producers

Commodities	Limits	Absolute Frequency			
		Group 1	Group 2	Group 3	Total
Cotton	0.90—1.10	49	163	71	283
Cotton	0.95—1.05	69	120	94	283
Soybeans	0.90—1.10	33	83	38	154
Soybeans	0.925—1.075	50	65	39	154
Corn	0.90—1.10	188	143	133	464
Corn	0.85—1.15	127	238	99	464
Rice	0.90—1.10	173	126	105	404
Rice	0.825—1.175	114	205	85	404
Rice[1]	0.80—1.20	17	83	33	143
Rice[1]	0.83—1.23	46	72	25	143
Beans	0.90—1.10	106	97	90	293
Beans	0.825—1.175	68	149	76	203

[1] States of Minas Gerais and Goiás.

Source: Accarini (1978), pp. 30-31.

3.2 — Determinants of price differentials

From an economic point of view, although there exists a vector of variables capable of influencing the prices received by rural producers we shall limit the following analysis to a proposal and discussion of those variables defined by the information contained in the sample. In view of the objectives of this study, we shall attempt first to define the variables, and then to formulate the hypotheses to be tested. These hypotheses will deal with the expected influence of these variables on prices. As will be observed, the variables are associated with the degree of control that producers exercise on resource allocation, and with the alternatives available to them for the marketing of surpluses. [12]

X_1: Storage Capacity

Since storage facilities allow producer to await the most favorable period to market his crop and obtain more advantageous prices, the hypothesis suggested for this variable is that if favorably influences prices.

The use of a better defined variable, such as the physical storage capacity relative to the quantity produced, was not possible with the information contained in the sample. For this reason, this variable was defined by the quotient of the value of silos and depositories existing on each holding and the value of the marketed production.

X_2: Scale of Operation

Since the distribution of holdings by size approximates a log-normal distribution, this variable was defined as the log of the total area of the establishment (in hectares). Considering that the size of the establishment should be positively associated to the quantity produced, to the use of modern techniques, and to lesser economic dependency of the producer on intermediate agents, the testable hypothesis is that this variable acts positively upon prices.

X_3: Scale of Sales

Considering the possibility that a diversification of crops can occur and that the producer can channel part of his production to consumption, the scale of operation could fail to capture the price effects which are derived from economies of scale in the search for better market opportunities. Defining this variable as the phy-

[12] As Raup (1969) points out, p. 1279, the power to influence market conditions generally is associated with the power to control supply, to alter demand, or to attract capital.

11

sical quantity of the product marketed, we can test the hypothesis that its influence over prices is favorable. The main reason for this hypothesis is the possible decline of transaction and information costs as the quantity sold increases.

X_4: Degree of Specialization

In principle, even if quantity sold could justify a search for better prices for the producer's crops, he would reap relatively little profit from such a search if the crop's share in his total agricultural income were small. It is thus possible to test the hypothesis that the degree of specialization, defined as the revenue obtained from the crop in relation to the total agricultural revenue, exercises a positive effect over prices.

X_5: Technological Index

In defining this variable as the number of modern practices adopted by the grower in his principal activity, we can formulate the hypothesis that this varibale will have a favorable effect upon prices. The reason for this assumption is that under these conditions the producer should be more market oriented, as well as more efficient in resource allocation and in the control that he exercises over input and output prices. In other words, he should have a greater entrepreneurial capacity.

X_6: Rural Extension

This variable was defined as the number of times in which the producer had contact with rural extension services, either via a demonstration of results, demonstrative or observation units. We can test the hypothesis that an increase in the number of these contacts allows the grower to produce better quality products, and to obtain more information concerning the conditions under which he can market his surpluses.

X_7: Educational Level

The hypothesis being put to the test concerns the variable "educational level", which is the number of years of schooling completed by the producer. The hypothesis states that this variable exercises a positive impact upon the prices received. As Amaral (1975; p. 26) points out, "through education the producer can more easily assimilate information about prices. Furthermore, producers having attained higher educational levels will be more able to evaluate the costs and benefits of the marketing alternatives available for their crops. The ability to understand new information, as a result of better education, can contribute to the development of the producer's marketing skills."

12

X_8: Land Ownership Structure

This variable is defined as the proportion of land belonging to the producer in relation to the farm's total area; in our analysis, it takes an eminently experimental nature. There is a lack of information regarding the type of contract agreed upon between the landlord and the party responsible for the farm, [13] which accentuates this experimental nature, as does the lack of information on the landlord's efficiency in resource allocation and market opportunities. On the one hand, he could be an extremely inefficient owner from this point of view; on the other, he could be organized on an entrepreneurial basis, using higher quality third party lands and be entirely market oriented.

X_9: Available Volume of Credit

We may assume that credit (i.e. the temporary transfer of resources to producers) grants greater freedom for the producers to obtain a better resource allocation, making them more efficient from an economic point of view. [14] Thus, one would expect a favorable influence of credit on prices.

It is important to remember, however, that although credit can render the producer more efficient, it is not necessarily true that credit will bring him the earnings derived from his increased efficiency. These earnings could be absorbed by high interest rates, low prices for the commodities sold, or high prices for the inputs acquired. This will depend on the credit source (i.e. whether it is institutional or informal) and on the type of commercial arrangement between the producer and the creditor. According to Bauer and Yamey (1954; p. 214), in the case of intermediate suppliers, what may first appear to be a forced sale or forced purchase, could simply be the indirect payment of part of the interest not explicitly charged. Moreover, as Abbott (1958; p. 127) points out, since in the case of the landless producers the collateral for credit is their future production, the risks of adverse price changes are transferred to the suppliers of informal credit, leading the latter to take precautions against eventual losses by increasing interest rates.

Thus, it is verified that although we know how this variable acts upon prices, there is not enough information available (re-

[13] As was previously seen, through this contract the producer may be obligated to sell part or all of his production to the landlord.

[14] Empirical evidence for some Brazilian areas has shown that the use of credit is positively related to the producer's technical and productive efficiency. See Barros (1973) and Erven (1969), among others.

garding, for example, the effect of credit on different types of land ownership structures) to test the variable in a convincing way.

X_{10}: Net Value of Bank Credit

This variable has been included to facilitate the isolated analysis of the effect of institutional credit upon prices. In view of the above observations, we can formulate the hypothesis that this effect is favorable. Both variables were defined as the value of new financing obtained during the year, excluding interest and amortization paid during the period.

X_{11}: Sources of Agricultural Information

Assuming that the producer's expectations, as well as his bargaining power, can be affected favorably by the amount of information available, and that the price of such information is greater than zero, we can formulate the hypothesis that the impact of this variable on prices is positive. This means that those producers with a greater number of sources of agricultural information (such as radio programs, newspaper notices, magazines and agricultural bulletins, expositions, and field days,[15] which is the definition of this variables would have lower information costs than the others. These costs, according to Stigler (1967; p. 291), bring "the agent who is involved in an exchange relation from a situation of ignorance to a situation of knowledge, a journey that is really possible to avoid".

X_{12}: Cooperatives

Both this variable and the two to follow were defined as the quantity sold to the different marketing channels. As we know, one of the objectives of the cooperative system is to group the economic interests of its members, insofar as the cooperative acquires greater competitive power in the product and input markets. We can thus formulate the hypothesis that the quantity sold through these agents exercises a favorable effect upon prices.

X_{13}: Processing Industries

Since these industries are practically obligatory passage points between the producer and the final consumer, and thus dispose of some monopsonistic power, they may exert as much downward pressure on prices as possible, as was previously noted in the case of cotton. It seems reasonable, therefore, to test the hypothesis that these agents have an unfavorable impact on prices.

---

15 "Field days" referes to producers' visits to experimental farms or to sites previously selected by the rural extension service as model units.

X_{14}: Middlemen

This type of intermediate agent places himself between the final consumer and the producer, or between the producer and industry, generally by processing the commodity and placing it in the most accessible time and place for consumption, industrialization, or processing. We may therefore expect the middlemen to pay the producer lower prices, as compared to other forms of marketing. The price differential should cover the costs of services rendered.

There are, however, other reasons for expecting this type of behavior. First, the obligation to market a crop through the merchant who furnished the credit and inputs, as we previously noted, puts the producer in a disadvantageous position, insofar as this limits his possibilities to obtain better prices through other channels. Second, as Bauer and Yamey (1954; p. 215) have pointed out, the number of middlemen almost necessarily declines as the distance to consumption centers increases, making these agents monopsonistic in relation to the producers. Third, and in the same vein, a deficient market information diffusion system [16] can exist, placing middlemen in an advantageous situation regarding the possibility of price discrimination, since they could gain from economies of scale and, therefore, from smaller information and transaction costs per unit bought.

It seems correct, therefore, to formulate the hypothesis that this variable acts negatively on the prices received by the producers.

3.3 — Empirical results

The empirical results obtained are presented in the following tables, first for the test on the equality-of-means of variables between groups, and then for the discriminant analysis.

In table 2 we identify, for each commodity, the variables whose averages differ significantly between groups, at a levelless than or equal to 10 percent. In the case of cotton, we note a very coherent set of variables, considering that it remains practically unaltered when we change the criteria for classification of groups and the number of groups analysed. The same occurs in the case of soybeans and, to a lesser extent, in the case of corn.

Checking the results for the analysis of rice cultivation, in aggregate terms we note that there occurs a great instability of

---

[16] This affirmation is made by Tecle (cited by Lele (1975; p. 114) who points to the absence of an adequate information system as primary cause of the unequal bargaining power of agents involved in the marketing process, of the low prices in effect, and of its accentuated dispersal of prices among markets.

Table 2

Importance of the Variables in the Characterization of Groups: Tests for Equality-of-Means

Commodities	X1 AB	X2 AB	X3 AB	X4 AB	X5 AB	X6 AB	X7 AB	X8 AB	X9 AB	X10 AB	X11 AB	X12 AB	X13 AB	X14 AB
Cotton (0.90-1.10)	**			**	**	*								*
Cotton (0.05-1.05)	**			**	**									*
Soybeans (0.90-1.10)	**	*	*				*	**	*			*		**
Soybeans (0.925-1.075)	**						*	**		*				**
Corn (0.90-1.10)	*	*	*	**							**			*
Corn (0.85-1.15)		*		*							*			*
Rice (0.00-1.10)		*		*						**			**	*
Rice (0.825-1.175)										**		*		
Rice[1] (0.80-1.20)	*	**			**	*					*			*
Rice[1] (0.83-1.23)		**			**		*			**	**		**	**
Beans (0.90-1.10)	**													
Beans (0.825-1.175)	*			*										

[1] Rice in Minas Gerais and Goiás
A = Analysis of All Three Groups
B = Analysis of the Extreme Groups

characteristics when we alter the classification criterion and the number of groups. As was noted previously, rice is an extensively cultivated product in Brazil, being second in land utilization. This factor seems to obscure the results, since it is not possible to rigorously identify a group of variables statistically significant for characterizing the groups. In this regard, it should be noted that the isolated analysis of rice cultivation in the states of Minas Gerais and Goiás produced excellent results, very similar to those obtained for cotton and soybeans.

With regard to the cultivation of beans, the fact that we dispose of a very poor set of variables impedes us from drawing a more definitive conclusion on the characterization of the groups. The only variable which systematicaly appears in the scale of operation.

In table 3, the results of the statistical significance tests for the discriminant functions are presented. The first point to be emphasized, when all the groups are analysed, refers to the low significance level of the tests for beans, where statistically, on the basis of discriminant functions, we cannot consider the groups as different.

Another important aspect is that the differences between groups can be considered statistically significant, at acceptable levels, only in the direction of the first discriminant function. With the excep-

16

Table 3

Discriminatory Power of the Canonical Variates:
Statistical Significance

Commodities		Three Groups		
		First Discriminant Function (percentages)	Second Discriminant Function (percentages)	Two groups (percentages)
Cotton	(0. 90—1. 10)	0.2	70	0.1
Cotton	(0. 95—1. 05)	1	70	0.5
Soybeans	(0. 90—1. 10)	4	20	10
Soybeans	(0.925—1.075)	10	50	10
Corn	(0. 90—1. 10)	2	50	10
Corn	(0. 85—1. 15)	10	50	20
Rice	(0. 90—1. 10)	20	50	10
Rice	(0.825—1.175)	10	50	10
Rice[1]	(0. 80—1. 20)	2	25	2.5
Rice[1]	(0. 83—1. 23)	1	20	0.5
Beans	(0. 90—1. 10)	20	20	10
Beans	(0.825—1.175)	70	70	20

[1]States of Minas Gerais and Goiás.

tion of rice cultivation in Minas Gerais and Goiás, and one of the cases of soybeans, the differences based on the second discriminant function can only be accepted at significance levels higher than 25 percent. [17]

When the analysis is limited to the groups located at the extremes of the percentage price differential scale, the statistical significance of the results is more revealing; at levels of at least 20 percent, we cannot reject the hypothesis that the groups differ on the basis of the discriminant function obtained.

Finally, it is important to point out that the results of the tests are generally more reliable for those commodities from better organized markets, such as cotton, soybeans, and rice in Minas Gerais and Goiás.

Tables 4 and 5 bring together the results of the tests on the contribution of the different characteristics for the discrimination.

[17] The implication of these results for the geometric representation of the groups is that it ought to contain only the dimension corresponding to one canonical variate.

17

Table 4

Contribution of the Characteristics to Discrimination: Three Groups

Commodities		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
Cotton	(0. 90—1. 10)	11	3*	E	1*	2*	9	6	5	7	13	12	8	10	4*
Cotton	(0. 95—1. 05)	12	2*	7	3*	1*	11	0	8	9	10	5	13	E	4*
Soybeans	(0. 90—1. 10)	9	4*	E	3*	E	6	7	1*	8	5*	12	11	10	2*
Soybeans	(0.025—1.075)	11	4	E	12	13	3*	7	2*	5	8	6	10	9	1*
Corn	(0. 90—1. 10)	6	8	2*	5	1*	11	7	4	12	13	3*	10	14	9
Corn	(0. 85—1. 15)	10	8	1*	2*	5	13	0	4	11	12	7	3	14	9
Rice	(0. 00—1. 10)	10	7	E	5	2*	8	13	12	9	3	11	4	1*	6
Rice	(0.825—1.175)	6	11	3	5	8	12	13	10	4	1*	9	2*	E	7
Rice[1]	(0. 80—1. 20)	9	2*	11	3*	4	13	12	10	7	5	8	6	E	1*
Rice[1]	(0. 83—1. 23)	9	1*	13	2*	10	11	6	12	8	5	7	4	E	3*
Beans	(0. 90—1. 10)	13	1*	E	5	8	3	11	4	9	12	2	6	10	7
Beans	(0.825—1.175)	5	1	E	8	13	4	0	3	10	11	2	12	7	6
Index		9,25	4,33	6,17	4,50	6,09	8,67	8,58	6,25	8,25	8,17	7,00	7,42	9,37	4,92

[1] States of Minas Gerais and Goiás.
* Significant at a level of at least 10 percent.

Table 5

Contribution of the Characteristics to Discrimination: Two Groups

Commodities		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
Cotton	(0. 90—1. 10)	12	3*	E	1*	2*	11	5*	E	6	8	9	10	7	4*
Cotton	(0. 95—1. 05)	7	2*	5	3*	1*	11	6	13	8	9	10	12	E	4*
Soybeans	(0. 90—1. 10)	4	8	3	6	9*	11	5	2*	7	E	E	E	10	1*
Soybeans	(0.925—1.075)	7	1*	E	E	8	E	4	3	5	6	10	11	9	2*
Corn	(0. 90—1. 10)	5	2*	12	3	7	14	6	4	9	10	1*	8	13	11
Corn	(0. 85—1. 15)	6*	9	E	5	8	11	4	2	7	10	1*	3	E	12
Rice	(0. 90—1. 10)	5*	E	E	4	11	E	8	10	7	6	9	2	1*	3
Rice	(0.825—1.175)	3*	8	E	2*	E	11	10	7	5	1*	9	6	12	4*
Rice[1]	(0. 80—1. 20)	1*	2*	E	4*	E	10	11	5	8	7*	12	9	6	3
Rice[1]	(0. 83—1. 23)	4	1*	9	3*	7	11	8	5*	13	10	12	6	E	2*
Beans	(0. 90—1. 10)	11	1*	9	2*	12	7	10	5	8	13	3*	6	4	E
Beans	(0.825—1.175)	4	1*	E	2*	12	9	6	8	10	E	3	7	5	11
Index		5,75	3,45	7,60	3,18	7,70	10,6	6,02	5,82	7,75	8,00	7,18	7,27	7,44	5,18

[1] States of Minas Gerais and Goiás.
* Significant at a level of at least 10 percent.

The numbers placed in these tables indicate the order of inclusion (using a "step-by-step" process) of the variables in the discriminant functions. The symbol E denotes the exclusion of those variables that do not contribute to discriminate the groups at a pre-established significance level. [18]

With the objective of conducting a more comprehensive analysis of the results, we can construct an index which permits us to compare the importance of the characteristics for the discrimination. This index, presented in the last line of the tables, was obtained by dividing the sum of the numbers found in each column by the number of cases in which the variable appears in the classificatory procedure. Since this index indicates the step in which, on average, each one of the variables was included, the smaller its value the more important the characteristic. Observing the values that his index assumes in the two tables, we can verify that the size of the farm, the producer's degree of specialization, and the quantity marketed via middlemen, occupy the first three positions. Considering, moreover, that this subgroup of variables appeared as significant the greatest number of times (at levels of up to 10 percent), its importance in relation to the other characteristics is clear. Comparing these results with those presented in table 2, we can verify that in the equality-of-means tests, too, these three variables proved to be important in characterizing the groups.

As for the sensitivity of the order in which the variables were included, with changes in the classification criteria adopted, we can verify that cotton, soybeans, rice in Minas Gerais and Goiás, and beans present, at least in the four first positions, a stable subgroup of variables.

Finally, verifying that the number of statistically significant variables is relatively small, we can conclude that the definition of a good classifying rule, in the sense previously mentioned, would not require the use of all the characteristics, if that was the principal objective.

In order to compare the results of the equality-of-means tests with those provided by the discriminant analysis technique, and to discuss the hypothesis formulated in subsection 3.2, we bring together in tables 6 and 7 the number of groups characterized by the variables from these two techniques. The characterization through the equality-of-means tests was done in the groups where the variables present larger means.

[18] The program BMDO7M, used for the application of the "stepwise" process excludes from the analysis those variates that do not pass the tolerance test at the level of 0.01 percent.

19

Table 6

Characterization of the Groups: Comparison of Results: Three Goups

Commodities		X_1 AB	X_2 AB	X_3 AB	X_4 AB	X_5 AB	X_6 AB	X_7 AB	X_8 AB	X_9 AB	X_{10} AB	X_{11} AB	X_{12} AB	X_{13} AB	X_{14} AB
Cotton	(0. 90—1. 10)	1 2	3 3	3 E	3 3	1 1	2 2	3 3	3 1	3 3	3 2	2 2	2 2	3 1	1 1
Cotton	(0. 95—·1. 05)	1 2	3 3	2 2	3 3	1 1	2 2	3 3	3 1	3 3	1 1	2 2	2 2	2 E	1 1
Soybeans	(0. 90—1. 10)	2 2	3 3	3 E	2 2	1 E	1 3	3 3	2 2	3 2	1 3	3 3	3 3	3 3	2 2
Soybeans	(0.925—1.075)	2 2	3 3	3 E	2 2	1 1	3 1	3 3	2 2	3 1	3 3	3 2	3 3	3 3	2 2
Corn	(0. 90—1. 10)	2 2	2 3	2 2	3 3	2 2	2 2	1 1	1 3	2 2	2 1	2 3	1 1	2 3	2 3
Corn	(0. 85—1. 15)	2 2	3 3	2 2	3 3	3 2	2 2	1 1	1 3	2 2	2 1	2 2	1 1	2 3	2 3
Rice	(0. 90—1. 10)	1 1	1 1	3 3	3 3	1 1	2 2	1 1	1 1	3 1	2 2	2 3	3 3	2 1	2
Rice	(0.825—1.175)	1 1	3 3	3 3	3 3	1 1	2 1	2 2	1 1	2 3	2 2	3 3	3 3	3 E	2 1
Rice[1]	(0. 80—1. 20)	1 1	3 3	3 3	2 2	3 1	3 3	3 3	3 1	1 1	2 2	3 3	3 3	3 E	2 2
Rice[1]	(0. 83—1. 23)	1 1	3 2	3 2	2 2	3 1	3 1	3 2	2 1	2 3	2 2	3 1	3 3	3 E	2 2
Beans	(0. 90—1. 10)	3 3	3 3	1 E	2 2	2 2	2 2	2 1	3 1	3 3	3 2	1 1	2 2	3 3	1
Beans	(0 825—1.175)	3 3	3 3	1 E	2 2	2 3	2 2	2 2	1 3	3 3	3 2	2 2	2 2	3 3	1 1

[1] States of Minas Gerais and Goiás.

A = Equality-of-means tests.

B = Results of Discriminant Analysis.

Table 7

Characterization of the Groups: Comparison of Results: Two Groups

Commodities		X_1 AB	X_2 AB	X_3 AB	X_4 AB	X_5 AB	X_6 AB	X_7 AB	X_8 AB	X_9 AB	X_{10} AB	X_{11} AB	X_{12} AB	X_{13} AB	X_{14} AB
Cotton	(0. 90—1. 10)	1 1	3 3	E 3	3 1	1 3	1 3	3 3	E 3	3 3	1 3	1 3	3 3	1 1	1
Cotton	(0. 95—1. 05)	1 1	3 3	1 1	3 3	1 1	3 3	3 3	3 1	3 3	1 1	3 3	1 1	3 E	1
Soybeans	(0. 90—1. 10)	3 3	3 3	3 3	3 3	1 3	1 1	3 3	1 1	3 1	1 E	3 E	3 E	3 3	1
Soybeans	(0.925—1.075)	3 3	3 3	3 E	1 E	1 3	3 E	3 3	1 1	3 1	3 3	3 3	3 3	3 3	3 1
Corn	(0. 90—1. 10)	1 1	3 3	3 1	3 3	3 3	3 3	1 1	1 3	3 3	3 1	3 3	1 3	1 3	1 3 3 3
Corn	(0. 85—1. 15)	1 1	3 3	E 3	3 3	3 3	1 1	1 1	1 3	3 3	1 1	3 3	1 1	3 E	3 1
Rice	(0. 90—1. 10)	1 1	1 E	3 E	3 3	1 1	1 E	1 1	1 1	3 1	1 3	3 3	3 3	3 3	3 1
Rice	(0.825—1.175)	1 1	3 3	E 3	3 1	E 1	1 1	1 1	1 3	1 1	3 3	3 3	3 3	1 1	1
Rice[1]	(0. 80—1. 20)	1 1	3 3	E 3	3 3	E 3	3 3	1 3	1 1	1 1	1 3	3 3	3 3	1 1	
Rice[1]	(0. 83—1. 23)	1 1	3 3	3 1	3 3	3 3	1 3	3 1	1 1	3 1	1 3	3 3	3 3	3 E	1
Beans	(0. 90—1. 10)	3 3	3 3	1 1	1 1	3 3	3 3	1 1	3 1	3 3	3 1	1 1	1 1	3 3	1 E
Beans	(0.825—1.175)	3 3	3 3	1 E	1 1	3 3	3 3	1 1	3 1	3 3	3 E	1 1	1 1	3 3	1 1

[1] States of Minas Gerais and Goiás.

A = Equality-of-means tests.

B = Results of Discriminant Analysis.

As may be observed, we generally have no reason to reject the hypotheses which test the effect of variables upon prices. Nevertheless, the following observations are noteworthy:

a)   Storage space is a necessary but not sufficient condition for the producer to be able to postpone the marketing of his crops and keep prices at a more favorable level. His financial compromises can force him to sell his production surpluses immediately, thus, in some cases, justifying the characterization of group 1.

b)   Interest rate subsidies to rural loans can render low-profit ventures economically feasible from a private perspective, thus provoking a credit distribution in compatible with the borrowers' efficiency. The possibility of rechanneling subsidized agricultural credit to a non-agricultural activity constitutes another reason for some of the inconsistent results presented by this variable. [19] Furthermore, there is no information available on the payment periods for interest and amortizations, nor on the due date of loans. Considering that the producer's financial compromises generally come due during the harvest season, this variable can have little influence on prices. Were there information available on credit for marketing, the results might be different.

c)   With reference to rice cultivation in Minas Gerais and Goiás, the favorable influence of middlemen can be explained by the strong competition that exists among them. As Smith points out (1973; pp. 103-107), the expansion and improvement of roadways and consequently the increased utilization of trucks in Minas Gerais brought services to a greater number of productive centers, thus reducing the oligopsonistic power of the middlemen. In the marketing of soybeans, however, more discrimination by middlemen seems to take place in the input than in the commodity market. Given the high degree of development of cooperatives, and the relative transparency of market price practices, the middlemen are forced to pay prices around the average, so as not to lose the clientele that acquired inputs from them not furnished by the cooperatives. [20]

d)   Although the variable "educational level" had given results consistent with the theoretical arguments formulated in subsection 3.2, it showed statistically significant results only in the cases in which the two extreme groups were examined. Among the pro-

[19]   According to Sayad (1976; p. 21) "the recent development of the financial sector must have sufficiently compromised the effectiveness of the credit program, since information costs ought to have diminished".

[20]   This fact was confirmed by interviews conducted with individuals directly involved in wheat and soybeans markets in Rio Grande do Sul.

ducts for which this was verified, cotton, soybeans and rice in Minas Gerais and Goiás stand out. In these cases, batter market organization might be making education a viable factor, aiding the producer in the acquisition, interpretation, and selection of alternatives that the market offers. In the case of the other products, this variable did not influence prices favorably, due to the excessively high information costs. It should be kept in mind that education is a necessary but not suficient condition for the producer to obtain economic advantages from it.

e) The number of sources of information used by producers proved to be a characteristic with a favorable impact on prices, though it was of little importance in differentiating among groups. This may be due to the fact that classification standards for agricultural commodities are not sufficiently developed and diffused in the majority of Brazilian regions. As Sturgess points out (1975; p. 73), the standardization of products contributes to the reduction of transaction costs, insofar as it allows the marketing of commodities based on a simple description, eliminating the need for physical inspection. It is important to point out that the quality of the information and the producers degree of confidence in it are very important. In this sense, perhaps, the number of sources is not a specific enough variable for capturing its effect on prices.

f) The technology employed by producers, measured by the number of modern techniques adopted, proved to more important in the case of cotton, a product which is largely industrialized and subject to a demand which is quite sensitive to quality. Moreover, some rather developed technologies, appropriate for a wide range of soil and climate conditions, are available to growers.

g) Of the possible forms of marketing analyzed in this study, cooperatives are those which present the greatest economic advantages to the producers in terms of prices. It should be recognized, however, that the discriminatory power of this variable was not statistically significant. The low level of activity of these agents in the majority of Brazilian regions is the likely cause of these results.

4 — Conclusions

Upon applying two techniques (equality-of-means tests and discriminant analysis) it was verified that, although there exist differences between the products, due basically to the degree of organization of the various markets, both in the case of three groups as in the case of only the two extremes, the size of the farm, the commodity's share in the producer's total income, and the quantity sold to the

middlemen, appear, overall, as the most important variables for the characterization of the groups. The first two favorably influenced prices. The middlemen, who generally operate among the less specialized, smaller scale producers, exercise a negative impact on the producer's income insofar as they are free to establish either lower prices for products, higher prices for inputs, or, depending on the commercial arrangements that they establish, eventually combine these two types of earnings.

Despite their unfavorable influence on prices, the middlemen were clearly present in the markets of the majority of products analyzed. The lack of a commodity standardization system, and sufficiently developed market information; the inadequate geographic dispersion of production, and the deficient transportation infrastructure all impede market integration and facilitate the active presence of middlemen. These factors cause an increase in information and transaction costs in Brazilian agriculture; the middlemen, in turn, pass these costs on to the rural producers by paying lower prices for the products they purchase or by charging higher prices for the inputs they supply, including informal credit. It should also be kept in mind, that the middlemen face decreasing costs in their search for market information, since they can manipulate a substantial volume of surplus, operating with a large number of small producers. A producer who operates on a large scale is able to play the same role as the middlemen, with the difference that the large scale producer does so for his own benefit.

The speculative earnings of middlemen could be curtailed if producers were to have access to a more efficient information system which would provide them with current crop forecasts, expected prices, and stocks existing in the various market segments. According to Brandt (1972; p. 69) although information services for agricultural markets initiated operations over 20 years ago in Brazil, they will still require a substantial amount of research in order to improve. For this purpose, parallel efforts would have to be made to develop norms for the classification of products [21] and marketing alternatives for producer would have to be sought out. Given the geographic dispersion of production, selling to middlemen is often the only way for producers to assure that their crops will reach consumer centers.

[21] According to Sturgess (1875; p. 73) this would help to increase the efficiency of the term markets and of the price system in the transmitting the demand stimuli to the producers. Thomsen (1951; pp. 267 and 270) indicates, however, that the geographic dispersion of production, the defficiency of means of communication, and the impossibility of taking into account all the characteristics of the commodity, are some of the principal difficulties in establishing a commodiy standardization system.

With regard to the scale of operation, we may raise the hypothesis that it is positively associated with the producer's economic capacity, granting him a greater degree of control on resources allocation and the marketing of surpluses. If the farmer has, for example, a sufficiently large economic structure, he may wait for the most favorable period to market his harvest, or he may even possess his own means of transportation, simplifying the delivery of crops to markets where he can obtain better prices; these options would be economically justified by the volume produced.

The crop's share of the producer's income exerts a favorable influence, due to the need for higher prices for the crops, given the producer's degree of specialization. If a particular agricultural good appears as important in the generation of the producer's income, the need for favorable prices becomes a question of survival in the market, independent of whether production is carried out on a small or large scale.

The other variables used to characterize the groups generally influence prices as was previously expected, which does not permit us to reject the hypotheses tested in this respect. In the cases where they were rejected, a more thorough analysis indicated peculiarities which could justify this occurrence.

The results seem to indicate that agricultural productive activity, which is quite fragmented, confronts a highly discriminatory marketing structure. The producer's position is this situation depends essentially on his economic power and the alternatives available to him for the marketing of his surpluses. These factors condition not only the type of commercial arrangement which the producer may make, but also the degree of discrimination to which he will be subject in dealing with intermediate agents. The obvious implication of this discriminatory structure is that unfavorable price offers keep the demand stimuli from being transmitted to producers, thus compromising their performance in the long run. In other words, this structure has an impact on the final results of the producer's economic activities; it depends, as he does, on the conditions of both supply and demand. Regarding the debate on the economic efficiency of large producers in relation to small producers, this observation appears to be extremely important.

References

Abbott, J. C. "Problemas de la Comercialización y Medidas para Mejorarla", FAO, Economic Development Institute, Washington, D. C., 1958.

24

Accarini, J. Honório. "Diferenciais de Preços na Agricultura Brasileira", Dissertação de Mestrado, F. E. A. da Universidade de São Paulo, 1978.

Alves, Denisard Cnéio de Oliveira. "Manufacturing Development in Equator: Duality and "X. Efficiency", Ph. D. Dissertation, Yale University, 1976.

Amaral, Cicely Moitinho. "Aspectos da Comercialização na Agricultura de Baixa Renda — Vale do Ribeira — Estado de São Paulo", Dissertação de Mestrado, FEA-USP, São Paulo, 1975.

Banco do Nordeste do Brasil S/A. "Mercado e Comercialização do Algodão do Nordeste", BNB, Fortaleza, 1964.

Barros, G. S. C."Análise Econômica de Fatores Relacionados ao Uso do Crédito Rural no Município de Piracicaba (SP) — 1969/70", Dissertação de Mestrado, ESALQ/USP, Piracicaba, 1973.

Bauer, P. T. e B. S. YAMEY. "The Economics of Marketing Reform", Journal of Political Economy, June, 1954.

Brandt, Sergio Alberto — "Pesquisas de Mercados e Preços Agrícolas no Brasil", X Reunião da Sociedade de Economistas Rurais, Brasília, 1972.

Calendário Agrícola Nacional. Calendário Agrícola Nacional. FGV-IBRE, Centro de Estudos Agrícolas, Rio de Janeiro, 1975.

Dias, Guilherme Leite da Silva. "Avaliação do Serviço de Extensão Rural: Considerações Gerais Sobre o Impacto Econômico da Extensão Rural", Estudos Econômicos, vol. 4, n.º 3, IPE-USP, 1974.

Erven, S. L. "Uma Análise Econômica do Uso de Crédito Rural e de Problemas de Política Creditícia no Estado do R. G. Sul", Estudos n.º 9, IEPE-UFRGS, 1969.

Instituto de Economia Agrícola. "Desenvolvimento da Agricultura Paulista", Secretaria da Agricultura do Estado de São Paulo, 1971.

Lele, Uma. "The Design of Rural Development", A World Bank Research Publication, The Johns Hopkin University Press, Baltimore, 1975.

M. A. Comissão de Financiamento da Produção. "Preços Mínimos: Regiões Centro-Oeste, Sudeste e Sul — Safra 74/75", Ministério da Agricultura-CEP, Brasília, 1974.

Pastore, José; Guilherme L. S. Dias e M. C. Castro. "Condicionantes da Produtividade da Pesquisa Agrícola no Brasil". Trabalho apresentado ao I Encontro Técnico sobre Agricultura, ANPEC/FIPE/SOBER, outubro, 1976.

Rao, C. Radhakrishna. "Advanced Statistical Methods in Biometric Research", Hafner Publishing Company, Darien, Conn., 1952.

Raup, Philip M. "Economies and Diseconomies of Large-Scale Agriculture". *American Journal of Agricultural Economics*, december, 1969.

Sayad, João. "Planejamento, Crédito e Distribuição de Riqueza". Trabalho para Discussão Interna n.º 23/76, IPE/USP, São Paulo, 1976.

Smith, Gordon W. "Comercialização e Desenvolvimento Econômico: O Estudo de um Caso Brasileiro 1930-1970", *Estudos Econômicos*, vol. 3, n.º 1, IPE-USP, 1973.

Stigler, George J. "Imperfections in the Capital Market", *Journal of Political Economy*. June, 1967.

Sturgess, I. M. "Some Possible Developments in the U. K. Cereais. Market", *Journal of Agricultural Economics*, January, 1975.

Tatsuoka, Maurice M. "Discriminant Analysis", *Review of Education Research,* December, 1954.

Thomsen, Frederick L. "Agricultural Marketing", McGraw-Hill B. C., Inc., New York, 1951.

Subcontracting and "disguised employment" in brazilian industrialization *

Anna Luiza Ozorio de Almeida **

1 — Introduction

In numerous Latin American countries industrialization has brought with it a greater number of jobs in services and less absorption of labor in industry than had been foreseen on the basis of the historical experience of Europe and the United States.[1] This disappointing absorption by industry has frequently been attributed to distortions in the costs of labor and capital caused by the industrialization policies adopted by these countries.[2] On the one hand, fiscal incen-

1 J. Ramos, *Labor and Development in Latin America* (New York: Columbia University Press, 1970); D. Turnham and I. Jaeger, *The Employment Problem in Less Developed Countries: A Review of the Evidence* (Paris: Organization for Economic Cooperation and Development [OECD], 1971).

2 Along these lines, see the review of W. Baer and M. E. A. Hervé, "Employment and Industrialization in Developing Countries", in *Quarterly Journal of*

tives and subsidized credit and exchange policies, among other factors, are blamed for reducing the cost capital. At the same time, social security and high minimum wages have been considered responsible for increasing the cost of industrial labor.[3] In countries where the work force is growing and urbanizing rapidly the overall result of these policies has been said to be a permanent and self reinforcing segmentation of the labor market.[4] For each skill level, those fortunate enough to obtain an industrial job receive a relatively high level of remuneration; those who are not as fortunate earn much less. In the case of the latter, either they are self-employed or they cluster into very small productive units, employing mostly family labor.[5]

Camouflaged and clandestine, in order to avoid the costs of licensing, legally required labor obligations and the other institutional costs of operation, these "micro-firms" of the informal sector operate under extreme shortages of capital, for they are discriminated against by the same policies that channel resources to large-scale industry.[6] They survive by overtaxing their own work capacity to meet the needs of family subsistence. With the expansion of the formal sector, the informal sector is expelled from industrial activities and is "tertiarized", taking refuge in retailing and in various services where the level of earnings is very low. For this reason, such family-based productive units are frequently seen as representative of a supposed "disguised unemployment" or "underemployment" of the urban work force.[7] According to this rather well-known interpretation

Economics, vol. LXXX, n.º 1 (February 1966), pp. 88-107; and O. Morawetz, "Employment Implications of Industrialization in Developing Countries: A Survey" in *The Economic Journal*, vol. LXXXIV, n.º 335 (September, 1974), pp. 491-542.

3 A. Harberger, "On Measuring the Social Opportunity Cost of Labor," in *International Labor Review*, vol. CVI, n.º 6 (June, 1971), pp. 559-579.

4 M. P. Todaro, "A Model of Labor Migration and Urban Unemployment in Less Developed Countries," in *The American Economic Review*, vol. LIX, n.º 1 (March, 1969), pp. 138-148; and T. Vietorisz and B. Harrison, "Labor Market Segmentation: Positive Feedback and Divergent Development," in *American Economic Review* (May, 1973), pp. 366-75.

5 We avoid imposing a quantitative limit on the definition of a small family firm due to our principal interest being to characterize, not its operation, but the specific way it fits into the rest of the economy, as will be seen in the following.

6 International Labor Organization, *Employment Incomes and Equality: A Case for Increasing Productive Employment in Kenya* (Geneva, 1972); T. G. McGee, "Policies for the Informal Urban Sector of the Less Developed Countries," 45th Study Seminar: "The Informal Urban Sector" (Brighton, England: Institute of Development Studies, University of Sussex, November, 1974).

7 Given the controversy that exists regarding the nature and even the name that should be given to this portion of the work force — "traditional",

of the employment problem in Latin America, the rapid growth of employment in services during Latin America industrialization mainly reflects the generation of a labor surplus which is itself caused by distorted factor costs. [8]

According to this same interpretation, therefore, a solution to the employment problem would require a reversal of distortions in the relative costs of labor and capital. If labor were to become cheaper and capital more expensive, industrial entrepreneurs would choose more labor-intensive technology and, with that, reduce the surplus of disguisedly unemployed workers in services.

One reaches a very different conclusion, however, after considering another interpretation of the problem. In this case, the starting point is the fact that capital-intensive technologies are generally found to be linked to large scale modes of operation. [9] Since, for

"informal", "unprotected", "marginal", and others — we adopt, for no particular reason, the denomination of "informal sector". The rest of the economy is called "formal sector". Since the formal-informal ratio is higher in industry than it is in services, the formal sector will often be equated to industry and the informal sector will often be equated to services in what follows. This imprecision is introduced merely for the sake of expository implicity and should not be taken literally.

[8] The contrast between this view and that which serves as a basis for analysis of the growth of employment in services in developed countries is great. See V. R. Fuchs (ed.), *Production and Productivity in the Goods and Service Industries, Studies in Income and Wealth*, vol. XXXIV (New York: NBER, Columbia University Press, 1969) and Organization for Economic Cooperation and Development (OECD), *Manpower Problems in the Service Sector*, International Seminar Series, vol. II (1966) one part of this literature attributes the growth of employment in services to a growth of the intersectoral productivity differential — e.g., V. R. Fuchs, *The Service Economy* (New York: Columbia University Press, 1968), as also V. R. Fuchs, "The Service Industries and U. S. Economic Growth Since World War II" (National Bureau of Economic Research, November 1977), Working Paper n.º 211, and W. J. Baumol, "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis", in The American Economic Review, vol. LVII, n.º 3 (June, 1967). Others point to the existence of a bias in final demand increasingly favorable to services — e.g., the so-called Fisher-Clark hypothesis which is based on two independent works: that of A. G. B. Fischer, "Capital and the Growth of Knowledge", in *The Economic Journal*, vol. XVIII, n.º 171 (September, 1933) and that of C. Clark, *The Conditions of Economic Progress* (Third Edition; New York: The Macmillan Co., Inc., 1957), as well as the pioneer work of G. J. Stigler, *Trends in Employment in the Service Industries* (Princeton, N. J.: Princeton University Press, 1966).

[9] See the discussion and literature reffered to by P. V. da Cunha, "A Organização de Mercados de Trabalho Urbano: Notas sobre Três Conceitos Alternativos", presented at the Sixth Meeting of the ANPEC (Gramado, December 4-8, 1978) and D. Felix, "The Technological Factor in Socioeconomic Dualism: Toward and Economy-of-Scale Paradigm for Development Theory", in M. Nash (ed.), *Essays in Honor of Bert Hoselitz*, published in *Economic Development and Cultural Change*, vol. XXV, Supplement (1977), pp. 180-211, esp. pp. 185-192.

managerial reasons discussed below, large firms pay higher average wages than do small firms, the coincidence between high wages and a high intensity of capital may be due to scale and not to distortions in the costs of these two factors. Indeed, according to modern personnel administration practices, among the many workers employed by large firms, a small number are specially selected for a succession of work stages and promotions within the so-called "internal labor market".[10] They earn progressively higher wages and benefits while the majority of industrial employees are excluded from these prospects of mobility. The greater part of the work force employed by the business sector competes for jobs in the so-called "external labor market" where it earns low wages and carries out simple and segmented, low-skill tasks which comprise the basic work process in the large modern firm.[11] When the very high wages, paid in the internal labor market, outdistance the low wages of the external labor market,[12] the average between the two may rise; however, this loses real meaning and progressively becomes a statistical creation — an empty intermediate zone. As the large firms take over increasing shares of industrial production, the observed mean industrial wage increases without implying, in the least, a real increase in the cost of low-skilled industrial labor, relative to the earning level in other sectors.

In fact, low-skill wage differential can be quite small and the tasks carried out by micro-firms of the informal sector may be quite similar to those performed by large firms of the formal sector. This will be so if not all the workers of the external market work within the premises of the industrial firm that hired them. Given the discontinuities of technological progress between different phases of the productive process, some tasks remain quite labor intensive, despite the mechanization of others.[13] Consequently, those which continue to demand a great deal of labor can be subcontracted

[10] P. Doeringer and M. Piore, *Internal Labor Market and Manpower Analysis* (Lexington, 1971).

[11] H. Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1974).

[12] For the Brazilian case, see, for example, the evidence presented by M. da Mata and E. L. Bacha, "Emprego e Salários na Indústria de Transformação, 1949/1969", in *Pesquisa e Planejamento Econômico*, vol. 3, n.º 2 (July, 1973), pp. 303-340.

[13] The lack of uniformity in the incidence of technical progress in English industrialization is documented in the work of R. Samuel, "Workshop of the World: Stem Power and Hand Technology in Mid-Victorian Britain," in *History Workshop Journal* (1977), pp. 6-72 and is analysed by J. S. Lyons, *The Lancashire Cotton Industry and the Introduction of the Powerloom 1815-1850*, doctoral dissertation in Economics (University of California, Berkeley, 1977).

externally, being performed at a lower cost in the informal sector than in the surveiled premises of formal sector. Subcontracting, being a piece-work arrangement, pays for tasks accomplished, not for labor-time expended. It thus bypasses the legal requirements of the employment contract [14] and reduces even more the cost of labor in the external labor market of the formal sector. Given the existence of a broad informal sector in the economy, an increase in the cost of industrial labor may cause a very different industrial response than might normally be supposed: aside from the substitution capital for labor, there may also occur a substitution of subcontracted workers for wage earners within the external labor-market of the formal sector. A large number of labor-intensive micro-firms, generally classified under "services" due to insufficient information about subcontracting, really work *for* but not *in* industry. It follows that part of the growth of employment in "services" during the process of industrialization, apparent in the censuses of various Latin American countries, may reflect more of a "disguised employment" in industry and less of a "disguised unemployment" in services than has generally been allowed for.

Of course, only a portion of the informal sector and its contingente in services truly constitute disguised industrial employment. In spite of this, a large part of the remaining informal sector is also intimately connected to industrial activity — if not in the sphere of production, at least in that of circulation. This is so because in the underdeveloped countries of today, the appearance of large firms, frequently foreign, create oligopolistic market structures, with their dynamic patterns of behavior, from the outset of the industrialization process. [15] These structures displace intermediate size firms, but may not fully dislodge the small-firm fringe. Thus, the informal sector may act as a passive protective cushion for the formal sector by multiplying during periods of expansionary stage in the business cycle, and absorbing the fruit of subsequent contractions. [16] In other circumstances, the formal sector may specialize in consumer goods for the middle class, leaving to the informal sector the production of goods and services consumed either by the very low or the very

[14] E. Epstein and J. Monat, "Labor Subcontracting and its Regulation", in *International Labor Review*, vol. CVII, n.º 5 (May, 1973), pp. 451-470.

[15] M. Merhav, *Technological Dependence, Monopoly and Growth* (London: Pergamon Press, 1969).

[16] See the recent work of H. Rattner, *Pequena e Média Empresa no Brasil 1963-1976* (São Paulo: Editora Símbolo, 1978) in which the high mortality-rate for the small Brazilian firm is made evident.

high income groups, [17] such as, for example, fashion goods, whose short life demands the flexibility of very small scale operations. [18]

In each of these cases, what is important for the purposes of our study here is the irreversibility of oligopolistic market structures [19] as well as their spread into a growing number of industrial branches. On the basis of this interpretation, policies seeking to change relative factor-costs, guided by the previous interpretation, would prove ineffective in terms of increasing industrial employment in the formal sector. Even more difficult would be the selection of sectors where industrial concentration could still be slowed down; it is impossible to shrink already existing large industries, or to promote intermediate scales of production. Once concentrated market structures have been set up and the interactions between large and small firms have been established, it becomes questionable whether the small firms of the informal sector ought to still be considered a "surplus" of labor to be "absorbed" by the large ones. What is important, now, is to understand how they have already been "absorbed" and which are the mechanisms that presently govern their particular form of "absorption". [20]

For example, in the case of goods subject to extreme seasonal fluctuations in demand, large producers may resort to subcontracting small ones during booms in order to reduce idle capacity during slack periods. Subcontracting may also reflect bottlenecks in long-term credit for the enlargement of productive capacity, especially in the case of middle-size firms. The increase in geographic concentration of industrial production may create an employment multiplier-effect, reducing vertical integration and expanding the subcontracting of

[17] See, for example, J. S. Oliveira and R. P. S. Prado, "O Biscateiro como uma Categoria de Trabalho: Uma Análise Antropológica," in *Sistemas de Informação para Políticas de Emprego* (Brasília: IPEA/IPLAN, September 1974), pp. 329-368, and L. R. Peattie, "Tertiarization and Urban Poverty in Latin America", in W. A. Cornelius and F. M. Trueblood (eds.), *Latin American Urban Research*, vol. V (New York: Sage Publications, 1975).

[18] A. P. Abreu, "Trabalho a Domicílio na Indústria de Confecção" (University of São Paulo, 1978, unpublished) and L. R. Peattie, "There's No Business Like Shoe Business: Notes from Bogotá" (Massachusetts Institute of Technology, 1978, unpublished draft).

[19] P. Sylos-Labini, *Oligopoly and Technical Progress* (Cambridge: Harvard University Press, 1962).

[20] Of course, the number and complexity of interactions between the business and family sectors are much greater than can be summarized in these few paragraphs. Refer, for example, to the views of M. C. Tavares, *Acumulação de Capital e Industrialização no Brasil*, Doctoral thesis (FEA/URFJ, 1976) and V. Tokman, "An Exploration into the Nature of Formal-Informal Sector Interrelationship" (Santiago, Chile: CLASCO, Seminar on the Informal Urban Sector, August 16-18, 1977).

the informal sector by the formal sector.[21] On the other hand, large firms may find vertical integration simpler than the coordination and quality control of a large number of technically deficient small suppliers. This, however, does not seem to have been the case of Japan, [22] where subcontracting played an important role in the diffusion of modern technologies from large to small firms and contributed greatly to the "trickling down" of benefits of industrialization to a much greater portion of the labor force than that employed within the confines of large firms of the formal sector.

In short, the growth of employment in small firms during Latin American industrialization may be attributed, in part, to growing "disguised employment" in industry, by way of subcontracting, and not just to a growing "disguised unemployment" in services, as has frequently been suggested. This may be especially true in the case of Brazil, which has the largest industrial sector in Latin America, and where, from 1950 to 1960, the share of Manufacturing Industries in total employment declined from 9.4 to 9.0 percent while the share of small-firm and domestic services (food, lodging, clothing, maintenance, repair, hauling, janitorial, personal and other services) grew from 9.8 to 12.2 percent.[23] Until recently a large part of this growth of employment in services during the fifties was interpreted as a growth of disguised unemployment during that period, especially because in the following decade the "Brazilian Miracle" seemed to have increased the share of Manufacturing Industries in total employment to 11.3 percent and reduced the share of the above listed services to 11.9 percent. However, according to the Brazilian demographic censuses, much of the growth in industrial employment during the sixties occurred among very small producers and self-employed workers in a group of occupations that, in 1970, were reclassified as industry, whereas in 1940, 1950 and 1960 they had been classified as services.[24] The increasing interrelatedness

[21] R. H. Coase, "The Nature of the Firm", in *Economica* (November, 1937), pp. 386-405, and W. Galenson, "Economic Development and the Sectoral Expansion of Employment", in *International Labor Review*, vol. LXXXVII, n.º 6 (June, 1963), pp. 563-579.

[22] T. Watanabe, "Economic Aspects of Dualism in the Industrial Development of Japan", in Economic Development and Cultural Change, vol. XIII, n.º 3 (April, 1965), pp. 293-312.

[23] All the figures referred to in this and in the following paragraph are taken from Chapters V and VI and the appendices of A. L. Ozorio de Almeida, *Industrial Subcontracting of Low-Skill Service Workers in Brazil*, Doctoral dissertation (University of Stanford, 1977). Consequently the handling of original data is not explained nor are the sources referred to in that work presented in this article.

[24] D. Werneck, "As Estatísticas sobre Emprego na Indústria de Construção," in *Pesquisa e Planejamento Econômico*, vol. 5, n.º 2 (December, 1975), pp. 577-592.

between large and small producers had already caused the establish-
ment censuses, since 1950, to classify all firms dealing with repairs
and maintenance as "industrial" whenever more than half of their
sales were made to industrial clients.

Meanwhile, from 1950 to 1970, the Manufacturing Industries
presented an impressive tripling of average scale (in terms of value
added per establishment) and of productivity (in terms of value
added per worker), with much larger increases among very large
firms (especially those with more than 500 employers).[26] In spite
of this, the average number of workers per establishment remained
surprisingly stable (15.9 in 1950; 16.1 in 1960; 16.4 in 1970).
Although the replacement of capital by labor may certainly have
been responsible for part of this constancy in employment per
establishment, there may also have occurred a voluminous replace-
ment of industrial employees by subcontracted workers. Unfortu-
nately, the number of subcontracted workers is not registered in the
censuses of industrial establishments but, at least, the payments made
in their behalf are discriminated in the information referring to
costs, where their average share varies over time from between
onefourth to one-third of the industrial payroll. Consequently, it
is certainly possible that industrial subcontracting is important in
explaining the evolution of employment in industry, as well as in
services during post-war Brazilian industrialization.

2 — Hypothesis specification

Although there is still insufficient information concerning the extent
and specific conditions of subcontracting in Brazil,[20] the limited
information available permits some testing of empirical hypotheses
regarding the determinants of this form of productive organization.
In particular, it would be important to examine those few services,
that have been systematically registered by the comparable industrial
censuses of 1940, 1950, 1960, 1970: repair, transport, advertising,
professional, services rendered by households and services rendered
by establishment. To what extent are the levels of industrial expen-
ditures in these services attributable to the scale of operation within

[26] G. O'Mara, "The Role of Small Scale Industry in Recent Brazilian Indus-
trialization" (World Bank: Development Research Center, April, 1978, un-
published draft).

[26] There are presently several field research projects in progress relating to
subcontracting in Brazil and in other South American countries, such as, for
example, Abreu, *op. cit.*, M. Bienefeld and H. Schmitz, "Capital Accumulation
and Employment in the Periphery" (University of Sussex, Institute of Develop-
ment Studies, Oct. 1976), Discussion paper n.º 98.

the industry, and to what extent are they a response to lower labor costs in non-industrial premisses. If the first type of determination by scale predominates, it might be possible to create policies aimed at strengthening the "trickle-down" effects of subcontracting for the informal sector. On the other hand, if the second type of determination predominates — based on inequality of labor costs — policies destined to protect the subcontracted sector may be self-defeating insofar as an increase in the cost of external labor may inhibit the extent of subcontracting itself.

If these two motives — "scale" and "inequality" — were, in fact, important determinants to industrial subcontracting, then it may be that industrial entrepreneurs consider their subcontracted workers to be factors of production, alongside capital and salaried employees within the industry. If these entrepreneurs were microeconomically efficient, in terms of cost minimization, their behavior with regard to subcontracting could be analyzed by way of the theoretical and empirical instruments of neoclassical production theory. In this way, and at the cost of losing much of the complexity of the real world and of the political economy of the issues touched upon above, the two reasons for subcontracting ("scale motive" and "inequality motive") can be reduced to those few characteristics entailed in the concept of an "abstract technology" [27] which are susceptible to empirical hypothesis testing and estimation within the framework of applied production theory. In particular by recourse to a flexible specification of the production function, [28] the effect of scale upon the ratio of subcontracted workers to industrial employees could be tested via its own specific elasticity of scale; the effect of labor-cost inequality upon the ratio of subcontracted workers to industrial employees can likewise be tested via the elasticity of substitution between these two types of labor.

This simplified representation of the problem can be illustrated by a conventional microeconomic graph, with the number of subcontracted workers L_s, on the ordinate axis, and the number of industrial employees L_I on the abscissa. Low cost labor in the informal sector increases the slope $(-W_I/W_s)$ of the isocost lines and increases the ratio of subcontracted workers to wage earners $(1 \rightarrow 2)$, in relation to the case of equilibrium in the labor market (in which $W_I/W_s = 1$). A succession of points of tangency between

[27] M. Brown, *On the Theory and Measurement of Technological Change* (London: Cambridge University Press, 1968).

[28] P. J. Dhrymes and M. Kurz, "Technology and Scale in Electricity Generation" in *Econometrica*, vol. XXXII, n.º 3 (July, 1964), pp. 287-315, and V. Mukerji, "A General S. M. A. C. Function with Constant Ratios on Elasticity of Substitution", in *The Review of Economic Studies*, vol. XXX, n.º 84 (October, 1963), pp. 233-236.

any two parallel isocosts $(-W_I/W_s)$, on the one hand, and progressively higher isoquants,[29] on the other, traces on expansion path which will be a straight line (1 → 3) only in the very special (and improbable) case of homogeneity. If the scale effect in subcontracting is non-homogeneous (which is more likely),[30] the expansion path can curve upward (large firms subcontracting relatively more than small firms: 1 → 3') or to the right (large firms subcontracting relatively less than small firms: 1 → 3").

The scale effect upon the degree of subcontracting is given by $c \lessgtr 1$, independently of wage inequality, in terms of the expansion path illustrated in the previous graph.[31] With respect to the inequality-effect of earnings between the two kinds of labor, the graph illustrates two extreme cases: $W_I/W_s = 1$ (perfect equilibrium in the labor market) and $W_I/W_s = 2$ (the level of industrial wages being double the level of wages in services). The larger the substitutability of industrial employees for subcontracted workers, the larger the degree of subcontracting for any given level of inequality. It is not possible to predict the form of the scale-effect, even though it can be expected, at least, that its direction will be positive (c greater than 0). As for the inequality-effect, it is also expected to be positive (b greater than 0), as illustrated in the graph. Thus, in accordance with this formalization of the problem, the scale- and inequality-effects, *a priori,* can be complementary (c greater than 1) or opposite (c less than 1). Should they be opposite, finding out if one predominates over the other, to the point where they can both be considered mutually exclusive, becomes an empirical question. Below we present a summary of the empirical results obtained up to the present in an ongoing research project, as well as some preliminary conclusions.

3 — Summary of empirical results

Empirical studies of production have been the target of growing criticism, owing to the many restrictive assumptions these studies require, to the controversy over the interdependence of capital measurements and general price and wage levels,[32] and to the many

[29] It is postulated, for greater simplicity in graphic illustration, that technologies are continuous, convex and have the usual neoclassical characteristics. These restrictions are discussed in Ozorio, *op. cit.*

[30] See, Felix, *op. cit.*

[31] Since L_s and L_I are determined simultaneously, the test of the hypotheses that $b > 0$ and $C \lessgtr 1$ requires specifications which are more complex than those indicated by the graph. This problem is treated in the Appendix to Ozorio, *op. cit.*

[32] See, for example, C. G. Harcourt, *Some Cambridge Controversies in the Theory of Capital* (London: Cambridge University Press, 1972).

doubtful adaptations that become necessary to reconcile available data with microeconomic concepts. Given the limitations of this article, we have omitted a more complete discussion of these problems, as well as a detailed presentation of the solutions attempted in obtaining the results presented below.

These solutions, in sum, consisted in the derivation of an econometric model corresponding to Graph 1, and in its application to data from the Industrial and Services Censuses of 1940, 1950, 1960 and 1970. For each of the six types of service expenditures registered by the industrial censuses — repairs, advertising, transportation, services rendered by establishments, services to households, and professional services — the coeficients of the inequality-effect and the scale-effect were estimated and compared (see b and c in Graph 1) for each census year. From this, one could infer the occurrence of changes over time in the determinants of subcontracting. The evolution of subcontracting in the traditional sectors — food and clothing — in the transport equipment sector, and in the rest of industry as a whole were estimated separately. This is the empirical structure upon which the results to be discussed below are based.
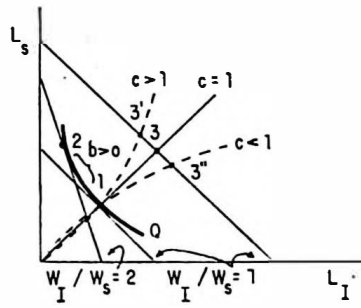
As expected, the inequality of earnings between subcontracted workers and wage earners appears as a positive, highly significant stimulus for industrial subcontracting of services. Nevertheless, the percentage of subcontracting that could be attributed to this effect turned out to be quite low, that is, subcontracting proved to be relatively inelastic in relation to wage-inequality — at least in the empirical applications obtained up to the present. It is interesting to note that some forms of subcontracting are more sensitive to relative wages of production workers, while others are more sensitive to relative wages of non-production workers. Thus, repair services, services rendered by establishments, services purchased upon house-

37

holds, as well as professiosal services, are significantly sensitive to relative wages of industrial production-workers. On the other hand, transportation services and advertising are significantly sensitive to relative salaries of industrial non-production-workers.

The effect of wage inequality in reducing employment of industrial workers was significant in the beginning of the period following the Second World War and declined during the 1960s. Thus, the reduction of wage inequality between urban and rural laborers, that seems to have taken place from 1960 to 1970, [33] may have weakened the effect of wage inequality on industrial employment, in the Brazilian case.

The principal cause of reduction of residual variance in the subcontracting regressions, however, was not the effect of inequality but rather that of industrial scale. This effect behaves quite differently for two groups of services. The first, which encompasses the case of professional services and of transportation does not conform to the model. The average small firm apparently subcontracts so much more of these services than the average large firm per unit of capital that it was not possible to estimate an expansion path (see graph) using cross-section data. Transports are services which are intensive in physical capital, such that their subcontracting is probably utilized mostly by small scale industrial establishments that avoid the fixed cost of owning equipment used only intermittently. Professional services, in turn, are skill-intensive, so their subcontracting permits small firms to make use of such skills, infrequently only as needed, rather than incur the fixed costs that arise from the permanent full-time employment of specialized workers.

Still with regard to the scale effect, the second group of services tested encompasses repair services, advertising, and services rendered by establishments and households. Small and medium-size firms also appear to subcontract a greater volume of these services, per unit of capital, than large firms; however, the difference is not as large as among the first group. Consequently it was possible to estimate the expansion paths for these four types of services subcontracted by Brazilian industry. The results suggest that in the long run, the estimated paths tended to decline from curves turned upwards (see graph) to curves turned to the right, or to horizontal lines. Thus, there seems to have occurred a change in this form of productive organization, from "high subcontracting" forms to "low-subcontracting" forms of industrial organization.

Although not directly related to the subject of subcontracting of services, it was interesting to observe that, in Brazil, during

[33] C. Salm, "Informação e Política de Emprego: Considerações Gerais", in *Sistemas de Informação* ..., *op. cit.*, pp. 301-314.

the decade of the 60's, the employment of industrial labor per unit of capital also seems to have declined more in large firms than in small ones. This result is especially important from a methodo-logical point of view, because, in explaining variations in labor/capital ratios in Brazilian industry, several authors have taken into consideration only their respective relative costs. The results related here, however, suggest that part of the variation in the proportion between labor and capital in Brazilian industry may be explained in terms of the effect of variations in industrial scale. [34]

In the decade of the 50's, import substitution in the transport equipment industry seems to have been such a stimulus to sub-contracting of other establishments that the estimated expansion path curved upward! In subsequent years, there seems to have been considerable vertical integration in these industries, reflected by a relative decline in their subcontracting. Industry in general, however, seems to have intensified subcontracting of services rendered by establishments during the same period.

The variations of the inequality effect referred to above, as well as the scale effect, were both inferred from the estimation of statistically significant differences in the parameters estimated for 1970 in comparison with those estimated for 1940, 1950 and 1960 based on the Brazilian economic censuses. Even keeping in mind modifications in the census definitions during the period considered, these results suggest that there may have occurred an important real change in the structure of production of Brazilian industry during the decade of the 60's. This result could be supported or weakened by the application of the same methodology to the economic censuses of 1975 and 1980.

As scale and industrial concentration have increased over the years, subcontracting seems to have declined. It is possible that the displacement of medium-sized firms by large ones has eliminated the main clients of subcontracted services. In this case, "disguised employment" in industry may be reverting at last to "disguised unemployment" in services. Small firms of the informal sector are

[34] A study which takes into consideration the scale effect in the estimation of the elasticity of substitution in Brazil is that of H. C. Tolosa, "Diferenciais de Produtividade Industrial e Estrutura Urbana," in *Pesquisa e Planejamento Econômico*, vol. 4, n.º 2 (June, 1974), pp. 325-352. Nevertheless, this focus, based on A. Griliches and V. Ringstad, *Economies of Scale and the Form of the Production Function* (Amsterdam: North Holland Press, 1971) only takes into account the *homogeneous* effect of scale, that is, the economies or dise-conomies of scale for the production function as a whole. It does not take into account the *non-homogenous* scale-effect, that is, the economies or diseconomies of scale that affect some factors more than others as was done in obtaining the results related here.

thus progressively eliminated from the system of production: first, as producers of goods, afterwards as suppliers of services.

4 — Conclusions

Until more precise information becomes available, we conclude that industrial subcontracting of various services increases with wage inequality between services and industry, and diminishes with the scale of the industrial plant. Thus, insofar as these results can be translated in terms of the propositions contained in the first part of this article, the "scale-effect" seems to predominate over the "inequality-effect" in the determination of service-subcontracting. The Brazilian case, however, presents the particularity that wage inequality between services and industry in the external labor market has *declined*, while industrial scale and concentration have increased. These changes acted together in reducing industrial subcontracting, especially during the sixties.

These results lead us to speculate on the viability of employment policies and of income distribution policies that aim at institutionalizing and adapting subcontracting so as to distribute to the informal sector some of the benefits of the expansion of the formal sector. It would be feasible, perhaps, to establish and to license credit associations or cooperatives that could serves, simultaneously, as clearinghouses for raw materials. These associations would institute collective bargaining over price-rates rather than wage-rates and would eventually be able to intermediate the extension of social security and other benefits for that large portion of the work force which works at home, in micro-firms or as self-employed labor, without stable employment links with the formal sector. They could, moreover, be used to improve the access of the informal sector to the technological progress generated by the formal sector, a process which seems to have played a critical role in the industrialization of other countries. Such policies would have the merit of taking into account the prevailing structural relations of the Brazilian economy, which have been present for some time and will probably remain for a long time in the future.

It is necessary to remember, nevertheless, that insofar as scale and concentration have increased in Brazilian industry, subcontracting seems to have declined. Consequently, any programs developed to expand subcontracting would not take the place of broader policies of industrialization and employment. They would only constitute a complement to programs favoring medium-size firms which, according to results obtained up to the present, seem not only to subcontract more, but also to employ more workers, relatively, than do large firms.

40

Agrarian structure, production and employment in the northeast region of Brazil *

Gervásio Castro de Rezende **

1 — Introduction

The objective of this study is the analysis of the agrarian structure of the Northeast region of Brazil. For this purpose, the Agricultural Census of 1970 will be utilized along with information and analyses obtained from case studies. This study will use as its basis empirical information as well as the basic elements of the theoretical analysis of "forms of the social organization of production" henceforth referred to as the "(social) forms of production". [1] *A form of production "*... refers to the way tasks are performed, that is the particular organizational forms which characterize the productive process. It comprises not only the social organization of this process, but the technological levels inherent to it, as well. The social organization

** The author is affiliated with the IPEA Research Institute.

[1] The *social* (or *historical*) *form* is distinguished from the *natural* (or *technical-material*) *form* of production. For a systematic discussion on this subject, see I. I. Rubin, *Essays on Marx's Theory of Value* (Detroit: Black and Red, 1972).

of production also comprises the means by which producers have access to the factors of production, the different ways of combining these factors and the relationships which exist among the various social groups involved in the process of production, distribution and circulation." [2]

Section 2 discusses the census data on "employed individuals", emphasizing the disproportionately large share of farm units of less than 10 hectares, as well as the predominance of the census category entitled "operators and family members" in the total of "employed individuals".

Section 3 presents census data on farming and livestock production, both for aggregates of agricultural activities as well as for individual activities, selected according to their relative importance, by state. The objective of the analysis is to identify the productive patterns of the farm units according to their "size", as well as the relative importance of the groups of farm units, classified by size, in the total production of the various activities.

In Section 4, these data are analyzed based upon information on the labor force (specifically, whether family labor, wage labor or sharecropping labor prevails). Other characteristics of the farm units are utilized as well with the same objective of characterizing the forms of production, particularly examining the relationship between the "size" patterns and the forms of production of the farm units.

Among the empirical phenomena presented in Section 4, emphasis is placed on the "segmentation" or "duality" of petty production (family farm) /capitalist production (capitalist farming). These phenomena serve as a frame of reference for the analysis of the basic aspects of employment and the determination of income level in the agricultural sector of the Northeast. *Petty production* is defined by the exclusive or predominant utilization of the family labor force, whose full employment sets a more or less defined limit on the scale (or size) of the productive activities. In this case, the denomination "petty" refers to the contrast with *capitalist production* in which wage labor predominates, and which has no "natural" limit to the production unit scale, thus rendering "large-scale" production possible (although not necessary). In the analysis of this segmentation, we identify the differential conditions of production which form the basis of the predominance of capitalist production in certain activities. Petty production is excluded from these activities, itself being the exclusive or predominant form of production

[2] W. S. Saint, Jr., *The Social Organization of Crop Production: Cassava, Tobacco and Citrus in Bahia, Brazil,* Latin American Studies Program, Dissertation Series n.º 76 (Ithaca: Cornell University, August, 1977), p. 100.

in other activities. The basic concept of the *structural subordination* of the small farm is developed, based on the analysis of the relations established between the same and capitalist production. For the purposes of this analysis, we are given the differential conditions of ownership and access to land and other means of production (including labor forces means of subsistence) by which they are characterized. The economic phenomena analyzed include (a) employment possibilities and the satisfaction of family subsistence needs in small-scale farming and, (b) the profit rate, real wage level and labor supply in capitalist farming. It must be kept in mind that the structural subordination of the family farm is also expressed in specific price formation laws for goods from both "sectors". Through critical contrasts, it is illustrated how the role of agrarian structure has been disregarded in the literature on "subsistence agriculture" and "rural poverty"; in addition, this study presents a criticism of the "dualist" theoretical tradition from various viewpoints.

Finally, a general perspective on the role of economic policy is presented in the concluding remarks of section 5.

2 — Size of the holding and employment

The role of "small farm units" in the absorption of the rural labor force is frequently emphasized in current literature on agriculture in the Brazilian Northeast, adopting as an empirical base the data on "employed individuals" from the Agricultural Census. [3] The data, as presented in table 1, indicate a large concentration of "employed individuals" in the categories designating smaller holdings, although the regional variation in this phenomenon should be pointed out. Thus it can be seen that concentration is the most extreme in the states of Maranhão and Sergipe, where approximately 82 and 71%, respectively, of the total number of "employed individuals" fall within the *less than 10 hectares* area-size category, while in states such as Ceará, Rio Grande do Norte and Bahia, this percentage varies between 38 and 46%. Different geographical conditions (especially variation of the relative importance of the semi-arid regions among the states) render inappropriate a stratification of the agricultural holdings by area size. This is because, in comparison with other regions of the Northeast, in the backlands, the limitations of natural resources (such as soil, climate, etc.), demand larger planting areas for the same total output obtained. It is thus possible that

[3] An important paper prepared on this topic by F. Sá Jr. is entitled "O Desenvolvimento da Agricultura Nordestina e a Função das Atividades de Subsistência", and appears in the review *Seleções CEBRAP*, n.º 1 (São Paulo, 1975), pp. 82-134.

Table 1

The Brazilian Northeast: Distribution of All Employed
Individuals by Farm-Size Categories

States	Total	Farm-Size Categories (by number of hectares)					
		Less than 10	10 ⊢ 20	20 ⊢ 100	100 ⊢ 500	More than 500	More than 100
1. Maranhão	1 182 711	82.3	3.0	6.4	4.8	1.9	6.7
2. Piauí	518 736	62.1	7.9	18.7	8.9	2.1	11.0
3. Ceará	1 021 712	37.6	15.1	29.3	13.4	4.6	18.0
4. Rio Grande do Norte	307 881	46.2	11.6	22.1	12.4	7.7	20.1
5. Paraíba	584 656	57.0	12 5	17.6	8.6	4.3	12.9
6. Pernambuco	1 128 244	63.7	9.7	12.9	7.6	6.1	13.7
7. Alagoas	430 279	58.3	11.3	14.1	9.0	7.4	16.4
8. Sergipe	268 782	70.7	8.8	12.8	5.3	2.3	7.6
9. Bahia	2 125 809	45.1	13.5	28.4	10.2	2.7	12.9

SLURCE: 170 Agricultural Census.

a holding of 50 hectares, for instance, in the backlands of Ceará, may be as "small" as one of five hectares in Maranhão. It is also worth noting that the regional differentiation in the distribution illustrated in table 1 is associated with the regional diversity of organizational forms of production. The discussion on this subject, however, must be postponed to some future occasion.

The concentration of "employed individuals" on "small-scale forms" is reflected more clearly in the very small share of holdings larger than 100 hectares in this total, reaching approximately 20% in only one state: Rio Grande do Norte. However, the total area of farm units in the Northeast is concentrated in these larger holdings, as may be observed in table 2: holdings of more than 100 hectares occupy between 59 (in Sergipe) and 84% (in Maranhão) of the total area of the farm units. [4]

[4] It should be kept in mind that the distribution presented in table 2 differs from the distribution of assets (particularly land ownership). Among other reasons, this is due to the fact that, may be observed, many of the small holdings are farmed by non-owners. However, there exists evidence that, in the larger area categories, the phenomenon of one landowner possessing more than one holding is considerably important. For the case of Southeastern Bahia, see Gervásio Castro de Rezende, "Produção, Emprego e Estrutura Agrária na Região Cacaueira da Bahia", published in the review *Pesquisa e Planejamento Econômico*, vol. 8, no. 1 (April, 1978), pp. 83-116. In addition, the possibility of the multiple counting of small plots will also be mentioned later. Finally, it should be kept in mind that this distribution is restricted to "producers", and therefore does not encompass the entire range of social groups involved in productive activities in the agricultural sector.

Table 2

The Brazilian Northeast: Distribution of Total Area of Holdings by Farm-Size Categories

States	Total	Farm-Size Categories (by number of hectares)					
		Less than 10	10 ⊢ 20	20 ⊢ 100	100 ⊢ 500	More than 500	More than 100
1. Maranhão	100.0	5.6	1.3	9.0	26.8	57.4	84.2
2. Piauí	100.0	3.1	2.0	14.9	30.2	49.8	80.0
3. Ceará	100.0	3.9	4.5	23.0	32.7	35.9	68.6
4. Rio Grande do Norte	100.0	4.1	3.8	18.5	28.2	45.3	73.6
5. Paraíba	100.0	8.1	6.1	22.1	30.4	33.3	63.7
6. Pernambuco	100.0	10.9	6.3	22.6	30.9	29.3	60.2
7. Alagoas	100.0	10.3	7.0	21.6	27.0	34.0	61.0
8. Sergipe	100.0	9.5	6.4	25.2	30.6	28.3	58.9
9. Bahia	100.0	4.7	4.5	24.6	31.4	34.8	66.2

SLURCE: 1970 Agricultural Census.

As we shall attempt to illustrate, this phenomenon is closely linked to the structural characteristics of production in the agricultural sector of the Northeast, especially the great importance of petty farming in the absorption of labor. [5] At this point, we may present several general features of this agrarian structure, based on tables 3 and 4, which give census data by occupational categories, defined according to the socio-economic status of the people employed.

As will be observed in table 3, the census category of "operator and unpaid family members", is predominant in all states in the total of "employed individuals", with a maximum share of approximately 95% in the states of Maranhão and Piauí and a minimum share of almost 73% in Ceará. This table also indicates that the categories of "sharecroppers" and "other status" practically did not appear anywhere in the Northeast, except in the states of Ceará, Rio Grande do Norte and Paraíba, where they reached a share of between 8 and 13%; in the remainder of the states, "sharecroppers" and "other status" do not account for more than 3% of the total share of "employed individuals". In the category of "sharecroppers", the census includes persons "subordinate to the administration of the holding who receive, as payment, a portion of the crop harvested". Since the census allows for "autonomous" sharecropping (in which

[5] F. Sá Jr., *op. cit.*, on the basis of agricultural censuses, defends the argument that small-scale agriculture expanded rapidly in the Northeast during the period 1950-65, through a process of multiplication of the *minifundios* (small holdings).

Table 3

The Brazilian Northeast: Distribution of All Employed Individuals Socio-Economic Categories

States	Total	Occupational Categories				
		Operator and Family	Permanent Employees	Temporary Employees	Share-croppers	Other Status
1. Maranhão	100.0	94.1	0.7	4.3	0.5	0.4
2. Piauí	100.0	96.8	0.8	1.3	0.7	0.3
3. Ceará	100.0	72.6	2.3	13.3	4.7	7.1
4. Rio Grande do Norte	100.0	73.6	4.1	9.9	11.4	1.1
5. Paraíba	100.0	79.6	4.2	8.4	7.0	0.9
6. Pernambuco	100.0	82.0	7.2	10.2	0.2	0.4
7. Alagoas	100.0	75.1	9.0	13.2	0.9	1.8
8. Sergipe	100.0	88.5	4.8	5.7	0.3	0.7
9. Bahia	100.0	84.1	4.4	8.6	0.9	2.1

SOURCE: 1970 Agricultural Census.

case the farm is considered a separate unit and the sharecropper and members of his family are included in the category of "operator") it is probable that substantive problems of interpretation have arisen. On the other hand, the "other status" category includes *moradores* (farm hands) and tenant farmers whose strict definition (in relation to "sharecropper-employees", "autonomous sharecroppers" or "permanent employees") constitutes a quite complex issue. These data should, therefore, be regarded with the appropriate qualifications.

In table 4, the data on "employed individuals classified by the occupational categories listed by the census, are presented by farm-size categories. What is first noticed is that the "operator and family members" category is predominant largely in smaller size categories, and there is a substantial decrease in the significance of this category as the size of the holding increases. This category's share remains, however, reasonably significant at least up to the of 100 to 500 hectares farm-size category; in Maranhão and Piauí, operators and family members represent more than two-thirds of the total number of employed individuals in the more than 500 hectares farm-size category. On the other hand, on the larger holdings the categories of "employees" ("permanent and temporary") and of "sharecroppers" and "other status" gain significance. Nevertheless, it is worth noting an interesting contrast between the States of Ceará, Rio Grande do Norte and Paraíba, on the one hand, and the States of Pernambuco, Alagoas, Sergipe and Bahia on the other, since in the former, the "sharecroppers" and "other status categories" assume a comparatively larger weight in the larger farm-size categories: it suffices to

Table 4

The Brazilian Northeast: of All Employed Individuals by Classified by Occupational Categories, by Farm-Size Categories

States and Occupational Categories	Farm-Size Categories (by number of hectares)				
	Less than 10	10 ├ 20	20 ├ 100	100 ├ 500	More than 500
1 — Maranhão	100.0	100.0	100.0	100.0	100.0
Operator and Family	95.7	88.4	90.0	83.9	66.1
Permanent Employees	0.9	1.1	1.6	4.3	10.0
Temporary Employees	3.4	8.6	7.6	9.9	13.5
Sharecroppers and Other Status	0.6	1.8	0.7	1.8	10.4
2 — Piauí	100.0	100.0	100.0	100.0	100.0
Operator and Family	98.9	96.9	96.0	90.5	69.4
Permanent Employees	0.2	0.5	0.9	2.6	9.8
Temporary Employees	0.6	2.0	1.8	3.2	7.5
Sharecroppers and Other Status	0.3	0.6	1.3	3.7	13.3
3 — Ceará	100.0	100.0	100.0	100.0	100.0
Operator and Family	86.8	80.8	69.7	47.9	21.2
Permanent Employees	0.9	1.2	2.3	5.1	9.2
Temporary Employees	9.6	11.9	14.8	19.2	20.9
Sharecroppers and Other Status	2.7	6.1	13.2	27.8	48.7
4 — Rio Grande do Norte	100.0	100.0	100.0	100.0	100.0
Operator and Family	92.8	83.0	69.1	38.3	13.4
Permanent Employees	0.9	2.0	4.2	11.4	14.4
Temporary Employees	4.5	8.1	11.8	17.3	26.9
Sharecroppers and Other Status	1.8	6.9	15.0	32.5	45.3
5 — Paraíba	100.0	100.0	100.0	100.0	100.0
Operator and Family	93.6	83.7	69.2	36.2	11.3
Permanent Employees	0.8	2.5	5.7	15.4	25.2
Temporary Employees	4.1	8.1	12.3	19.1	29.2
Sharecroppers and Other Status	1.5	5.6	12.8	29.3	34.2
6 — Pernambuco	100.0	100.0	100.0	100.0	100.0
Operator and Family	95.7	86.2	76.1	32.7	5.9
Permanent Employees	0.7	2.6	5.5	32.6	54.5
Temporary Employees	3.4	10.6	16.9	32.8	38.4
Sharecroppers and Other Status	0.2	0.6	1.5	1.9	1.2
7 — Alagoas	100.0	100.0	100.0	100.0	100.0
Operator and Family	93.1	83.6	66.5	19.4	3.8
Permanent Employees	1.0	3.4	9.4	35.7	47.9
Temporary Employees	4.9	10.4	20.0	39.0	38.6
Sharecroppers and Other Status	1.0	2.5	4.1	5.9	9.8
8 — Sergipe	100.0	100.0	100.0	100.0	100.0
Operator and Family	95.5	80.9	39.2	41.9	14.5
Permanent Employees	1.7	2.9	8.7	29.2	40.6
Temporary Employees	2.4	4.5	8.9	26.1	44.0
Sharecroppers and Other Status	0.4	2.6	2.7	2.7	0.8
9 — Bahia	100.0	100.0	100.0	100.0	100.0
Operator and Family	95.1	88.3	79.2	58.1	14.0
Permanent Employees	0.7	1.9	5.1	14.6	31.3
Temporary Employees	3.2	7.3	11.3	20.4	76.4
Sharecroppers and Other Status	1.0	2.4	4.4	6.9	9.3

SOURCE. 1970 Agricultural Census.

note that, in Ceará, these categories represent almost 50% of the total number of employed individuals on farms of more than 500 hectares, in contrast with Pernambuco and Sergipe, where the share of these categories, in the same farm-size categories. is only approximately 1%. This result in itself indicates a regional differentiation of organizational forms of production and the corresponding patterns of land and labor use on the large farms of the Northeast.

3 — Economic activities and size of holding

As was observed in the previous section, rural employment in the Northeast takes the form of "occupations" with socio-economic characteristics which, as we shall attempt to demonstrate, play a fundamental role in determining employment conditions and income in rural areas. Since the data showed that there is correlation between occupational types and farm-size categories, [6] it can be assumed that, through an examination of the economic activities, or, more generally, of the economic characteristics of the farm units, it is possible to analyze the concrete conditions under which these occupations are exercised. Insofar as the analysis demonstrates that these economic characteristics of farm units are fundamentally characteristics of a *structural* nature, we have established a theoretical perspective of the relationship between rural employment, production and *agrarian structure*.

3.1 — Size of the holding and production patterns

It is possible to identify differentiation in the production patterns of holdings classified by size. For this purpose, table 5 presents the percentages, of total output, [7] of the aggregates of economic activities (livestock, permanent crops and temporary crops) for all holdings and for various sub-groups of holdings classified by size. In tables

[6] This correlation between occupation types and farm-size also appears, although in much more complex forms (varying activity by activity and region by region), under more concrete conditions, and only an equally complex and detailed analysis can demonstrate it. For example, see Gervásio Castro de Rezende, *op. cit.*, where an empirical analysis is presented, using the cocoa region of Bahia as a reference.

[7] Note that the data on "value of production" were obtained by the census directly from the producer with regard to animal-raising activities; for farming activities, these data were calculated based on the average sales price or, in the case of agriculture not oriented to the market, on the basis of the market price in effect during the period of the harvest. See *Instruções de Coleta* of the 1970 Census.

48

Table 5

The Brazilian Northeast: Percentage Share of Economic Acctivity Aggregates of the Value of Total Production of Holdings, by Farm-Size Categories

Economic Activity Aggregates	Farm-Size Categories (by number of hectares)					
	All Holdings	Less than 10	10 ├─ 20	20 ├─ 100	100 ├─ 500	More than 500
1 — Maranhão	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	19.6	14.2	20.0	25.1	38.8	46.7
Permanent Crops	2.9	2.2	4.6	5.3	4.4	4.4
Temporary Crops	57.4	61.8	65.1	57.2	45.3	32.1
2 — Piauí	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	32.9	24.5	33.6	36.7	44.3	43.9
Permanent Crops	5.8	4.2	7.8	7.8	6.9	5.6
Temporary Crops	47.0	63.8	48.8	43.2	29.1	16.2
3 — Ceará	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	31.1	27.8	22.4	29.6	36.5	39.8
Permanent Crops	22.2	19.3	22.7	23.8	22.8	22.0
Temporary Crops	35.9	44.4	39.7	36.8	29.9	24.9
4 — Rio Grande do Norte	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	29.8	18.1	24.9	32.1	34.0	35.6
Permanent Crops	28.1	17.6	29.2	30.4	32.0	32.9
Temporary Crops	37.2	58.6	39.5	31.7	29.5	27.5
5 — Paraíba	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	23.1	16.0	22.1	30.0	28.2	23.0
Permanent Crops	21.2	14.4	24.3	26.9	26.5	19.1
Temporary Crops	53.0	60.4	50.4	40.3	43.4	55.4
6 — Pernambuco	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	19.6	10.2	28.1	36.8	18.2	6.6
Permanent Crops	8.5	10.6	14.1	13.2	6.1	2.7
Temporary Crops	69.4	66.8	55.1	47.6	74.0	88.7
7 — Alagoas	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	12.9	14.3	18.7	21.2	12.8	5.5
Permanent Crops	5.8	11.4	13.0	8.7	2.5	1.9
Temporary Crops	78.7	71.7	64.8	67.2	83.1	89.3
8 — Sergipe	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	30.6	13.0	32.9	47.4	51.7	31.6
Permanent Crops	23.1	21.6	22.7	21.7	11.9	40.7
Temporary Crops	44.3	63.8	41.3	28.3	33.4	27.2
9 — Bahia	100.0	100.0	100.0	100.0	100.0	100.0
Total Livestock	24.7	16.5	18.1	18.9	28.2	53.8
Permanent Crops	31.6	16.6	24.5	37.0	42.5	27.7
Temporary Crops	38.1	61.1	51.3	38.1	24.5	13.8

SOURCE: 1970 Agricultural Census

6 and 7, the same percentages are presented for specific crop and livestock activities.

We shall now proceed to examine in greater detail the composition of output by size of holding. It may be observed in table 5, that in all states, the livestock aggregate becomes more significant as the size of the holding increases. In a few cases, however, particularly Pernambuco and Alagoas, due to the predominance of sugar-cane plantation, the trend is reversed in the larger form-size categories. Second, with the notable exception of the same two states (and Paraíba, also due to sugar cane) the temporary crops tend to contribute in a diminishing degree to total output according to the size of the holding. Finally, regarding the permanent crops, it is noteworthy that in the States of Ceará, Rio Grande do Norte and Paraíba there is no significant variation in the share of these crops in total output, according to the size of the holding. This same observation seems to apply to Sergipe (with the exception of the largest form-size category, in which this share increases to more than 40%), but not to Bahia where, up to the form-size category of 500 hectares, there is an increasing share of permanent crops in economic activity.

Once specific activities are detailed, however, clearer patterns of the differentiation of economic activity between holdings can be observed, according to their size. Beginning with crop activities (table 6), in ePrnambuco and Alagoas a sharp contrast is drawn between sugar cane and *roçado* * crops, i.e., the sum total of beans, manioc and corn grown. [8] (The same applies to Paraíba and Sergipe, although to a lesser degree). *Roçado* crops rapidly decrease in significance as the total area of the holding increases. Thus, in ePrnambuco and Alagoas they account for more than 45% of the output on holdings of less than 10 hectares, but less than 1% on holdings larger than 500 hectares. Inversely, sugar cane has little significance in the economic activity of holdings of less than 10 hectares (approximately 3% of the output of these holdings in Pernambuco and less than 5% in Alagoas). However, it assumes a clearly dominant

* Translator's note: *roçado* is land cleared by slash-and-burn agriculture; in the context of this paper the author uses this term primarily to refer to those crops — i. e., beans, manioc, corn — which are commonly cultivated in this type of agriculture.

8 The term "*roçado*" as used in rural areas of the Northeast, refers to an area under plantation where these three crops predominate, alongside other subsidiary crops (manioc, by itself, constitutes "*roça*"). See B. A. Heredia, "Trabalho Familiar dos Pequenos Produtores da Zona da Mata", Master's thesis in Social Anthropology (Rio de Janeiro, Museu Nacional, 1977), and A. Garcia Jr., "Terra de Trabalho" (Rio de Janeiro, Museu Nacional, 1975). It is probable that many of the holdings which we classified as "*roçado*" actually cultivate a combination (or "consortium") of these three crops, but the census classification is based on "principal" crops considered separately.

Table 6

The Brazilian Northeast: Percentage Share of Specific Crop Activities
of the Value of Total Production of Holdings by Farm-Size Categories

Specific Crop Activities	All Hold-ings	Farm-Size Categories				
		Less than 10	10 ⊢ 20	20 ⊢ 100	100 ⊢ 500	More than 500
1 — Maranhão						
Rice	32.8	34.9	40.8	34.2	25.8	18.3
Roçado	16.5	18.6	14.7	14.7	11.0	6.8
2 — Piauí						
Rice	9.9	15.4	6.4	6.6	5.6	3.1
Roçado	25.2	31.4	32.4	26.8	16.9	5.8
3 — Ceará						
Arboreal Cotton and Others[a]	18.1	14.3	17.6	19.4	19.8	20.0
Sugar Cane	5.7	5.4	5.5	6.1	5.6	5.8
Roçado	22.2	30.6	26.4	22.8	16.4	11.7
4 — Rio Grande do Norte						
Arboreal Cotton and Others[a]	25.3	15.1	24.3	26.0	28.8	31.6
Herbaceous Cotton	6.0	9.9	8.5	5.0	3.7	3.3
Sugar Cane	5.0	1.1	1.8	3.5	11.1	10.1
Roçado	19.1	40.4	23.2	16.6	9.3	7.2
5 — Paraíba						
Arboreal Cotton and Others[a]	19.3	11.6	22.0	25.2	25.1	18.5
Herbaceous Cotton	5.4	8.1	5.2	4.2	4.0	3.0
Sugar Cane	12.4	1.5	3.3	7.0	20.2	40.0
Roçado	24.6	44.8	26.2	18.3	11.8	5.2
6 — Pernambuco						
Sugar Cane	36.9	2.9	11.5	12.8	63.2	84.2
Roçado	20.5	45.3	28.2	17.5	4.1	1.0
7 — Alagoas						
Sugar Cane	50.8	4.4	13.0	33.0	60.3	83.3
Roçado	13.5	44.7	28.2	12.8	2.3	0.8
8 — Sergipe						
Oranges	4.3	6.0	5.7	5.6	2.0	0.4
Coconuts and Others[b]	17.6	13.8	14.9	14.9	9.3	40.1
Rice	3.0	2.0	4.0	4.5	3.4	3.3
Sugar Cane	8.6	1.1	1.6	4.2	23.2	19.6
Roçado	24.7	46.0	28.0	15.8	4.6	2.1
9 — Bahia						
Cocoa	22.2	3.5	12.8	28.3	35.6	19.5
Sugar Cane	1.8	1.5	1.1	0.9	2.2	4.5
Roçado	28.0	44.5	39.2	29.6	17.0	7.0

SOURCE: 1970 Agricultural Census.

[a] Arboreal cotton accounts for the following percentages of the total for this item for « all holdings »: Ceará: 84.1%; Rio Grande do Norte: 69.8% and Paraíba: 72.3%.

[a] Coconut prodution accounts for 83.7% of the total of this item for « all holdings ».

51

character in holdings of more than 100 hectares, reaching, in both states, approximately 84% of the output of holdings with more than 500 hectares. It is interesting to observe the "cut-off" which exists in Pernambuco between holdings of more than 100 hectares and those smaller.

Roçado farming exercises a fundamental role in the economy of small farms in all the states, with the exception of Maranhão, where rice is the important crop, not only for small farms but for all farm-size categories. *Roçado* farming is gradually replaced as the size of the holding increases, bestowing little economic significance upon corn, beans and manioc for holdings classified in the larger size categories.

It is also worth examining the opposing trends in the percentages of total output of cocoa and *roçado* farming in Bahia, by farm-size category. On holdings of less than 10 hectares cocoa represents 3.5% of output while *roçado* is fundamentally important (as in the other states), contributing 44.5%. By contrast, in the farm-size category of 100 to 500 hectares, cocoa accounts for almost 36% of output, whereas *roçado* accounts for less than 17%. [9]

As was previously indicated for the "permanent crops" aggregate, it is clear that arboreal cotton, in the States of Ceará, Rio Grande do Norte and Paraíba, does not show a significant trend of altering, one way or another, its share in the total output of the various farm-size categories. This same observation can also be applied to coconut growing in Sergipe, even for the largest size category (over 500 hectares).

Finally, the other activities listed in the table, which are not of major economic importance in the various states, are characterized in several instances by maintaining the same share of total output, independent of the size of the holding (sugar cane in Ceará, rice in Sergipe). In other cases, this share declines slightly (herbaceous cotton in Rio Grande do Norte and Paraíba, oranges in Sergipe), or increases slightly (sugar cane in Bahia).

Upon applying this discussion to livestock activities, an important conclusion can be proposed based on table 7. As was pointed out in the analysis of table 5, the *aggregate* of these activities ("total livestock") generally assumed increasing economic importance as the size of the holding increased. It is now worth noting that the *composition* of this aggregate also changes significantly

[9] The phenomenon of the sharp drop in the share of cocoa, which is found between the two size classes of 100 to 500 hectares and more than 500 hectares, is due to characteristics peculiar to the cultivation of cocoa, as will be discussed later on in the text.

Table 7

*The Brazilian Northeast: Percentage Share of Specific Livestock
Activities in the Value of Total Production of Farm-Size Category*

Specific Livestock Activities	All Hold-ings	Less than 10	10 ⊢ 20	20 ⊢ 100	100 ⊢ 500	More than 500
1 — Maranhão						
Beef Cattle	6.7	2.2	0.4	10.6	21.5	32.3
Dairy Farming	2.6	1.1	4.2	5.1	8.3	8.3
Medium-Size Animals	4.6	4.8	3.4	4.1	4.5	3.2
Fowl and Small Animals	5.2	5.7	5.4	4.7	3.6	2.0
2 — Piauí						
Beef Cattle	12.7	4.3	10.8	15.0	23.4	28.4
Dairy Farming	6.8	3.8	7.9	8.7	10.0	10.0
Medium-Size Animals	7.5	8.1	7.7	8.5	7.2	3.8
Fowl and Small Animals	5.2	7.8	6.3	3.6	2.7	1.0
3 — Ceará						
Beef Cattle	11.3	4.6	6.4	10.6	16.5	21.4
Dairy Farming	11.6	7.0	8.5	12.1	15.0	15.9
Medium-Size Animals	3.0	3.2	3.2	3.5	2.9	1.6
Fowl and Small Animals	4.8	12.8	3.8	3.0	1.8	0.6
4 — Rio Grande do Norte						
Beef Cattle	14.3	5.2	0.5	14.8	18.5	21.3
Dairy Farming	10.6	5.8	8.6	11.5	13.2	12.5
Medium-Size Animals	1.5	1.6	1.8	1.9	1.4	1.0
Fowl and Small Animals	2.9	5.4	3.9	3.9	0.8	0.6
5 — Paraíba						
Beef Cattle	9.8	5.1	7.4	10.5	13.9	15.4
Dairy Farming	8.6	5.4	8.9	11.3	12.4	6.9
Medium-Size Animals	1.5	1.8	1.9	1.7	1.1	0.7
Fowl and Small Animals	3.1	3.6	3.9	6.4	0.8	0.2
6 — Pernambuco						
Beef Cattle	7.5	5.7	9.0	13.7	9.3	3.4
Dairy Farming	5.4	3.4	7.3	11.3	6.4	2.4
Medium-Size Animals	1.5	2.1	2.3	2.5	0.8	0.2
Fowl and Small Animals	5.2	7.9	9.4	9.1	1.6	0.5
7 — Alagoas						
Beef Cattle	7.1	5.1	10.8	13.1	7.5	3.7
Dairy Farming	3.3	2.0	4.7	6.1	3.6	1.7
Medium-Size Animals	0.6	1.6	1.1	0.7	0.3	0.1
Fowl and Small Animals	1.8	5.5	1.9	1.3	1.4	0.1
8 — Sergipe						
Beef Cattle	10.0	3.8	10.0	30.9	36.2	24.6
Dairy Farming	7.8	3.2	8.8	12.8	13.8	6.3
Medium-Size Animals	1.0	1.2	1.5	1.3	0.7	0.3
Fowl and Small Animals	2.7	4.6	3.4	2.3	0.9	0.3
9 — Bahia						
Beef Cattle	14.8	4.4	7.8	9.6	19.1	44.6
Dairy Farming	4.6	2.3	3.4	4.2	6.3	7.5
Medium-Size Animals	2.8	4.3	3.7	3.0	1.8	0.9
Fowl and Small Animals	2.3	5.3	3.0	2.0	0.9	0.5

according to the size of the holding, since, whereas cattle-raising and dairy farming increase their share in total output (although the former clearly increases more than the latter), the raising of the medium-size animals (sheep, goats, swine, etc.) and, especially, small animals (chickens, rabbits, etc.) decreases in importance with the size of the holding. Consequently, livestock activities, as a whole, not only have less economic significance on small, as compared to larger holdings, but also differ in their nature, particularly in relation to the need to tie up resources in stocks of animals and feed for the herd (that is, grazing land).

3.2 — Aggregate output and size of holdings

Whereas the objective of tables 6 and 7 was to examine the relative position of the various specific activities in the global economic activity of each farm-size category, the objective of tables 8 and 9 will be to analyze (using the same data) the relative position of the farm-size categories in the overall picture of agriculture in the Northeast, based on the respective shares in total output of each specific activity.

Once again, we shall begin by discussing crop activities. The sugar cane/*roçado* contrast in Pernambuco and Alagoas is markedly predominant in small farms in the total output of *roçado* activities, and the small significance of these farms in terms of the total output of sugar cane: this is clearly the conclusion to be reached in view of the large share of farms of less than 10 hectares in the total output *roçado* farming (70 and 63% in Pernambuco and Alagoas, respectively), and their very small share in the total output of sugar cane (less than 3% in both states). The same contrast is clearly indicated inversely in the predominance of holdings of more than 100 hectares in the total output of sugar cane (in which their shares are more than 85% in Alagoas and almost 90% in Pernambuco) and a truly insignificant amount, in relation to the total, in the output of *roçado* (between 5 and 7% in the two states). It is worth noting that this kind of contrast between sugar cane and *roçado* farming is also seen in Paraíba and Sergipe. However, in Rio Grande do Norte, sugar cane production is concentrated on holdings of more than 100 hectares, and almost half the total output of the *roçado* is derived from farms of less than 10 hectares, while the total share of the farm-size categories of 20 to 100 hectares and 100 to 500 hectares in *roçado* farming is not insignificant (almost one-third). These classes of holdings reveal an even greater importance in this activity in Bahia, where they constitute almost half the total output; in that same state, on the other hand, sugar cane does not display the

same degree of concentration in holdings larger than 100 hectares, whose share is about 60% of the total, with the remaining 40% produced by holdings of less than 100 hectares (in comparison, these percentages are, approximately, 78 and 22%, 81 and 19%, 90 and 10%, 85 and 15%, 35 and 15%, respectively, for Rio Grande do Norte, Paraíba, Pernambuco, Alagoas and Sergipe). It is important to observe, finally, that in Ceará, sugar cane and roçado barely differ in terms of the respective percentage distributions of the total output by farm-size category.

The growing of cocoa in Bahia, on the other hand, is concentrated in the two farm-size categories of 20 to 100 hectares and 100 to 500 hectares which, together, account for about 80% of the total output. In order to analyze the concentration of cocoa production, however, it is necessary to keep in mind that, first, the gross output per hectare is considerably higher than that of other crops, and therefore a given farm-size category for cocoa is larger when compared to those of other crops. Second, the concentration of production further takes the form of ownership of various holdings by the same producer, a phenomenon which takes on greater importance due to the fact that "multiple ownership" is highly differentiated, depending on whether it is small-scale farming (based on family labor) or capitalist farming (based on wage labor).[10] Since this additional information is available, we may also consider the growing of cocoa as a concentrated production, notwithstanding the contradictory information furnished by the census data.

However, while arboreal cotton production structure, exhibits a nearly identical pattern in the three states selected (Ceará, Rio Grande do Norte and Paraíba), it does not indicate a concentration in the *extremes* of distribution; on the contrary, it comprises holdings larger than 20, but smaller than 500 hectares, which accounts for the major share of the total (between 50 and 60%). It is clear that this conclusion indicates specific characteristics in the growing of arboreal cotton which will be discussed in the next section.

With reference to the other crops listed in table 8, the first observation to be made is that there is a marked predominance of small units in rice production in Maranhão and Piauí. In an interesting contrast to roçado in Pernambuco and Alagoas, however, it is noteworthy that this high concentration is not derived from the exclusiveness of small farm units in rice production. It must be kept in mind (see table 6), that this crop displayed economic

10 See Gervásio Castro de Rezende, *op. cit.*

Table 8

The Brazilian Northeast: Percentage Share of Farm-Size Categories in the Value of Total Production According to Specific Crop Activities

Specific Crop Activities	All Holdings	Size Category (by number of hectares)				
		Less than 10	10 ⊢ 20	20 ⊢ 100	100 ⊢ 500	More than 500
1 — Maranhão						
Rice	100.0	75.1	5.5	10.0	6.4	3.0
Roçado	100.0	79.5	4.0	8.5	5.9	2.1
2 — Piauí						
Rice	100.0	68.2	4.9	14.0	9.6	3.3
Roçado	100.0	54.4	9.6	22.3	11.3	2.4
3 — Ceará						
Arboreal Cotton and Others[a]	100.0	18.4	11.9	31.8	24.2	13.7
Sugar Cane	100.0	22.0	11.9	31.7	21.9	12.5
Roçado	100.0	32.1	14.6	30.5	16.3	6.5
4 — Rio Grande do Norte						
Arboreal Cotton and Others[a]	100.0	13.8	8.9	25.9	26.9	24.5
Herbaceous Cotton	100.0	37.8	13.1	23.8	14.5	10.8
Sugar Cane	100.0	4.4	2.9	14.3	44.7	33.7
Roçado	100.0	48.8	11.2	21.1	11.5	7.4
5 — Paraíba						
Arboreal Cotton and Others[a]	100.0	19.7	12.6	28.6	23.8	15.2
Herbaceous Cotton	100.0	49.8	10.6	17.0	13.8	8.8
Sugar Cane	100.0	4.0	2.9	12.3	29.8	51.0
Roçado	100.0	59.9	11.7	16.3	8.8	3.3
6 — Pernambuco						
Sugar Cane	100.0	2.6	2.6	5.3	36.9	52.9
Roçado	100.0	69.7	11.6	13.2	4.3	1.2
7 — Alagoas						
Sugar Cane	100.0	1.6	1.8	11.2	39.0	46.4
Roçado	100.0	62.8	14.4	16.2	4.8	1.8
8 — Sergipe						
Oranges	100.0	56.6	10.0	23.6	8.2	1.7
Coconuts and Others[b]	100.0	31.7	6.3	15.4	9.4	37.2
Rice	100.0	26.4	0.7	26.7	19.8	17.4
Sugar Cane	100.0	5.2	1.4	8.7	47.6	37.1
Roçado	100.0	75.2	8.5	11.6	3.3	1.4
9 — Bahia						
Cocoa	100.0	3.3	5.8	42.8	37.5	10.6
Sugar Cane	100.0	17.1	6.2	17.2	28.5	31.0
Roçado	100.0	33.3	14.0	35.5	14.2	3.0

SOURCE: 1970 Agricultural Census.
[a] See Table 6.
[b] See Table 6.

importance for all farm-size categories (rice production constituted approximately 1/4 of the total output of holdings of 100 to 500 hectares). Thus the predominance of small farm units in rice production can only be the result of the large relative weight of these small farms in the agriculture of the region. In another type of contrast which points, once again, to the need to take into consideration the regional diversity which exists in the agriculture of the Northeast, according to table 8 small farms are not predominant in rice production in Sergipe; on the contrary, farm units of less than 20 hectares account for only 35%, which is less, therefore, than the share attributed to holdings of more than 100 hectares (approximately 37% of the total).

In the case of herbaceous cotton, it is interesting to note that the percentage distribution of its total output, according to farm-size categories, is essentially the same as *roçado* production. It is reasonable to assume that this result was forseeable, given the prevalence of the association of cotton with *roçado* crops.

To complete the analysis of table 8, it is worth mentioning the case of oranges and coconuts, in Sergipe. Oranges are primarily produced on small and medium-size holdings (less than 100 hectares); but in coconut production, very small plots (less than 10 hectares) seem to coexist with very large holdings (more than 500 hectares).

Table 9, which lists the distribution of the total output of livestock production (according to the same farm-size categories), it can be observed that medium and large-size holdings predominate in livestock production (beef cattle and dairy cows), whereas small farm units increase in importance in the raising of medium and small-size animals. It was previously pointed out (see the discussion of table 7), that livestock production, taken separately or in the aggregate, constitutes a relatively small share of the total economic production of small farms. However, in table 9 it is clear that this fact does not prevent these same small farms from being the principal source of fowl, eggs and small animals, and from producing significant shares of the total production of medium-size animals (goats, swine, etc.). This is, of course, due to the large number of small rural farm units in the Northeast, which renders the sum of the results of this production, on these small farm units important in the regional aggregate, together with the fact that these activities (raising of medium and small-size animals), are of relatively little importance on the larger holdings. However, the same does not occur in livestock production.

Table 9

The Brazilian Northeast: Percentage Share of Farm-Size Categories in the Value of the Total Production of Specific Livestock Activities

Specific Livestock Activities	All Holdings	Size Category (by number of hectares)				
		Less than 10	10 ⊢ 20	20 ⊢ 100	100 ⊢ 500	More than 500
1 — Maranhão						
Beef Cattle	100.0	23.6	4.3	15.2	26.4	25.8
Dairy Farming	100.0	29.3	7.1	18.7	26.0	16.8
Medium-Size Animals	100.0	74.1	3.3	8.6	8.0	3.7
Fowl and Small Animals	100.0	77.4	4.6	8.7	5.6	2.1
2 — Piauí						
Beef Cattle	100.0	14.8	6.4	24.7	31.0	23.0
Dairy Farming	100.0	24.0	8.7	26.7	24.7	15.1
Medium-Size Animals	100.0	46.8	7.7	3.6	16.3	5.3
Fowl and Small Animals	100.0	65.4	9.1	14.5	8.8	2.0
3 — Ceará						
Beef Cattle	100.0	9.4	7.0	27.9	32.3	23.4
Dairy Farming	100.0	14.1	9.0	31.0	28.7	17.0
Medium-Size Animals	100.0	24.5	13.3	34.2	21.2	6.8
Fowl and Small Animals	100.0	61.3	9.9	18.5	8.0	1.5
4 — Rio Grande do Norte						
Beef Cattle	100.0	8.3	6.8	25.0	30.4	29.1
Dairy Farming	100.0	12.6	7.6	26.3	29.5	23.2
Medium-Size Animals	100.0	24.0	11.2	29.9	21.4	13.3
Fowl and Small Animals	100.0	43.0	12.4	32.7	6.6	4.1
5 — Paraíba						
Beef Cattle	100.0	17.1	8.3	23.5	26.1	24.9
Dairy Farming	100.0	20.8	11.4	28.7	26.3	12.6
Medium-Size Animals	100.0	40.0	14.1	25.1	13.7	7.1
Fowl and Small Animals	100.0	37.2	13.2	44.2	4.4	1.0
6 — Pernambuco						
Beef Cattle	100.0	24.1	10.1	28.2	26.9	10.0
Dairy Farming	100.0	19.9	11.5	32.5	25.6	10.4
Medium-Size Animals	100.0	44.6	13.6	26.6	12.0	3.2
Fowl and Small Animals	100.0	48.2	15.2	27.1	6.9	2.4
7 — Alagoas						
Beef Cattle	100.0	13.5	10.5	31.5	30.0	14.6
Dairy Farming	100.0	11.8	10.0	31.7	31.7	14.8
Medium-Size Animals	100.0	49.8	12.9	18.9	13.9	4.5
Fowl and Small Animals	100.0	57.7	7.4	12.5	21.7	0.7
8 — Sergipe						
Beef Cattle	100.0	8.0	7.5	29.5	33.8	21.2
Dairy Farming	100.0	16.9	8.5	29.9	31.5	13.2
Medium-Size Animals	100.0	49.2	11.4	22.9	12.2	4.3
Fowl and Small Animals	100.0	67.8	9.4	15.1	6.0	1.7
9 — Bahia						
Beef Cattle	100.0	6.3	5.3	21.8	30.1	36.5
Dairy Farming	100.0	10.6	7.4	30.5	31.8	19.7
Medium-Size Animals	100.0	32.2	13.4	35.5	15.2	3.7
Fowl and Small Animals	100.0	47.7	12.9	28.3	8.6	2.5

SOURCE: 1970 Agricultural Census.

4 — Economic activities and social forms of production

In the previous section, we attempted to examine the patterns of economic activity of rural holdings by size categories (tables 6 and 7), as well as identify the manner in which these farm-size categories fit into the productive agricultural activities in the Northeast region of Brazil (tables 8 and 9).

Since the empirical analysis was limited to a mere stratification of farm-size categories (constant for all states) the need for a greater disaggregation, which would take into consideration the great regional diversity, is recognized.[11] Given the limitations of this paper, however, this regionalized empirical analysis will not be made. References will be made to the regional diversity of natural resources in this section, the principal objective of which is to characterize the social forms of production prevalent in the different activities included in our analysis. Through the identification and analysis of *structural* characteristics of these social forms, we will present several perspectives of theoretical approach, which are of interest not only for the analysis of the relation between production and the "size" of the holding, but also, and more importantly, for the analysis of employment and income in the agricultural sector of Northeastern Brazil.

4.1 — Occupational categories of labor, economic activities and social forms of production

With this purpose in mind, table 10, is presented below, based on census data on the "principal activity".[12] It is appropriate to initiate our discussion of table 10 by emphasizing, once again, the contrast between sugar cane and *roçado* in Pernambuco and Alagoas. If it is assumed that, of the total of employed individuals, the percentages of the categories of "Operator and Unpaid Family

---

11 At the aggregate level of stratification, it is not possible to know in what proportion holdings of 20 to 100 hectares, let us say, in Ceará or Bahia, are located in semi-arid regions, a circumstance which makes it meaningless to consider them "larger" than plots of less than 10 hectares, in those and in other states, which are located in regions with more favorable natural resources.

12 According to the census, the "principal activity" was defined as that "which provided the largest source of income to the producer, thereby constituting the economic basis of the undertaking". Since this information was obtained through direct questioning of the producer, it is appropriate to use this data on "principal activity" only for the purpose of obtaining an order of magnitude, thus conceding errors of information by virtue of the difficulty or even impossibility of response to this question in cases of substantial diversification of production.

Table 10

The Brazilian Northeast: Distribution of Total of Employed Individuals, Classified by Occupational Category and Specific Economic Activities

Activities	Occupational Categories[a]			
	Operator and Family	Permanent Employees	Temporary Employees	Sharecroppers and Other Status
1 — Maranhão				
Livestock	72.1	10.5	15.1	2.3
Rice	80.4	0.4	8.8	1.3
Roçado	93.0	0.3	5.6	1.1
2 — Piauí				
Livestock	87.4	4.6	2.6	5.4
Rice	97.3	0.3	1.6	1.6
Roçado	97.9	0.3	1.3	0.5
3 — Ceará				
Livestock	40.7	7.8	·24.1	18.5
Arboreal Cotton	62.3	2.4	14.8	20.5
Sugar Cane	42.1	6.8	41.4	9.8
Roçado	71.5	1.2	19.4	7.8
4 — Rio Grande do Norte				
Livestock	52.2	15.2	10.3	13.3
Arboreal Cotton	62.8	4.6	10.9	21.7
Herbaceous Cotton	77.9	3.7	13.8	4.6
Sugar Cane	17.7	18.2	57.2	6.8
Roçado	83.5	1.9	9.0	4.7
5 — Paraíba				
Livestock	50.3	12.0	19.2	9.6
Arboreal Cotton	67.1	4.4	10.4	18.2
Herbaceous Cotton	79.9	2.2	10.1	7.9
Sugar Cane	19.2	34.1	40.2	6.5
Roçado	85.8	1.8	9.2	3.1
6 — Pernambuco				
Livestock	66.6	11.6	20.2	1.6
Sugar Cane	16.3	45.4	37.7	0.6
Roçado	90.3	1.1	8.0	0.6
7 — Alagoas				
Livestock	52.7	12.7	27.5	7.0
Sugar Cane	9.7	40.7	46.0	3.6
Roçado	90.2	1.7	6.8	1.2
8 — Sergipe				
Livestock	67.0	11.5	17.3	3.4
Oranges	81.5	17.0	1.4	0.1
Coconuts	65.5	26.1	7.2	1.2
Rice	59.2	5.3	17.9	17.6
Sugar Cane	18.3	42.3	30.3	0.1
Roçado	94.2	1.0	4.1	0.7
9 — Bahia				
Livestock	65.3	10.1	10.8	4.8
Cocoa	40.3	30.6	26.0	2.2
Sugar Cane	68.8	7.4	18.5	5.4
Roçado	84.2	1.5	10.6	3.7

SOURCE: 1970 Agricultural Census.

Includes only males over 14 years of age.

Members", on the one hand, and of "Permanent Employees" and "Temporary Employees", on the other, can be taken as quantitative indicators of the relative importance of *family labor* and *wage labor,* respectively, then it can surely be said that sugar cane cultivation in these states is, a type of farming activity based on wage labor, and as such is a *form of capitalist production* whereas *roçado* farming is an activity based on family labor and, therefore, is a form of petty production.[13] This differentiation in forms or production between sugar cane and *roçado* farming can also be applied to Paraíba and Sergipe; with regard to Rio Grande do Norte, however, the smaller percentage of "permanent employees" together with a larger percentage of "temporaries" should be noted, since they may indicate a lesser degree of utilization of wage labor in the production of sugar cane. In Ceará and, and even more so in Bahia, not only are the "temporaries" predominant, in relation to the "permanent employees", but also the category of "operators" is much more significant, indicating that petty farming accounts for a larger share of sugar cane production in these states. It is worth remembering in this respect that it is precisely in these latter two states that sugar cane production exhibits a lesser degree of association with farm-size categories (see tables 6 and 8).

This new form of the sugar cane/*roçado* contrast includes the regional differentiation in sugar cane production and allows us to propose that the association of sugar cane and *roçado* farming with farm-size categories (as described in the previous section) is related to an association of these activities with forms of production. The existing regional diversity in the association of *roçado* with farm-size categories (according to tables 6 and 8)[14] should be pointed out. Furthermore, it should be acknowledged that this regional diversity is not explained by the evidence of the differentiation of forms of production (see, for instance, the lesser percentage for the "operator" category in Ceará). However, this problem may be illusory, since

[13] A discussion of limitations presented by these data on "employed individuals", from the point of view of the analysis of this section, has been included in an appendix which, due to problems of space, was omitted here but can be furnished by the author upon request. These limitations are derived primarily from the fact that the information on "employed individuals" merely represents a "count" of persons who, *on the date of the survey* (12/31/70), were "actively engaged on the farms".

[14] Taking, for example, the farm-size category of 20 to 100 hectares, in Ceará and Bahia, it can be seen that *roçado* constitutes a significant share of the total value of production on holding of this size (about 23 and 30%, respectively. See table 6). In addition, in these states, a significant proportion of the total production of *roçado* was derived from holdings of this size class (about 31 and 36%, respectively. See table 8). For Alagoas, however, these same percentages are, respectively, about 13 and 16%.

we should recall the difficulty in comparing farm-size categories between states in which there are differences in resource endowment, access to markets, etc. Regional diversity of the association of productive activities with farm-size categories specifically tends to be greater than the diversity of association with forms of production, and therefore the results of tables 6 and 8 are not necessarily incompatible with the evidence of table 10, which suggests that, throughout the Northeast, *roçado* farming is predominantly an activity carried out on petty holdings.

In general terms, it is possible to show that in other farming activities as well, economic activity patterns by farm-size categories related to the forms of production.

According to table 10, rice production in Maranhão and Piauí is based on family labor, but in Sergipe wage labor and sharecropping are more significant, [15] while the respective distributions of the total output according to farm-size, also differ (see tables 6 and 8). Conversely, family labor and wage labor (or rather, small-scale farming and capitalist farming) appear to coexist in coconut production in Sergipe. This is compatible with the earlier findings that coconuts are produced on small, as well as large, holdings. Finally, is may also be observed that orange production takes place predominantly on "medium-size" holdings, which utilize mostly wage labor. [16]

In view of the predominance of medium and large-size holdings in livestock production (at least in terms of the aggregate of all commodities derived from animals) one would think that this would involve high percentages of "permanent employees" and "temporary employees". The contrary is observed, however, in that at least 50% of the individuals employed consists of "operators". In order to clarify this apparent paradox, it would first be necessary to proceed to a greater disaggregation, since this is possible due to a differentiation of forms of production, according to specific livestock

[15] For a description of family farming in rice production in Maranhão, see M. C. Andrade, *A Terra e o Homem no Nordeste* (São Paulo: Brasiliense, 1973), pp. 223-234, and O. G. Velho, *Frentes de Expansão e Estrutura Agrária* (Rio: Zahar, 1972). In Sergipe, the tasks of preparing the land and taking the initial steps in planting are performed by wage labor while cultivation, in the strict sense, and harvesting are performed by sharecropping. Cf. M. C. Andrade, *op. cit.*, pp. 135-138.

[16] W. S. Saint Jr., *op. cit.*, in his study on Cruz das Almas (BA), found that the orange-growing which requires large amounts of resources takes place on medium-size farm units, which significantly utilize wage labor. The author also mentions, but does not analyze, the existence of plantations in orange-growing. It is especially significant that this crop is not grown on family farms as are manioc and tobacco. On the other hand, manioc and tobacco are not grown on capitalist farms.

activities (for example, cattle-raising is characterized by a greater incidence of wage labor as compared to dairy farming). These data for livestock should, however, cautiously be interpreted for at least three reasons. First, it would be necessary to examine to what extent operators hold managerial tasks (sales and purchasing, etc.) in livestock raising, since in this case, the operator's labor does not correspond to *family labor* as defined in petty production: on the contrary, it is easily concluded that the "operator's" specialization business management and property administration is only possible when the production tasks which provide the manpower input required for production are exclusively or predominantly exercised by other laborers. This prevents the characterization of the activity as petty production. We may thus establish, as an empirical principle for the analysis of the form of production, that the operator's labor is only *family labor* in those cases in which the tasks of production are predominantly (even though not exclusively) performed by this "operator", as certainly takes place, for example, with *roçado*. Second, it is interesting to note that, since the total number of laborers in livestock production is quite small as compared to other activities, the quotient of the ratio (the number of operators, to the total number of employed individuals) tends to be relatively higher in livestock than in other activities. This is because the numerator does not diminish proportionately, and may not even change. Third, it is possible that, in part, this small absorption of manpower in livestock activities may not be strictly a technical phenomenon. It is known that in the Northeast, tasks required for this activity, such as the cultivation of grazing land and feeding the herd, are actually performed without hiring manpower, and as a by-product of the agricultural activity of small farmers on large landholdings. This characteristic of the *social form of production* in livestock raising does not appear in the census, however, due to the precise definition of farm units. Actually, the labor performed in livestock raising appears in the census for small farm units.

In the planting of cocoa, the high percentages of "permanent employees" and "temporary employees" in the category of "employed individuals" indicates the predominance of capitalist production. Nevertheless, when compared with sugar cane cultivation in the Zona da Mata, is appears that a much larger proportion of cocoa is produced on petty farms, considering the fact that 40% of the employed individuals are "operators". This census item conflicts with another result obtained in the specific analysis of the cocoa-growing region, in which a much clearer predominance of capitalist

farming of cocoa has been noted.[17] Since the census category of "operator" includes not only those persons who actively work on the property, but also those who perform administrative and managerial tasks, it is fitting to ask to what extent this discrepancy truly suggests an inappropriate definition of the census in relation to the needs of our analysis.

The census generally does not explain how the activity of the "operator" is divided between "administration" and "production". In the cocoa region, however, we may present an especially interesting finding, in this regard.[18] No less than 30% of the holdings, encompassing approximately 56% of the total area, are operated by "Administrators"; in addition, and consistent with the latter statistics, 45% of the holdings, accounting for 65% of the total area, responded that the respective "Producers" reside *off* these properties.[19] This means that, *at least*, 30% of the "operators" on cocoa holdings do not exercise *family labor* activities; they rather perform functions which correspond to capitalist production since, as clarified above, when only wage labor is assumed it is possible for managerial functions to be considered a *specific occupation*. It may naturally be expected that a still greater percentage of the "operators" included in the census survey are involved, in the same way, in managerial functions, and for this reason it should be concluded, notwithstanding the appearance to the contrary suggested by table 10, that the cultivation of cocoa is capitalist production to a very high degree.[20]

To complete the discussion on table 10, we shall consider the cultivation of cotton, while bearing in mind the differences between

[17] Gervásio Castro de Rezende, *op. cit.*

[18] The reason for this possibility in the activity under discussion is due, on the one hand, to the common practice in the cocoa region of the hiring of *administrators* and, on the other, the fact that the census considers these administrators as "operators" if they in fact assume management functions on the holdings (see *Instruções de Coleta* of the 1970 Census).

[19] *Censo Agropecuário da Bahia* (1970: Note that these data relate to the *Cocoa Zone*, which is confused, at any rate, with the actual cultivation of cocoa. The information of "form of administration" was not published at the level of "principal activity".

[20] This conclusion can be further reinforced if we consider that in the case of the cocoa region, the quantity of wage labor in the category of "temporary employees" is probably greater than in any other agricultural activity or region, due to the smaller seasonality of demand of cocoa (a phenomenon proved by the author, in data surveyed by CEPLAC, which have not yet been published). This smaller seasonality of agricultural labor for cocoa is indirectly confirmed by the presence in the region of a social category of laborers who live in small clusters scattered around the region, earning wages on a "temporary" basis all year long.

arboreal cotton and herbaceous cotton. In fact, besides being of much greater regional economic significance, arboreal cotton is different from herbaceous cotton in terms of its importance in the economics of medium and large-size holdings (see table 6), and also in relation to the large share of arboreal cotton which is produced on these holdings (cf. table 8).[21] It should be observed that arboreal cotton is significantly distinguished from the herbaceous — and also, with the exception of rice in Sergipe, from all the other activities listed in table 10 — by the larger percentage of employees ("sharecroppers" and categories of "other status") which, together, represent about 20% of the total number of employed individuals. Since these occupational categories (see table 4) are equally predominant on holdings of more than 100 hectares in Ceará, Rio Grande do Norte and Paraíba,[22] it is reasonable to infer that arboreal cotton (although its cultivation implies the importance of predominance of medium-and-large-size holdings), is not necessarily considered capitalist production since its production appears to be based on sharecroppings,[23] on the medium and large-size holdings.

It is, however, necessary to consider the high percentage of "operators" employed in this activity (attaining approximately 67% in Paraíba) as an indicator of a significant proportion produced

[21] Those farm units with up to 20 hectares account for approximately 50 and 60% of the total output of the herbaceous cotton in the States of Rio Grande do Norte and Paraíba (the only states included in the table), but these percentages diminish, in the case of arboreal cotton, to about 23 and 32% and, on the other hand, holdings of more than 100 hectares account for only 25 and 24% of the herbaceous, but the figures rise to 51 and 39%, of the arboreal cotton.

[22] In Ceará, for example, "sharecroppers" and "other status" represent approximately 49% of the employed individuals on holdings of more than 500 hectares, whereas "permanent employees" account for less than 10%.

[23] It is important to emphasize the small percentage of "permanent employees" in arboreal cotton and on the large farm units of those states. "Temporary" employees, on the other hand, may actually represent a small amount of wage labor during the total period of production. In this context, it is relevant to refer to statistics which reveal that in Ceará 70% of the output of arboreal cotton is derived from undertakings in which the area planted with cotton (which is different from the total area of the farm unit) is not more than 20 hectares. Cf. OIT/CNRH/PREALC, *Empleo Rural en el Nordeste* (Brasília, s.d.), pp. II-8, citing SUPLAM/MA, *Algodão: Produção e Abastecimento, Perspectivas e Proposições* (Brasília, junho de 1975). F. Oliveira, *Elegia para uma Re(li)gião* (Rio: Paz e Terra, 1977), p. 41, refers to the "non-sugar agrarian Northeast", which "is converted into a vast cotton plantation, from Maranhão to Bahia", and declares that "(...). The structure of production of this commodity is not the 'plantation'; (the vast cotton plantation') is in fact composed of the endless segmentation of small and isolated crops". The historical formation of this structure is discussed in M. C. Andrade, *op. cit.*, pp. 150-159 and 188-198.

by petty farming. It does not appear justified to attribute the difference between this percentage and the higher one recorded for herbaceous cotton, to the diversity of association of these activities with farm-size categories shown in tables 6 and 8. Since arboreal cotton tends to be located, to a greater extent than the herbaceous, in semi-arid zones, a regionalized empirical analysis would be necessary (as stated previously in our discussion on *roçado*) so as to define farm-size categories differentiated according to regions, and thus be able to speak of a "diversity of association of activities with farm-size categories" in a more satisfactory manner.

In analyzing table 11, it is easily verified that there is a significant differentiation between activities, and therefore, between social forms of production, in terms of utilization of means of production (that is, the factors of production complementary to labor), including the form of the operator's access to land. Two indicators appear in the table: the proportion of producers who do not own the respective holdings (i.e. renters, sharecroppers or "occupants") and the average area of the holdings.

Without stopping to examine the particular aspects nor the different regional manifestations of the phenomenon, we may conclude that those activities in which petty farming predominates display a much greater incidence of non-owner producers, together with a much smaller average area of the holdings.[24] This fact allows us to incorporate into the discussion of the forms of production the *structural* characteristics which are derived from the relative conditions of ownership and the operators' access to the means of production. We shall now focus our study on *agrarian structure,* in the analysis of employment and production, through the explicit consideration of these different structural conditions.

[24] Several brief comments on the table include: (i) the utilization of land of third parties in sugar cane production probably corresponds to capitalist rent, as indicated by the average area of the plots of non-owners; (ii) one would expect that additional information on quality of the soils, climatic risks, annual period of inactivity due to drought, etc., would reinforce the differentiation of resources between the forms of production; the largest example is the Agreste*/Zona da Mata complex, but in the cocoa region the same phenomenon can be verified (cf. Gervásio Castro de Rezende, *op. cit.*); (iii) note, upon comparing the average areas of holdings of landowners and those who do not own the land, that the latter usually are smaller, since it involves *area under cultivation,* and not total area of a property. Thus, it is possible (to given an interesting example), that the productive capacity given by the average area of 12 hectares of holdings of landowners planting *roçado* in Alagoas, may be equivalent to those of 3 hectares of average area of the plots of non-landowners for this same crop and state.

* Translator's note: Agreste is a zone of bare rocky soil in the Northeast.

Table 11

The Brazilian Northeast: Structural Characteristics of Holdings According to Economic Activities

Activities	Non-Owner Producers		Averago Arca of Holdings (by number of hectarcs)		
	Number of Holdings	Total Area	All Holdings	Landowner Holdings	Non-Landowner Holdings
1 — Maranhão					
Livestock	49.5	5.6	240.2	449.5	27.0
Rice	90.0	24.4	17.5	132.5	4.7
Roçado	90.6	17.8	9.0	78.8	1.8
2 — Piaul					
Livestock	48.0	3.6	153.7	284.6	11.6
Rice	74.0	12.4	13.9	65.5	3.3
Roçado	68.7	11.8	21.6	61.0	3.7
3 — Ceará					
Livestook	19.1	10.0	152.7	169.8	80.0
Arboreal Cotton	32.6	12.6	54.1	70.2	20.8
Sugar Cane	20.5	21.1	30.3	33.9	21.7
Roçado	45.6	22.1	28.5	40.8	13.8
4 — Rio Grande do Norte					
Livestock	17.1	9.6	165.9	181.0	92.8
Arboreal Cotton	26.3	13.1	57.5	67.8	28.8
Herbaccous Cotton	59.3	16.7	31.2	63.8	8.8
Sugar Cane	15.7	4.5	89.5	101.4	25.4
Roçado	50.9	9.6	13.0	21.7	4.5
5 — Paraiba					
Livestock	16.1	7.3	78.4	86.6	35.4
Arboreal Cotton	22.2	9.9	40.5	46.9	18.1
Herbaccous Cotton	49.8	13.5	13.9	24.0	3.8
Sugar Cane	34.1	9.2	93.4	128.6	25.3
Roçado	47.9	22.1	7.7	11.5	3.5
6 — Pernambuco					
Livestook	13.5	4.9	75.8	83.3	27.4
Sugar Cane	35.8	33.7	93.9	97.0	88.3
Roçado	43.0	4.9	8.3	12.4	2.9
7 — Alagoas					
Livestoek	6.5	3.0	71.1	73.7	33.5
Sugar Cane	33.5	14.5	163.0	215.9	66.7
Roçado	31.9	10.5	9.1	12.0	3.0
8 — Sergipo					
Livestock	3.2	2.2	71.8	72.6	48.2
Oranges	5.0	1.9	6.8	7.0	2.5
Coconuts	5.3	1.2	18.6	19.4	4.1
Rice	26.0	11.7	24.5	29.2	11.1
Sugar Cane	24.4	6.4	87.0	107.9	22.8
Roçado	32.1	6.3	7.8	10.8	1.5
9 — Babia					
Livestock	7.5	3.9	107.2	111.4	55.8
Cocoa	9.2	3.2	65.8	70.2	22.8
Sugar Cane	14.1	6.5	25.3	27.6	11.7
Roçado	19.3	7.0	20.2	23.1	8.2

SOURCE: 1970 Agrioultural Census.

4.2 — Small-scale farming, capitalist farming and agrarian structure

Among the empirical results discussed so far, let us consider specifically the predominance of capitalist farming in crops such as sugar cane and cocoa, in contrast with the predominance of farming in other crops, such as subsistence crops. This clearly implies a "segmentation" or "duality" of the forms of production. As we shall see, the analysis of said duality sheds light upon several fundamental aspects characterizing agriculture in the Northeast, particularly with regard to agrarian structure.[25]

Some general perspectives of a theoretical nature are indispensible for our analysis. In the case of capitalist farming, it is clear that the utilization of wage labor, with monetary expenditures on wages, the flow of inputs and investment in capital goods, is designed to permit the sale of the commodity in the market, so that the investment can be recovered. Moreover, this form of production also assumes the expectation of profitability, that is, the expectation of surplus value to be appropriated with the sale of the goods. This assumption of profitability actually corresponds to the inherent characteristic in this form of production of the conversion of all its activities (and, in any one activity, all the decisions related to the productive process[26]) into a single *quantitative* value form. The activities thus become indistinguishable in this form, except in quantitative terms; it is for this reason that they are subject to the imposition of producing a single profit rate (or rate of return).[27]

[25] It is interesting to note an important point: this "segmentation" reflects specific historical conditions, and for this reason the analysis is limited to the regions of the Zona da Mata and the Southeast of Bahia (Cocoa Zone). The regional integration with international trade and, particularly, the dominance of the plantation as the unit of production constitute fundamenal aspects for the genesis and reproduction of this "duality". Historically the technical backwardness, of sugar cane and cocoa cultivation prevents this "segmentation" from being judged in the light of classical analysis which necessarily were based on an application to agriculture of the *technical* contrast of "small"/ "large-scale" production, thus developing an overall view of the subordination of petty production to capitalist production.

[26] The well-known law of proportionality of marginal productivities and prices of factors precisely indicates this conversion (or "reduction") to *value* which corresponds to the rationality of the capitalist form of production.

[27] The uniformity of profit rate among activities merely fulfills a function of simplicity of exposition. It is clear that perfect mobility of capital does not exist, given differential entry requirements. In addition, it is fundamental that different risks exist among activities. One could speak more precisely of a *structure* of profit rates, which would be an empirical question of great interest and certainly indispensable for certain analytic purposes. It is important

This is its "capitalist" character, which involves an organization of production with well defined characteristics, such as centralized and coordinated administration in the use of resources, involving labor control (which can be of various types, depending on the forms of capitalist farming), so as to assure productive efficiency for lower unit costs of production.

Let us consider now, in contrast, family farming. The lack of wage labor and of the corresponding category of wage incomes reflects specific market relations, different from the commercial relation characteristic of capitalist farming. To be more specific, the assumption of profitability valid for capitalist farming is not established for farming, or rather, family farming does not presuppose *capitalist profit* as a fixed category, detremined by the relation between the profit rate and the amount of capital invested. This does not occur because family farming does not utilize the means of production and of subsistence, acquired both inside and outside the market, but because these means of production and subsistence, even when acquired in the market (or rather, even in the case of the family farm with a clearly commercial orientation), do not have an autonomous *social* existence, separate from the labor force, as occurs in capitalist farming, and therefore the production does not become a mere *instant* of the value of *capital*. Consequently, farming is not subject to the same capitalist rationality or, put differently, does not undergo the same type of decision, at the economic system level, which is imposed on capitalist farming.[28]

In analyzing the "family farming/capitalist farming duality" as defined previously, it is appropriate to re-state and carefully examine several basic concepts presented previously in another study.[20]

The fundamental notion of the analysis is that the differential conditions of ownership and access to the means of production which characterize the relative placing of petty producers and capitalist producers in the agrarian structure, determine production

to remember, however, that even in this more complex form there exists a relationship between any single capitalist production (capital) and the total formed by the other capitalist productions (other capitals). This relationship necessarily follows from the capitalist character of production; its absence is contradictory to the very nature of capitalist production.

[28] We do not intend to adopt Chayanov's "theory of the peasant economy", the basic elements of which are incorporated into much of current neoclassical literature. Cf. D. Thorner et alii (eds.), *The Theory of Peasant Economy* (Homewood, Ill.: Richard D. Irwin, 1966). For a critique of this theoretical approach, see J. Ennew et alii, "Peasantry as an Economic Category", in *Journal of Peasant Studies*, vol. 4, n.° 4 (July, 1977), pp. 195-322, and G. Littlejohn, "Peasant Economy and Society", in B. Hindess (ed.), *Sociological Theories of the Economy* (London: Macmillan Press, 1977), pp. 118-156.

[20] Gervásio Castro de Rezende, *op. cit.*

possibilities which are radically different in the respective forms of production. Unlike capitalist producers (i.e. the "other side of the coin" of their historically determined privileged conditions) for the petty producers, production options do not include crops or other agricultural activities which, like sugar cane, cocoa or livestock, presuppose more favorable natural resources and a better endowment of the means of production. This includes means of subsistence necessary in cases, such as cocoa, which involve a longer period of production. Only activities such as *roçado* farming which takes place under more primitive technical conditions, has a short growing cycle and can be planted on lowergrade soils, adjust both to ownership conditions, access to land and other means of production which prevail among small farmers, and to the other structural characteristics, to be discussed later, of family farming, which also helps to explain the limited importance of activities such as sugar cane, cocoa or beef cattle raising in this form of production.

It is appropriate to explain why capitalist farming is not applied to *roçado*. Consistent with the theoretical perspective which we have adopted, it is proposed that the predominance of family labor in this activity is explained by the hypothesis that the incorporation of *roçado* into the sphere of capitalist farming is not compatible with the rationality of this form of production, or rather, does not produce the ruling profit rate. [30]

An analysis of the data in table 12, notwithstanding qualifications regarding the way the data was obtained indicates that whereas sugar cane cultivation gives a positive profit rate, *roçado* farming in the capitalist form would result in a highly negative profit rate. [31] The same conclusions were obtained in empirical

[30] Note that the hypothesis does not exclude the possibility of utilization of wage labor as such, but rather assumes that it is not *predominant*. Wage labor, in addition to other forms of utilization of extrafamiliar labor (such as the "exchange of work days"), is found in family farming and even in subsistence agriculture — but this same finding shows that this outside labor is limited to the critical stages of the productive cycle and for this very reason fulfills a specific role, which is that of making a fixed allocation of family labor feasible during the *total period of the productive process*. Since this form of wage labor presupposes family farming it is clear that it cannot be regarded as an indicator of the presence of capitalist farming in this activity. In order for an activity to be capitalist, wage labor must be *predominant*.

[31] It would also be useful to determine if the positive profit rate found on holdings of more than 100 hectares in an "equilibrium rate", in the previously established sense of representing the general profit rate or, in more realistic terms, of representing the "usual" profit rate for this production, in the totality of the capitalist productions of he Brazilian economy. In this sense, it is useful to mention that its level approximates that found in other papers. See, for example, Claudio R. Contador, *Tecnologia e Rentabilidade na Agricultura Brasileira*, Coleção Relatórios de Pesquisa (Rio de Janeiro: IPEA/INPES, 1975), n.º 28, and Gervásio Castro de Rezende, *op. cit.*

analysis conducted for the cocoa region of Bahia, in which the same calculations could be made based on a direct classification of the enterprises according to the form of production. Since the census does not permit the same type of analysis, we limited our study to Pernambuco and Alagoas, where it seems reasonable to assume a close correlation, at least in the aggregate, between farm units of less than 10 hectares and family farming (and, also, subsistence crops), on the one hand, and holdings of more than 100 hectares and capitalist farming (of sugar, in particular), on the other.

The "profit rate of account" from the table is the result of a high calculation in which it is "simulated" that family labor had been actually paid according to the market wage. In conceptual terms, Y is the "net income", obtained by subtracting actual expenditures on wages, seeds, fertilizers, taxes, depreciation, etc., from the gross value of production; where L_f is the total amount of labor (in man-years) of the family group and K is the value of the means of production used. If w is the market wage, then r_c, the "computed profit rate" is obtained by the formula $\dfrac{Y - w.L_f}{K}$

It is clear that the greater the importance of wage labor in an agricultural activity, the more this computation will produce a rate which approximates the actual profit rate. However, the greater the importance of family labor, the more r_0 represents the profit rate which *would result* if the corresponding crop had been produced using wage labor, obviously assuming the same technical level and productivity of the two types of labor.

In this case, however, this computation should only be an estimate, given the assumptions made (see the footnotes for table 12). Note first that the difference in average wage between holdings (hardly campatible with reality) may reflect a problem in the calculation of this wage, since, for the quantity of "temporary" wage labor, it was allowed to take half the number of these "employees" recorded on the date of the census, on the hypothesis (arbritrary) that these employees would work only half the year, whereas "permanent employees" would work the entire year. It is probable that for the smaller farms this hypothesis of calculation may lead to an overestimate of the quantity of wage labor within this form and, therefore, to an underestimate of the actual wage paid. On the other hand, since the average wage obtained in each size category was used to estimate the amount of wages which would correspond to family labor, it is clear that the underestimate of this wage involves an overestimate of the computed profit rate in

family farming. Second, in order to quantify family labor, an underestimate was adopted through the exclusion of women and children less than 14 years old, given the findings of part-time employment. It cannot be determined to what extent this procedure succeeds in compensating for the omission, in the empirical analysis, of seasonal wage labor on the part of small-scale producers in addition to the possibility of the multiple counting of these producers in the census survey. Third, the very concept of profit rate of account implicitly assumes that one man-day of family labor corresponds, in terms of productivity to one man-day of wage labor, which is the case only if the duration and the intensity of the day of labor are the same. Notwithstanding all these reservations and in view of the great magnitude of the differential, the results appear to constitute convincing proof to support the hypothesis, whose proposition is based on a previous empirical segmentation framework which can hardly be explained in other terms.

Since it is acknowledged that the average wage is barely adequate to satisfy the subsistence needs of the labor force, the fact that a level of income lower than this wage level has been found in family farming could perhaps be considered in itself proof that family farming is actually "subsistence agriculture". This is a type of agriculture whose production, whether or not traded on the market, is limited to the satisfaction of the subsistence needs of the family, often failing to satisfy even those. It is interesting to note that this conclusion linking "subsistence" agriculture to family farming is reinforced by the great importance of subsistence crops (roçado) in the economic activity of family farming (i.e. basic food crops, which are directly consumed). Since this characteristic of "subsistence" is a predominant theme in discussions on the agriculture of the Northeast, it will be analyzed here from several viewpoints and we shall present a critique of the approaches which have tended to disregard the role of agrarian structure.

Behavioral and cultural norms have often been designated as the origin of this characteristic of petty farming (or rather of this form of family farming in the context of the petty capitalist farming duality). [32] The contrary is true, however: this characteristic is actually the result of a structural *limitation* itself caused by the

[32] For a non-critical reference to these approaches of "subsistence agriculture", see E. R. A. Alves, "An Econometric Study of the Agricultural Labor Market in Brazil: A Test of Subsistence and Commercial Family Farm Models", Ph. D. thesis. (Purdue University. 1972), partially reproduced in E. R. A. Alves and G. E. Schuh, "Agricultura de Subsistência: Teste de um Modelo de Equilíbrio Subjetivo nas Condições do Brasil", in J. Pastore (ed.), *Agricultura e Desenvolvimento* (Rio de Janeiro: APEC-ABCAR, 1973).

subordinate relationship of small-scale farming *vis-à-vis* the dominant forces in the agrarian structure. [33]

There are researchers, however, who seek to explain a varied range of features, such as the reputed resistance to innovations, the diversification of productive activities, the preference for activities whose products which can be consumed on the farm (and even more

Table 12

The Brazilian Northeast: Profit Rate of Account by Farm-Size Category

Size Category (by hectares)	"Net Income" per Employed Male in the Family[a] (Cr$)	Average Wage[b] (Cr$)	Profit Rate of Account[c] (%)
1 — Pernambuco	827	1,462	(—) 10.0
Less than 10	529	996	(—) 24.6
10 ⊢ 20	906	1,048	(—) 2.7
20 ⊢ 100	1,156	1,242	(—) 0.9
100 ⊢ 500	3,107	1,580	3.2
More than 500	17,022	1,675	5.8
2 — Alagoas	1,059	1,583	(—) 6.4
Less than 10	408	1,035	(—) 32.0
10 ⊢ 20	777	1,179	(—) 7.4
20 ⊢ 100	1,542	1,360	1.3
100 ⊢ 500	6,750	1,733	6.4
More than 500	46,380	1,836	12.9

SOURCE: 1970 Agricultural Census.

[b]Depreciation was not deducted. The denominator consists of only males at least 14 years old. Wage expenditures divided by the number of permanent employees added to half the number of temporary employees. Includes only males at least 14 years old.

[c]The numerator is the "net income" minus the amount imputed to employed family members (only males at least 14 years old) given by the computed average wage for the respective size class. The denominator is the total "value of assets" (including value of the land).

[33] See Gervásio Castro de Rezende, *op. cit.*, for an interpretation of the relation $r_a < r$ (where r_a is the profit rate of account and r is the average rate of profit) as a structural condition of existence of family farming in this agrarian structure, as well as the argument that, over time, the income per petty producer is limited to a maximum given by the algebraic symbols $w + rk$, where w is the wage level in force and k is the relation of the value of the means of production/manpower, both utilized in family farming. The wage level is determined by the cost of reproduction of the labor force, so we may conclude that the standard of living of the wage laborer is a limiting factor in the determination of income in family farming.

so, those which can be stored, such as manioc), [34] seasonal wage labor, avoiding formal credit, [35] etc., in terms of decision-making characterized by a substantial degree of "aversion to risk" on the part of petty farmers, giving rise to the slogan: "subsistence first". [36]

Two critical observations should be made with regard to this literature. The first is that if the structural limitation of family farming is explicitly introduced into the analysis (and it is thus clarified why petty farmers *remain* subject to the primacy of subsistence) we may postulate another slogan: "subsistence only", which transfers the issue to the level of the agrarian structure.

The second observation is still more important. A crucial dimension of family farming is lost from sight when its analysis is reduced to the "subsistence first" principle. It should be observed that this principle implicitly assumes that subsistence can only be attained through family farming.

This is untrue, since there exists a labor market both in agriculture and in urban areas. It is actually the "survival as a petty farmer first" principle which is the most applicable, as it defines a given socio-economic category. In other words, it is not a matter of a mere *physical-biological*, or *natural* reproduction (recognizing, naturally, the social and historical character of family "subsistence needs"). Reproduction is not being threatened, since it can be satisfied under different socio-economic conditions (including wage labor), but rather *social reproduction*, through which the existence of the family as a social entity is materialized, inte-

[34] In the words of a petty farmer, "(manioc) is the only crop which waits for the needs of the people". Cf. B. A. Heredia, *op. cit.*, p. 51. The ability to be stored, as well as other attributes of manioc which make it a crucial crop in the economy of small-scale farmers, are discussed by B. A. Heredia, *op. cit.*, pp. 60-61, 140 ss., and A. W. Johnson, *Sharecroppers of the Sertão* (Stanford: Stanford University Press, 1971), p. 55. Also see the characterization of manioc as a "subsistence" activity in W. S. Saint Jr., *op. cit.*, pp. 49-64. These characteristics of manioc are fully acknowledged in world-wide literature. See University of Georgia Team, *A Literature Review and Research Recommendations on Cassava* (AID Contract no. csd/2497, March, 1972). On the other hand, the census confirms this aspect, since the harvest of manioc in the Northeast is distributed through out the year; this is not the case, however, for the States of Rio Grande do Sul and Santa Catarina.

[35] B. A. Heredia, *op. cit.*, points to the existence of this "escaping" from formal credit on the part of petty farmers. The relation of the production with the market, given the primacy of subsistence, is well characterized not only in said thesis, but also in the work of A. Garcia Jr., *op. cit.*

[36] A good example of this literature is found in G. L. S. Dias and B. M. A. Salomon, "O Processo Decisório na Agricultura de Baixa-Renda", a paper presented at the 1.º Seminário de Modernização da Empresa Rural (Rio de Janeiro: Centro de Pós-Graduação em Desenvolvimento Agrícola, Fundação Getulio Vargas — EIAP/SUPLAN, May, 1977).

74

grating and forming a historically determined structure of social relations of production. [37]

Once the social aspect of family farming is acknowledged, [38] the participation of petty producers in the labor market in the form of seasonal wage labor, can be analyzed in a more satisfactory manner. This participation can be interpreted as a "strategy" or recourse of socio-economic reproduction of the petty producer, following the example of, and to the same extent as, other decisions taken at the household level. [39] Going further, it should be clarified that such "stategy" is also in itself contradictory to family farming, objectively manifested in the fact that the decision is only taken *as a last resort*. It is only taken when, due to the precarious nature of small-scale farming conditions, for the family's subsistence needs, only wage labor can render viable the major objective being threatened, which is, the reproduction of the social condition of petty farmer. [40] In this sense, seasonal wage labor is actually not a

[37] It is interesting to observe that F. Sá Jr., *op. cit.*, not only bases his concept of "subsistence agriculture" in terms of non-commercial production of self-consumption, but interprets the large expansion of family farming in the Northeast as a result of "recess of employment levels in the capitalist activities' of the economy" (p. 93), absorbing the labor which "cannot be employed in the more capitalist activities of the economy" (p. 92). It may reflect an "economic regression", in which the function of surplus labor absorption is "transferred to farm units oriented to regional consumption" (p. 94). In short, the family farm is a "residue". Clearly, the social character of family farming escaped the author, and it is significant that his analysis relate to the period 1950-65, but makes not a single reference to the social and political movements of the Peasant Leagues, a phenomenon of great importance in the recent history of the Northeast and which could, perhaps, be interpreted as in political action of petty farmers for the specific purpose of breaking the structural barriers to their conditions of production, through agrarian reform.

[38] A complete specification of this social content is heyond the limitations of this paper and involves issues such as the nature of the class of petty farmers, the ideology inherent in this form of production, etc. For illustrative purposes only, one can refer to the notion of "bondage" associated with wage labor, which was identified among family farmers of the Maranhão frontier by O. G. Velho, *op. cit.*, pp. 129-131, or the interpretation of family farming in the Caribbean as a form of "resistance to the domination of the plantation", Cf. Sidney Mintz, "The Caribbean", in *Daedalus* (1974), particularly pp. 61-62.

[39] The suggestion of this perspective of seasonal wage labor is found in J. S. Leite Lopes, "Notas Críticas ao 'Desemprego e Subemprego no Brasil' ", in *Dados*, no. 18.

[40] R. R. Ringuelet, "Migrantes Estacionales de la Region del Agreste del Estado de Pernambuco", Masters thesis in Social Anthropology (Rio de Janeiro: Museu Nacional, 1977), refers to a *contrast* between labor in subsistence farming ("labor on what is mine") and wage labor ("outside labor", in contrast to the *internal labor* of controlled production) (cf. p. 63). In an extremely meaningful way, this author points out that this contrast is found more in wage labor in the *Agreste* region, whereas in the *Zona da Mata* "the situation is more anonymous and allows the *agreste* farm to remain 'uncontaminated' and allows the *corumba* to remain as autonomous producer on the farm" (cf. p. 86). The "preference" for wage labor in the *Zona da Mata* is also referred to in

"strategy" or a "recourse", but is imposed, that is, it is not dependent upon the will of the petty farmer. Upon becoming a necessary assumption of family farming, the "occasional" or "temporary" wage makes social existence as a petty farmer possible only insofar as social existence as wageearner occurs simultaneously. [41]

The neoclassical perspective loses sight of this character of compulsion present in seasonal wage labor which is then interpreted as an objective expression of a "rational choice" on the part of the petty farmers, or rather, it is suggested that participation in the labor market is the result of an equalization of the marginal productivity of family labor at the wage which can be obtained in the labor market, which is defined as its "opportunity cost".

Note, first that empirical support of this hypothesis has not been found, [42] as one would have expected, in view of the fact that this participation is closely associated with the *minifúndio*. As an analytical perspective of the phenomenon, its basic error lies in the underlying premise of "rationality", which implies the equalization of the two activities of labor, assuming that the family allocates its labor in such a way as to maximize the income from its *total* activity. [43] Such "equalization" represents denial of the specific social

interviews reported in A. Garcia Jr., *op. cit.* Ringuelet also illustrates that the conditions of autonomous production of these *corumbas* are extremely precarious (as also shown by A. Garcia Jr.). Also see Gervásio Castro de Rezende, *op. cit.*, for a close association between seasonal wage labor and *minifúndio* in the cocoa region.

[41] Since we have this relation in view in the labor market, the family farmer in this agrarian structure can be referred to as a "semiproletariat". Cf. A. Corten, "Valor de la Fuerza de Trabajo y Formas de Proletarización", in *Revista Latinoamericana de Sociologia*, no. 1 (Nueva Época, 1974). Also see S. Mintz, "The Rural Proletariat and the Problem of Rural Proletarian Consciousness", in *The Journal of Peasant Studies* (April, 1974), in which the author, referring to this type of family farmer who also works as wage laborer, suggest that he should be considered a "cultural type... in a kind of fluid equilibrium" (cf. p. 321). Also see R. Frucht, "A Caribbean Social Type: Neither 'Peasant' nor 'Proletarian' ", in Social and Economic Studies, vol. 16, no. 3, pp. 285-300.

[42] If one accepts the calculations, table 12 shows that this equalization actually does not take place. The same conclusion is obtained, based on the analysis of the estimated production function from a sample covering the entire Northeast, in P. I. Scandizzo and T. Barbosa, "Substituição e Produtividade de Fatores na Agricultura Nordestina", in *Pesquisa e Planejamento Econômico*, vol. 7, no. 2 (August, 1977), pp. 367-404. Also see the results of the laborious econometric analysis of E. R. Alves, *op. cit.*

[43] Thus, J. N. Bhagwati and S. Chakravarty, "Contributions to Indian Economic Analysts: A Survey", in *American Economic Review* (September, 1969), Supplement, pp. 41-42, do not discuss their initial premise in the following formulation: "(...) if the family is taking a decision on *overall* income derived from input of work-hours by the family as such (then it follows that), the opportunity cost of peasant family labor equals the wage". With this premise, they intend to "use the theory" to critique A. K. Sen, "Peasants and Dualism with or without Surplus Labor", in *Journal of Political Economy*, vol. 74, no. 6 (October, 1966),

characteristics of these labor activities, and could perhaps be interpreted as the result of a transfer of the rationality of the proletariat to the petty farmer without simultaneously transferring its social and historical existence. The proletariat's labor, "isolated" as it is from the means of production (and, for that very reason) constitutes a commodity which is offered only on the basis of payment received. (This "rationality" of the proletariat would thus assume an absolute, "natural", or rather *non-historical* character) .' However, there is no reason for an equalization between the results of two activities of labor which are objectively, more than mere activities of "labor", they constitute *social production relationships* and, for that very reason, take on meanings completely different and antagonistic in the perspective of petty farmers. [44]

We shall now illustrate the importance of the agrarian structure in the study of the determination of the real wage and the profit rate in the capitalist sector. From the analytical point of view, it is appropriate to divide the issue into separate questions, i.e. (i) a question of value, that is, the relation of exchange between the two sectors, and (ii) the determination of the *real* wage, that is, of the vector B of quantities of wage-goods. [45]

pp. 425-450, which attemps to justify, but unsuccessfully, the non-equalization of the marginal product in family farming at the market wage. Also see W. R. Cline, *Economic Consequences of a Land Reform in Brazil* (Amsterdam: North-Holland, 1970) , pp. 25-27, for another example of the same difficulty confronted by Sen, and for the same reason, which is, for not specifying the social contents of these activities. For other illustrations from neoclassical literature, see E. R. Alves, *op. cit.*; C. Nakajima, "Subsistence and Commercial Family Farms: Some Theoretical Models of Subjective Equilibrium", in C. T. Wharton (ed.) , *Subsistence Agriculture and Economic Development* (Chicago: Aldine, 1969) ; M. R. Rosenzweig, "Neoclassical Theory and the Optimizing Peasant: An Econometric Analysis of Market Family Labor Supply in a Developing Country", Discussion Paper no. 72, Research Program in Development Studies (Princeton University, March, 1977) ; P. K. Bardhan, "A Model of Growth of Capitalism in a Dual Agrarian Economy", in J. Bhagwati and R. S. Eckaus (eds.) , *Development and Planning* (London: George Allen & Unwin, 1972) .

[44] It is interesting to refer to a possible attempt to preserve the notion that the phenomenon is an expression of a "rational" allocation of family labor, maintaining the neoclassical jargon, through the introduction in the utility function of the family, of a "disutility" associated with wage labor, or a "preference" for autonomous labor, thus "equilibrium" in terms of "subjective real income". It is worth noting, first that in this new formulation, the objective differentiation present in labor activities, and expressed in the supervisory relationship, in inspection, in payment for time or task, etc., for wage labor, is different and contrasts with labor in family farming. It falls beyond the limits of the analysis, in favor of subjective representations which are not explained. Second, it seems clear that this new formulation, contrary to the previous one (or rather, negated by the new one) , cannot be tested, and therefore is void of empirical content.

[45] This same breakdown can be noted in the classical article on dualism by W. .Arthur Lewis, "O Desenvolvimento Econômico com Oferta Ilimitada de

With regard to the first question, it can be affirmed that the differential of the profit rate of account implies a value (or relative price) of the goods supplied by small-scale farming which is less than the "price of production" (defined by the inclusion of the current profit rate). This corresponds to the production of the same goods in the capitalist form. It is, in fact, through this differentiated process of value formation that, at the market level, the "segmentation" of forms of production are established according to the activities. If we assume that the vector B of wagegoods is given, we may then conclude that, the greater the share of petty farmers commodities in the total market supply of these goods, the smaller the cost of labor in terms of goods produced in the capitalist sector, and the greater the available surplus to be appropriated in the form of profit rate. [46]

With reference to real wage B, one can consider for critical discussion the "dualist" theory, according to which real wage in the capitalist sector ("modern sector") is determined by the level of real income of the small farm ("traditional" or "subsistence" sector), or rather, that the supply of wage labor is "unlimited" at a wage level given by the real income in family farming. However, this dualist theory does not specify under what conditions such relation of determination takes place. This is a particularly serious deficiency, since one cannot assume a "spontaneous" transfer, based on "rational" decision-making, since these income categories correspond to labor activities which have different and even antagonistic socio-economic contents, as can be proven, not only by the previously discussed findings of seasonal wage labor, but also in the overall historical experience of the "capitalist sectors" of underdeveloped economies. [47] It is especially significant that the dualist theory takes the real level of income in family farming as given and thus loses sight of the relation between the agrarian structure and the limitation of the conditions of production and of generation of income in

Mão-de-Obra", in A. N. Agarwala and S. P. Singh (eds.), *A Economia do Subdesenvolvimento* (Rio de Janeiro: Forense, 1969), pp. 406-456.

[46] This argument was presented previously in Gervásio Castro de Rezende, *op. cit.*, and is based on the analytical structure of Sraffa. See P. Sraffa, *Production of Commodities by Means of Commodities* (Cambridge: Cambridge University Press, 1960). (In passing, it is fitting to allude to an interesting conclusion: production function analyses can contain specification errors for not capturing the effect of this differential law of value, attributing it, erroneously, to difference of productive efficiency; a typical example of analysis, which can contain this error of specification is found in P. L. Scandizzo and T. Barbosa, *op. cit.*)

[47] See Gervásio Castro de Rezende, "Plantation Systems, Land Tenure and Labor Supply: A Historical Analysis of the Brazilian Case with a Contemporary Study of the Cacao Regions", Ph. D. Thesis (University of Wisconsin, 1976).

family farming, on the one hand, and the formation in this sector of a labor source for capitalist farming. [48]

5 — Final Remarks

The more general theoretical perspective to which this paper attempted to contribute is the problem of rural employment in the Northeast in that it manifests structural production characteristics, i. e., its analysis requires the explicit consideration of the prevalent social forms and of the relative conditions in which these different forms of production are linked together. For this purpose, we presented the specific analysis of the employment situation and the determination of rural income in the context of the "duality" of family farming/capitalist farming since, as we attempted to illustrate, employment reflects precisely the relations established between these two forms of production. We were also able to show the manner in which this general perspective may be specified in other contexts, such as that of the cotton/cattle/*roçado* "complex" in the backlands. This task, however, will be delegated to a future research endeavor since it presupposes proper empirical analysis and theoretical definition.

Several economic policy implications emerge from this theoretical perspectives as well as a critique of the common approach to low levels of employment, income and productivity (in the Northeastern agricultural region of Brazil) which attributed these problems to limits on technology or *natural resources* (climate, soils, etc.), disregarding the importance of agrarian structure. However, once the various social forms of production are specified, the possibility arises of differentiating economic policy instruments according to their effectiveness in altering the prevailing structural conditions, depending, of course, on the general political conditions. Consequently, we can define *alternative strategies* of rural development for Northeastern Brazil in which the objectives of growht in output and productivity relate in different ways to the objectives of employment and distribution of income. A policy of aid to family

[48] In contrast to the dualist theory, and having in mind the historical evidence, it is possible to argue that the wage, like all the other characteristics of wage labor, is not determined *outside* (that is, in the "subsistence sector"), but rather *within* the process of accumulation. In this new perspective it is necessary to specify the historical forms of this accumulation, so as to permit the analysis of social forms of labor which preceded wage labor, such as slavery and the "morador system" in the production of sugar cane. It is also possible to integrate the actual objective conditions of production and appropriation of income in family farming as well as the subjective opinions of family farmers, into this analysis. On this subject, see Gervásio Castro de Rezende, "Plantation Systems...", *op. cit.*

farms obviously enables policy makers to attack the problem of rural employment in the Northeast at its source, and thereby avoid a trade-off between growth in production and productivity and absorption of labor by agriculture. It is important to note, however, that "to aid family farms" means to alter their structural conditions, which pressuposes a compatible political framework, given that, in the "duality context", these structural conditions are also capitalist farming conditions. In other contexts (such as the backlands and the cotton/cattle/*roçado* "complex") these are also conditions of the economic, social and political base of large landowners, merchants and money-lenders. It is this very interconnection of production forms and antagonistic interests of socio-economic groups which renders the alternative strategy of "modernization" (presently adopted by the Government), by reason of the instruments utilized (such as subsidized rural credit, incentives for the utilization of "modern inputs", etc.) a reinforcement of existing structural conditions, discriminating against petty producers. In this sense, it contributes to the weakening of the capacity to absorb labor into family farming. It is noteworthy that the utilization of an occasional increase in demand for wage labor may not be justified (through, for example, incentives for *laborintensive* techniques) in order to define a "net effect" of labor absorption, since, as was noted, the movement from one occupation to another, involving a process of proletarization, is not of a spontaneous nature and, for that reason, involves a loss of wellbeing for the petty farmers involved. [49] Moreover, neither is it justified to assume, particularly in certain activities and regions, that the very objectives of growth of output and productivity can be attained. [50] In the latter case, it is possible to say that aid to family farming not only affect directly the objtive of employment and income distribution, but appears to be the only strategy for the increase of output and productivity.

[49] Another aspect which should be considered is the seasonality of the demand for labor. See Y. Sampaio and J. Ferreira, *Emprego e Pobreza Rural* (Recife: UFPe, 1977), which emphasizes the importance of this problem in the analysis of recent structural transformations in the Northeast.

[50] We are dealing here with situations in which not only is the technique "traditional", but it corresponds to determined social relations of production, such as sharecropping in the cotton/beef cattle/*roçado* "complex" in the backlands. In themselves, they provide the basis for the acquisition of monetary income by the landowner. The intended "modernization" therefore may not be *viable*, since it involves not only an "adoption" of technology but actually a change in the relations of production, beginning by the transformation of the very economic content of the *latifundio*. See P. L. Scandizzo, "Resistance to Innovation and Economic Dependence in Northeastern Brazil", Working Paper RPO: 273/XIV/1 (Washington: World Bank, October, 1974), and Y. Sampaio, "Modelos de Otimização na Agricultura do Nordeste do Brasil, com Ênfase em Agricultura de Consorciação em Parceria", Comunicação n.º 39 (Recife: PIMES, 1975).

Accelerated growth and the labor market: the brazilian experience *

Roberto Castello Branco **

Abstract

This paper analyzes the behavior of the urban labor market during a period of substantial economic growth in Brazil (1969 to 1973). It explores the theoretical relationship between economic growth and labor market disequilibria. Empirical evidence supports this hypothesis. A human capital earnings function explains a considerable share of the labor earnings variance. Its explanatory power is higher and the effect of education on wages is stronger for precisely the most dynamic sectors of the Brazilian economy. The empirical results suggest, however, that economic growth in Brazil increased the opportunities for social mobility.

1 — Introduction

This paper proposes to analyze the behavior of the urban labor market in Brazil during the phase of accelerated economic growth between the late 1960's and the early 1970's. Two phenomena in particular have given rise to the interest which exists in this

analysis. They are as follows: a) the systematic relation between economic growth and income distribution; b) the urban sector of the Brazilian economy has registered the most significant increases in the disparities of relative incomes.[1]

In a context of rapid economic growth, as quantitative and qualitative transformations take place in the productive structure, an increase in the share of output of the more advanced technological sectors should logically provoke a sharper expansion in the demand for the services of more highly qualified workers. Given the present lack of skilled human resources in Brazil, our hypothesis suggests that this situation contributed to a disproportionate increase in the earnings of those individuals with a greater ability to efficiently perform the more complex tasks required by the modernization of the economy.

This paper will thus give emphasis to the imbalances which are associated with the fuctioning of impersonal market forces, and sharpened by Government intervention in economic affairs. We shall simultaneously underscore the transitory nature of these disequilibria and attempt to identify those factors which act to correct them.

In economic literature, it has been suggested that labor market disequilibria result from an institutional process established to protect the capitalist system through the creation and maintenance of an occupational structure characterized by rigid hierarchical patterns. The forecasts based on these assumptions are quite pessimistic, warning of trends toward economic stagnation, permanent segmentation of the labor market, and a nearly complete blockage of social mobility.[2]

In the final subsection, following the analysis of labor force wage inequality, we will attempt to determine whether such opportunities expanded during the period in question (1969 to 1973). As opposed to the segmentation hypotheses, the modern economic growth theory leads us to anticipate that the diversification and complexity acquired by the occupational and organizational structure contributed to the intensification of the social mobility process.

This paper has been organized as follows:

In section 2, we shall describe the principal arguments concerning the impact of economic growth on the behavior of the labor market.

In section 3, the effects of investments in human capital on individuals' earnings are discussed. The two basic forms of investment considered are: a) formal education; and b) on-the-job

[1] In this regard, see Langoni (1973).
[2] For an analysis of labor market segmentation theories, see Cain (1976).

training. We derive the earnings function used to estimate returns to these investments and to explain individual wage differences. In addition, the controversies on these models' limitations are summarized and the data utilized in the empirical section of this study are described.

In section 4, the earnings function is estimated for the urban sector and disaggregated for the 28 subsectors into which it is divided. Subsequently, we again disaggregate the urban sector into three major subsectors for the purpose of identifying the nature and intensity of the disequilibria with greater clarity.

In section 5, we shall analyze the contribution of economic growth to social welfare, within the limits imposed by the use of cross-sectional data. For this purpose, we analyze the situation encountered by participants in the labor force and the bahavior of real wages over time.

Finally, section 6 is a summary of the principal results obtained and their most significant implications.

2 — The impact of economic growth on the labor market

Economic growth does not imply a state of equilibrium, but is rather characterized by frequent disequilibria.

The maintenance of a self-sustaining process of economic growth depends upon the continuous emergence of higher lucrative new investment opportunities. These opportunities are, in turn, produced by a combination of factors, of which the most important include the incorporation of natural resources and the introduction of technological innovations.[3]

Investment opportunities are not uniformly distributed. Likewise, they are identified in several ways and their effects are diverse. The dynamics of economic growth therefore tend to generate income disparities manifested on the sectorial, regional and personal levels. It should be pointed out that this occurs independently of the institutional base on which the economic system operates and as we shall see, Government intervention can contribute to the creation or intensification of disequilibria.

The differentiated trends of the economic sectors is particularly determined by the differences in their capacity to generate and

---

[3] In the more advanced stages of the growth process, technological progress tends to acquire greater degrees of importance as a generating source of investment opportunities; it facilitates the discovery of and economic utilization of natural resources.

83

absorb technological innovations and by their income elasticities of demand. This, as we know, is confirmed by extensive empirical evidence which records considerable transformations in their economic structure parallel to the growth in real income of the country.[4]

One of the clearest trends is the decrease of agriculture's relative share in the total output of the economy, which is basically compensated by the increased share of industry. This reflects the differences between the income elasticities of demand for the products of these two sectors. In the case of Brazil, given the importance of the locational aspect of the absorption of technological innovations by agriculture, the strategy of importing techonological packages contributed to the acceleration of this process.

Disequilibria associated with growth also appear within the major sectors of the economy. In view of the low technological level of Brazilian agriculture, this sector's performance is characterized by considerable variance in growth rates, which are determined by fluctuations in climatic conditions.[5] Disequilibria within this sector are thus largely aleatory, making long-term trends in the production structure more difficult to identify.

Industry, however, exhibits quite clear long-term changes. Research findings indicate that the chemical, transport equipment, electrical equipment, machinery and metals industries considerably increased their share in the composition of Brazilian industrial output in recent decades.[6] In compensation, the relative importance of the so-called "traditional" industries (textile, food, clothing, etc.) was significantly reduced.[7] Such modifications in the productive structure had been foreseen, since there were upward shifts the relative positions of those branches of industry having the greatest technological content and whose products coincidentally possessed higher income elasticities of demand.

Changes in the tertiary sector are not quite as in agriculture and industry. It is still possible, however, to identify the subsectors which have undergone relatively more rapid expansion in recent periods, such as financial institutions and electric energy services, which experienced considerable technological and organizational transformations.

4 In this regard, see Kuznets (1966).

5 For the period 1948-1977, the variation variability (standard deviation/average) of the annual expansion rate of the agricultural sector was 84%, in contrast with 51% for the manufacturing industry.

6 In this regard, see Langoni (1975), chap. 4.

7 Following Schults (1964), we define traditional industry as that in which productivity is low or grows more slowly.

One of the results of the unbalanced growth of the economy is that the derived demand for labor does not occur in a uniform maner. In view of the complementarity between modern physical capital and human capital, there is a disproportionate increase in demand for the services of workers having better professional qualifications. [8]

Nevertheless, we must consider the behavior of the actual labor supply, which is related to two interdependent components, quantity and quality. In Brazil, high birth rates in previous decades resulted in rapid population growth. [9] As can easily be perceived, for a given level of family income, a greater number of children will mean lower per capita expenditures on health, nutrition and education, which are extremely important factors in the formation of the productive capacity of individuals. Furthermore, higher birth rates tend to occur precisely in the poorer strata of the population. Thus, intense demographic expansion resulted in an oversupply of unskilled individuals, which impeded the adjustment of the labor market, particularly when the economy underwent profound transformations.

In further reference to the labor supply, a fundamental aspect is related to the difference in elasticities. Indeed, given the minimum time required for appropriate labor training, the elasticity of the supply of skilled workers is relatively low, which also aggravates wage inequalities throughout the process of economics growth.

It is also possible to anticipate the widening of wage differentials between the diverse economic subsectors for individuals with approximately equal skill levels. With the acceleration of growth and the consequent disparities of expansion rates, the demand for a given labor category obviously tends to develop in a differentiated form among subsectors. Given the high costs of mobility and the imperfections in the access to information, the logical consequence is the increase in the earnings differentials.

In this respect, it is important to point out that those individuals having attained higher educational levels avail of greater opportunities to benefit from the disequilibria. Education, besides directly facilitating increased productivity on the market, develops in individuals the ability to perceive and adapt better and more rapidly to economic changes; this has been confirmed by the empirical evidence furnished by a series of studies conducted for various countries. [10] This ability assumes crucial importance in a developing

[8] For empirical evidence on the complementarity of physical and human capital, see Fallon and Layard (1975).

[9] For data on the demographic expansion in Brazil, see Kogut (1976), Table 22, p. 39.

[10] In this regard, see Schultz (1975).

economy, in which these changes are more frequent, since it permits those with higher levels of formal education to exploit wage disequilibria through job changes.

As the Brazilian economy envolved in disequilibrium (reflecting the market forces at work) institutional interventions seem to have reinforced labor market imbalances. The industrial development policy implemented after World War II was implicitly based on the concept that the accumulation of physical capital was the only important source of economic development. [11] Consequently, it was generous in the concession of subsidies for the utilization of this factor. Thus, distortions in the relative prices of production factors made the importation of technology profitable from the private point of view without creating the need to significantly adapt to the country's prevailing conditions. [12] The new innovations were adopted due to the relative scarcity of factors from developed countries. They were relatively intensive in the use of modern physical capital and skilled labor, thus increasing the pressures exerted upon the labor market.

In short, it can be presumed that the combined action of the above-mentioned forces influenced the transitory rise of relative earnings differentials in favor of individuals with better professional qualifications.

3 — Investments in human capital and wages

3.1 — Derivation of the human capital earnings function

In view of the hypotheses formulated on the relation between economic growth and the labor market, investments in human capital probably perform an important role in the explanation of the

[11] Even in 1964, the PAEG (Government Plan for Economic Action) based their projections on a model of the Harrod-Domar type: ... "In the Brazilian case, in which the population is growing currently at a rate of 3.5% annually, with the incremental relation capital/output estimated at 2.0, and depreciations reaching annually about 5% of gross product, a gross rate of investments of 12% annually would be needed to make the real gross product grow at least at the same rate of demographic expansion" ... In this regard, see *Programa de Ação Econômica do Governo 1964-66*, Ministério do Planejamento e Coordenação Econômica, May 1965, chap. II, section 2.3.

[12] This does not mean that domestic industry uses the same relation between the factors as industry in the country exporting the technology. Actually, since real wages in Brazil are certainly lower than those in effect in the developed countries, Brazilian firms ought to encourage some adaptation through more labor-intensive employment in auxiliary operations, such as storage, cleaning, administration, etc.

differences in individual wages. We shall proceed, then, to the derivation of the human capital earnings function, developed by Mincer (1970, 1974) and Becker (1975).

We shall consider the following variables:

C_t = cost of investments in human capital (primarily formal education and on-the-job training) in cruzeiros, in a given period t; [13]

E_t = wage potential in period t, or rather, the wage which the individual would receive if he were to devote his time to working without sacrificing part of it invest in human capital;

$W_t = E_t - C_t$ = the net wage received for period t, which approximates the observed wage insofar as the direct costs of investments in human capital are lower;

$K_t = \dfrac{C_t}{E_t}$ = the ratio between investment costs and wage potential, which is interpreted as the fraction of time which the laborer devotes to the increase of his stock of human capital in period t.

Considering that the potential wage in a specific period consists of the potential wage of the previous period plus returns from investments in human capital made in this period, the equation can be written as:

$$E_t = E_{t-1} + r^* \, C_{t-1} = E_{t-1} \, (1 + r^* \, k_{t-1}) \qquad (1)$$

where:

r^* = internal rate or return to investments in human capital, assumed to be the same for any period of time. [14]

[13] The expression "on-the-job training" has a broad meaning here, encompassing the training conducted through formal programs, and informal training, which involves the acquisition of useful skills and knowledge through the performance of tasks at the place of work. What is important is its essential characteristic represented by costs incurred by employee and/or employer in the expectation of future gains in productivity.

[14] Mincer (1974), chap. 1, p. 9-11 proves that this is an internal rate of return or, rather, the discount rate which equalizes the present value of costs and benefits derived from investments in human capital.

By mathematical induction, equation (1) can be rewritten as:

$$E_t = E_o \,(1 + r^* \, k_t) \,\ldots\, (1 + r^* \, k_t) = E_o \prod_{j=1}^{t} (1 + r^* \, k_j) \qquad (2)$$

Knowing that the term $r^* k_j$ is small, when we apply logarithms to (2) we can apply the equivalency between $log \,(1 + a)$ and a when is a number of small magnitude and obtain:

$$log \; E_t = log \; E_o + \sum_{j=1}^{t} r^* \, k_j \qquad (3)$$

Now drawing the distinction between investments in formal education and investments in on-the-job training, we may rewrite equation (3) as:

$$log \; E_t = log \; E_o + r_s \sum_{j=1}^{s} k_j + r \sum_{j=s+1}^{t} k_j \qquad (4)$$

where:

r_s = private rate of return to investments in education.

r = private rate of return to investments in training. [15]

One of the main implications of the analysis of the optimum allocation of investments in human capital over a lifetime is that it is anticipated that these investments will decrease with age. [16] Two fundamental reasons are responsible for this prediction, as we present below.

First, since life is finite, postponing investments in human capital reduces the current value of its marginal benefits. Furthermore, since time is an important input in the formation of the individual's stock of knowledge, the marginal costs of these investments should increase with age. This would not hold as true only in the case where investments in human capital increase the capacity to absorb new skills and knowledge more than the capacity (productivity) to perform tasks in the labor market. [17]

[15] There are reasons to assume a priori differences between the magnitudes of these rates. Non-pecuniary returns to formal education, a greater volume of public subsidies to education and a lesser degree of uncertainty associated with investments in training, due to the improved knowledge of the individual of his capacity and motivation, are several of the reasons listed by Mincer (1962).
[16] In this regard, see Ben-Porath (1967).
[17] Tests conducted by Ben-Porath (1970) and Lazear (1976) support the opposite hypothesis, that is, that beginning at a certain stage, investments in human capital contribute relatively more to increase productivity in the market than to absorb new skills and knowledge.

Therefore, the shifts over time of cost and marginal benefits curves explain the concentration of investments in human capital at the beginning the life span. On the other hand, the existence of a fixed factor in the production of human capital (the capacity to absorb knowledge) determines a positive inclination for the marginal cost curves within each period, and explains why the investments tend to be distributed throughout life.

Nevertheless, the decrease in investments is not necessarily monotonic. It is possible that in the initial stages of the accumulation, given the reduced magnitude of the stock of human capital, all available time is devoted to the formation of additional human capital. This qualification of the Ben-Porath models leads to the hypothesis that during the school age phase, the proportion of potential wages invested is equal to 100%. In other words, in equation (4) $k_j = 1$, for $0 < j \leqslant s$, which is equivalent to assuming that the occasional wages received during the school age period compensate for direct costs incurred by the individual with investments in education. [18]

Incorporating this hypothesis into the model, it can be written:

$$log \ E_t = log \ E_o + r_s \ s + r \sum_{j=s+1}^{t} k_j \qquad (5)$$

Although this supposition facilitates empirical analysis, it can produce biases in the computation of the rate of return to education (r_s), as Leibowitz demonstrates (1976). [19]

Economic theory does not indicate any general form for the specification of the decline of investments in training over a lifetime. Mincer (1974) works with two alternative specifications: one linear and the other exponential. We shall work only with the linear by reason of the greater mathematical simplicity involved. [20]

[18] An exception to this generalization is found in Haley (1973), who explicitly acknowledges that investments in human capital are greater during the school age period than during the working experience phase.

[19] Leibowitz (1976) demonstrates that, even granting that between individuals and between the years of schooling the average value of k were equal to *one*, r_s can constitute a biased estimate of rate of return to education. In addition, if the average value of k during school is greater (less) than one, the estimated coefficient r_s overestimates (underestimates) the rate of return to education.

[20] On the other hand, results obtained for Brazil by Senna (1975) and the United States by Mincer (1974), reveal no significant differences between the portions of the variance of wages explained by the logistic earnings function in a derived from the hypothesis of exponential decline of investment, and by the earnings function in a parabolic form, implied by the assumption of the linear decline of investments.

We shall therefore adopt the hypothesis that:

$$k_j = k_a - \left(\frac{k_o}{T} \right) t \tag{6}$$

k_o = fraction of potential wages invested in the initial period of participation in the labor market;

T = total period of net investment in human capital;

t = number of periods of experience in the labor market.

Substituting (6) in (5) and rewriting this last equation in continuous terms we get:

$$\log E_t = \log E_o + r_s S + r \int_o^t \left[k_o - \left(\frac{k_o}{T} \right) c \right] hom \tag{7}$$

$$\log E_t = \log E_o + r_s S + r k_o t - \frac{r k_o}{2T} t^2 \tag{8}$$

Since $W_t = E_t - C_t$, we can obtain a function for net wages:

$$\log W_t = \log E_o + r_s S + (r k_o) t - \left(\frac{r k_o}{2T} \right) t^2 + \log (1 - k_j) \tag{9}$$

Expanding the term $\log (1 - k_j)$ in accordance with a Taylor series, we finally obtain:

$$\log W_t = \log E_o - k_o \left(1 + \frac{k_o}{2} \right) + r_s S +$$
$$+ \left[r k_o + \frac{k_o}{T} (1 + k_o) \right] t - \left[\frac{r k_o}{2T} + \frac{k_o^2}{2T^2} \right] t^2 \tag{10}$$

One of the limitations of the model of equation (10) is the assumption that individuals are continuously employed after concluding their formal schooling. The notorious problems of applying this model to the analysis of female earnings are a good illustration of the resulting difficulties: the intermittent participation of married women in the labor market implies the formation of discontinuous investment trajectories, which makes the use of

equation (10) unfeasible for the estimation of their wages, consequently requiring the use of "segmented" earnings functions. [21]

The use of samples which include only men and the adoption of the reasonably realistic hypothesis of the uninterrupted participation of male workers in the labor market, helps overcome this problem. Nevertheless, new complications emerge insofar as job changes results in discontinuities in the investment profile. The hypothesis suggests that different jobs require not only different quantities, but different *qualities* of investments in human capital.

The incorporation of this limitation into the model leads us to opt for the use of a segmented earnings function. Given the available data, we shall use a formula which explicitly distinguishes the following two periods of investment after the school age phase: (a) the period between the year in which schooling is concluded and the initiation of the current job, and (b) the period corresponding to the duration of the latter, which should be capturing the greatest share of specific investments of the firm, given the need to adapt the skill level to the new occupational or even functional characteristics.

Consistent with the optimum allocation of investments in human capital throughout the life cycle, we introduce the hypothesis that the initial investments (k_o) in the current job are negatively correlated to the extension of previous experience.

In this manner, equation (7) is transformed into

$$log\ E_t = log\ E_o + r_s\ S + r_1 \int_o^{t_1} [k_{o_1} - \beta_1\ e_1]\ de_1 +$$

$$+ r_2 \int_o^{t_2} [k_{o_2} - \beta_2\ e_2]\ de_2,\quad (11)$$

bearing in mind that the investments made in previous jobs are expressed by:

$$k_{t_2} = k_{o_2} - \beta_2\ t_2 \quad (12)$$

and those effected in the present job are expressed as:

$$k_{t_1} = k_{o_1} - \beta_1\ t_1 \quad (13)$$

[21] See Mincer and Polachek (1974) with respect to the use of segmented functions to explain wage differences among women.

where, in turn, the initial investment (k_{0_i}) is represented by the function:

$$k_{0_1} = \alpha - \gamma \ t_2 \tag{14}$$

t_1 is the duration of the current job and t_2 is the duration of previous jobs.

Carrying out the appropriate mathematical operations, we obtain the "segmented" human capital earnings function:

$$log \ W_t = (log \ E_0 - \alpha) + r_s \ S + (r_1 \ K_{0_t} + \gamma) \ t_1 - \left(\frac{r_1 \ \beta_1}{2}\right) t_1^2 +$$

$$+ (r_2 \ \alpha + \beta_2) \ t_2 - (r_2 \ \gamma) \ t_1 \ t_2 - \left(\frac{r_2 \ \beta_2}{2}\right) t_2^2 \tag{15}$$

It is interesting to note in this equation the presence of a term of interaction between t_1 and t_2, which reflects the fact that the influence of experience in the present job on wages is negatively correlated to the extension of previous experience, consistent with the forecasts of economic theory.

3.2 — Criticism of the human capital model

Upon analyzing the criticism of the validity of the model presented in the previous section, we find it appropriate to classify it in two groups:

a) Criticism which suggests the possibility of overestimating the rates of return to investments in human capital, given the omission in the human capital earnings function of representatives of differences in natural ability and family background; [22]

b) Criticism based on the argument that, although inequalities of earnings are associated with differences in educational levels, such findings do not reflect differentials of productive capacity produced by investments. According to its authors, the relation between education and wages is fundamentally derived from the use of the level of education of individuals as a mechanism of signaling preexistent differences in talent. This is known as the "screening" hypothesis.

The first is the older of the hypotheses and in economic literature there can be found a considerable number of studies whose principal concern is the estimation of biases in the rates of return

[22] We are using the term "natural ability" as synonymous with intelligence.

to education. [23] Estimates generally vary quite a bit with the different measures of intelligence and family background used, as well as with the other variables which are held constant in the regressions. Nevertheless, the results of such studies indicate that the net effect of schooling on income is substantially greater than the effects of these two variables. This would support the validity of the fundamental concept of the theory of human capital, that is, the notion of a causal relation between schooling and income, through increases in productivity.

The interdependence of education, intelligence, family background and wages is extremely complex. In the discussion on the role of these variables, it is common to confuse the *net* contributions of ability and family background with their *total* contributions: their effects on wages through investments in human capital are also computed into the latter.

An examination of these relationships reveals that in developed economies, natural ability and family background significantly influence the accumulation of the stock of human capital of individuals. Nevertheless, confirming previous results, their net effects on income were relatively small in comparison to those of formal schooling asd work experience. [24]

In Brazil, the combination of a reduced stock of human capital and high investment flows suggests the weakening over time of the links between family wealth and level of education. Table 1 reports variations in the number of registered students, corrected by the growth of school age population, by level of education during the period of 1962 to 1970. The data presented demonstrate the extraordinary reaction of the educational system to the demands of economic growth, especially at the unversity level.

Concurrently, it is important to mention that throughout past decade, the Government altered the form of subsidizing education, at least with regard to direct subsidies. As may be observed in table 2, the share of direct subsidies in enrollments between 1962 and 1972 decreased in university education while increasing in the other levels. The greatest allocation of public resources to the lower

[23] The bias of the estimated coefficient of the scholarity (S) variable due to the omission in the human capital earnings function of a variable which has a net effect on wages, is expressed by $\gamma_i b_{xi \cdot y}$, where γ_i is the true coefficient of the variable omitted (x), while $b_{xi \cdot y}$ is the coefficient of the variable x in the auxiliary regression between x and s with the other variables (y) held constant. On the estimate of these biases see Jencks (1972), Bowles (1972), Hause (1972), Griliches & Mason (1972), Taubman & Wales (1975) and Griliches (1976).

[24] See, for example, Leibowitz (1974, 1976), Griliches (1976) and Klevmarken Quigley (1976).

levels of the educational system benefit students from lower income families, facilitating their access to the university, the costs of which can be financed through part-time work or through loans from the educational program. [25]

In this paper, we will not attempt to estimate the net effects of intelligence and family background on wages. The strongest reason for this omission doubtlessly is the lack of data which could enable us to determine the possible effects of these variables.

Table 1

Increase in Enrollment by Level of Education: 1962 to 1970 [*]

Level	%
Elementary	51.0
Junior High School	161.0
High School	197.4
University	284.9

Source: From the *Anudrio Estatístico do Brasil e Censos Demográficos.* FIBGE. (*The Statistical Yearbook of Brasil and the Demographic Census*).

[*]The variation in the number of enrollments was corrected by growth of the school age population corresponding to each educational level. The following age groups were considered by educational level: 5–9 years old: Elementary; 10–14 years old: Junior High School; 15–19 years old: High School; 20–24 years old: University.

Table 2

Distribution of Enrollments Between Public and Private Schools by Educational Level

Year	Elementary		Junior High-School		High-School		University	
	Publ.	Priv.	Publ.	Priv.	Publ.	Priv.	Publ.	Priv.
1962	88,0	12,0	36,9	63,1	34,9	65,1	59,7	40,3
1972	92,1	7,9	69,7	30,3	57,3	42,7	40,4	59,6

Source: From the *Anudrio Estatístico do Brasil.* FIBGE.

25 This reallocation of government subsidies is also recommend from the point of view of economic efficiency, bearing in mind that the social return to investments in education in Brazil are higher at lower levels of education. In this regard, see Langoni (1974).

The second set of critiques is more directly related to the logical bases of the theory of human capital, since they question productive role attributed to education. The focal point for screening models is the information costs associated with the identification of employee productivity, particularly for higher-paying jobs, such as those in administration and management. Thus, the hypothesis is that the formal education level of the candidates for these jobs is used to minimize the costs involved, given that they reflect several of the characteristics, such as intelligence and perseverance, which are considered to be essential for the efficient performance of functions to be conferred on them. [20]

The tests conducted, although they may lend support to the basic assumptions of the theory of human capital, cannot reject the hypothesis that a portion of the returns derived from education should be attributed to their use as a filter. [27]

Another critique rests in the interpretation of the format of lifetime wage profiles as a reflection of the biopsychological development of individuals. The physical and mental maturation during the initial years of participation in the labor force and the decline at more advanced ages (phenomena independent of the individual's activity) are determinants of the concavity typical of the wage profiles. Empirical evidence, while verifying the effect of the factors on the behavior of wages, suggests that this effect is relatively small. [28]

The explanation of the returns to years of experience in the labor market as a result of institutional arrangements which set seniority criteria as a basis for obtaining promotions, is another question raised. The mere existence of regulations of this type does not rule out the assumption that investments which generate increases in productivity may be responsible for wage differentials, unless promotions are granted without any considerations whatever to employee efficiency. Nevertheless, this possibility tends to diminish as the dynamism of the economic activity increases, since the tasks to be carried out become increasingly differentiated and complex.

Finally, it should be acknowledged that differences in preferences for risk and non-pecuniary return influence the choice of jobs and, occasionally, wage differentials. [29] Since the samples which we used are composed exclusively of wage earners, the wage differentials associated with risk differences are most likely small as compared

20 See, for example, Arrow (1973) and Spence (1973).
27 In this regard, see Layard and Psacharopoulos (1974) and Taubman & Wales (1975).
28 Tests of this hypothesis are found, for example, in Taubman (1975), Klevmarken & Quigley (1976) and Lazear (1976).
29 In this regard, see Rosen & Thaler (1975) and Taubman (1975).

to those which would appear, were we to also deal with the rewards derived from physical capital.

3.3 — The data

The data utilized are the result of an analysis of the Law of the 2/3, conducted annually in April by the Ministry of Labor. The information obtained refers only to employees in the urban sector whose labor contracts fall under the jurisdiction of the Consolidated Labor Laws (CLT). [*] Therefore, the data excludes the following categories: rural laborers, domestic employees, government employees. and, obviously, self-employed workers.

We utilized two samples relating to the years 1969 and 1973, which contain information concerning 71,521 and 67,433 males, respectively.

Like all data sets, the Law of the 2/3 contains several imperfections. There are, for example, no precise indications of the duration of the individual's actual experience in the labor market. Consequently, we use a proxy, defined as the age of the individuals minus an estimated age of entry into the labor market (based on the level of education). We were able to identify the exact duration of the individual's experience within the firm by using the information on the year during which he was hired by the firm at which he was employed when he responded to the questionaire. Thus, it was possible to divide the experience variable into the following two components: (a) the *actual* experience in the present job, which should include a relatively greater share of investments in training specific to the firms, and the training potentially acquired in previous jobs, with a greater content of investments in general training.

4 — Wage differentials: the empirical evidence

The segmented earnings function was estimated through the following regression:

$$\log W_i = b_0 + b_1 S_i + b_2 t_{1i} + b_3 t_{1i}^2 + b_4 t_{2i} + b_5 t_{2i}^2 + b_6 (t_{1i} t_{2i}) + \mu_i$$

where:

W_i = hourly wage of

S_i = years of schooling of ith individual.

[*] Consolidação de Leis do Trabalho.

96

t_1 = years of experience in the present job of the ith individual.

t_2 = years of experience in previous jobs of the ith individual.

and the anticipated signs for the coefficients are:

$$b_1 > 0, \; b_2 > 0, \; b_3 < 0, \; b_4 > 0, \; b_5 < 0 \text{ e } b_6 < 0.$$

The results of the estimation of this function for the urban sector for the years 1969 and 1973 are presented in table 3. All of the coefficients estimated were statistically significant at a level of 5% and presented the expected sign. The proportion of variance observed for individual wages explained by the model is 43% for 1969 and 45% for 1973. The share explained by the differences among investments in human capital is rather large, bearing in mind the deficiencies in the measurement of the variables. Such is the case of formal education, for example. Its empirical measure (years of schooling) hides significant differences in the quality of investments made.

The impact of additional years of education on hourly wages is greater than the impact of the current experience (t_1) in the firm and that of previous experience (t_2) in the labor market. This result was anticipated, due to the acceleration of demand for labor with a relatively small stock of human capital as given. This process influences the obtaining of "quasi-rents" by investors in education, however, with the modernization of the economy, the intensification of investments in training and the more rapid obsolescence of knowledge tend to benefit younger people within the higher levels of schooling. When cross-sections are used, this phenomenon dampens the effect of experience on wages.

Table 3

Estimate of the Segmented Human Capital Earnings Function for the Urban Sector *

Year	Regressions
1960	$\log W = -0{,}9628 + 0{,}1236\,S + 0{,}0731\,t_1 - 0{,}0018\,t_1^2 + 0{,}0325\,t_2 - 0{,}0006\,t_2^2 - 0{,}0013\,t_1 t_2$
	$\bar{R}^2 = 0{,}428$ (200.85) (64.03) (-39.87) (43.35) (-23.00) (-29.73)
1973	$\log W = -0{,}0959 + 0{,}1396\,S + 0{,}0760\,t_1 - 0{,}0013\,t_1^2 + 0{,}0354\,t_2 - 0{,}0005\,t_2^2 - 0{,}0014\,t_1 t_2$
	$\bar{R}^2 = 0{,}448$ $(198\ 10)$ (54.57) (-23.46) (29.34) (-24.78) (-24.41)

* The statistics t are in parentheses.

Comparing the results for 1969 with those for 1973, we note that the rate of return to investments in schooling increased, from 12.9 to 14%. This suggests that, despite the response of the educational system to pressures of demand for skilled labor, the disequilibria in the labor market did not show signs of correction.

The data from table 4 show that between 1969 and 1973 there was a slight improvement in the educational composition of the labor force, with the proportion of employees having less than a Junior High School level education falling from 74.3 to 72%. Nevertheless, whatever the definition of wages used, its growth rate increases with the level of schooling. Thus, for example, whereas college graduates obtained an increase in monthly wages, in real terms, of 56.2% between 1969 and 1973, elementary school dropouts, or illiterates had increased their earnings by 23.9%.

The segmented earnings function was estimated on a disaggregate basis for each one of the 28 subsectors into which we divided the urban sector. The results of these regressions are presented in tables A1 and A2 in the appendix.

The proportion of the explained variance of individual hourly wages varied moderately among the subsectors. For 1969, the explanatory power of the model was greater than 40% in eight of them (paper and cardboard (41.3%); mining (41.8%); tobacco (47.8%); chemicals (49.4%); financial institutions (50.6%); education and health (52.1%); electric energy (60.0%) and petroleum (61.6%), and lower than 20% in only three printing (15.3%); furniture (17.7%) and clothing and footwear (18.0%).

Table 4

Wages by Schooling Level
(in 1973 Cruzeiros) •

Educational Level	% of the labor force		Average hourly wage			Average monthly wage		
	1969	1973	1969	1973	1969/73 in %	1969	1973	1909/73 in %
Illiterate/Elementary Incomplete	35.3	32.4	1.77	2.39	35.1	359.93	446.02	23.9
Complete Elementary	39.0	39.6	2.60	3.42	27.2	492.22	629.43	27.9
Junior High School	13.5	13.8	4.71	6.29	33.6	801.50	1084.64	35.3
High School	7.9	8.5	6.96	10.12	45.4	1114.46	1639.66	47.1
University	4.3	5.7	12.33	19.47	57.9	1885.85	2945.21	56.2

• Deflator utilized: Cost of Living Index for Rio de Janeiro, base 1905/1907 = 100.

98

For 1973, as was previously seen in aggregate terms, the explained portion of the wage variance increased, surpassing 40% in the following nine subsectors: leather goods (41.3%); paper and cardboard (41.6%); beverages (43.2%); mining (44.0%); financial institutions (44.8%); education and health (47.3%); tobacco (47.8%); chemicals (51.7%); petroleum (56.5%) and electric energy (59.4%). It was less than 20% in two subsectors: printing (14.8%) and furniture (18.0%).

With few exceptions, the estimated coefficients of the independent variables are statistically significant and possess the anticipated sign. The results suggest that there were significant differences in the impact of the investments in human capital on wages among the subsectors, which would be a reflection of the disequilibria associated with the growth process. In fact, Chow's structural stability test, when applied to each one of the two sets of regressions, fails to accept, in both cases, the null hypothesis that the vectors of the coefficients, estimated within each subsector, are equal. [30]

For the purpose of examining the disequilibria of the urban labor market in greater depth, we aggregated the 28 subsectors of the sample into three sectors having the following composition:

a) Sector 1: chemicals, petroleum, vehicles, machinery, mining, tobacco, electric energy and financial institutions;

b) Sector 2: metals, plastics, paper and cardboard, rubber, non-metallic equipment, beverages, commerce, communications, education and health and miscellaneous;

c) Sector 3: lumbering and mining, food, textiles, footwear and clothing, wood, furniture, leather and civil construction.

The criterion adopted for this division was based on the degree of dynamism exhibited by the subsectors, measured specifically by the growth of output and level of technological modernization. For the manufacturing industry, it was possible to obtain uniform information on the behavior of these variables, though it was necessary to construct a proxy for the absorption of technological innovations, which are presented in table A3 of the Appendix. For the other subsectors, the solution found was to place them in sector 2. The exceptions were the civil construction subsector, classified in sector 3, and electric energy and financial institutions, included in the most dynamic of the sectors, sector 1. These exceptions stood

[30] The F values estimated were, for 1969 F (189, 71.325) $=$ 96.11 and for 1973, F (189, 67.327) $=$ 124.88. Both fell in the region of rejection given that $F_{.01}$ (189, $\propto$) $\cong$ 1.35.

a part, due to the significant differences in the relative intensity of their utilization of skilled labor. [31]

Clearly, this division is considerably arbitrary, though the same would be true, were more precise information available. The central objective is to shed light upon the intersectorial disparities: as we shall now see, this objective is satisfied by the classification which we have adopted.

The data of table 5 clarify the differences among the three sectors selected with respect to the average level of schooling and the behavior of real wages. The typical laborer of the most dynamic sector possessed, in 1973 and incomplete junior-high school education, whereas the employee in the most traditional sector had only an incomplete elementary education. Monthly wages in the dynamic subsectors expanded by 50%, in real terms, between 1969 and 1973, in contrast to the variation of 38.8% in the traditional subsectors.

The results of the estimation of the segmented human capital earnings function for the three sectors are presented in table 6 and table 7 shows the marginal contributions of each one of the independent variables in each regression. [32]

In all of the regressions, schooling is the most important explicative variable, in view of the magnitudes of the estimates of its coefficient and of the values of its marginal contribution. Reflecting the trend of demand for labor, the (implicit) average rates of return to investments in formal education varied among the three sectors. In 1973, for example, one additional year of schooling generated an increase of 15.5% in the hourly wage of employees in the subsectors encompassed in sector 1, but an increase of only 11.7% was registered for those of sector 3. [33] Similarly, the impact of the duration of experience in the present job is more important in sector 1. This may suggest the existence of greater returns to investments in specific training in the dynamic subsectors due to their greater absorption of technological innovations.

[31] In 1973, the average number of years of schooling of the labor force employed in the civil construction, electric energy and financial institutions subsectors was, respectively, 3.5, 7.0 and 10.4. For the urban sector as a whole, the average years of schooling was 5.5 years.

[32] The marginal contribution of a variable h is expressed as $R^1 - R^2_A$, where R^1 is the coefficient of determination of the regression when all the explained variables are in the equation, and R^2_A is the coefficient of determination of the regression when the variable h is excluded from the equation. In turn, the expression $R^1 - \Sigma_A (R^1 - R^2_A)$ furnishes the degree of multicollinearity between the independent variables considered in the equation. The value of the marginal contribution estimates the isolated importance of an independent variable to explain the observed variance of the dependent variable. See Theil (1971), p. 167-71.

[33] Chow's test rejected the hypothesis of equality of the sector of coefficients.

100

Table 5

Schooling and Wage Levels of the Labor Force

Sectors	Years of Schooling		Average Hourly Wage*			Average Monthly Wage*		
	1969	1973	1969	1973	1969/73 in %	1969	1973	1969/73 in %
Sector 1	6.6	7.0	5.40	8.17	48.8	867.77	1 301.06	49.9
Sector 2	5.4	5.7	3.46	4.86	40.4	599.46	841.40	40.4
Sector 3	3.6	3.8	2.14	2.98	39.3	403.31	599.65	38.8

* In 1973 *cruzeiros*. Deflator utilized: Cost of living index for Rio de Janeiro, base 1965-67 = 100

Table 6

Segmented Human Capital Eearnings Function Regressions Within the Sectors

(1) 1969 Dependent Variable: log W

Sectors	Independent Variables						Constant	$\bar{R}^2$
	S	t_1	t_1^2	t_2	t_2^2	$t_1 t_2$		
Sector 1	0.1437 (93.20)	0.1025 (38.98)	−0.0015 (−21.50)	0.0477 (23.75)	−0.0009 (−22.25)	−0.0015 (−15.00)	−1.039	0.5553
Sector 2	0.1150 (122.34)	0.0663 (40.16)	−0.0010 (−19.80)	0.0345 (31.94)	−0.0006 (−29.50)	−0.0011 (−18.17)	−0.9102	0.3524
Sector 3	0.1005 (67.89)	0.0296 (12.64)	−0.0005 (−6.71)	0.0242 (18.50)	−0.0004 (12.38)	−0.0008 (−11.00)	−0.7814	0.2315

(2) 1973

Sectors	Independent Variables						Constant	$\bar{R}^2$
	S	t_1	t_1^2	t_2	t_2^2	$t_1 t_2$		
Sector 1	0.1553 (89.03)	0.0079 (30.81)	−0.0016 (−15.83)	0.0411 (17.85)	−0.0009 (−15.60)	−0.0015 (−11.30)	−0.1017	0.5569
Sector 2	0.1264 (118.17)	0.0714 (34.15)	−0.0012 (−17.45)	0.0268 (20.87)	−0.0005 (−18.30)	−0.0011 (−13.04)	0.0287	0.3666
Sector 3	0.1170 (72.79)	0.0275 (9.75)	−0.0005 (−5.30)	0.0166 (10.42)	−0.0003 (−8.16)	−0.0008 (−7.00)	0.1660	0.2612

In the two years considered, 1969 and 1973, the proportion of the observed variance of wages explained by the independent variables is also larger in the modern subsectors. In 1973, the portion explained in sector 1 was 55.7% as compared to 36.7% in sector 2 and only 26.1% in sector 3.

Therefore, the results obtained in this analysis support the hypothesis that in a more dynamic and complex economic environment, investments in human capital, and especially in formal education, become essential for the determination of productivity of individuals and, consequently, of their earnings in the market.

5 — Inequality and opportunities for social mobility

The acceleration of economic growth tends to accentuate inequality in the distribution of wages by benefitting the more highly skilled individuals. Indeed, this is confirmed in the period in question, with the logarithmic variance of hourly wages rising by approximately 27%. For various reasons, from the normative point of view and for a given level of income, more equality is doubtlessly preferable to less equality. Nevertheless, the negative implications in terms of social welfare of an increase of the inequality of relative incomes in a context of economic growth are very questionable.

Logarithmic variance, as well as other conventional measures of inequality, are inappropriate as a base for inferences with respect to variations in the level of welfare of the society in a growing economy. The fundamental reason is that, being static, they are unable of detecting the mobility of individuals at the various income levels, one of the principal effects of the process of economic development. Thus, the use of these measures does not provide an answer to an essential question regarding the problems of inequality and poverty, with respect to the trend in the income or wealth of people over a lifetime.

Given the lack of a cross-section sample, we are limited to an analysis of the increase in disparity of urban labor force wages between 1969 and 1973.

We shall first analyze the behavior of real wages over this period. As has already been observed (table 4), the earnings of employees in the urban sector (disaggregated by educational levels) increased considerably, although the rates rose with the level of schooling. Table 8 further shows that the group most benefitted by the increases in real income (those with a university education) is precisely that in which wages are most unevenly distributed. Such a finding is important insofar as it casts doubts on the interpretation

Table 7

Marginal Contribution of Each Variable Within the Sectors

(1)   1969

Variables	Sector 1	Sector 2	Sector 3
S	0.3320	0.2830	0.2199
l_1	0.0590	0.0305	0.0078
l_1^2	0.0193	0.0077	0.0026
l_2	0.0229	0.0218	0.0164
l_2^2	0.0168	0.0135	0.0102
$l_1 l_2$	0.0107	0.0071	0.0060
$\sum (R^2 - R_h^2)$	0.4607	0.3636	0.2629
R^2	0.555	0.352	0.231
$R^2 - \sum (R^2 - R_b^2)$	0.0963	-0.0111	0.0309

(2)   1973

Variables	Sector 1	Sector 2	Sector 3
S	0.3271	0.2860	0.2490
l_1	0.0387	0.0238	0.0045
l_1^2	0.0102	0.0062	0.0014
l_2	0.0130	0.0089	0.0051
l_2^2	0.0099	0.0069	0.0031
$l_1 l_2$	0.0052	0.0035	0.0027
$\sum (R^2 - R_h^2)$	0.4041	0.3353	0.2658
R^2	0.557	0.366	0.261
$R^2 - \sum (R^2 - R_b^2)$	0.1531	0.0314	-0.0044

of the increases in income inequality in the Brazilian urban sector as a negative factor.

Table 9 outlines average monthly wages, in 1973 cruzeiros, of the urban labor force, disaggregated for the 28 original subsectors of the sample. In addition to the extraordinary increase in real wages between 1969 and 1973, at an annual geometric rate of 9.3%, it is noteworthy that this occurred in all of the subsectors considered. The lowest annual growth rate was in the order of 5.5%, which is still quite significant.

One of the reasons frequently cited as an explanation for the increase of inequality of income in Brazil is the wage policy implemented after 1964. Nevertheless, the data of table 10 suggest that the minimum wage was of litte importance as a parameter of employees' wages under the Consolidated Labor Law System (CLT). In 1969, 75.6% of the workers in our sample received earnings greater than the highest minimum wage in effect in the country, a proportion which rose in 1973 to 83.6%. This becomes still more significant if we observe that during the period to which the comparison relates (April 1969 to April 1973) there was an increase in real terms of the highest minimum wage in the order of 4.3%. Furthermore, in disaggregated terms, it can be verified from table 10 that the increase of the proportion considered occurred in all subsectors, even in those in which the services of low-skilled labor are employed in a more intensive form, as is the case of the wood (from 48.1% to 56.5%) and leather goods (from 48% to 56.4%) industries.

Table 8

Inequality of Hourly Wages by Level of Schooling (1973)

Level	Logarithmic Variance*
Illiterate/Incomplete Elementary	0.293
Complete Elementary	0.386
Junior High School	0.671
High School	0.735
University	0.773

*The emphasis of this article on logarithmic variance does not mean that we consider it superior to other conventional measures of inequality. Its utilization is due to the fact that it can be related theoretically to the distributions of investments in human capital. The model developed in this way was estimated for the Brazilian urban sector, explaining a considerable portion of the differences of inequality of wages between the subsectors. See Castello Branco (1977).

Table 9

Average Monthly Wages of the Urban Labor Force (in 1973 Cruzeiros) *

Subsectors	1969	1973	(Geometric) rate of annual growth
Lumbering and Mining	372.40	504.90	7.9
Mining	521.90	646.70	5.5
Focd Products	403.30	565.70	8.8
Beverages	444.80	703.70	12.1
Tobacco	777.60	1.173.90	10.S
Textiles	527.00	785.50	10.4
Footwear and Clothing	373.20	598.30	12.5
Wood	329.20	408.40	5.5
Furniture	380.90	499.20	7.0
Paper	482.90	763.50	12.1
Printing	555.30	876.90	12.1
Leather goods	334.60	454.10	7.9
Rubber	487.70	747.0C	11.3
Chemicals	819.20	1.260.50	11.4
Petroleum	1.515.60	2.053.90	7.9
Plastics	509.7C	866.20	14.2
Non-metallic Minerals	415.C0	611.60	10.2
Metals	618.30	946.20	11.2
Mechanical Equipment	675.00	965.90	9.4
Vehicles	704.10	1.180.20	13.8
Civil Construction	441.70	608.20	8.3
Electric Energy	735.20	1.133.40	11.4
Commerce	597.90	763.10	6.3
Financial Institutions	1.139.10	1.777.80	11.8
Transportation	544.90	704.90	6.7
Communications	731.80	1.012.80	8.5
Education and Health	712.60	1.049.80	10.2
Urban Sector	597.10	851.20	9.3

* The deflator utilized was the cost of living index for Rio de Janeiro, base 1965—67 = 100

The analysis of the trend in real wages by educational levels and branches of economic activity suggests that their increase was generalized, though characterized by differentiated rates. Consequently, the scenario presented is quite distinct in terms of wellbeing from that in which the increase of inequality was accompanied by the absolute losses of real income of certain segments of the labor force.

On the other hand, the decrease of the relative importance of the minimum wage as an indicator of wages in the urban labor market, combined with the returns to experience, suggests that economic growth created conditions for a sharper rise in wages throughout the income profile. Thus, even individuals who, due to their low level of skill, enter the labor force at low wage levels, can rapidly surpass the class boundary which the minimum wage represents through investments in human capital.

Finally, the analysis of the characteristics of the individuals who entered the labor market during the economic boom phase provides additional persuasive evidence on the simultaneous increases in inequality and social mobility.

In an economy which grows slowly, the jobs occupied by new laborers naturally tend to reflect the pre-existing structure. In contrast, in a considerably dynamic economy (reflecting transformations in the organizational and occupational structure) the new jobs created require larger investments in human capital and, in compensation, offer more significant rewards to highly skilled labor.

Indeed, those who began in the urban sector in 1969 possessed higher levels of schooling than the other employees, which suggests that they were better prepared to confront the greater complexity of a modern economy. [34] The new laborers, who represented approximately 13% of the sample for 1973, received in that year monthly wages higher than those who had entred the formal labor market prior to 1969 (Cr$ 926,15 as compared to Cr$ 840,00 in 1973 prices).

Another aspect to be emphasized concerns the distribution of earnings of these new members of the labor force. Their relative wages show approximately 17% more inequality than that recorded for other labores in the sample. It is certain, therefore, that this worsened the income distribution in 1973, although it is clear that no negative connotation can be attributed to this fact.

[34] 7.5 years of schooling as compared to 5.2 years for senior workers.

Table 10

*Proportion of the Urban Labor Force Receiving Wages Above the
Highest Minimum Wage in Effect in the Country**

(in %)

Subsectors	1969	1973
Lumbering and Mining	55.9	62.6
Mining	64.8	68.4
Food Products	67.2	79.0
Beverages	64.9	72.0
Tobacco	76.8	90.7
Textiles	80.0	89.1
Footwear and Clothing	54.7	74.8
Wood	48.1	56.5
Furniture	60.0	69.7
Paper	65.8	75.6
Printing	77.6	86.7
Leather goods	48.0	56.4
Rubber	65.4	77.3
Chemicals	83.6	89.4
Petroleum	96.5	97.6
Plastics	82.3	84.6
Non-Metallic Minerals	57.8	72.8
Metals	88.7	93.6
Mechanical Equipment	85.2	93.4
Vehicles	82.4	90.2
Civil construction	76.1	87.8
Electric Energy	91.0	95.2
Commerce	78.2	82.0
Financial Institutions	97.7	98.8
Transportation	81.9	87.7
Communications	74.2	82.9
Education and Health	89.6	96.6
Urban Sector	75.6	83.6

*   The values of highest minimum wage in effect in the country in April 1969 and 1973, when the
research of the Law of the 2/3 was conducted, which generated the data of this study were, respec-
tively, Cr$ 257,80 and Cr$ 268,80, in April 1973 cruzeiros. The deflator utilized was the cost of living
index for Rio de Janeiro, base 1965—67 = 100.

As a result of the benefits offered by the greater dynamism of the labor market, the average rate of return to investments in formal education, estimated for this group through equation (10), is 19.6% higher than the value obtained for the total labor force (15.1%) for 1973. [85]

$$log \ W = -1.5908 + 0.1960 \ S + 0.0932 \ t + -0.0010 \ t^2$$
$$(40.05) \qquad (2.48) \qquad (-0.73)$$

$$R^2 = 0.348$$

6 — Summary and conclusions

The central hypothesis presented in this paper was that the increase in earnings inequality is closely connected with the disequilibria associated with the process of economic development. The results of the analysis of the behavior of the urban labor market in Brazil during the phase of accelerated economic growth between 1969 and 1973 provided wide support of its validity.

The variables associated with investments in human capital explain considerable portions of the observed variance of individual earnings of employees under Consolidated Labor Laws System. The importance of these variables was greater still in the more dynamic sectors of the economy, in which the complexity of the tasks to be carried out requires higher degrees of professional qualification.

Real wages increased extraordinarily during this four-year period. As was expected, the more highly skilled individuals benefitted disproportionately from these gains in real income. Nevertheless, empirical evidence suggests that the increase in wages was widely spread among the members of the labor force.

Results obtained through the analysis of the earnings of the individuals who entered the formal labor market of the urban sector during the period under consideration indicate that growth of the economy contributed to create an extensive range of opportunities for social mobility.

At the same time, given the empirical evidence provided by the analysis conducted, one cannot accept the interpretation that the increase of inequality of wages of urban laborers, observed for the period 1969 to 1973, contains negative implications for the well-being of society.

[85] Estimated for a similar earnings function. In this regard, see . Castello Branco (1977).

Table A 1

Segmented Human Capital Earnings Function Regressions Within the Subsectors (1969)[a]

Dependent Variable $= \log W$

Subsectors	Independent Variables							
	S	t_1	t_1^2	t_2	t_2^2	$t_1 t_2$	cte	$\overline{R^2}$
Lumbering and Mining	0,1089 (17,35)	0,0533 (5,16)	—0,0009 (— 3,00)	0,0168 (2,80)	—0,0002 (—1,50)*	—0,0009 (—2,87)	—0,0159	0,314
Mining	0,1402 (25,53)	0,1104 (13,39)	—0,0027 (—10,50)	0,0162 (3,00)	—0,0003 (—2,70)	—0,0014 (—5,11)	—0,0737	0,418
Food Products	0,1082 (35,35)	0,0391 (9,49)	—0,0007 (— 6,27)	0,0196 (6,77)	—0,0003 (—5,00)	—0,0008 (—6,25)	—0,8364	0,311
Beverages	0,1075 (19,13)	0,0431 (4,79)	—0,0006 (— 2,46)	0,0248 (4,30)	—0,0005 (—4,64)	0,0001 (—0,11)*	—0,8695	0,312
Tobacco	0,1460 (12,17)	0,0705 (5,16)	—0,0010 (— 2,71)	0,0653 (4,11)	—0,0016 (—4,46)	—0,0018 (—2,83)	—1,1373	0,478
Textiles	0,1241 (24,33)	0,0165 (8,54)	—0,0008 (— 5,27)	0,0256 (5,52)	—0,0004 (—3,60)	—0,0009 (—4,35)	—0,8270	0,256
Footwear	0,0898 (16,57)	0,0302 (4,32)	—0,0005 (— 2,50)	0,0161 (3,33)	— 0,0002 (—2,20)	—0,0007 (—2,30)	—0,8473	0,180
Wood	0,0873 (20,08)	0,0263 (3,88)	—0,0004 (— 2,10)	0,0116 (3,25)	—0,0002 (—2,14)	—0,0003 (—1,65)*	—0,7814	0,204
Furniture	0,0860 (14,43)	0,0485 (5,74)	—0,0008 (— 2,80)	0,0302 (6,26)	—0,0004 (—1,10)	— 0,0011 (—4,60)	—0,9280	0,177
Paper	0,1394 (23,86)	0,0690 (7,77)	—0,0013 (— 4,41)	0,0376 (6,24)	—0,0006 (— 4,60)	—0,0012 (—3,84)	—1,1571	0,413
Printing	0,0586 (8,56)	0,0596 (6,42)	—0,0008 (— 3,00)	0,0535 (6,72)	—0,0009 (— 7,00)	—0,0013 (— 2,88)	—0,7667	0,153
Leather Goods	0,0970 (10,24)	0,0136 (2,05)	—0,0001 (0,47)*	0,0181 (3,44)	—0,0003 (— 2,80)	—0,0003 (—1,62)*	—0,8822	0,307
Rubber	0,0999 (17,05)	0,0922 (8,31)	—0,0019 (— 5,51)	0,0246 (3,88)	—0,0004 (— 3,00)	—0,0013 (—3,69)	—0,8038	0,306
Chemicals	0,1605 (34,37)	0,0764 (8,09)	~ 0,0013 (— 4,37)	0,0496 (8,00)	—0,0009 (— 7,38)	—0,0012 (—3,19)	—1,1292	0,494
Petroleum	0,1251 (16,02)	0,1282 (8,45)	—0,0031 (— 4,74)	0,0335 (—3,00)	—0,0008 (— 3,24)	—0,0002 (—0,30)*	—0,6358	0,616
Plastics	0,1187 (16,60)	0,0965 (5,57)	—0,0025 (— 3,92)	0,0357 (4,40)	—0,0005 (— 2,63)	—0,0016 (—2,49)	—0,9055	0,353
Non-Metallic Minerals	0,1267 (31,52)	0,0478 (7,06)	—0,0009 (— 4,33)	0,0213 (5,80)	—0,0004 (— 5,29)	—0,0009 (—4,50)	— 0,8894	0,330
Metals	0,1041 (26,33)	0,0654 (10,99)	—0,0011 (— 6,17)	0,0233 (5,00)	—0,0002 (— 1,82)*	—0,0007 (3,65)	—0,6329	0,408
Mechanical Equipment	0,1363 (55,18)	0,0833 (19,24)	—0,0015 (—10,64)	0,0463 (18,10)	—0,0008 (—15,60)	—0,0016 (—9,87)	—0,9770	0,373
Vehicles	0,1193 (24,14)	0,1023 (12,26)	—0,0023 (— 7,35)	0,0512 (10,12)	—0,0010 (— 9,00)	—0,0010 (—5,68)	—0,8487	0,245
Civil Construction	0,1093 (49,89)	0,0832 (13,68)	—0,0020 (8,05)	0,2060 (13,63)	—0,0004 (—10,25)	—0,0013 (—7,33)	—0,7502	0,299

109

Subsectors	Independent Variables							
	S	t_1	t_1^2	t_2	t_2^2	$t_1 t_2$	cte	R^2
Electric Energy	0,1311 (28,37)	0,0621 (8,85)	—0,0007 (— 3,40)	0,0329 (5,20)	—0,0007 (— 4,67)	—0,0007 (—2,34)	—0,8244	0,600
Commerce	0,1233 (55,26)	0,0653 (17,28)	—0,0008 (— 7,30)	0,0392 (17,10)	—0,0007 (—13,40)	—0,0012 (—0,67)	—1,0433	0,340
Financial Institu- tions	0,0948 (36,17)	0,1116 (32,73)	—0,0017 (—17,30)	0,0497 (16,41)	—0,0008 (—11,71)	—0,0015 (—9,07)	—0,5469	0,506
Transportation	0,1011 (44,72)	0,0805 (25,80)	—0,0012 (—13,67)	0,0264 (11,77)	—0,0004 (— 9,50)	—0,0010 (—9,09)	—0,8393	0,306
Communications	0,1025 (28,09)	0,0680 (10,83)	—0,0006 (— 3,20)	0,0492 (11,18)	—0,0009 (— 9,44)	—0,0018 (—6,63)	—1,0322	0,276
Education and Health	0,1264 (42,13)	0,0296 (3,55)	—0,0005 (— 2,21)	0,0155 (3,32)	—0,0003 (— 2,50)	—0,0006 (—2,00)	—0,8058	0,521
Miscellaneous	0,1361 (85,04)	0,0631 (20,28)	—0,0009 (— 0,78)	0,2849 (14,10)	—0,0005 (—12,25)	—0,0008 (—8,20)	—1,0466	0,483

*Statistic t in parenthesis.
Not significant at the 5% level.

Table A 2

Segmented Human Capital Earnings Function Regressions Within the Subsectors (1973)[a]

Dependent Variable $=$ log W

Subsectors	Independent Variables							
	S	t_1	t_1^2	t_2	t_2^2	$t_1 t_2$	cte	$\bar{R}^2$
Lumbering and Mining	0,1252 (19,65)	0,0299 (2,79)	—0,0002 (0,73)*	0,0286 (4,23)	—0,0005 (—3,36)	—0,0010 (—2,48)	—0,1400	0,3441
Mining	0,1395 (24,90)	0,0782 (8,29)	—0,0016 (—5,26)	0,0046 (0,68)*	—0,0002 (—1,13)*	—0,0007 (—2,15)	0,0481	0,4401
Food Products	0,1300 (38,11)	0,0540 (10,44)	—0,0012 (—7,63)	0,0183 (5,21)	—0,0003 (—3,25)	—0,0010 (—5,61)	— 0,0362	0,3448
Beverages	0,1478 (21,03)	0,0652 (5,59)	—0,0012 (—3,25)	0,0039 (0,54)*	—0,0001 (—0,60)*	—0,0006 (—1,24)*	—0,0378	0,4315
Tobacco	0,1416 (10,41)	0,0817 (4,45)	—0,0011 (—2,15)	0,0152 (0,95)*	—0,0004 (—0,02)*	—0,0018 (—2,63)	0,1118	0,4784
Textiles	0,1404 (27,80)	0,0629 (7,26)	—0,0014 (—6,81)	0,0257 (4,71)	—0,0005 (3,54)	—0,0014 (—4,76)	0,0409	0,3453
Footwear	0,1051 (13,05)	0,0521 (4,23)	—0,0010 (—2,50)	0,0102 (2,06)	—0,0001 (0,31)*	—0,0010 (—2,00)	0,0582	0,1804

Subsectors	Independent Variables							
	S	t_1	t_1^2	t_2	t_2^2	$t_1 t_2$	cte	$\bar{R}^2$
Wood	0,0058 (20,52)	0,0281 (3,20)	—0,0002 (—0,71)*	0,0093 (2,16)	—0,0001 (—1,34)*	—0,0007 (—2,23)	0,0524	0,2345
Furniture	0,1086 (16,12)	0,0267 (2,86)	—0,0001 (—0,45)*	0,0224 (3,85)	—0,0004 (—2,77)	—0,0005 (—1,69)*	—0,0044	0,1800
Paper	0,1570 (23,51)	0,0853 (6,58)	—0,0020 (—4,74)	0,0336 (3,89)	—0,0006 (—2,75)	—0,0017 (—3,28)	—0,2494	0,4163
Printing	0,0053 (11,57)	0,0551 (3,74)	—0,0005 (—1,02)*	0,0198 (5,95)	—0,0009 (—4,79)	—0,0014 (—2,53)	0,0877	0,1480
Leather Goods	0,1337 (20,26)	0,0387 (3,92)	—0,0009 (—2,83)	0,0168 (2,28)	—0,0002 (—1,13)*	—0,0009 (—2,53)	—0,1927	0,4133
Rubber	0,1193 (16,48)	0,1299 (9,17)	—0,0027 (—5,51)	0,0327 (4,21)	—0,0005 (—3,38)	—0,0020 (—3,11)	—0,1822	0,3618
Chemicals	0,1687 (35,15)	0,1049 (9,92)	—0,0022 (—5,53)	0,0371 (5,97)	—0,0007 (—4,79)	—0,0016 (—3,70)	—0,2079	0,5174
Petroleum	0,1160 (14,58)	0,1024 (7,83)	—0,0017 (—3,37)	0,0007 (0,06)*	—0,0001 (—0,30)*	0,0002 (0,31)*	0,4860	0,5669
Plastics	0,1529 (18,46)	0,0876 (4,56)	—0,0009 (—1,31)*	0,0414 (4,25)	—0,0008 (—3,57)	—0,0012 (—1,55)*	—0,2653	0,4053
Non–Metallic Minerals	0,1476 (29,87)	0,0613 (6,88)	—0,0012 (—4,37)	0,0206 (3,94)	—0,0004 (—2,58)	—0,0007 (—2,00)	—0,0872	0,3920
Metals	0,1120 (27,19)	0,0770 (10,76)	—0,0017 (—7,00)	0,0273 (5,46)	—0,0034 (—8,97)	—0,0010 (—3,23)	0,3052	0,3301
Mechanical Equipment	0,1380 (45,54)	0,0973 (17,62)	—0,0022 (—10,75)	0,0343 (10,75)	—0,0007 (—10,14)	—0,0014 (—5,63)	0,0695	0,3650
Vehicles	0,1440 (28,09)	0,1414 (13,50)	—0,0040 (— 9,78)	0,0534 (9,55)	—0,0011 (— 9,60)	—0,0029 (—5,84)	0,0244	0,3130
Civil Construction	0,1201 (53,59)	0,0652 (11,15)	—0,0017 (— 7,39)	0,0129 (5,88)	—0,0003 (— 5,00)	—0,0008 (—3,67)	0,2958	0,3102
Electric Energy	0,1469 (29,39)	0,0875 (10,93)	—0,0013 (— 5,04)	0,0206 (2,95)	—0,0001 (— 0,00)*	—0,0008 (—2,26)	—0,0732	0,5941
Commerce	0,1376 (53,98)	0,0630 (13,67)	—0,0008 (— 4,88)	0,0301 (11,30)	—0,0006 (— 9,33)	—0,0012 (—6,16)	—0,1704	0,3563
Financial Institutions	0,1134 (34,17)	0,0952 (21,30)	—0,0013 (— 9,57)	0,0403 (11,25)	—0,0008 (— 8,89)	—0,0008 (—3,95)	0,3706	0,4481
Transportation	0,1082 (42,43)	0,0732 (18,54)	—0,0011 (— 8,15)	0,0205 (7,84)	—0,0003 (— 5,17)	—0,0009 (—5,06)	0,1002	0,3873
Communications	0,1218 (28,66)	0,0497 (6,26)	—0,0003 (— 1,04)*	0,0297 (6,21)	—0,0006 (— 5,00)	—0,0016 (—5,06)	0,0063	0,2848
Education and Health	0,1323 (39,15)	0,0432 (4,88)	—0,0007 (— 2,13)	0,0154 (3,04)	—0,0003 (— 2,17)	—0,0007 (—2,00)	0,1177	0,4734
Miscellaneous	0,1525 (92,44)	0,0663 (17,96)	—0,0009 (— 6,83)	0,0209 (9,83)	—0,0003 (— 6,40)	—0,0012 (—8,20)	—0,2011	0,5225

[a]Statistic t in parentheses.
*Not statistically different form zero at the 5% level.

Table A 3

Indicators of Growth and Technological Progress*

	Average Growth Rate (1966/72) in %	Technology Index**
Sector 1	13,0	1 078
Sector 2	11,3	874
Sector 3	8,8	598

*Includes only urban manufacturing industry subsectors.
**Index of purchases of new machinery and equipment from foreign sources during the period 1966/72 (base: 1966). For further details, see Castello Branco (1977).

On the other hand, bearing in mind that this phenomenon resulted from the disharmony between the rapid expansion of demand for skilled labor and the slow reaction of supply, it can be regarded as a transitory phenomenon.

Nevertheless, the period of time needed for the adjustment of the labor market and, consequently, for significant improvements in wage distribution to be manifested, cannot be anticipated.

Incentives to the increase in the flows of investments in human capital caused an increase in their expected rate of returns. This increased expectation, in turn, contributed to the correction of the existing disequilibria over time. In compensation, it should be acknowledged that, in contrast to the magnitude of these flows, the size of the stock of human capital in Brazil in relation to the requirements of modern technology and its continual changes is small.

Furthermore, other factors such as the still relatively high rates of demographic expansion, inter-regional disparities and disparities in technological diffusion among the economic sectors reinforce the forecast that additional income inequalities will continue to accompany the process of economic growth for a reasonably long time to come.

In this context, aspects concerning governmental intervention in economic affairs take on great importance. It becomes imperative that such intervention be limited only to those cases where it is strictly necessary. In other words, the objective of economic policy

112

should be to gradually eliminate distortions in the relative factors of production and to contribute positively to increase the oportunities of access to education and to other investments in human capital for the poorest segments of society.

References

Arrow, K. "Higher education as a filter". *Journal of Public Economics, 2*:193-216, July 1973.

Becker, G. *Human Capital.* 2 ed. New York, Columbia University Press, 1975.

Ben-Porath, Y. "The production of human capital and the life cycle of earnings". *Journal of Political Economy, 75*:352-65, Part I, Aug. 1967.

———. "The production of human capital over time". In: Hansen, W. L., ed. *Education, income and human capital.* New York, Columbia University Press, 1970. p. 129-47.

Bowles, S. "Schooling and inequality from generation to generation". *Journal of Political Economy, 80*:S 219-51. May/June 1972.

Cain, G. "The challenge of segmented labor market theories to orthodox theory: a survey. *Journal of Economic Literature, 14*:1.215-57. Dec. 1976.

Castello Branco, R. "Crescimento acelerado e o mercado de trabalho: a experiência brasileira". Tese doutoral não publicada apresen. tala à EPGE-FGV, 1977.

Chiswick, B. *Income inequality.* New York, Columbia University Press, 1974.

Fallon, P. & Layard, P. "Capital-skill complementarity, income distribution and output accounting". *Journal of Political Economy, 83*:279-301, June 1975.

Griliches, Z. "Wages of very young men". *Journal of Political Economy, 84*:S 69-86, Aug. 1976.

———. & Mason, W. "Education, income and ability". *Journal of Political Economy, 80*:S 74-103, May/June 1972.

Haley, W. "Human capital: the choice between investment and income". *American Economic Review, 63*:929-45, Dec. 1973.

Hause, J. "Earnings profile: ability and schooling". *Journal of Political Economy, 80*:S 108-38. May/June 1972.

Huffman, W. "Decision making: the role of education". *American Journal of Agricultural Economists, 61*:85-97, Feb. 1974.

Jencks, C. *Inequality: a reassesment of the effect of family and schooling in America*. New York, Basic Books, 1972.

Klevmarken, A. & Quigley, J. "Age, experience, earnings and investments in human capital". *Journal of Political Economy, 84*:47-72, Feb. 1976.

Kogut, E. *Análise económica do fenómeno demográfico no Brasil*. Rio de Janeiro, Fundação Getulio Vargas, 1976.

Kuznets, S. *Modern Economic Growth*. New Hawen, Conn., Yale University Press, 1966.

Langoni, C. *Distribuição da renda e desenvolvimento económico do Brasil*. Rio de Janeiro, Expressão e Cultura, 1973.

———. *As causas do crescimento económico do Brasil*. Rio de Janeiro. APEC, 1974.

———. *A economia da transformação*. Rio de Janeiro, José Olympio, 1975.

Layard, R. & Psacharopoulos, G. The screening hypothesis and the returns to Education. *Journal of Political Economy, 82*:985-98, Oct. 1974.

Lazear, E. "Age, experience and wage growth". *American Economic Review, 66*:548-58, Sept. 1976.

Leibowitz, A. "Home investments in children". In: Schultz, T. W. ed. *Economic of the family*. Chicago, The University of Chicago Press. p. 432-52.

——. "Years and intensity of schooling investment". *American Economic Review, 66*:321-34, June 1976.

Mincer, J. On-the-job training: costs, returns and some implications. *Journal of Political Economy, 70*:50-79, Oct. 1962.

———. *Schooling, experience and earnings*. New York, Columbia University Press, 1974.

———. & Polachek, S. Family investments in human capital: earnings of women. *Journal of Political Economy, 82*:S 76-108, Mar./Apr. 1974.

114

Morley, S. & Williamson, J. Growth, Wage policy and inequality: Brazil during the sixties. Madison, University of Wisconsin, July 1975 (SSRI Workshop Series) .

Rosen, S. & Thaler, R. The value of saving a life: Evidence from the labor market. In: Terleckyj, N., ed. *House-hold production and consumption*, New York, Columbia University Press, 1975. p. 265-98.

Santos, F. Crescimento econômico e a demanda derivada por mão-de-obra no Brasil. *Revista Brasileira de Economia, 30*:475-500, out./dez. 1976.

Schultz, T. W. *Transforming traditional agriculture*. New Haven, Conn., Yale University Press, 1964.

———. "The value of ability to deal with disequilibria". *Journal of Economic Literature, 13*:827-46, Sept. 1975.

Senna, J. J. Schooling, job experience and earnings in Brazil. Tese doutoral não publicada apresentada a The Johns Hopkins University, 1975.

Spence, M. Job market signalling. *Quarterly Journal of Economics, 87*:355-74, Aug. 1973.

Taubman, P. *Sources of inequality in earnings*. Amsterdam, North-Holland, 1975.

———. & Wales, T. Education as an investment and a screening device. In: Juster, F., ed. *Education, income and human behavior*, New York, McGraw-Hill, 1975. p. 95-122.

Theil, H. *Principles of econometrics*. New York, John Wiley & Sons, 1971.

Tinbergen, J. *Income distribution*. Amsterdam, North-Holland, 1975.

Welch, F. Education in production. *Journal of Political Economy, 78*:35-59, Jan./Feb. 1970.

Functional distribution of income in the manufacturing sector: aspects of labor's share in the short-run *

Roberto B. M. Macedo **

1 — Introduction

This paper analyses the behavior of labor's share (or the share of salaries and wages) in the distribution of income generated by the Brazilian manufacturing sector. It is divided into two sections; the first deals briefly with theoretical aspects and the second presents an empirical analysis based on data from the Brazilian sector, focusing on the period 1966-1975.

2 — Theoretical aspects

2.1 — Labor as a variable factor

At the theoretical level, one can speculate about the behavior of labor's share in the short-run, based on two different models: the neo-classical model and the Kalecki model. [1] It is assumed initially that:

    a) labor is the variable factor;

    b) in the short-run, the firm's production plant is fixed;

    c) nominal wages are fixed;

    d) in a competitive market situation, the firm adjusts its production to variations in the price of the product.

[1] This paper focuses the problem from a microeconomic point of view.

. . Given these assumptions, the behavior of labor's share in the above-mentioned models can be analyzed using diagrams 1.1 and 1.2, which correspond to the neo-classical and the Kalecki models respectively. In these diagrams, AVC is the average variable cost, MC is the marginal cost and Q represents the quantity produced. In diagram 1.2, q_M is the point of maximum utilization of capacity.

Under perfect competition (typical of the neo-classical model), the firm will seek to produce at the point where price equals marginal cost. Labor's share will then depend on the average variable cost/marginal cost relation. Diagram 1.1 indicates that between points q_0 and q_1 the average variable cost decreases while marginal cost rises, thus, between points q_0 and q_1 the behavior of labor's share will vary inversely with the volume of production. If, during the economic cycle each firms production level varies within these limits, the behavior of labor's share within the industry as a whole will be (excepting problems of aggregation) anticyclical. That is, labor's share increase during periods of contraction of economic activity and decreases during periods of expansion. [2] After q_1, it can be shown that, if the production function is of the *CES* type (constant elasticity of substitution), labor's share will continue to be anti-cyclical in behavior if the elasticity of substitution is less than unity. [3] During the expansion ary phase, for example, the corresponding decrease in real wages should lead to a reduction in the value of labor's share, if the elasticity of substitution is less than unity.

In the Kalecki model, marginal cost equals average variable cost and the behavior of labor's share in income will depend on the firm's "degree of monopoly", with which it will vary inversely. It would be interesting, however, to determine the factors which explain short-run variations in the degree of monopoly. Kalecki himself cites several studies on this subject, specifically those by Harrod (1935) and Joan Robinson (1936). [4] According to Harrod, the degree of monopoly is cyclical, increasing during phase of expansion and declining during recession, because consumers are more cautious during recessions, seeking more information with respect to market prices. Thus, the market functions more efficiently, causing the degree of monopoly to decline during depressions. It

[2] Strictly speaking, between q_0 and q_1 the firm will suffer a loss or reduction of so-called "normal profits", in which case it is preferable to cease production. Given that it has fixed costs (which will be discussed later), the firm will continue production, so long as variable costs are covered.

[3] For an analysis of various aspects of the CES function, see Henderson and Quandt (1971), pp. 85-88.

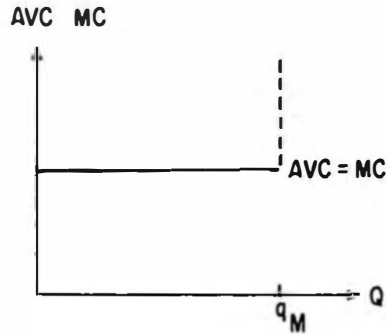[4] Kalecki (1939), p. 183.

118
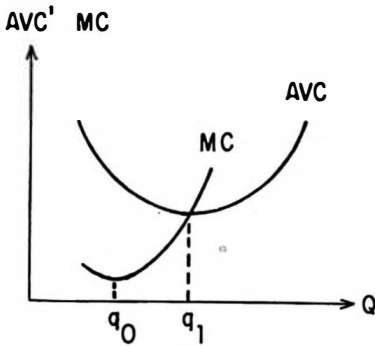
Diagram 1.1   . Diagram 1.2

is interesting to observe that this will also lead to the anticyclical behavior of labor, as is suggested in the neo-classical model. Kalecki, however, does not accept this point of view, preferring Joan Robinson's views, according to which the degree of monopoly increases during recessions, when there exists a greater tendency for the formation of cartels and other types of collusion among entrepreneurs in defense of their prices.

2.2 — Labor as a quasi-fixed factor (or the internal labor market)

As an alternative to assumption (a), let us now assume that: (a.1) labor is a quasi-fixed factor of production.

This less restrictive focus is adopted in the context of various models. In the neo-classical tradition, the contributions of Oi (1962) and Becker (1964) emphasize that a significant share of the labor factor, transcending the level of management and supervision and characterized especially by the level of training, should be considered a fixed cost or, more properly, a quasi-fixed cost. This characteristic of labor cost is also emphasized by those who developed the concept of an "internal labor market" [5] such a market is developed inside the firm, resultant of economic and institutional conditions, its essential characteristic being the stability of the employment relationships. Access to this market is made through ports of entry, which link it to the external labor market. As a rule, this access is limited to the lower level jobs at the bottom of the firm's pro-

[5] For a detailed explanation of the concept of the internal labor market, see Doeringer and Piore (1971).

Diagram 1.3   Diagram 1.4

ATC' AFC   ATC' AFC
AVC MC   AVC' MC
                     MC
          ATC
          AVC

                  ATC
                  AVC = MC

          AFC
                  AFC

q₀ q₁ q₂
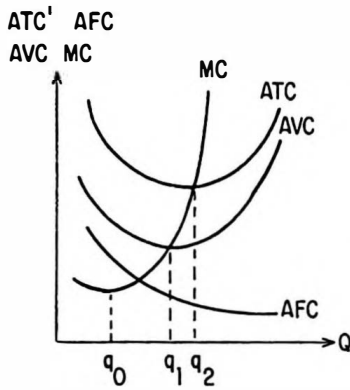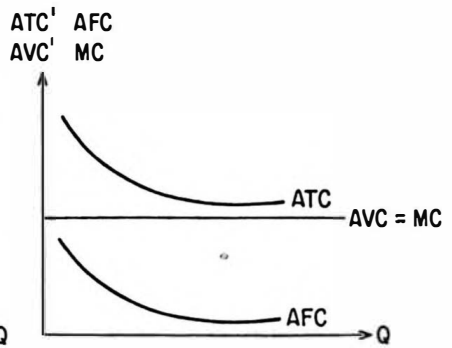
AVC = Average Variable Cost
ATC = Average Total Cost
AFC = Average Fixed Cost
MC = Marginal Cost

motion ladders and the attainment of more stable positions at a
higher level depends on transfer and promotion mechanisms
operating within the firm. The concept of internal market is, in
essence, a more comprehensive way of understanding the stability
of the employment relationship than the strictly economic approach
of Oi and Becker, as mentioned above.

In the Kalecki model, again it would be a simplification to
consider labor merely as a variable cost. In this own words:

"Certain types of wages have the character of "overhead" and,
for that very reason, should decrease less during contractions
and increase less during expansions than wages in general. This
being the case, total real wages should fluctuate less throughout
the cycle than the real income of the private sector as a whole". [a]

Given that part of the labor factor displays fixed cost charac-
teristics, it can be observed in diagrams 1.3 and 1.4, that the
proposition stating that the behavior of labor's share will be anti-
cyclical, is strengthened. These diagrams illustrate the role of fixed
costs in the determination of average total cost, in the neoclassical
and Kalecki models, respectively. The average fixed costs is repre-
sented by *AFC* and average total cost by *ATC*, i.e., the curves

[a] Kalecki (1954), p. 75.

representing *AFC* are explained by the quasi-fixed costs of labor or, more comprehensively, by the functioning of internal labor markets.

In the neo-classical model, the lowest point on the *ATC* curve (which now includes the variable and quasi-fixed costs of labor), that is, q_2, will remain to the right of q_1, increasing, therefore the production range in which labor's share is characteristically anti-cyclical, insofar as the firm adopts the policy of adopting the price equal to marginal cost rule. After q_1, the anti-cyclical behavior of labor's share will continue to depend on the elasticity of substitution being less than unity.

In the Kalecki model, *ATC* will also vary inversely with the quantity produced. If the degree of monopoly is cyclical (*à la* Harrod), the anti-cyclical behavior of labor's share will become more accentuated. If the degree of monopoly is anti-cyclical (*à la* Joan Robinson), the quasi-fixed costs of labor will reduce the magnitude of the cyclical behavior of labor's share and perhaps even transform it into anti-cyclical behavior.

2.3 — The price-wage lag effect

The previously established assumption (*c*), that nominal wages do not vary guaranteed the stability of the cost curves in the analysis developed throughout the two previous subsections. The absolute rigidity of wages is, however, a very strong assumption. In economic literature, nevertheless, it is common to find references to the "lag effect", that is, the proposition that price variations lead wage variations, resulting in the anti-cyclical behavior of labor's share, especially in the case of galloping inflation. [7] In a period of inflation, the proposition is that prices rise before and/or more rapidly than wages, thereby decreasing labor's share in income. During a period of deflation, or at least of a reduction in the rate of inflation, prices would again be affected first, with wages falling less than prices and/or the latter rising less than the former, consequently increasing labor's share. Still, for these propositions to be treated as emerging hypotheses of a theoretical model, it would be necessary to examine the causes of the price-wage lag. It is obviously not expected to encounter this lag in the models which assume accurate inflation forecasts and no delays in the readjustment of contracts between economic agents.

Nevertheless, one cannot reject *a priori* the suggestion that employers and employees form, or are led to form, their expectations

[7] See Burkhead (1953, p. 209), Bach and Ando (1957), p. 1 and Scitovsky (1964), pp. 17-18, as well as various quotes of these authors.

of inflation according to different magnitudes, due to unequal access to information, or to different interpretatioss of the same. Nor can we disregard the performance of the mechanisms which may prevent or delay a rapid readjustment of labor contracts, such as those derived from government policy (e.g., wage policy in Brazil), institutions (e.g., long-term contracts) and other market characteristics (e.g., unequal bargainisg power).

Under these conditions, let us assume, as an alternative to the above assumption (c) that:

(c.1) The price/wage ratio (p/w) fluctuates in the same direction of the cycle, that is, it increases when the level of economic activity expands and declines with the contraction of such activity.

In the neo-classical model, this alternative assumption does not significantly alter the results of the analysis, since the previous assumption led only to a more restricted case. In other words, it was assumed that p/w fluctuated in the direction of the cycle since w was constant. It is now assumed that w can vary without altering the cyclical behavior of p/w. Thus labor's share will continue to display anti-cyclical behavior up to q_s in diagram 1.3 and the same behavior will be observed subsequently if the elasticity of substitution is less than unity.

Given the new assumption (c.1), the anti-cyclical behavior of labor's share in the Kalecki model will continue if the degree of monopoly follows the same direction of the cycle. If the degree of monopoly is anti-cyclical, it is senseless to impose assumption (c.1). This holds because, if, for example, the degree of monopoly increases during recessions, p/w also increases if w is constant.

If w is not constant, but (p/w) increases in the recession due to a rise in the degree of monopoly, labor's share, as a variable cost, will decrease, losing its anti-cyclical nature. Under these circumstances, however, one cannot refer to a "lag effect", as introduced by (c) or (c.1). Thus in the Kalecki model, the anti-cyclical behavior of labor's share can only be a result, in this case, of the quasi-fixed costs of labor.

2.4 — An econometric implication

Labor as a quasi-fixed factor has an econometric implication related to a model which is commonly utilized to obtain estimates of the elasticity of substitution. This model is based on the first order conditions of a problem of profit maximization involving a firm

with a production function of the CES type. The equation used for estimation is as follows:

$$V/L = a\, w^\beta \tag{1.1}$$

where V is the value added, L represents the services of the labor factor, w is the rate of wages and a is constant. Assuming constant returns to scale, constant price of capital and equilibrium in perfect competition, Arrow, Chenery, Minhas and Solow (1961) showed that β in (1.1) can be interpreted as the elasticity of substitution σ.

Substituting σ for β in (1.1), dividing each side by w and inverting, we get:

$$Lw/V = a^{-1}w^{1-}\,\sigma \tag{1.2}$$

Since Lw/V is the labor's share, (1.2) shows how it varies with w. If w increases this share decreases remains constant or increases, depending on whether σ is greater thas 1, equal to 1 or less than 1, respectively. In practice, (1.1) is estimated measuring w by the average wage $(\overline{w})$. Based on time-series data, the results obtained for σ show estimates generally less than 1, as pointed out by Nadiri (1970) and Nerlove (1967).

Note that the variable used in (1.1) and (1.2) are the same. In an empirical study which estimates the parameters of these relations, (1.1) will use the same statistical information needed to estimate (1.2). If (1.1) obtains estimates of σ which are less than 1 in time-series, it is implied that when put in the form of (1.2), the data will show a relation between the labor's share and the average wage, which will take on the profile described in diagram 1.5.

Labor as a quasi-fixed fator differentiates the demand for labor in the economic cycle. Thus, during a period of expansion, the firm hires new employees who are unfamiliar with the company's system of production; the new workers are hired at the entry level at the low end of the wage scale, thus causing the average wage to decrease, "ceteris paribus". During periods of costraction, employees with the least experience will usually be the first to be discharged. Since these employees occupy positions at the lower end of the pay scale, the average wage will increase, "ceteris paribus". Under these conditions, the average wage will also display the same anti-cyclical behavior, typical of labor's share as a result of labor being a quasi-fixed factor.

Note that the "ceteris paribus" condition was emphasized here. This is due to the need to isolate the effect of variables which

can obscure the anti-cyclical behavior of the average wage. Thus, if a period of expansion is of long duration, new employees can advance on the wage scale, while the more senior employees can be promoted. The growth in productivity will allow for the corresponding wage increase. If this takes place is a generalized manner the firms average wage will tend to rise, which will be added to the tendency to decrease resulting from' the hiring of new employees at the lowest levels of the wage scale. [8]

If the anti-cyclical behavior of labor's share also appears in the case of the average wage, the Lw/V and w data will show a relationship such as that in diagram 1.5 and will produce an "elasticity of substitution" less than 1 when equation (1.1) is applied. Note also that, in this case, the results are obtained by a correlation between labor's share and the average wage due to a phenomenon which may or may not occur independently of the validity of the model expressed by equation (1.1). In other words, the result obtained should not necessarily be interpreted as a result of a mechanism in which the relation of capital to labor responds to variations in the wage rate alongside a CES production function and in the context of a situation of profit maximization in perfect competition. As was demonstrated above, it is possible to interpret the result in a different way, based on the quasi-fixed costs of labor or, more generally, on the functioning of the internal labor markets. [9]

Diagram 1.5

---
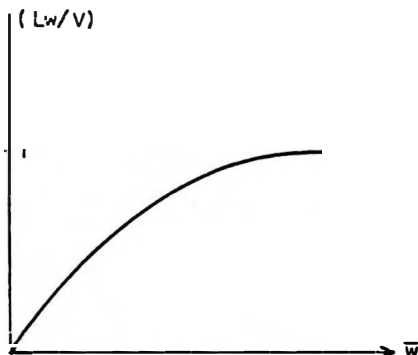
[8] Regarding a method of isolating the two effects, see Macedo (1976), pp. 263-264. This subject will be dealt with again in subsection 3.8.
[9] Under these conditions, an empirical test of the neo-classical model should require independent evidence with respect to the values of elasticity of substitution. By independent evidence we mean, for example, that which would result from a direct estimate of the parameters of a CES production function.

124

Empirical aspects related to the problem discussed in this subsection will be examined is subsection 3.8.

3 — Labor's share in the short-run: an empirical analysis

3.1 — Introduction

As was pointed out in the previous section, the analysis of labor's share in the short-run can be conducted in the context of two models: the neo-classical and the Kalecki models. These models focus on the problem of price formation in different ways, which may lead to various hipotheses regarding labor's share in the short-run. These hypotheses, however, are not necessarily divergent and, therefore, should not be considered capable of allowing the empirical test of either model. A specific study of price formation in the Brazilian manufacturing sector would be necessary for such a test but a study of this type falls beyond the scope of this paper.

Nevertheless, in both the neo-classical and the Kalecki models, it is assumed that the quasi-fixed costs of labor render the behavior of labor's share anti-cyclical. The lag effect also has this result, both in the neo-classical model and in one of the versions of Kalecki's model; that is, the model in which the degree of monopoly is cyclical. Under these conditions, the strategy adopted for the empirical analysis was to analyse the behavior of labor's share in the short-run and, bearing in mind that it was generally characterized as anti-cyclical, we sought to examine the role played by the lag effect and the quasi-fixed labor costs in this behavior. As will be seen later, the presentation of the data to be analyzed made it necessary to also examine the role played by two additional factors: variations in the prices of raw materials and the effect of aggregation.

The empirical analysis to be conducted throughout this section is divided into eight additional subsections. In subsection 3.2 monthly data for the period 1966-1975 are presented, which confirm that labor's share has an anti-cyclical nature. In subsection 3.3 the problem of the aggregation of data is discussed, and in subsection 3.4 the problem of price variations of raw materials is analyzed. Subsection 3.5 deals with the effect of quasi-fixed labor costs, while subsection 3.6 focuses on the price-wage lag. Subsection 3.7 discusses the available annual data. Econometric implications, related to the estimation of the elasticity of substitution between factors, are explored in subsection 3.8. Subsection 3.9 presents several additional considerations and summarizes the conclusions of this paper.

3.2 — Monthly data

The Brazilian Institute of Geography and Statistics (IBGE) collects data on a monthly basis for the manufacturing sector on employment value of production and payroll, aggregated at a two-digit level of classification. This information is obtained on the basis of simple panels determined annually. The basic difficulty in the utilization of data obtained is this manner is determining whether the annual alteration of the sample panels impairs the analysis to be conducted. In other words, it must be known to what extent variations found between years reflect merely an alteration in the sample panels.

Until 1968, the annual panels were quite broad, encompassing the entire country. Thus, for example, the 1968 panel included firms which, in December of that year, had a total of 2,218,278 employees, while the 1970 Census registered 2,634,630 employees. As of 1969, and especially since 1970, the panels have become more limited. The purpose of the monthly survey was to provide the government with information on economic trends; the size of the panel made the collection of data difficult and delayed the presentation of the results. Consequently, the sample panel was significantly reduced and limited to the States of São Paulo, Guanabara, Minas Gerais, Pernambuco and Rio Grande do Sul. [10] In order to obtain as compatible a series as possible, the option of analyzing only surveys from the State of São Paulo for the period 1966-1975 was adopted. Since the largest share of the manufacturing sector is concentrated within this state, the adoption of said criterion at least eliminated the problem of different regional coverage of the sample panels, although the problem of different coverage in terms of firms included in the annual panels still remained.

In order to identify the behavior of labor's share (S), the ratio between the payroll (W) and the value of production (Y), that is, $S = W/Y$, was adopted as its measure. The utilization of this ratio is obviously not the best procedure as a measure of labor's share in value added. Thus, for example, payroll costs include the remuneration of directors and high-level executives, and it is uncertain whether this remuneration is payment to the labor factor or return on capital invested. [11] But not that it is our intention to measure the short-run *variations* of labor's share rather than its absolute value. This eliminates, at least in part, several of the

[10] Thus, in June, 1975, for all states surveyed, the panel included firms having a total of 992,579 employees.

[11] The definition adopted by the IBGE for the variables — number of actively employed personnel, payroll and value of production — appears in the appendix.

126

deficiencies of the measurement, since the factors which encumber analysis of the absolute value of labor's share are present in all of the periods involved in the analysis over time and, although they affect the level of labor's share, they may not necessarily affect the direction of its variations, especially if they constitute a small portion and/or vary in the same direction as labor's share.

The major difficulty of the procedure adopted to measure labor's share arises in the denominator of the ratio which defines said share. This results from the use of the value of production rather than the value added which occurs due to a lack of data on the latter. Although it can be assumed that, in physical terms, the proportion of raw materials in output is fixed in the short run, the same cannot be said about its value. Although we are dealing with monthly observations, the prices of raw materials may hinder the analysis of labor's share, since the value of production can vary as a result of changes in the prices of the raw materials and not necessarily of the value added.

In the absence of an alternative procedure we adopted the assumption that the ratio between the total wages and the value of production reasonably reflects the variations in labor's share. Mention will be made if it is judged that the behavior of other variables (specially raw material prices) may impair our analysis. As will be seen later, the problem of the prices of raw materials acquires particular importance in the analysis of the data for 1973, the year of the so-called "raw material crisis" in Brazil.

In order to provide an overview of the behavior of labor's share during this period, the measurement of this share was initially placed on two graphs, together with the employment level (actively employed personnel) recorded monthly. The placement of the employment level will serve to analyze the behavior of labor's share in employment and production cycles. The two graphs were separated where there was a major modification in the sample panel, as was recorded by the variation in the number of employees in January, relative to the month of December of the previous year. Thus it was recorded that the most important change took place in 1970, from which two graph resulted: one for the period January, 1966/June, 1970 (graph 2.1, below) and the other for the period January, 1970/December, 1975 (graph 2.3, which appears later). [12] With further reference to the first graph, a relatively significant modification in the sample panel was recorded beginning in January, 1969. In order to provide an idea of the magnitude of the modifications of the annual panels, the connection between the points

[12] For the first half of 1970, two sample panels are superimposed, for which reason this semester appears in both charts.

127

of December of each year with those of January of the following year were not made on either graph.

The first graph reveals that, during the period from January, 1966 to June, 1970, the manufacturing sector underwent two periods of contraction: during the second semester of 1966 (which extended until February, 1967) and during the second semester of 1969. Labor's share is characteristically anti-cyclical during these periods of contraction, reaching peak levels in both cases. During periods of expansion, the anti-cyclical nature of labor's share is less clear in graph 2.1. Thus, during the first seven months of 1966, labor's share did decrease with the expansion of employment. However, the period of growth in employment beginning in 1967 generally indicates a decreasing trend. Seasonal variations, with peaks in the months of December and January (probably related to the payment of the 13th monthly wage, end-of-year bonuses and also consistent with seasonal changes in employment) do not offset the decreasing trend of the period, revealed by the position of the peaks, which corresponds, in the opposite direction, to the expansion of employ- ment during the period. In 1969 and 1970, the behavior of labor's share is consistent with the anti-cyclical hypothesis, during periods of growth as well as periods of contraction in employment.

It is clear however that seasonal variations impair the analysis of the two series. For the period covered in graph 2.1, it was impossible to eliminate the seasonal variations with the construction of specific indices for the period, given the fact that the changes which the sampling panels underwent, the reduced number of years of the period and the occurence of cycles undoubtedly led to very unstable coefficients of seasonal variation.

As will be seen later, the period from January, 1971 through July, 1974 was not influenced by these problems, with the exception of small changes in the sample panels. Therefore, it was decided to obtain indices of seasonal variation based on the series of this period which, applied to the data of graph 2.1, resulted in graph 2.2.[13] Therefore the latter shows the series of graph 2.1 with the elimination of seasonal variation. The uncertainties which arise in this procedure are: a) the period 1966-70 may be characterized by patterns of diverse seasonal variation and b) the differences between the sample panels are sources of errors in the calculation and the application of the seasonal variation indices.

However, graph 2.2 confirms that, during periods of contraction in employment, labor's share always increases. Although labor's share accompanies the growth in employment during the first seven
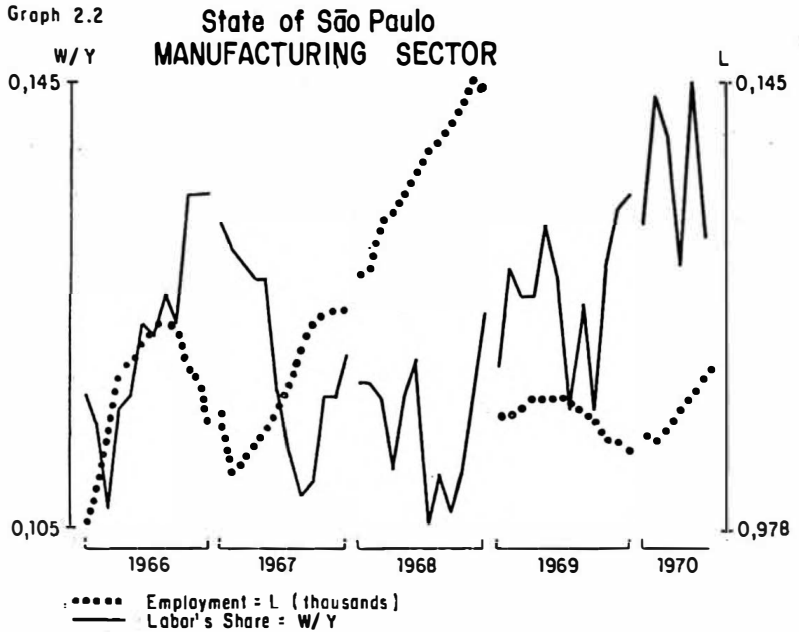
13 The indices were obtained by the ratio to the moving-average method.

State of São Paulo
MANUFACTURING SECTOR

Graph 2.1

••••• Employment = L (thousands)
——— Labor's Share = W/ Y
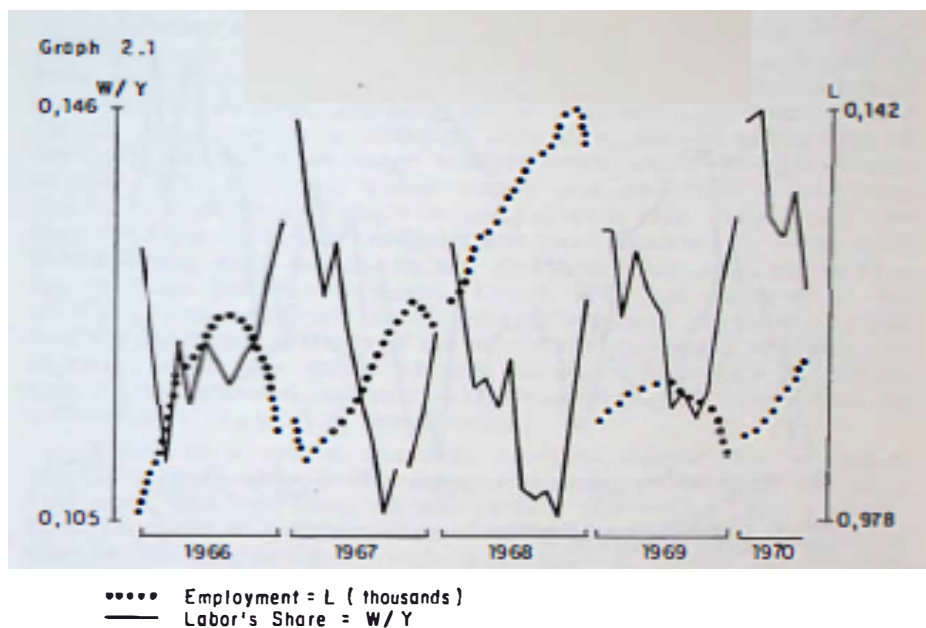
months of 1966, its declining trend, which began in 1967, now
becomes clearer. In 1969 and 1970, the correction of the seasonal
variation rendered the previous pattern unclear. Were there no
doubts regarding the procedure adopted for the correction of the
seasonal variation and if there existed interest in analyzing isolated
periods of the series presented, it would be fitting to study the
causes of the atypical behavior in the first seven months of 1966 and
the first six months of 1969. The significant oscillation in labor's
share during the middle of 1967, which appears both in graphs 2.1
and 2.2, also would merit further attention.

Graph 2.3, which relates to the period 1970-75, corresponds
to a permanent expansion of employment which began in early 1970
and lasted until mid 1974. Since then, a decrease in the level of

129

Graph 2.2   State of São Paulo
W/Y   MANUFACTURING SECTOR

•••••• Employment = L (thousands)
———— Labor's Share = W/Y

employment is observed, followed by a slight recovery in 1975. The behavior of the series of labor's share shows itself to be (in accord with the anti-cyclical hipothesis) first declining, and then stabilyzing with employment. Nevertheless, the presence of seasonal variations does not allow for the identification of an increase of the share as a result of the drop in employment at the end of 1974.

During the period of January, 1971 to July, 1974, the variations in the annual sampling panels were reduced, as can be deduced from the behavior of the employment series during December and January. The greater homogeneity of the employment series and labor's share, together with the absence of cycles during this period, facilitated the calculation of more reliable indices for the correction of seasonal variation during the entire period 1966-75. With regard to the period 1970-75, the corrected data are shown in graph 2.4, where the anti-cyclical behavior of labor's share is clearer for the period as a whole. At the end of 1974, there was a decrease in employment, which was not accompanied by an increase in labor's share, although the latter did not continue to fall.

130

Graph 2.4, points out that labor's share suffered a very sharp decline in 1973. The year 1973 was characterized by three phenomena which strongly affect the problem under analysis. First, there was a reversal of the declining trend in the inflation rate, [14] which magnified the lag effect, since many labor contracts had possibly been signed based on the expectation that the inflation rate would continue to decline. Second, the mathematical formula adopted for the wage policy in effect at that time, for the calculation of the rates of collective wage readjustments under the jurisdiction of the CLT (Code of Labor Laws) was such that it only very slowly incorporated changes in the inflation rate. As a result, the rates of these collective readjustment were considerably lower than the inflation rates which, in the short-run, may have provoked a lag between prices and wages. Third, 1973 was the year of the so-called "raw material crisis": incertain sectors, economic growth reached the physical limits of the accelerated expansion of productive capacity, while the prices of raw materiais (especially petroleum rose on the international market). These issues will be discussed in subsections 3.4 and 3.6, respectively.

Taken as a whole, the data analyzed suggest that, during a tenyear period, only a few isolated periods, which total less than two years, did not show an anti-cyclical pattern for labor's share. Even so, there is a degree of uncertainty regarding these exceptions, due to the mechanisms which were used to correct for seasonal variations. Lacking an immediate explanation for these few cases of atypical behavior and having no interest in studying specific subperiods of the period 1966-75 for analytical purposes it was decided to proceed under the conclusion that during this period as a whole, the behavior of labor's share was predominantly anti-cyclical. Hence, it is deemed appropriate to determine which factors are responsible for this plenomenon.

3.3 — The problem of aggregation

Our first concern will be to ascertain whether the observed phenomenon is a result of the aggregation of data. In other words, it is possible that the anti-cyclical behavior of labor's share, observed for the sector as a whole, might simply be the result, during a period of expansion, of an increased importance of those industries of the sector in which labor's share is lower and, in the case of

[14] The general index (column 2 of the national indices of the *Conjuntura Econômica*) shows the following rates of variations calculated on the basis of the annual average indices: 17% (1972), 15.1% (1973), 28.6% (1974) and 27.7% (1975).

the contraction of economic activity, of an increased weight of those industries in which this share is greater.[15]

In order to isolate the contribution (for the result obtained for the sector as a whole) of variations in the relative importance of each industry and of the respective values of labor's share, the problem must be formalized. Labor's share for the sector as a whole is obtained by summing the payrolls in each industry i, and dividing the result by the sector's value of production that is:

$$W/Y \equiv \sum_i W_i/Y \qquad i = 1, \ldots, n \qquad (2.1)$$

where W is the total payroll, Y is the total value of production and the subscript i refers to the value of the variable in each of the n industries of the manufacturing sector.

Expressing (2.1) may be rewritten in the following manner, multiplying and dividing its right side by Y_i:

$$W/Y \equiv \sum_i (Y_i/Y) \qquad (W_i/Y_i) \qquad (2.2)$$

It is clear, therefore, that labor's share in the total is a weighted average of labor's shares in each industry, with weights given by the contribution of each industry to the total value of production. To continue, expression (2.2) will be simplified, with $S = W/Y$, $S_i = W_i/Y_i$ and $c_i = Y_i/Y$, that is,

$$S = \sum_i c_i S_i \qquad (2.3)$$

It is easy to demonstrate that, between two periods, 0 and 1, the discrete variation, designated by Δ, of (2.3), can be broken down as follows:

$$\Delta S \equiv \sum_i (c_{i0}\, \Delta S_i + S_{i0}\, \Delta c_i + \Delta S_i\, \Delta c_i) \qquad (2.4)$$

where subscript 0 refers to the base period.

The first two terms of the right side of (2.4) show the contribution, for the total variation, of the variations of the shares S_i and of the weights c_i, respectively. The third term represents the interaction of these two variations and, given that we are dealing with variations of numbers less than one, its contribution is, in general, insignificant.

---

[15] Within each industry (metals, machinery, etc.) problems of aggregation may also arise. Nevertheless, in monthly series it is not possible to study each industry since this is the lowest level of aggregation available.
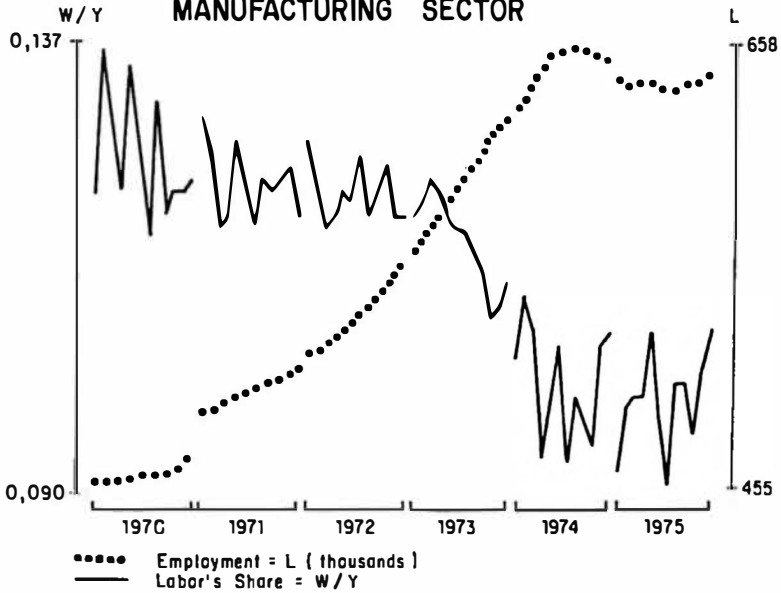
Graph : 2.3

State of São Paulo
MANUFACTURING SECTOR

W/Y
0,137

L
658

0,090

455

1970   1971   1972   1973   1974   1975

●●●●● Employment = L (thousands)
——— Labor's Share = W/ Y
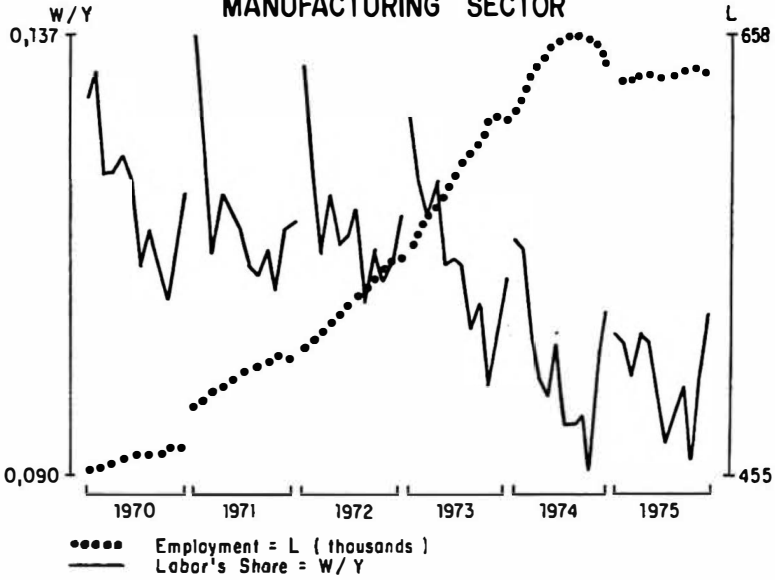
Graph 2.4

State of São Paulo
MANUFACTURING SECTOR

W/Y
0,137

L
658

0,090

455

1970   1971   1972   1973   1974   1975

●●●●● Employment = L (thousands)
——— Labor's Share = W/ Y

In order to separate impirically the contribution of the variation of the shares and weights, the breakdown involved in (2.4) was applied to the 15 industries included in the monthly surveys, separately studying two periods. The first covers the variations which occurred between the first half of 1966 and the six-month period of October, 1966 to March, 1967. During this period, labor's share increased in the sector as a whole; the results of the breakdown are shown below in table 2.1. Adding vertically its last two columns, we obtain, respectively,

$$\sum_i S_{i0} \, \Delta c_i = - \; 0.00225$$

$$\sum_i c_{i0} \, \Delta S_i = 0.01779$$

This indicates that the variation in labor's share in the various industries was the principal determinant of the increase in the share for the entire sector. On the other hand, the variation of the weights reduced labor's share. The same table shows an increase in labor's share in all of the industries, except three: paper and cardboard, food and tobacco. With the exception of the second, these industries had little weight in the total, which explains why did not significantly influence the result obtained for the sector as a whole, regarding the increase in labor's share. The decrease in the share in the food industry was not influential, since the decrease was small.

The second period chosen for the application of formula (2.4) was 1970-74. Beween these two periods there was a decline in labor's share and the results are shown below in table 2.2. Once again, adding the last two columns vertically we obtain, respectively,

$$\sum_i S_{i0} \, \Delta c_i = - \; 0.00503$$

$$\sum_i c_{i0} \, \Delta S_i = - \; 0.01658$$

which again indicates that the variation in labor's share in the various industries was the principal determinant of the decrease in labor's share in the sector as a whole. Here the variation of the weights also reduced labor's share. The same table shows a decrease in labor's share in all of the industries, with the exception of four: non-metallics, transport equipment, rubber and clothing-footwear. With the exception of the second, these industries had little weight in the total, which explains the fact that they did not significantly influence the result for the sector as a whole, regarding the decrease

134

in labor's share. Nor was increase in labor's share in the transport equipment industry influential, since it was small in magnitude.

The experiment presented in tables 2.1 and 2.2 indicates, therefore, that the result obtained for the sector as a whole cannot be attributed to a problem of aggregation, although this aggregation actually does hide the diverse behavior of a few industries. An analysis of this diverse behavior is not an objetive of this study.

3.4 — The problem of the prices of raw materials

In section 3.2 it was stated that the adoption of the value of production rather than the value added created the problem of determining to what extent the variations observed in W_i/Y_i simply reflect the increase in the cost of raw materials and intermediary commodities, involved in Y_i. If information were available (even at the aggregated level) on (a) the nature of the raw materials and intermediary commodities utilized in each industry, that is, an input-output matrix and (b) the corresponding prices and their variation over time, it would then be possible to determine which sectors were most affected by the variation in the prices of raw materials and intermediary commodities. The information corresponding to item (a) is available.[10] With regard to item (b) however although there are price indices for several industries in this sector, as published in the review *Conjuntura Econômica*, the criterion of aggregation is not always the same as the input-output matrices available. Furthermore, neither the price indices nor the matrices use the same criteria adopted in the survey of data utilized in the previous section. Moreover, there are serious limitations in the available price indices, since it is well known in Brazil that these indices, especially those of 1973, underestimate the rise in prices which actually took place. Note in graph 2.4, that 1973 was the year in which labor's share underwent its most significant decline; this may have been caused, at least in part, by the price rises in raw materials during that year.

As a result of all of these difficulties, the plan to conduct a detailed examination of the effect of price variations in raw materials was deleted from this study. Nevertheless, a general comparison can be made of the price variations of various groups of raw materials and linked with the behavior of labor's share during the period of 1970-74. Comparing the first two columns of table 2.2, shown previously, one can ascertain that the decrease labor's share was greater in the chemical and food industries, where

---

[10] See, for example, Leão, Silva, Giestas and Nóbrega (1973) and IBGE (1976).

labor's share was roughly reduced by one half between 1970 and 1974. Table 2.3, which appears below, shows, on the other hand, a comparison between price variations of various groups of raw materials, using an index of raw materials in general and indices of raw materials more closely linked to the chemicals sector (fuels and lubricants) and others more closely linked to the food sector (oilseeds, animal products and derivatives) .

It is clear that raw materials in general grew much less than the other indices covered by the table. Thus, it can be concluded that the variation in the prices of raw materials contributed to the decrease in the share of wages, at least in certain branches of the industry, including the chemical and food industries, during the period from 1970 to 1974.

3.5 — Labor as a quasi-fixed factor (or the internal labor market)

Empirical evidence covering the role of labor as a quasi-fixed factor is less scarce and clearly shows its importance in shaping the anti-cyclical behavior of labor's share in the short-run. The empirical evidence presented here complements that which has already been presented in other studies by the author.[17] In order to bring the discussion to a more general level, the concept of internal labor market will be frequently used in place of labor as a quasi-fixed factor. At the theoretical level, one can discuss the quasi-fixed labor costs without implying other characteristics of the internal labor market such as its institutional character and its promotion and transfer mechanisms. Nevertheless, from the empirical point of view, the discussion in this paper does not permit this distinction and therefore we shall interchange the two concepts.

The additional evidence presented here refers to the manufacturing sector in the city of São Paulo. Based on a sample obtained from questionnaires of the "Law of 2/3" and processed by the Institute for Economic Research (IPE) , the following ratio was calculated for each industry of the sector:

$$R = \frac{\text{employees with less than one year of service in the firm}}{\text{total number of employees}}$$

R can be understood as an index of labor turnover, since the newly hired employees either increased the number of employees or substituted those who left the firm voluntarily or otherwise. Thus, if the number hired for expansion were known, the balance would

---

[17] Macedo (1974) , chap. 4 or (1976) .

Table 2.1

São Paulo — Manufacturing Sector Breakdown of the Total Variation of Labor's Share in the Value of Production Between 1966 and 1967

Industry	S, c and Variations							
	(*) S_{66}	(**)S_{67}	ΔS	c_{66}	c_{67}	Δc	$S_{66}\Delta c$	$c_{66}\Delta S$
Non-Metallic Minerals	0,155	0,160	0,005	0,0396	0,0438	0,0042	0,00003	0,00020
Metallurgy	0,169	0,178	0,009	0,1116	0,1066	—0,0050	—0,00085	0,00100
Machinery	0,193	0,222	0,029	0,0448	0,0471	0,0023	0,00044	0,00130
Electrical Equipment	0,112	0,145	0,033	0,0881	0,0869	—0,0012	—0,00013	0,00291
Transport Equipment	0,134	0,167	0,033	0,1569	0,1365	—0,0204	0,00273	0,00518
Paper and Cardboard	0,110	0,100	—0,010	0,0276	0,0400	0,0124	0,00136	—0,00028
Rubber	0,092	0,093	0,001	0,0351	0,0371	0,0020	0,00018	0,00004
Chemicals	0,064	0,082	0,018	0,1328	0,1211	—0,0117	0,00075	0,00239
Drugs, Cosmetics, Soaps	0,073	0,077	0,004	0,0129	0,0162	0,0033	0,00024	0,00005
Plastics	0,121	0,150	0,029	0,0174	0,0157	—0,0017	—0,00021	0,00050
Textiles	0,113	0,145	0,032	0,1355	0,1113	—0,0242	—0,00273	0,00434
Clothing, Footwear	0,137	0,145	0,008	0,0269	0,0307	0,0038	0,00052	0,00022
Food Products	0,063	0,059	—0,004	0,1456	0,1805	0,0349	0,00220	—0,00058
Beverages	0,104	0,134	0,030	0,0197	0,0200	0,0003	0,00003	0,00059
Tobacco	0,100	0,086	—0,014	0,0052	0,0067	0,0015	0,00015	—0,00007
Total	0,117	0,130	0,013					

Source of Raw Data: Monthly Surveys prepared by IBGE.

(*) S_{66} = Labor's Share during the first half of 1966, corrected for seasonal variation.

(**) S_{67} = Labor's Share during the period October, 1966 to March, 1967, corrected for seasonal variation.

Table 2.2

*São Paulo   Manufacturing Sector Breakdown of the Total
Variation of Labor's Share in the Value of Production
Between 1970 and 1974*

Industry	S, c and Variations							
	S_{70}	S_{74}	ΔS	c_{70}	c_{74}	Δc	$S_{70}\Delta c$	$c_{70}\Delta S$
Non-Metallic Minerals	0,147	0,151	0,0042	0,0384	0,0273	0,0111	0,00163	0,00016
Metallurgy	0,151	0,114	—0,0369	0,0886	0,0907	0,0021	0,00032	—0,00327
Machinery	0,166	0,155	—0,0108	0,0629	0,0731	0,0102	0,00169	—0,00068
Electrical Equipment	0,140	0,136	—0,0040	0,0913	0,0760	—0,0153	—0,00214	—0,00037
Transport Equipment	0,140	0,145	0,0050	0,2101	0,1695	—0,0406	—0,00568	0,00568
Paper and Cardboard	0,128	0,092	—0,0360	0,0369	0,0364	—0,0005	—0,00006	—0,00133
Rubber	0,077	0,088	0,0110	0,0434	0,0262	—0,0172	—0,00132	0,00048
Chemicals	0,095	0,042	—0,0530	0,1202	0,1909	0,0707	0,00672	—0,00637
Drugs, Cosmetics, Soaps	0,059	0,064	0,0050	0,0279	0,0202	—0,0077	—0,00045	0,00014
Plastics	0,132	0,114	—0,0180	0,0176	0,0156	—0,0020	—0,00026	—0,00032
Textiles	0,130	0,107	—0,0230	0,0855	0,0598	—0,0257	—0,00334	—0,00197
Clothing, Footwear	0,124	0,127	0,0030	0,0229	0,0167	—0,0062	—0,00077	0,00007
Food Products	0,056	0,026	—0,3000	0,1275	0,1812	0,0537	0,00301	—0,00383
Beverages	0,156	0,145	—0,0110	0,0156	0,0101	—0,0055	—0,00086	—0,00017
Tobacco	0,052	0,037	—0,0150	0,0112	0,0062	—0,0050	—0,00026	—0,00017
Total	0,119	0,101	—0,0180					

be a net index of personnel turnover. It can be said, then, that the index R overestimates turnover. In addition to R, indices R_1 and R_2 were also calculated. The first corresponds to the value of R for the case in which the numerator as well as the denominator of the above formula refer to employees who receive up to two minimum wages monthly. R_2 corresponds to the employees whose monthly earnings are above two minimum wages. Under these conditions, it is easy to verify that R is a weighted average of R_1 and R_2, with weight given by the proportions of the total number of employees receiving up to two minimum wages and above two minimum wages, respectively. The results of the calculations of R, R_1 and R_2 are presented in table 2.4, together with data on average earnings in each industry included in the table, obtained from the same source. The inclusion of the average earnings data is for later use.

Two important conclusions can be drawn from the data in table 2.4. The first is that labor turnover is greater for those who earn less, and this is consistent with the reasoning behind the concept of an internal labor market.[18] The second conclusion is that this idea is supported by another way of focusing on the information available from the same table. It was assumed that the value of average earnings reflects the quasi-fixed labor costs associated with the internal labor markets. That is, the higher costs of a hierarchical wage structure emerging from on-the-job training, institutional mechanisms and other causes, are proportional to the wages which would be in effect in the absence of such costs. Thus, among industries, one can anticipate an inverse correlation between the average earnings and R, used here as an approximate measure of turnover. This was confirmed by a statistical test.[19]

The empirical evidence presented in this subsection is certainly open to criticism. Nevertheless, when added to the others already cited, it is believed that the overall results constitute a substantial indication that employment relationships in the Brazilian manufacturing sector are organized in such way that they lead to quasi-fixed costs of labor. We may thus conclude that this phenomenon is one of the causes of the anti-cyclical behavior of labor's share.

[18] Taking the values of R_1 and R_2 from table 2.4, we tested $R_1 = R_2$ against $R_1 > R_2$ using the "t" statistic. We found $t = 11.494$, which precludes the acceptance of the hypothesis of equality at the level of 1%. For the test, it was assumed that the variance of the two groups are different. Under this condition, the test is an approximation.

[19] The coefficient of linear correlation between the two variables is -0.764. The hypothesis of zero correlation cannot be accepted at the 1% level against the hypothesis of negative correlation ($t = -4.729$).

3.6 — The lag between prices and wages

In principle, it should be a relatively simple problem to associate the effect of the lag between prices and wages with the behavior of labor's share. Were there a time — series of wages and prices available for the manufacturing sector, we could measure the lag effect by the ratio between these two variables, that is, by the real wage. Then, the variations of this wage could be associated with the behavior of labor's share. However, conceptual and empirical problems present several obstacles with regard to the ability of a wage/price ratio to measure the lag effect over time.

With reference to the numerator of this ratio, a major problem is that the available data on wages in the manufacturing sector only allow for the calculation of the average earnings employee and this measure is far from being appropriate for the intended purposes. First, it is by itself affected by the existence of quasi-fixed labor costs which, as was seen in the previous section, has empirical support to explain the variations observed in labor's share. In subsection 1.4, it was explained that this mechanism provoke anti-cyclical behavior of the average wage, insofar as the reductions and expansions in employment, concentrated at the lowest levels of the wage scale, should have, respectively, a positive and negative impact on the average wage level of the employees on the firms payrolls.

Second, the average earnings per employee can vary due to changes in the number of hours worked per employee, a variable which is of cyclical behavior, decerasing during contractions in employment and increasing during periods of expansion.

Table 2.3

Brazil: Price Variations in Raw Materials — Selected Indices, 1970-74

Indices	Variation between 1970 and 1974 (%)
Raw Materials in General	106.98
Fuels and Lubricants	147.50
Agricultural Raw Materials: oilseeds	142.98
Animal Products and Derivatives	141.72

Source: Indices 13, 20, 46 and 48, respectively from *Conjuntura Econômica*.

A third problem is that the lag effect can be selective, affecting only a portion of the employees of the firm and not necessarily being reflected in the value of the average earnings of all its employees. Bacha (1975) and Wells (1975) suggested that after 1964 the lag affected wages at the lower levels of the wage scales but not those of employees with higher positions in the hierachy, since the former group had been hurt more by the ban on union activity, their bargaining power depending more heavily on union activities than the second group. Because they held highranking positions those of second group had not only greater bargaining power in individual trms but were also directly involved in the determination of their own wage or salary levels.

As if these difficulties did not suffice, other problems arise affecting the price indices used in the calculation of the wage/prices ratio. These problems were mentioned in subsection 2.4. Let us examine the case of 1973, a year in which the credibility of the price indices is recognizadly lower. As has already been pointed out, in that year conditions were propitious for the lag effect. The inflation rate, which had ben decreasing until then, began to rise. With this change of direction, it is possible that real wages had decreased because many labor contracts were apparently signed not foreseeing that the rate of inflation would change direction. Furthermore, the mathematical formula adopted by wage policy for the calculation of collective wage readjustments incorporated the effect of significant changes in the rate of inflation only very slowly.

Notwithstanding all these difficulties, we decided to continue the analysis. Thus in the following pages, we will analyze data on real average earnings for the period of 1966-1970, without concerning ourselves with the above-mentioned problems. Later, we will comment on several conclusions which should be qualified as a result of these problems. Moreover in the discussion which follows, we will not initially question whether the lag effect is derived from the typical rigidity of labor contracts or if it can be attributed to government wage policy. Later on, the latter issue will be the object of specific comments.

Graph 2.5 shows, for the period of January, 1966 to June, 1970, the behavior of monthly data on real average wages, using the wholesale industrial price index as a deflator.[20] It can be seen that wages grew in 1966, stabilized in 1967 and decreased, in 1968, recovering as of 1969. Comparing this behavior with labor's share during the same period (see graph 2.2), three basic conclusions can be drawn.

[20] Index no. 18 of *Conjuntura Econômica*. In the remainder of this section, the data on real average earnings will be referred to simply as wages.

141

First, the lag effect cannot be singled out as the cause of the increase in labor's share in late 1966 and early 1967, since wages stabilized during that period. Second, the lowest levels in labor's share in 1968 can be explained partially by the wage decrease of that year. Third, the largest values in labor's share during the recession of late 1969 and early 1970, can also be explained by the lag effect, since wages rose during that period.

The behavior of wages in the period 1970-75 can be assessed by reviewing graph 2.6, in which it can be observed that wages rose until mid 1973, showed a slight declining movement until late 1974, and then began to recover.

This wage trend was compared with the behavior of labor's share during the same period (see graph 2.4). We may conclude that, first, the lag effect does not appear to be responsible for the declining trend in the share of wages through mid 1973, bearing in mind the growth in wages during the same period. Second, from that point, through to early 1975, the decrease in wages occurs as labor's share decreases, and it was likely one of the factors responsible for the reduction in labor's share, especially considering that the decrease in wages during this period is underestimated in relation to the downward bias which the deflator presents in that year. Third, during the recession of late 1974, which extended into 1975, wages rose but not to the point of clearly contributing to an increase in the share of wages.

As was said previously, in analyzing the lag effect it was not intended to isolate the effect of the typical rigidity of labor contracts from the effect of the Government wage policy. With regard to the latter, it is interesting to observe that there are strong indications of its effect, at least in two periods. [21] The first is 1968, a year characterized by a sharp decrease in labor's share and during which one of the most important changes in post 1964 wage policy took place. Until then the so-called "inflationary residue" (an allowance for future inflation), which enters into the calculation of the wages readjustments determined by the Government, was persistently underestimated. In May, 1968, the Government modified the calculation formula correcting, at least in part, the underestimation of the "inflationary residue". Thus, the wage rate readjustments began to correspond more closely to the inflation rates. Both the underestimation of the residue and the modification introduced by the Government are consistent with the behavior of labor's share in 1968 and immediately afterwards. That is, the underestimation of

[21] The aspects of wage policy discussed below are based on the study by Cipollari and Macedo (1975).

142

Table 2.4

City of São Paulo — Manufacturing Sector Values of R and the Average Earnings by Industry — 1974

Industry	Values of R			
	General (R)	Up to two Minimum Wages (R_1)	More than two Minimum Wages (R_2)	Average Earnings (*)
Food Products	0.25	0.31	0.19	3.64
Boverages	0.13	0.41	0.08	5.49
Tobacco	0.15	0.20	0.15	5.74
Textiles	0.25	0.33	0.18	2.88
Clothing and Footwear	0.29	0.31	0.22	2.16
Wood	0.32	0.41	0.22	2.92
Furniture	0.29	0.38	0.23	3.30
Paper and Cardboard	0.23	0.31	0.17	3.63
Publishing and Printing	0.26	0.34	0.21	4.17
Leather and Hides	0.29	0.35	0.19	2.50
Rubber	0.23	0.31	0.17	3.32
Chemical and Drugs	0.24	0.33	0.19	5.05
Petroleum Derivatives	0.17	0.27	0.13	5.81
Plastics	0.34	0.41	0 23	2.87
Non-Metallic Minerals	0.25	0.30	0.18	3.66
Metallurgy	0.26	0.39	0.19	4.12
Machinery and Electrical Equipment	0.29	0.38	0.21	3.93
Transport Equipment	0.27	0.35	0.23	4.12

Source of Raw Data: Questionnaires from the "Law of the 2/3" Sample from the Institute for Economic Research (IPE).

(*) Units of the monthly minimum wage (Cr$ 312,00) per worker, in April, 1974.

the residue explains the aggravation in the decrease of the labor's share in 1968 and the correction of the formula explains its recovery.

The second period in which we find indications of the effect of the wage policy is that of 1973 to 1975. As was previously seen, late 1973 and late 1974 were periods characterized by a decrease in labor's share and in wage levels. In January, 1975, the government again modified the formula significantly, now basing it on the reconstitution of the real average wage for the 12 months prior to the wage readjustment. With the sudden rise in inflation rates in 1973 and 1974, the existing formula, which was based on the 24 month previous to the readjustment, only very slowly incorporated the increase in the inflation rates. As a result, after the change introduced by the government, the wage rate readjustments rose quickly and, by 1975, exceeded the inflation rate. This is consistent with wage increases since then.

Although the data is, for these two periods, consistent with that which could be anticipated form the effect of the wage policy,

it is not possible to distinguish this effect from the typical rigidity of the labor contracts. In other words, it is possible that the behavior of the data reflects circumstances in which individual contracts are rigid for a certain period of time, during which it is difficult for the employee to obtain wage radjustment if there is, as in 1973 and 1974, a substantial increase in the inflation rate. [22] Strictly speaking, in order to separate the two efects it would be necessary to define more precisely the relation between the behavior of the wages of the sector and the collective wage readjustments obtained by the respective labor unions. In addition to the difficulties already mentioned regarding the analysis of the real average wage, it should be pointed out that this variable and the collective nominal wage readjustments are subject to seasonal variations whose pattern also needs to be determined.

In concluding this section, it is worth mentioning several circumstances in which the previously mentioned problems relating to the measurement of the lag effect limit the conclusions reached. Such limitations are: a) the wage stability of 1967 and the growth in wages since 1970 can be partially associated with the variations in the number of hours worked; b) the growth in wages after 1970 can be, in part, related to the underestimated price indices even before 1973; c) the 1968 wage decreases can be partially attributed to the expansion in employment in the lower levels of the wage scale. Taken as a whole, it is understood that these limitations are more serious in the case in which the existing variation is small (e.g. in the case of wage stability in 1967) but does impair the analysis when the variation is very lage (e.g., the growth in wages since 1970) . It should however be clear that the are a series of underlying assumptions to the conclusions reached in this section regarding the lag effect. These conclusions are summarized below.

For the entire period of 1966/70, and considering only the periods in which labor's share showed clear anti-cyclical behavior, there are indications that the lag effect, taken in the broad sense (that is, without distinguishing the effect of wage policy) explains: a) the downward variation of 1968 and of the period of 1973 to 1974; b) the upward variation between 1969 and 1970. Nevertheless, the lag effect does not explain the increase which took place in 1966 nor the decrease between 1970 and early 1973.

---

[22] During the period cited, there was a sudden change in the inflation rate; it was unlikely that this change was incorporated into individual labor contracts, even in the absence of the wage policy. In 1968, however, government policy can be considered responsible, even if in an indirect way, for the decrease in real wages, insofar as the government contributed to the generation of an optimistic forecast of the inflation rate which, though reflected into individual labor contracts, did not materialize.

With regard to the wage policy there are indications that it explains the behavior of labor's share on at least two occasions: a) for the 1968 decrease and the subsequent recovery; b) for the decrease of 1973 and 1974 and for the recovery afterwords. It was not possible, however, to isolate the effect of wage policy from that of the typical rigidity of the labor contracts. This was probably more important during the second period than in 1968.

3.7 — Annual data

In addition to the monthly data already discussed in this paper, IBGE publishes annual surveys of the manufacturing sector. These surveys are available for the period 1949/73, with the exception of the years 1950-51, 1960-61 and 1971. The difficulty in the utilization of these data is the lack of homogeneity of the criterion adopted for the selection of the industrial establishments covered by the various surveys. Thus, there are census surveys encompassing the population of the establishments, together with surveys which include only the establishments with five or more employees or those whose total value of production represents 90% of the sector. [23] Under these conditions, it is difficult to follow the variations in the value of labor's share over the years since it is possible that the variations observed may be merely the result of the different criteria adopted for the surveys. Note that the problem of the different sampling criteria in this case is much more serious than that observed in the case of the monthly surveys. In the latter, at least the analysis of labor's share within each year, between months, is not impaired by the fact that different annual sample panels were adopted. Here, the different criteria obviously detract from the annual comparisons. Furthermore, in the case of the monthly data, there were several years in which the modification of the sample panels was minimal.

Even so, the data available on an annual basis were analyzed, both for the entire manufacturing sector and for the various industries of the sector, at the two-digit level. [24] For the period 1949/73, the typical pattern of behavior of the data, for the entire sector as well as for the various industries, is that the employment series exhibits a growing trend whereas labor's share shows a diminishing trend. With regard to these trends, one can assume that the different

[23] For a detailed explanation of the survey criteria for the period 1919/69, see Bacha, da Mata and Modenesi (1972), Appendix A.4.1.
[24] Bearing in mind the problems identified in relation to the annual data and in order to avoid excessive use of tables and graphs, the following discussion is presented in a summarized form.
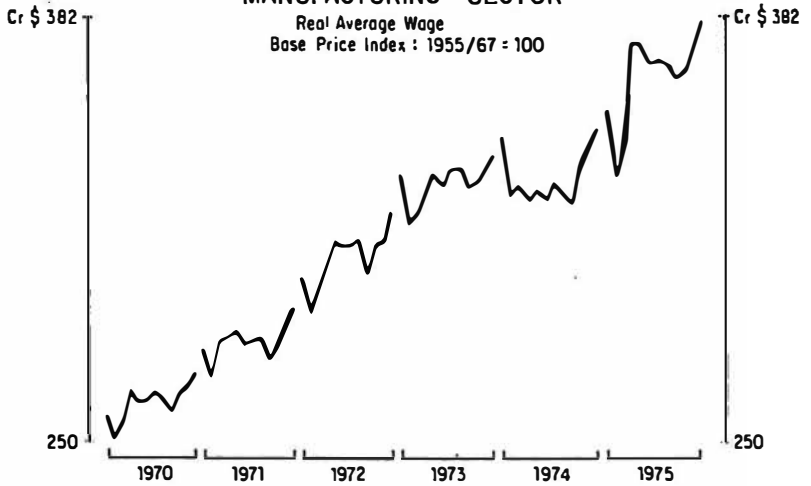
Graph 2.5

State of São Paulo
MANUFACTURING SECTOR

Real Average Earnings
Base Price Index : 1955/67 = 100

Cr $228

Cr $228

162

162

1966   1967   1968   1969   1970
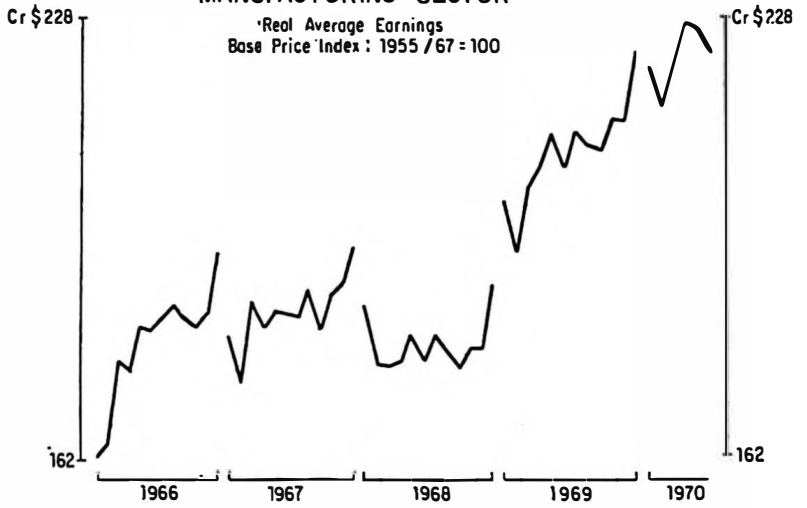
Graph 2.6

State of São Paulo
MANUFACTURING SECTOR

Real Average Wage
Base Price Index : 1955/67 = 100

Cr $ 382

Cr $ 382

250

250

1970   1971   1972   1973   1974   1975

146

survey criteria of the annual data were probably not influential enough to alter the profiles of the trends observed. Nevertheless, the series did not confirm, in the case of the period of 1966/69, the anti-cyclical behavior pattern of labor's share as found in the monthly data. The oscillations around the trend are very irregular and this may have been as much the result of the different sampling criteria as the fact that several of the cycles through which the manufacturing sector passed were of short duration and can only be analyzed by the monthly data. [25] This is the case, for example, for the year 1969, as can be observed in graphs 2.1 and 2.2, which were previously discussed.

This pattern of behavior is summarized in table 2.5, which indicates the correlation coefficients between annual employment series and labor's share. Given the availability of the data, these variables were measured according to two criteria, S being the share of total wages and S_t the share corresponding only to production workers. S_t therefore excludes the wages of administrative personnel. In order to calculate the correlation coefficients, the employment series was separated according to an identical criterion.

The annual data prepared by the IBGE regarding the manufacturing sector are more detailed than the monthly surveys. It was therefore possible to calculate S and S_t taking the quotient between the payroll and the "value added to raw materials", assuming that the variations of the latter reflect the variations in the economic value added in a more precise manner than the value of production. [26]

With the exception of the textile industry, all of the correlation coefficients in table 2.5 are negative. Among the various industries, the textile industry is that in which the trend of employment growth is less accentuated, which may have contributed to the observed result, since, in the case of labor's share, the textile industry was no exception to the rule, showing a decreasing trend. The results of the "t" test, also shown on the table, indicate that the correlation coefficient are significantly different from zero at the 5% level, with few exceptions.

It should be emphasized that, if it were not for the opposite direction in the trends of the employment series and labor's share, the negative sign of the correlation coefficient could be interpreted simply as indicative of the anti-cyclical behavior of the latter variable.

[25] Wells (1975) for example, did not find evidence of the anti-cyclical behavior of labor's share during the period of 1964/67 (pp. 194-95). At least since 1966 this is due to the fact that only annual data were analyzed.

[26] The definition adopted by the IBGE in the case of the annual data is basically that of the Industrial Censuses and is presented in the Appendix.

Here it is interpreted simply as indicative of the trends of opposite directions observed in the two series.

Given the problems encountered in the survey criteria of the annual series and the possibility of cycles of short duration, the monthly surveys are much more appropriate for the analysis of the hypothesis that labor's share is anti-cyclical in behavior. If it were not for the existence of monthly data, the analysis of this paper would be significantly weakened, since, even if the annual data confirmed such hypothesis, there would be uncertainties regarding their validity within segments of the years surveyed and regarding the effect of the different survey criteria.

Nevertheless, the annual data reflect trends whose identification is not necessarily impaired by the critiques made with regard to the sampling criteria. In dealing with trends observed over a period of two decades, however, it is understood that the phenomenon transcends short-run analysis and should be analyzed separately. [27]

3.8 — Econometric implications

We shall now return to the discussion begun in subsection 2.4, and re-state equation (1.1), with which we may theoretically obtain an estimate of the elasticity of substitution σ:

$$V/L = a \ w^{\sigma} \tag{2.1}$$

This equation, or its transformation has often been applied in empirical studies. In Brazil, Bacha, da Mata and Modenesi (1972) applied the equation.

$$L = c \ w^{\beta_1} \ v^{\beta_2} \tag{2.2}$$

which is a transformation of (2.1), assuming that β_2 is not necessarily equal to 1, as in (2.1), which, in the context of the model on which this equation is based, is the equivalent of accepting that the returns to scale are not necessarily constant. In the estimate made by the above-mentioned authors, the series cited in the previous section were used, utilizing the value of production in place of the value added V.

Although the authors cited have not interpreted the ω coefficient as the elasticity of substitution, this can be done once the hypotheses implied in the model from which (2.1) or (2.2) are reduced forms. The fact that their estimates of β_1 are less than 1 and consistent,

---

[27] See Macedo (1977), chaps. 3 and 4.

148

with the usual assumption regarding the value of σ in the short-run has already led several authors (such as Rebouças (1975) and Taylor and Cardoso (1976)) to interpret these estimates as elasticities of substitution.

The annual data on which these estimates are based exhibit the survey-related problems referred to in the previous section. There are other reasons why it is questionable whether the estimates of Bacha, da Mata and Modenesi (1972) can be interpreted as elasticities of substitution. [28]

The following is an adlitional argument opposing the utilization of (2.1) or (2.2) for the obtaining of the σ estimates, when this is done based on time-series and taking the average wage as a measure of the wage rate. The theoretical part was examined in subsection 2.4 and, in order to discuss the empirical aspects, use will be made of data from the manufacturing sector in the United States, where the surveys are subject to a homogeneous criterion from year to year.

Taking the annual data of V, L and $\bar{w}$, for the period 1949/72, from the "Annual Survey of Manufactures", the following equation was estimated: [29]

$$\widehat{V/L} = 1.022 + 0.637\ \bar{w} + 0.0289\ t$$
$$(5.141) \qquad (5.762)$$

$$R^2 = 0.998 \qquad D.W. = 0.68$$

where the variables V/L and w are represented by the respective logarithms and t is a time trend introduced to represent "technological progress", as is usually done in the applications of (2.1), since both V/L and $\bar{w}$ can display a growth trend which, if not isolated, would lead to biased estimates of the coefficient of $\bar{w}$. [30]

The coefficient of $\bar{w}$ is less than 1, consistent with results normally obtained for the elasticity of substitution in time-series. However, further examination of the data used reveals that: (1) the

---

[28] Macedo (1974), chaps. 3 and 4, or (1975) and (1976).

[29] V is the value added, L is the number of man-hours employed in production and $\bar{w}$ is the average wage (earnings) obtained by dividing the production payroll by the number of man-hours employed. The figures in parentheses correspond to the "t" statistic.

[30] The introduction of the time trend in (2.3) can also be interpreted as a correction for the rise in prices and nominal wages due to inflation. Another interpretation, along the lines of "technological progress", would be that the increase in the quality of labor results in a growth in productivity (V/L) which, in turn, results in higher wages ($\bar{w}$); this effect should be isolated in order to estimate the elasticity of substitution net of this effect.

manufacturing sector of that country passed through cycles of production and employment during the period; (2) the S series (labor's share) and $\bar{w}$ series, excluding the effect of the trend, are positively correlated during most of the period; (3) this positive correlation occurs concomitantly with an anti-cyclical behavior of both variables, excluding the trend.

More precisely, graph 2.7, shows the L, $\bar{w}$ and S (labor's share) series, in logarithms, excluding the trend. A vertical line was drawn along the points corresponding to 1958, in order to highlight the period 1958/72. On the one hand, it can be seen that, except for the period 1949/57, there is a clear negative correlation between L and w. On the other hand, with the same exception, it can be observed that the correlation between L and S is negative, which reflects the anti-cyclical behavior of labor's share. It also follows that the correlation between S and $\bar{w}$ is positive which as was seen in subsection 2.4, will produce a "satisfactory" result (less than one), for the value of the elasticity of substitution in the short-run.

Since the behavior of the data is atypical during the period 1949/57, it was decided to re-estimate equation (2.3) separately for this period and again for the period 1958/72. The results obtained were the following (we shall repeat equation (2.3) in order to facilitate the comparison) :

For 1949/72

$$R^2 \quad D.W.$$

$$V/L = 1.022 + 0.637\ \bar{w} + 0.0289\ t \quad 0.998 \quad 0.68 \qquad (2.3)$$
$$\qquad\quad (5.141) \qquad (5.762)$$

For 1958/72

$$V/\tilde{L} = 1.018 + 0.805\ \bar{w} + 0.0193\ t \quad 0.999 \quad 2.27 \qquad (2.4)$$
$$\qquad\quad (12.664) \qquad (7.200)$$

For 1949/57

$$V/\tilde{L} = 1.205 - 0.048\ \bar{w} + 0.0670\ t \quad 0.997 \quad 1.62 \qquad (2.5)$$
$$\qquad\quad (0.306) \qquad (8.539)$$

Comparing the above results, it is clear that in terms of the "t" test, as well as for the Durbin-Watson and R^2 coefficients, the results for the period 1959/72 are the "best", with the difference in the case of R^2 being minimal. Furthermore, it is clear that the data from this period are the most influential in the determination of the

result obtained for the period as a whole. Observe that in the regression for the period 1949/57 the sign of the $\bar{w}$ coefficient is negative and does not differ significantly from zero at the 5% level.

Nevertheless, it is evident that there econometric results usually interpreted as elasticity of substitution are derived from the patterns of behavior which the variables L, $\bar{w}$ and S follow throughout the economic cycle. These patterns of behavior can be explained on the basis of the existence of quasi-fixed costs of labor or by the functioning of internal labor markets.

In the United States, evidence exists indicating the importance of these two approaches in the analysis of the labor factor. [31] We have seen in section 3.5 of this study that, for the case of the Brazilian manufacturing sector, important evidence also exists

Table 2.5

Brazil — Manufacturing Sector — 1949/73 — Correlation of Coefficients: Between Total Employment and S (r_1) and Between Employment in Production and s_1 (r_2)

Industry				
Total	—0.78	(5.21)	—0.77	(5.29)
Non-Metallic Minerals	—0.61	(3.24)	—0.64	(3.63)
Metallurgy	—0.76	(5.00)	—0.78	(5.56)
Machinery	—0.60	(3.18)	—0.52	(3.06)
Electrical and Communications Equipment	—0.51	(2.52)	—0.58	(3.06)
Transport Equipment	—0.17	(0.72)*	—0.12	(0.57)*
Wood	—0.58	(3.03)	—0.60	(3.27)
Furniture	—0.65	(3.61)	—0.59	(3.16)
Paper and Cardboard	—0.40	(1.87)*	—0.57	(3.04)
Chemicals	—0.61	(3.28)	—0.74	(4.69)
Rubber	—0.30	(1.34)*	—0.15	(0.67)*
Leather and Hides	—0.61	(3.30)	—0.35	(1.63)*
Textiles	0.31	(1.38)*	0.43	(2.06)*
Clothing and Footwear	—0.52	(2.58)	—0.57	(3.04)
Food Products	—0.62	(3.36)	—0.54	(2.84)
Beverages	—0.47	(2.24)	—0.61	(3.38)
Tobacco	—0.38	(1.76)*	—0.32	(1.49)*
Publishing and Printing	—0.72	(4.40)	—0.77	(5.33)

Source of Raw Data: Annual Surveys of the IBGE, covering the Manufacturing Sector.
Note: (1) "t" values are placed in parentheses· (2) the series used does not include the years 1950/51, 1960/61 and 1971.
*Indicates that the "t" test precludes the rejection of the hypothesis that the correlation is null, at the 5% level.

31 See Oi (1962) and Doeringe and Piore (1971), among others.

151

indicating the same. Therefore, the interpretation of equations such as (2.1) or (2.2) which are either computed with currently available data or, with improved data in the future, should be made with caution. Although the purpose of applying these equations is to obtain estimates of σ, this paper demonstrates that the respective econometric results are subject to an alternative explanation.

Until this point, this alternative explanation took only one step forward in the understanding of the phenomenon analyzed. By itself, it doesn't exclude the validity of the explanation which explicitly involves the value of the elasticity of substitution. One can however speculate about the plausibility of one explanation when compared to the other.

Along these lines, one can defend the greater plausibility of the explanation based on quasi-fixed costs of labor, or on the internal labor markets, based upon four arguments. First, its premises are less rigid, not taking into consideration those required by the estimating the elasticity of substitution experiment: perfect competition, some short-run substitution between capital and labor, an aggregated production function with constant elasticity of substitution, unaltered cost of capital, homogeneity of the labor factor and (especially for equation (2.1)) constant returns to scale. Second it provides an explanation of the variables during the economic cycle, rather than considering the values of the variables without taking into account the nature of their variations over time. Third, the average wage is analyzed as such rather than as an *ad-hoc* measure of the wage rate. In this respect, it is important to note that the average wage has an anti-cyclical behavior which goes against the cyclical behavior predicted for the wage rate by the theoretical reasoning behind the explanation which focuses on the elasticity of substitution. Fourth, the interpretation of the econometric results obtained with the function (2.2), as a product of quasi-fixed labor costs or the functioning of the internal labor markets, is supported by empirical evidence independent of the computed functions, as was stated above. In the Brazilian case, the same cannot be said, with regard to the explanation centered on the elasticity of substitution, which until now only subsists in relation to the estimates presented in the study by Bacha, da Mata and Modenesi (1972), without being corroborated by independent empirical evidence (e.g., direct estimate of a CES function).

3.9 — Additional considerations and summary

Once it was found that labor's share (as measured by the ratio between payroll and the value of production) has anti-cyclical

152

behavior, this study set out to identify the determinants of this phenomenon encountered in the Brazilian manufacturing sector. First, it was demonstrated that the result could not be attributed simply to a problem of aggregation. Next, the role played by the price variations in raw materials during the period 1970/74 was examined, this was a period during which in labor's share decreased at the same time as production and employment expanded. It was concluded that the price variations in raw materials can be singled out as partially responsible for the decrease in labor's share, at least in some industries of the sector, such as the chemical and food industries.

Having examined the above factors (whose role was derived only from the statistical procedures adopted) we proceeded to examine others, which were the object of theoretical analysis in the paper. In this case, it was worthwhile to examine two effects operating in the same anti-cyclical direction: the lag effect between prices and wages and the effect of the quasi-fixed costs of labor or of the functioning of internal labor markets.

There is evidence that the lag effect explains the behavior of labor's share during several segments of the period analyzed, although it is not valid for the other segments of the period. One specific case of lag effect (that is, the effect of government wage policy) was shown to be consistent with the behavior of labor's share during a few segments of the period, although not valid for others. The explanation based on the wage policy does not hold for periods in which, despite the restrictive character normally attributed to this policy, labor's share actually rose.

Regarding the anti-cyclical effect of quasi-fixed costs of labor on labor's share, this is the effect most clearly explained by the analysis conducted. First, it is worth emphasizing that, while the lag effect sometimes does not hold in the explanation of the anti-cyclical behavior of labor's share, this does not occur with the effect of the internal labor markets. Second, even when the lag effect explanation is consistent, it competes with the explanation whose major element is the role of quasi-fixed costs of labor. Nevertheless, with respect to the latter, there is empirical evidence available obtained independently of the data which served as a basis for the analysis of labor's share. This guarantees a greater degree of credibility for the latter explanation, except for late 1973 and 1974, when the lag effect is too clear to be confused with the operation of quasi-fixed labor costs. Third, several doubts persist regarding the procedures adopted to measure the lag effect, and it is worth noting that the available evidence regarding the internal labor markets is generally less questionable.

153

It was also demonstrated that the existence of quasi-fixed labor costs provides an alternative explanation for econometric results usually interpreted as capable of providing an estimate of elasticity of substitution.

With regard to some type of evidence on the operation of the neo-classical and Kalecki models, anti-cyclical behavior in very different sectors (of factors which influence price formation: competitive conditions, elasticities of demand, degrees of monopoly, homogeneity of the commodity, etc.), suggests that such behavior is probably the result of elements which can operate equally well in either model. This reinforces the potential influence of the lag effect and, especially, by the occurrence of quasi-fixed costs of labor.

Graph 2 . 7
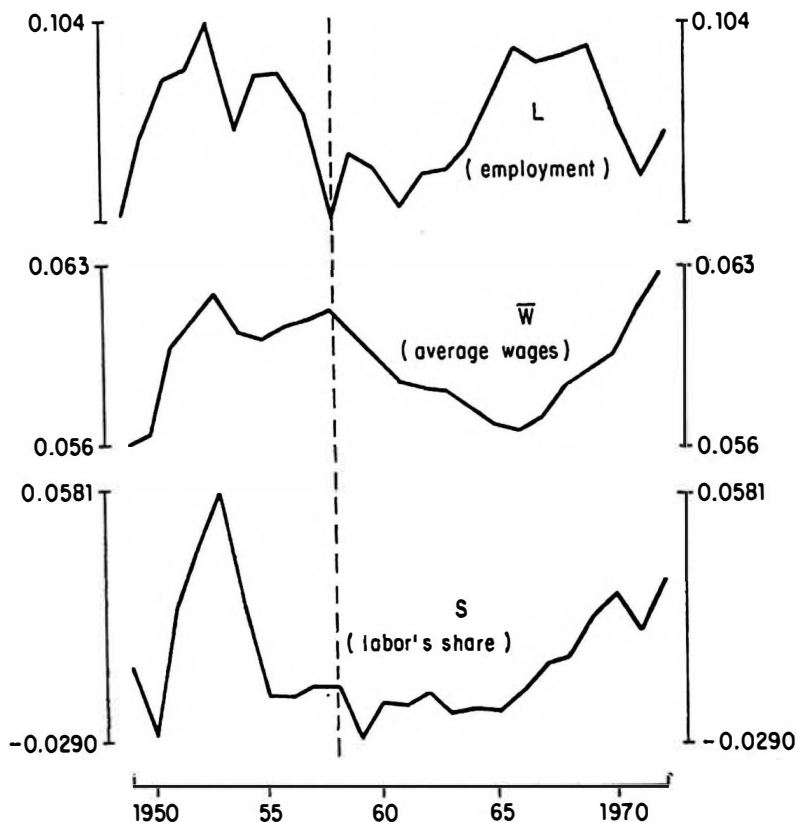
Appendix

Monthly data — definitions used by the IBGE

Actively Employed Personnel (Employment) — The group actively employed personnel includes those who, on the last day of each month, were actively engaged in the establishments surveyed, including those who were on vacation or on leave for a period of not more than 30 days.

Wages And Salaries — (Payroll) — Includes monthly payments to administrative and production workers minus the deduction of contributions for social security welfare and social services. This includes withdrawals ("por labore") of owners or partners, and compensation of board members of corporations and other business entities, as well as commissions and bonuses. Not included are defrayal of travel expenditures and profit sharing payments.

Value of Production — Corresponds to the value of the sale, in the factory, of total goods produced monthly by the industrial establishment, including not only goods sold, but also those trans-ferred to other establishments of the same firm, those made for internal use, those distributed withouth charge and those main-tained in inventory. Not included in the value of production are taxes on industrialized products (IPI) and on value added (ICM) . The value of production also includes revenue from industrial ser-vices rendered to third parties, as are designated those operations of an industrial nature — intermediate or finishing — performed by establishments on raw materials or semimanufactured products belonging to third parties. This category includes the processing of agricultural commodities for third parties and, by extension, revenue from the installation or maintenance of machines and equipment produced by the establishments.

Census data — definitions used by the IBGE

Actively Employed Personnel (Employment) — Includes those actively engaged in the establishment on December 31 (of 1959 for the 1960 Census; of 1970, for the 1970 Census) , on a full-time or part-time basis including owners or partners, personnel on vacation or on leave for a period of not more than 30 days and unpaid family members of owners or partners. Actively employed personnel are divided into three major groups: owners or partners actively engaged in the establishment; production personnel; and adminis-

trative personnel and other employees. Not included are domiciliary workers, that is, those who work in their own homes, receiving remuneration for specific chores, piece-work of finishing, using materials furnished by the establishments. The monthly average of actively employed personnel was obtained by adding the number of people actively employed in the establishment during each month of the year and dividing the result by the number of months of information registered.

Expenditures on Wages — (Payroll) — Wages include payments made for the entire month deducting amounts for social security welfare and social assistance (employee's share). Included are bonuses, commissions, the 13th monthly salary, supplementary payments for specified services or expenses, as well as compensation of board members of corporations and other business entities. Not included are *perdiem* expense allowances paid to employees for travel and to employees in outside services. Also excluded are expenditures for the payment of domiciliary workers, which falls in the category of contracted services.

Value of Production — The value of production corresponds to the value of sales or transference within the factory, of the total amount of goods produced by the industrial establishments during the year. Of this production, which encompasses not only goods sold but also those transferred to other establishments of the same firm, those distributed free of charge and those maintained in stock, the amount of the IPI, ICM and ISS (service tax) and the tax on the production of mines, are deducted. Also included in the value of production is revenue derived from industrial services rendered to the firm itself or to third parties, as are designated those operations of an industrial nature — intermediate or finishing performed by establishments on raw materials or semimanufactured products. This category includes the processing of agricultural commodities and, by extension, revenues derived from the installation or maintenance of machines, equipment and other products manufactured by the establishments themselves; as well as, in the publishing and printing industry, the income derived from advertisements.

"Value Added to Raw Materials" — This was calculated by subtracting from the value of production the total expenditures for raw materials and components, wrapping and packing materials, fuel, lubricants, electric energy purchased and, for contracted services, the amount paid to domiciliary workers, representing, consequently, the value added to that of raw materials and components and materials consumed during production by the industrial work performed on the premisses.

156

References

Bach, G.L. e Albert Ando, "The Redistributional Effects of Inflation, *Review of Economics and Statistics* 39 (February, 1957) : 1/13.

Bacha, Edmar L., Milton da Mata e Rui L. Modenesi, *Encargos Trabalhistas e Absorção de Mão-de-Obra,* Rio de Janeiro, IPEA-INPES, 1972.

Bacha, Edmar L., Hierarquia e Remuneração Gerencial", *Estudos Econômicos* 4 (1), 1974: 143/176.

Becker, Gary S., *Human Capital.* New York: Columbia University Press, 1964.

Burkhead, Jesse, "Changes in the Functional Distribution of Income", *Journal of the American Statistical Association* (June, 1953) : 192/219.

Cipollari, Pedro e Roberto B.M. Macedo, "Indexation of Wages: Some Aspects of the Brazilian Experience", trabalho apresentado no Seminário IPE-NBER sobre Correção Monetária. São Paulo (February, 1975). mimeo.

Doeringer, Peter B. e Michael J. Piore, *Internal Labor Markets and Manpower Analysis.* Lexington, D. C., Health & Co., 1971.

Fundação IBGE, *Matriz de Relações Industriais: Brasil, 1970,* Rio de Janeiro, 1976.

Harrod, Roy F., *The Trade Cycle.* Cambridge: University Press, 1935.

Henderson, James M. e Quandt, Richard E. — *Microeconomic Theory,* Tokyo: McGraw-Hill Kogakusna, 1971.

Kalecki, Michael, "The Distribution of National Income" in *Essays in the Theory of Economic Fluctuations,* London: Allen & Urwin, 1939.

Kalecki, Michael, "The Distribution of National Income" (Revised — 1954) ", in *Selected Essays on the Dynamics of the Capitalist Economy,* Cambridge: University Press, 1971.

Leão, Antonio Sérgio Carneiro, Silva, Carlos Ribeiro da, Giestas Elcio e Nóbrega José, — "Matriz de Insumo-Produto no Brasil", *Revista Brasileira de Economia* 27 (July, 1973: 3/10).

Macedo, Roberto B.M. *Models of the Demand for Labor and the Problem of Labor Absorption in the Brazilian Manufacturing Sector.* Tese de Doutoramento, Havard University, 1974 .

"Uma Crítica das Estimativas da Elasticidade de Substituição Obtidas para a Indústria de Transformação", *Estudos Econômicos* 5 (3) , 1975: 141/164.

"Uma Interpretação Alternativa da Correlação entre Emprego e Salário nos Estudos de Demanda de Mão-de-Obra", *Pesquisa e Planejamento Econômico* 6 (April, 1976) : 241/65.

Distribuição Funcional na Indústria de Transformação: Aspectos da Participação do Trabalho. Tese de Livre-Docência, Universidade de São Paulo, Faculdade de Economia e Administração, 1977.

Nadiri, M. I., "Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey", *Journal of Economic Literature* 7 (December, 1970) : 1137/77.

Oi, Walter "Labor as a Quasi-Fixed Factor", *Journal of Political Economy 70* (October, 1962): 538/55.

Rebouças, Osmundo E. *Interregional Effects of Economic Policies.* Tese de Doutoramento, Harvard University, 1975.

Robinson, Joan, "Book Review: Harrod's The Trade Cycle", *Economic Journal* (December, 1936) .

Scitovsk Tibor, "A Survey of Some Theories of Income Distribution", *The Behavior of Income Shares,* Vol. 27 Collection Studies in Income and Wealth, of the National Bureau of Economic Research. Princeton: University Press, 1964.

Taylor, Lance e Cardoso Eliana, "Crescimento, Distribuição e Balanço de Pagamentos: Algumas simulações para o Brasil", *Pesquisa e Planejamento Econômico 6* (April, 1976) : 61/106.

Wells, John. "Distribuição de Rendimentos, Crescimento e a Estrutura da Demanda no Brasil na Década de 60", em Ricardo Tolipan e Artur Carlos Tinelli, eds., *A Controvérsia sobre a Distribuição de Renda e Desenvolvimento.* Rio de Janeiro: Zahar, 1975.

Technological diffusion in the footwear and cotton textile industries of Brazil *

Helio Nogueira da Cruz **
José Roberto M. de Barros **

1 — The diffusion of technological innovation

There exist three distinct, though not exclusive, paths by which the production of goods and services of a given country can grow in the long-run: through a growth in the stock of the factors of production currently used in the productive process; through a reallocation of the factors currently utilized in various activities; and through the increased productivity of presently available factors, due to technological innovation in the production process.

In the long-run, the first two growth paths are admittedly rather limited in their ability to contribute to the growth of total production, unless they accompanied by a process of technical innovation. It is possible, for example, to increase the output of a given economy by shifting factors from activities with a low productivity to those with high productivity. That process, however, is clearly limited by the demand structure and the productivity level of the more productive activities.

As it became clear that in the long-run it is technical progress that most decisively determines the economy's growth capacity, this became a subject of great interest to economists. Nevertheless, despite

the considerable amount of research conducted in this field to date, our knowledge about the entire process of technical change is doubtlessly very incomplete, whether in terms of its origins or of its exact consequences. Notwithstanding these discomforting antecedents, the objective of this study is to discuss a particular aspect of the process of technical change: the diffusion of technological innovation.

For our purposes, it is useful to begin with a definition of technology: "Technologies are bodies of skills, knowledge, and procedures for marking, using, and doing useful things. The concept of technology centers on processes that are primarily biological and physical rather than on psychological or social processes". [1]

The bodies of knowledge referred to above must follow a long path before being totally incorporated into the productive process. In other words, technical progress does not represent a single act, but rather a complex phenomenon with many conceptually distinct aspects. In a didatic manner, we can distinguish among the following phase in the process of tecnical change: " (1) invention or applied research, i.e., the processes of obtaining new ideas and rendering them technically feasible, which may be demonstrated through small-scale testing; (2) the development of plans on a commercial scale; (3) innovation, which takes place by putting plans into full-scale practical use; (4) imitation or diffusion of innovations to additional producers or users. In addition, minor processes of improvement can occur within any of these phases. Finally, the diffusion of technology ... is not merely a matter of exact imitation, but usually involves significant processes of technological adaptation". [2]

It should be pointed out that the sequence of phases described above is not in the least meant to be univocal and linear. A complete feedback system is conceivable, and in practice actually does exist, and it is frequently impossible to distinguish all of the phases in the study of a given technology. What we wish to emphasize is that our study will primarily focus upon problems associated with the diffusion of two technologies rather than their invention or innovation. Since these phases are conceptually distinct, it is methodologically possible to use something similar to partial equilibrium analysis, that is, to discuss models that assume the existence of a producer who

[1] R. S. Merryll, "The Study of Technology", in *International Encyclopedia of Social Sciences* (The Macmillan Company and the Free Press, 1968) , vol. 15, pp. 576-586.

[2] Ibid. Our difficulty in understanding more clearly the process of technical change is well illustrated by the problem of the relation between science and technology. *A priori*, it is clear that since technology is "a body of knowledge and procedures" it should maintain some relation with scientific development. Nevertheless, an analysis of the literature reveals that the type of relation involved has yet to be clearly established.

makes commercial use of a new technology and, then, to consider which mechanism leads other producers to utilize the same tecnique.

In the context of an underdeveloped country, there are several reasons why the study of the diffusion of production techniques is important, perhaps even more important than the study of inventions or innovation. First, a large number of the technologies used are imported,[3] usually inherent to capital goods; in this case, the question of diffusion is clearly more important than that of invention.[4]

Second, as Tavares[5] has pointed out, the sustained dynamism of industrial growth depends increasingly on the adoption of new techniques, whether they be domestic or imported. Moreover, the utilization of new imported technologies leads to the creation of a base of (incorporated) knowledge within the industrial sector, that is indispensable to the success of technological policy.

Finally, the diffusion of new technologies frequently stimulates the local capital goods industry, via demand. This is very clear in the case of the footwear industry: the recent modernization process in the industries of São Paulo and Rio Grande do Sul preceded and stimulated the expansion of machinery producers to the point that today local industry fills the majority of orders. More important, it does so with a reasonable degree of technical sophistication, as reflected, among other things, in the registration of new machine patents.

2 — The diffusion model

The study of the diffusion of techniques can be made on three distinct levels: among sectors, within a single sector, and within a firm. The first level is the most general and the most difficult; its purpose is to study the differential pattern of diffusion in the different industrial branches, given the body of new techniques available to various sectors. Clearly, it is important to discern not only in which sectors the expansion of new technology is fastest, but also what causes the varying rates of diffusion.

[3] This does not mean that all imported technology is appropriate to the country. This question is, however, beyond the scope of the present study.

[4] Even though it is frequently the very process of diffusion that results in a certain number of small innovations, we discuss this case below, in the analysis of the footwear industry. See also, J. M. Katz, *Importación de Tecnología, Aprendizaje Local e Industrialización Dependiente* (Washington, D. C.: Organization of American States, 1972).

[5] José Tavares de Araujo, Jr. (ed.) *et al., Difusão de Inovações na Indústria Brasileira: Três Estudos de Caso,* Monograph Series (Rio de Janeiro: IPEA/INPES, 1976), n.º 24.

At a less aggregated level, it is possible to center our attention upon a particular sector. At this level, by definition, the characteristics of the industrial sector are given, and the differences among firms determine the speed and the pattern of diffusion, as well as the alterations in the general conditions of the sector over time.

Finally, it is possible to study how technological diffusion takes place within a firm. This problem arises because in most cases the adoption of a new technology does not necessarily imply that the firm's entire production process will immediately be carried out by means of the new technique. This occurs commonly when the production process is discrete rather than continuous, and particularly when the innovation is embodied in new machinery. In such a case, technological diffusion takes the form of a replacement process: diesel locomotives replace steam locomotives numerically controlled machine-tools replace machine-tools without controls, etc. Once again, what is of interest here is a description of the diffusion process and an attempt to identify, at the level of the firm, the causes of differences in diffusion.

In this study, we shall concentrate upon an anlysis of the diffusion of innovation at the level of two industrial sectors: the textile and footwear industries.

In order for the process of expansion of techniques to be studied quantitatively, it is indispensable at the outset to establish the manner in which this phenomenon can be measured. The simplest the possible measure is the percentage of firms, at specific points in time, which utilize the innovations, in relation to the total population or samples. Over time, this cumulative distribution should give the pattern and the velocity of the diffusion process. Similarly, by dividing the population into those firms which use and those which do not use the innovation, it is possible to study which characteristics of the firms are most responsible for the effective utilization of the innovation.

This form of measurement is deficient in that it gives equal weight to firms that use the innovation with varying intensities. For example, the same weight is given to a firm which, at a given point in time, replaces all its machines with the new type and another which replaces only 5 percent (given the same stock of machines in the two firms). Therefore, we propose a more refined measure: the pattern of diffusion will be given, within one firm or among firms, by the percentage of production (or employment) generated by the new technology. Or, in the case of a new machine, by the percentage of new machinery in relation to the total stock.

Such a distinction among measurement techniques is not overly important to this study, since it is characteristic of the equipment analyzed (conveyors and ulsters) that, when adopted, it immediately

162

becomes responsible for the entire production process (at least at the level of the section). This means that diffusion within the firm is instantaneous.

It is thus clear that the study of diffusion should be conducted on two levels: (a) the description of the pattern and speed of diffusion, and (b) the attempt to identify causes of that pattern. Regarding the latter, the hypotheses raised by the literature on the subject fall into two groups: those dealing with differences in the characteristics of the firms, and those dealing with differences in market structure. In the remainder of this section, we shall consider the pattern of diffusion, and how it can be explained by differences at the level of the firm. In the next section, we will broach the problem of market structure.

The basic model of technique diffusion found in economic literature (and which we shall use in this article) was formulated by Mansfield,[6] and suggests that the adjustment process has a logistic form. In the field of economics, this format was initially suggested by Griliches[7] and others, although its formulation is not new to other branches of the social sciences. This logistic function can be explained by a model that includes essentially economic factors dealing with the displacement of supply and demand curves for new machinery.

During the first phase, few firms adopt the new machinery. This is due to a low level of demand for the product (owing to the risks of introduction as well as to lack of information concerning the effective advantages of the innovation given local conditions of production) and to the low level of sypply, due to higher manufacturing costs. (Production of the innovation is generally made to other during this initial phase and therefore lacks the advantages of large-scale production; also, the modifications which adapt the product to local conditions are yet to be made).

The second phase is characterized by rapid growht. The risks of using the innovation are reduced (firms attach greater importance to the information generated by the use of machinery by pioneer firms than to supplier's reports, thus attesting to the importance of externalities in the diffusion process). There is a reduction of production costs on the supply side, thus widening its market, and small adaptations are frequently made which expand the market further still.

[6] E. Mansfield, "Technical Change and the Rate of Imitation", in *Econometrica*, vol. 29 n.º 4 (October, 1961), pp. 741-766.
[7] Z. Griliches, "Hybrid Corn: An Exploration in the Economics of Technological Change", in *Econometrica*, vol. 25, n.º 4 (October, 1957).

In the third phase, growth is less accelerated, with the manufacturing costs of machinery stabilized. This provokes a replacement of the old equipment by the new.

Finally, the rate of growth is further reduced, demand is generated only for replacement of the expansion of the sector to which the innovation is destined.

The Mansfield model can be presented in the following form:

We shall assume that:

$i = 1 \ldots x$, represents the various industrial branches;

$j = 1 \ldots y$, new productive techniques;

$n_{ij} = $ total users, real or potential; [8]

$m_{ij}(t) = $ number of firms which have already introduced the innovation in year t;

$\pi_{ij} = $ profitability of an investment in the innovation under consideration, relative to alternative investments;

$S_{ij} = $ investment required by the innovation, as a percentage of the total active capital of the firms.

We define $\lambda_{ij}(t)$ as the proportion of firms which introduce the innovation in $t + 1$, that is:

$$\lambda_{ij}(t) = \frac{m_{ij}(t + 1) - m_{ij}(t)}{n_{ij} - m_{ij}(t)}$$

The basic model can now be formulated. The hypothesis is that the proportion of new users of the innovation in $t + 1$ is a function of the proportion of firms that had already introduced the innovation in t. It is also a function of the profitability of investment, of the size of the required investment, and of other unspecified variables, that is:

$$\lambda_{ij}(t) = f_i \left(\frac{m_{ij}(t)}{n_{ij}}, \pi_{ij}, S_{ij}, \ldots \right) \tag{1}$$

[8] This number must be defined, since certain innovations are not equally applicable to all the firms of the industry under consideration. Usually, this is only due to problems of scale, that is, certain innovations require a minimum scale to become economically feasible. As will be seen below, this problem applies to the cases presented in the present study.

164

Our expectation is that the sign of $\frac{m_{ij}(t)}{n_{ij}}$ should be positive, that is, the larger the number of firms already using the innovation, the faster it will be absorbed. As stated before, greater use increases information and reduces risk, all of which should have an effect on $\lambda_{ij}(t)$.

The sign of π_{ij} should be positive simply because a high profitability of the innovation should stimulate its adoption, even after discounting for different risk aversions. On the other hand, the larger the S_{ij} (with π_{ij} constant) the smaller should be $\lambda_{ij}(t)$, because the effective utilization of the innovation will depend upon the ability to overcome the problem of financing the investment.

Finally, with π_{ij} and S_{ij} constant, $\lambda_{ij}(t)$ should vary among industries since the environment it not uniform among industrial sectors. The environment varies because the industrial structure is not uniform, and because of differences in growth perspectives, attitudes toward risk, etc.

Given that $\lambda_{ij}(t)$ can assume continuous values, equation (1) can be expanded by a Taylor series, which, after simplification, results in:

$$m_{ij}(t) = \frac{n_{ij}}{[1 + e^{-(l_{ij} + \theta_{ij} t)}]} \tag{2}$$

where $l_{ij} = $ a constant of integration, and:

$$\theta_{ij} = b_1 + a_{i1} \pi_{ij} + a_{i2} S_{ij} + z_{ij} \tag{3}$$

where $z_{ij} = $ a random variable.

Equations (2) and (3) suggest the basic results of the model: first, the diffusion of innovations among industries follows a logistic pattern, equation (2). The greater or lesser speed of diffusion is described by the value of θ_{ij}. Second, the pattern of diffusion (θ_{ij}) depends fundamentally on the profitability of the innovation and on the size of investment required by the innovation. [9]

If the proposed hypothesis are reasonable, we can obtain an estimate for the rate of diffusion (on the basis of a very simple model), as well as an economic "explanation" for its absolute level and for inter-industry differences in adoption. It should be noted that the model was constructed explicitly in such a way that it could be applied between industrial sectors as well as :ithin the same

[9] For a more detailed deduction of equation (2), see Mansfield, *op. cit.*

sector. In fact, it has also been used to attempt to explain diffusion within the same firm. [10]

The model given by equation (3) generally has a good statistical performance. [11] Nevertheless, several additional variables were tested, all of which were rejected by statistical criteria. For the sake of illustration, these variables are listed below:

a)   Durability of equipment, in the expectation that the more durable the machine, the less need there will be for replacement and diffusion;

b)   the firms rate of growth possibly signifying smaller risk aversion and greater financial capacity to invest;

c)   the year during which the innovation was introduced, assuming that the longer the period, the more information will be available, and the greater will be the diffusion;

d)   the business cycle phase, assuming that diffusion is greater during the expansion phase.

The Mansfield model, among others, was taken up more recently by Romeo. [12] It is interesting to observe that aside from π and S, Romeo is able to successfully introduce new extension to equation (3). His new variables are as follows: a) the structure of the industry: it is expected that, holding all else constant, the less concentrated the industry the more rapid the diffusion of the innovation; [13] b) the scale of the industry: it is expected that the larger the scale, the slower will be the diffusion process (in the sense that each firm within the industry will have to invest more, in absolute value, to make the same progress, than the firms of smaller industries) ; and c) expenses for research and development as a percentage of sales: it is expected that the large these expenses, the more rapid will be the diffusion, given the greater familiarity with the innovation.

As was previously stated, two approaches have been taken in the study of technological diffusion: on the one hand, models which explain the diffusion pattern, are formulated, and on the other, the characteristics of the innovative firms (as compared to the others) are studied. Having discussed the first, we shall move to the second,

[10] E. Mansfields, "Intrafirm Rates of Diffusion of an Innovation", in *The Review of Economics and Statistics,* vol. XLV, n.º 4 (November, 1963). pp. 348-359.

[11] See Mansfield. "Technical Change...", *op. cit.*

[12] A. A. Romeo. "Interindustry and Interfirm Differences in the Rate of Diffusion of an Innovation", in the *Review of Economics and Statistics,* vol. LVII, n.º 3 (August, 1976) , pp. 311-319.

[13] The next section returns to a discussion of the relation between market structure and innovation diffusion.

166

and in doing so, present the study by Romeo, [14] which we consider to be sufficiently representative.

The group of users and of non-users of an innovation can be distinguished by three basic characteristics: a) profitability of the innovation (in relation to risk, as was discussed above); b) the size of the firm, in the sense that larger firms have a greater stock of machines, greater productive diversification, and greater financial capacity, all of which leads to a greater probability of adopting the innovation; and c) quality of administration; it is assumed that the younger and more trained the management of a firm, the more open the firm will be to using innovations, other things being equal. It should be observed that this model demonstrates a good statistical performance.

Finally, in order to complete this review, it should be remembered that the dependent variable can be measured in two ways: in a discrete way, by using a binary variable which assumes the value of 1 for firms which utilize the innovation and 0 for the remainder, [15] or in a continuous way, where the dependent variable measures the number of years that a firm waited to introduce the innovation after it was first adopted by the industrial sector.

The research described in the second part of this study closely follows the models presented until now, excepting only those re-adaptations deemed necessary to the cases under study.

3 — Market structure and the diffusion process

In the models presented up to now, little attention has been given to the role of market structure in the diffusion process. Actually, the basic model expressed by equations (1), (2), and (3) seems to be more compatible with a competitive structure. So much so that in the study by Romeo, [16] the explicit consideration of industrial concentration is made, assuming greater diffusion with less concentration. The inclusion of the absolute size of the firm as an important variable needs not to be interpreted as an explicit consideration of market structure, but, on the contrary, as a measurement of the operational scale of the industry.

[14] Romeo, *op. cit.*

[15] As Globerman has shown, the extensive utilization of discrete variables can lead to the appearance of heterocedasticity problems. See S. Globerman, "Technological Diffusion in the Canadian Tool and Die Industry", in the *Review of Economics and Statistics,* vol. LVII, n.º 4 (November, 1975), pp. 428-434.

[16] Romeo, *op. cit.*

In constrast to Mansfield's treatment of this subject, many economists suggest that the role of market structure is much more important than has been previously recognized, [17] and that more concentrated structures would result in a more rapid rate of adoption. The basic idea here, which originated from Schumpeter, is that technological innovation is stimulated by the competitive strategy of oligopolistic firms, because it generates rents for innovators and more forcefully guarantees the maintenance of desired market shares. Due to these competitive mechanisms, in less competitive markets we should observe greater research efforts, greater production, and greater diffusion of innovations. [18] Or, as Tavares says, [19] "when an important firm in a given industrial sector introduces a new technique, its closes competitors tend to copy it quickly in order to maintain their relative positions in the market. The factor responsible for the speed of diffusion in this case is that, for the firms which dominate the market, the opportunities of access to knowledge are absically identical. Thus, when one firm introduces an important innovation, the competitors should not encounter very serious difficulties in doing likewise within a relatively short interval of time".

Tavares also suggests that the degree of integration should be considered as an explanatory variable of the diffusion process. "The second hypothesis suggested, that the velocity of diffusion varies inversely with the degree of vertical integration of firms, implies that once a new process is introduced into the market, the firms which opted not to change have at their disposal a considerably wide range of possibilities for maintaining their relative positions in the sector without innovating. Thus, they can postpone the decision to innovate until the moment they seem most convenient, while carrefully examining the results obtained by firms which have innovated, accompanying subsequent development and adaptations which the new method of production underwent, and extending the useful life of that machinery which uses only pre-existing techniques, etc."

In the final part of this study, we shall return to a discussion of these hypotheses within the context of our own research.

[17] Among other things, because in a very concentrated market structure the profitability of an innovation cannot always be assumed to be exogenous.

[18] It should be noted, however, that the study by Kamien and Schwartz suggests that there is little conclusive evidence with respect to the expected positive relation between concentration and the effort expended on innovations, and concentration and the production of innovations. They conclude that "the Shumpeterian hypothesis is far from clear". See M. I. Kamien and N. L. Schwartz, "Market Structure and Innovation: A Survey, in *Journal of Economic Literature*, vol. XIII, n.º 1 (March, 1975), pp. 1-37.

[19] J. Tavares, "A Difusão de Novos Processos Industriais", in *Revista de Administração de Empresas*, vol. 15, n.º 1 (January/February, 1975).

4 — The equipment analyzed: conveyors and ulsters

We shall attempt to accompany the diffusion process of conveyors and ulsters using information from questionnaires [20] applied directly to the footwear and the cotton spinning sectors. We will also make use of a substantial amount of information obtained in direct contact with businessmen and technicians of those two sectors. We will first present a brief description of conveyors and ulsters, and subsequently go on to verify whether the trajectory or diffusion of the two types of machinery conforms to the model suggested by the theory.

By using the econometric results and additional information, we shall explain how diffusion occurred in each case. Finally, we shall try to relate the speed of adoption of conveyors and ulsters to the characteristics of the firms.

a) Conveyors

Conveyors (or the conveyor belt) are machinery used to transport materials and products within footwear plants, being used principally in the guilt-stitching sections and in the assembly and finishing sections.

The belt is activated by manual processes which are electrical or motorized. Different types of central command can be used, from hydraulic to pneumatic control.

The length, width and operational speed of the belt varies depending upon the facilities of each factory and upon each product to be transported. Thus an individual design is needed for each machine to be installed. Its construction is modulated, permitting a subsequent increase in the number of posts. The introduction of modernizing components is foreseen by the manufacturers of the conveyors belts. The introduction of conveyors in the assembly and finishing sections is indicated for production volumes above 200 to 300 pairs a day. In the case of the guilt-stitching section, the volume of production required to make its introduction worthwhile is even greater.

The advantages of the conveyors are: reduction of stock in circulation, economy of space, more rapid distribution of materials, and

---

[20] Fifty questionnaires were used in the footwear sector of the municipality of Franca (State of São Paulo) and 30 in the textile sector (State of São Paulo, various municipalities). For a discussion of the characteristics of the sample, see H. N. Cruz, "Alternativas e Difusão Tecnológicas: O Caso do Setor de Calçados no Brasil", Doctoral thesis (São Paulo, FEA/USP, 1977) and Mendonça de Barros, *et al.*, "Escolha Tecnológica: O Caso da Fiação de Algodão", Paper for Internal Discussion, n.º 12 (São Paulo, IPE, 1976).

greater facility of production control. Generically, it transforms the process of assembly and guilt-stitching into a long production line. The operational rhythm is determined by machines (the production process becomes more continuous) and imposes layout notion in the factories.

b) Ulsters

The machinery was developed in Switzerland in 1946, and arrived in Brazil in 1949. At the present time, there are nearly 200 ulsters in Brazil.

The ulster is a complex of machines whose purpose is to analyse the regularity of textile threads (i. e., number of *neps*, types of irregularity), and, through sucessive tests, indicates the source of phenomenon (i. e., which of the previous phases of the threading process). The equipment is modular, permitting the utilization of components without the need to operate the entire machinery. For example, it can use the spectograph together with the regulator.

This equipment is recommended for factories which produce more than 4.000 spindles (and possibly with modern machines, for otherwise the full potential of the equipment would be difficult to take advantage of). It is chiefly the exporting factories that make use of this equipment, due to stricter standards of quality. There is no similar machinery within Brazil and, even on the international market, there are few competitors. The machinery is electronic and highly advanced.

Today, to buy an ulster in its country of origin, it costs approximately $ 52,000 Swiss francs, keeping in mind that one must consider the costs of import fees, etc. It should be noted that the manufacturer does not offer loans to his clients, granting at most one year's credit, when a 20 percent down payment is made.

The operation of the equipment is simples, demanding no special skills, however a specially trained engineers is required to interpret the results. There are specialized courses for this purpose, given by the factory.

Although this service can be subcontracted, in practice this seldom occurs, due to the frequency with which the machines are adjusted and to the repetition of operations needed for adjustments and localization of mechanical faults.

5 — The adjustment of conveyors to be logistic curve

In this section we seek to determine whether the diffusion of conveyors has obeyed the logistic form, as foreseen in our theory and verified in other studies.

170

We made four attempts at adjustment to the logistic curve, all presenting results with high statistical significance. Graph No. 1 shows the cumulative distribution of the conveyors over time, suggesting in itself, a logistic form.

The first attempt was made using only the conveyors introduced in the assembly and finishing sections. We determined a value of 35 for n (the number of firms with conveyors, towards which it should tend after the process of adjustment is concluded. It should be noted that we are thus respecting the production structure with small and large firms, and that for small firms it is not economically feasible to introduce conveyors). The results are highly significant, as the regression 1 of table 1 shows.

A second attempt at adjustment to the logistic curve was made for the conveyors in the assembly and finishing sections with a value of $n = 35$, this time, however, abandoning the first three observations, as suggested by Griliches. [21] The idea behind Griliches' sugestion is that the first values may not necessarily correspond to the logistical standard. The results remain highly significant.

Graph 1

CUMULATIVE DISTRIBUTION OF CONVEYORS
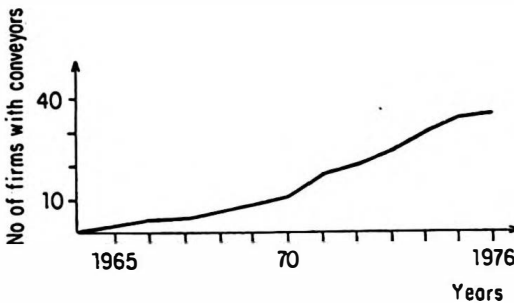
[21] Z. Griliches, "Production Functions in Manufacturing: Some Preliminary Results", in M. Brown (ed.), The Theory and Empirical Analysis of Production, NBER Studies in Income and Wealth, vol. 31 (New York: Columbia University Press, 1967).

The third and fourth attempts included the conveyors of the guilt-stitching section as well. Since this equipment is economically feasible only for large scales of operation (possibly over 1,500 pairs a day) we raise the value of n to 50. The third attempt presents the results using all the observations, while the fourth attempt excludes the first three, as in the case of the previous regression (2). The results remain highly significant.

<div align="center">

Table 1

The Adjustment to the Logistic Curve — Conveyors

</div>

Test Number	Types of Conveyors	Constant (t)	Parameter Θ_{ii} (t)	n	R^2	Number of Observations
1	Assembly and Finishing	— 4.19403 (—27.0315)[a]	0.502810 (26.6972)[a]	35	0.9862	12
2	Assembly and Finishing	— 2.99171 (—25.9352)[a]	0.56139 (28.1659)[a]	35	0.9913	9
3	Guilt-stitching, Assembly and Finishing	— 3.73760 (—37.1750)[a]	0.441386 (32.3104)[a]	50	0.9905	12
4	Guilt-stitching, Assembly and Finishing	— 2.9400 (—18.6192)[a]	0.476596 (16.9850)[a]	50	0.9703	9

[a] Parameters significant at 1%.

It seems safe to conclude that the diffusion process for conveyors closely followed the logistic standard. The statistical results are highly significant.

Furthermore, the rate of adoption for conveyors was quite high relative to other industrial studies, as demonstrated by table 2, from Mansfield, [22] and the data from table 1 above.

The rapid diffusion of conveyors is explained by the substantial reduction of costs that the new process permits [23] and a rapid expansion of the market (principally due to exports). [24]

[22] See Mansfield, "Technical Change...," *op. cit.*

[23] Due to a lack of more complete information, it was not possible to determine the profitability of the process which uses conveyors as opposed to manual transportation. There is, however, a strong consensus that the process would revolutionize the sector.

[24] As the table that follows indicates, the footwear sector of Brazil presented a higher rate of growth from 1968 on, with the advent of exports. For greater details on this sector, see Cruz, *op. cit.*

172

Table 2

Volues of θ_{ij} in Various Industries

Processes	θ_{ij}
Diesel Locomotive	0.20
Centralized Traffic Control	0.19
Car Retarders	0.11
Continuous Wide Strip Mill	0.34
By-Product Coke Ovens	0.17
Continuous Annealing	0.17
Shuttle Car	0.32
Trackless Mobile Loader	0.32
Continuous Mining Machine	0.49
Tin Container	2.40
High Speed Bottle Filler	0.36
Pallet Loading Machine	0.55

Source: Mansfield, "Technical Change ...," *op cit.*

Through the research conducted on this sector, we collected additional information that clarifies and confirms the diffusion process for conveyors.

a)   First Phase of the Introduction of Conveyors

The first mechanized conveyors appeared in the Brazilian footwear industry in 1965. It should be noted, however, that the conveyor assembly-line system was introduced by Ford in the automobile industry in the beginning of the century, and in the 1930's appeared in the footwear sector. In the 1950's it was widely used throughout Europe and the United States, which means that the Brazilian industry for a long time resisted in installing this radical innovation.

The introduction process of the conveyors attests to the importance of adapting the innovation to local conditions. The introduction of the first conveyor in the Brazilian footwear industry appeared as an answer not only to the problem of transportation stock but as a way to improve the layout of the factory. The first conveyor was ordered by Samello from a firm specializing in industrial transport systems, which emphasize the interindustrial nature of the techinical change process and reveals the adaptation effort that was required for the production of a conveyor belt geared to the needs a footwear factory.

b) Second Phase of the Conveyors Diffusion

Two wears after the introduction of the conveyor by the pioneer firm, followers begin to appear in rapidly growing numbers. The machine industry for the footwear sector began to produce conveyors (that is, the components, as the belt in itself is adapted to each factory) initially upon order and soon afterwards with operations geared to the market. Thus there was a cost reduction. Soon afterwards, numerous improvements occurred in the conveyors, permitting several types of control systems as well as the utilization of conveyors in different sections of the factory. What aided this rapid diffusion of conveyors was the strong growth in footwear production, due, was previously seen, to a growth in exports, which increased the demand for conveyors.

It should be also noted that the study of the diffusion of conveyors attests to the importance of externalities, since the firms attached a great deal of importance to the experience of other industrialists with machinery. Thus, within the very process of diffusion, there is a creation of information. In addition, the spatial concentration of production must have aided the spread of that information.

c) Third Phase of the Conveyors Diffusion

In this phase, there is only demand for replacement of machinery and for growth of the footwear sector as a whole. Wherever the replacement of old methods by new ones could feasibly take place, it has already occurred. This phase was reached around 1975, according to numerous impressions obtained from the sector and verified by the sample survey of firms.

Therefore, it seems safe to conclude that not only were the econometric tests favorable, but other information tends to confirm as well that the diffusion of conveyors in the footwear industry accompanied the pattern predicted by the theory.

6 — The adjustment of ulsters to the logistic curve

The adjustment of ulsters to the logistic curve also showed good results, as suggested by simple observation of the cumulative distribution of the number of ulsters in the sample firms, presented in the graph 2 below.

Table 3 shows that the econometric adjustment to the logistic function, in the case of the ulsters, also presented fairly high levels of statistical significance, both in the case in which all the information was used, as well as in the case in which we exclude the information from the first three firms which adopted the machinery, as Griliches suggests.
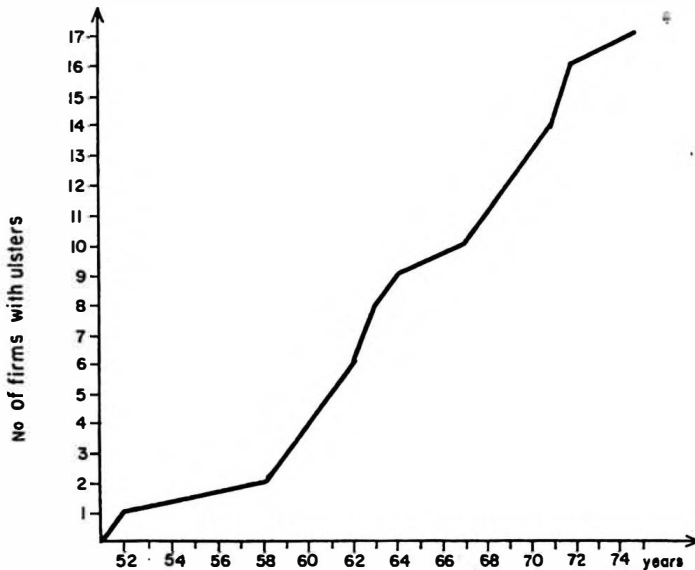
Graph 2
CUMULATIVE DISTRIBUTION OF ULSTERS

Table 3

The Adjustment to the Logistic Curve — Ulsters

Test Number	Constant (t)	Parameter θ_{ij} (t)	n	R^2	Number of Observations
1	— 3.56658 (—26.1444)[a]	0.217535 (23.7057)[a]	20	0.9395	25
2	— 2.51976 (—13.7500)[a]	0 217501 (13.5325)[a]	20	0.9151	19

[a] Parameters significant at 1%.

Although the first ulsters appeared in the sample firms in the early 1950's, it was in the 1960's that the diffusion process accelerated. The parameter which measures this rate of diffusion (θ_{ij}) presented low values, as compared to the case of the conveyors, owing to the slower diffusion (though close to the mean of the values in table 2)

which began in the early 1950's. This slower diffusion is probably due to the fact that the large amount of necessary resources to introduce ulsters makes them economically feasible only at a large scale of operation. It should be pointed out that the textile sector in this period presents a much slower growth rate than the footwear sector. Also in this case, it was not possible to compare the profitability of the equipment in relation to alternative processes.

7 — Additional information concerning the diffusion of ulsters

In the case of ulsters, it should be noted that the equipment arrived in Brazil close to three years after its appearance in Europe, which reveals that the crossing of international borders was rapid, principally if we consider the example of conveyors previously examined. Since we are dealing with rather complex electronic equipment, it is not easy to implement adaptations that might arise from their use in the factories. Adaptations to the peculiarities of conditions in Brazil also are made difficult by the lack of domestic firms manufacturing similar products, since the product requires a large market to be produced, making it difficult to gear the manufacture of such products to the specific needs of different regions.

The acceleration of the diffusion of ulsters grows stronger with the increase in exports, as the quality standards required in the international market are more demanding than those that prevail in the domestic market. It may be concluded, therefore, that the market for this study is subject to the performance of Brazilian exports. It should be noted that the response by domestic producers of capital goods, which was evident in the case of the conveyors, did not hold in the case of the ulsters, probably due to the relatively small size of the Brazilian textile sector in relation to the specifications required for the production of such complex machinery.

8 — Characteristics of the firms which adopted conveyors

We shall now attempt to trace the diffusion process of conveyors, identifying the characteristics of firms that first adopted them in relation to the other firms of the sector.

The first study which tried to associate the adoption rate of a technical innovation to the characteristics of the firm was that of

Mansfield.[25] It presents as principal variables for the adoption of an innovation: the size of a firm and the profitability of the innovation for a firm *vis-à-vis* other firms, with a positive relation in both cases. Other explanatory variables that it proposes are the rate of growth, age of the president of the firm, liquidity, and the profit trend, all of which presented statistically non-significant results for the chosen industries.

Globerman and Romeo,[26] following the lines of Mansfield's work, obtained similar results.

In its simplest form.[27] the model can be presented as follows:

$$d_j = Q_j^{al} \; H_j^{al} \; S_j^{al} \; F^{aj};$$

where d_j = number of years that the firm waits to adopt an innovation;

H_j = measure of profitability of the innovation;

S_j = size of firm;

Q_j = measures a scale factor;

I = random variable;

and where it is expected that a_1 and a_2 are negative.

9 — Variables used

We shall attempt to introduce some modifications in the preceding model, and to adapt it to the conditions of the two sectors studied, as well as to the wealth of information available through the research of IPE/USP. We shall adopt the following variables:

a) Footwear Sector

i) Size Variable: the justification given by Mansfield is that the larger firms run lower risks as pioneers, due to greater availability of financial resources and to greater facility for experimentation (more information, more qualified personnel) ; the larger firms have a greater amount of equipment making it more probable that the

[25] E. Mansfield, "The Speed of Response of Firms to New Techniques", in *Quarterly Journal of Economics,* vol. LXXVII, n.º 2 (May, 1963), pp. 290-309.
[26] See Globerman, *op. cit.,* and Romeo, *op. cit.*
[27] We shall present additional variables which will be introduced in model (I), maintaining the same structure of H_j, S_j or Q_j.

innovation will be suitable to their needs; and, owing to a greater number of machines, the probability that they will have to replace old machinery is greater (and, therefore the impediments to rapid adoption are diminished).

It seems important to point out that the growth of firms implies surpassing a number of indivisibilities, including those required for the adoption of any innovation

We shall adopt as proxy variables for the size of firms, the value of sales in 1975 and the value of capital applied to machinery, also in 1975.

ii) Information Variable: measured by the number of trade fairs (multiplied by 3) [28] and of magazines that the firms receive (multiplied by 1) thus constituting an information index. The justification is that knowledge of innovations could have played an important role in determining the rate of diffusion of conveyors. The relevance of this variable was inferred from the questionaires, where we inquired about the kinds of information most utilized.

iii) Education Variable: measured by the maximum level of education attained by individuals of the firms in the sample. This substitutes the age variable of the Mansfield model, essentially because of its joint effect with the information variable and the foundation of the firms.

iv) Foundation Variable: attempts to measure the experience of the firm in the sector, by the number of years since its foundation.

v) Firm's Rate of Growth Variable: seeking in this way to determine the machinery needed for the growth which arises from the modernization of the sector and of the firms. The rate of growth was calculated alternatively by criteria of sales and of capital (the rate of change between 1973 and 1975) insofar as these were the only ones available.

vi) Export Variable: utilized due to the enormous modernizing influence which arose from pressures of the external sector. It can, in the case of conveyors, also reflect the demands for standardization imposed by the large importers.

b) Spinning Sector

The variables chosen in the spinning sector were practically the same as in the footwear sector with the exception of the rate of growth, which we were unable to calculate due to lack of information.

---

[28] The possibility of multiplying the number of trade fairs by three and of adding it to the number of magazines and journals arose in interviews with technicians from the sector.

178

i) Size Variable: we adopt three alternative measures to evalute the size of the sample firms: sales, measured by the value of sales for September 1975 of all the firms' products; capital, measured by the value of the Balance of Capital plus Reserves and Funds in 1975 for the samples firms; and spindles: the number of spindles is the measure most commonly used in the sector to identify the size of a spinning.

ii) Information Variable: measured by the same criteria as in the footwear sector.

iii) Education Variable: measured by the number of engineers in the firms in 1975. This variable, however, is related more directly with the production level than in the case of the footwear sector (where the presence of engineers is not widespread) .

iv) Foundation Variable: same criteria as the footwear sector.

v) Exports: same criteria as the footwear sector.

10 — Econometric fit

a) Footwear Sector

We used these variables both with continuous and discrete values. The idea of using discrete variables in cases such as this had already occurred to Globerman, [20] who tried to show that there are more critical values than continuous relations in determining various types of behavior.

We attempted to test this model for the entire sample as well as for the case that includes only firms with conveyors, in order to overcome the problem arising from the fact that it is only beyond a certain size that introduction of an innovation becomes economically feasible.

It is important to point out that the results which were obtained are more consistent with those generally presented in the literature, especially in the case of continuous variables, as the values found in table 4 attest.

The adoption of a logarithmic form, which is more in line with the theory developed previously, has shown itself more capable of specifying the phenomenon, and substantially improves the results.

It should be pointed out that the size variable performs quite consistently among all the firms included in the samples, both in the cases where the variable was measured by the value of sales and

[20] See Globerman, *op. cit.*

Table 4

Explanation of the Conveyors — Regression Analysis

Number	Number of Observations	Independent Variables	Coefficients of Key Variables and Student "t"	R^2
1	50	FUND; INFC; SALC; EXPC; EXPD; (Continuous)	$0.0713 + 0.000$ (SALC) $+ 2.0206$ (EXPD) 2.1957[b] 1.9373[c]	0.2831
2	48	EDU; INFC; KPTC; RGK; (Continuous)	$-0.1091 + 0.3448$ (EDU) 4.6877[a]	0.3232
3	39	SALC; EDU; INFC; RGS; (Continuous)	$-1.2873 + 2.1689$ (EDU) 4.0826[a]	0.3105
4	39	EDU; INFC; SALC; RGS; (Continuous)	$-0.4626 + 0.3514$ (EDU) $+ 0.0060$ (RGS) 4.8085[a] 1.4929	0.4286
5	50	EXPD; EDU; NAD; SALD; INFD; (Discrete)	$0.5372 + 0.2645$ (EDU) $+ 0.2475$ (NAD) 3.3775[a] 2.4140[a]	0.4010
6	48	KPTC; RGK; INFC; (Continuous)	$-0.9698 + 1.8631$ (EDU) $+ 0.0003$ (KPTC) 3.4966[a] 2.8139[a]	0.3733
7	50	EXPD; SALD; EDU; INFD; NAD; (Discrete)	$0.5410 + 0.0413$ (SALD) $+ 0.2358$ (NAD) $+ 0.2426$ (EDU) 0.4951 2.2416[b]	0.4041
8	33	FUNDC; INFC; SALD; EXPC; EXPD; (Continuous)	$4.4660 + 0.0000$ (SALD) 2.2827[b]	0.1439
9	33	SALD; EXPC; FUNDC; INFC; EXPD; (Continuous)	$4.4660 + 0.000$ (SALD) 2.2827[b]	0.1439
10	32	KPTC; RGK; INFC; EDU; (Continuous)	$4.8917 + 0.0002$ (KPTC) 2.8945[a]	0.2183
11	33	KPTC or VDC; EXPC; NANO; FUND; INFC; EDU; (LOG Continuous)	$1.4759 + 0.0349$ (EXPC) 2.2543[a]	0.1408
12	50	SALC; EXPC; INFC; NANO; FUNDC; EDU; (LOG Discrete)	$-11.7415 + 0.7822$ (SALC) $+ 1.6388$ (EDU) $+ 1.4597$ (FUND) 2.8302[a] 1.8582[c] 2.8211[a]	0.5662
13	50	EXPD; SALD; NTK; INFD; EDU; NAD;	$-0.0171 + 0.0806$ (SALC) $+ 0.3138$ (NAD) $+ 0.2081$ (EDU) 0.8061 2.3383[a] 2.5762[a]	0.41131
14	49	KPTC; INFC; NANO; EXPC; FUNDC; EDU; (LOG Continuous)	$-7.6900 + 0.5662$ (KPTC) $+ 1.7812$ (EDU) $+ 1.1611$ (FUNDC) 2.9015[a] 2.1106[a] 2.1477[a]	0.5756

[a] Significant at 1%
[b] Significant at 5%
[c] Significant at 10%

Symbols used: EXPC = Exports — Continuous;

EXPD = Exports — Discrete (2 is exported, 1 is not exported);

SALC = Sales — Continuous;

SALD = Sales — Discrete (under 5,000 Cruzeiros = 1; 5,000 to 10,000 Cruzeiros = 2 and over 10,000 Cruzeiros = 3);

NANO = Conveyor — Continuous;

NTK = Conveyor — Discrete (with conveyor = 2; without conveyor = 1);

INFC = Information — Continuous;

INFD = Information — Discrete (over 20 = 3; 10 to 20 = 2; under 10 = 1);

EDU = Education (college = 3; high school = 2; primary = 1);

FUND or FUNDC = Years of Foundation — Continuous;

FUNDD = Years of Foundation — Discrete (over than 15 years = 3; from 5 to 15 years = 2; less than 5 years = 1);

KPTC = Capital — Continuous;

KPTD = Capital — Discrete;

RGK = Rate of Growth of Capital;

RGS = Rate of Growth of Sales.

in the case where it was judged by the amount of capital. The level-of-education variable performs even more significantly. In the case of the discrete variables, the variable which measures the number of years since the foundation of the firm performs strongly, showing that a minimum of experience must be important for the more rapid adoption of new equipment. Only with less rigorous criteria of statistical rejection can the variables for exports (discrete) and for the rate of growth of sales be accepted.

In the case of the sample which includes only the firms with conveyors, the size-of-firm variable, is almost exclusive, whether measured by the value of sales or by capital.

Other variables were doubtlessly important to the diffusion process of the conveyors, but were eliminated due to the presence of multicollinearity.

It is known, for example, that in the process of technological diffusion the information variable plays an important role. And the reasons are not only theoretical. According to our questionnaire, firms attribute great importance to the experience of other industrialists with the machinery (it could be argued, along these lines, that the education variable also measures the phenomenon of information, and that the latter does pass the test for statistical significance, but not in the most adequate manner). It can surely be concluded, however, that the identification of a size variable, the inclusion of the number of years since the firm's foundation, and the education variable give highly satisfactory results.

The quality of our results can be judged by comparing them with those obtained in other similar studies. The studies of Romeo and Globerman, on the diffusion of the systems of numerical control in machine-tools in the United States and Canada, indicate an R^2 of 0.464 and 0.265, respectively. The statistically significant variables in the case of Globerman were the size of firms (measured by the number of employees) and the age of its president (his sample is of 82 firms). In Romeo's study, the same variables appear, as well as the education of the president of the firm (his sample includes 104 firms).

These comparisons allow one to conclude that the results obtained with the conveyors, 1) are consistent with those found in relevant economic literature, 2) bring to light the role of other variables that previously had been little explored, and 3) from a statistical point of view, were superior to those genrally found.

b)   Spinning Sector

As in the case of conveyors, the utilization of discrete variables and the application of a logarithmic specification did not imply

182

significant differences of fit; we opted, in this case, to present the results using only continuous variables with a linear specification.

Alternatively using the three measures of size, these always appear as important variables in explaining the fit of function to a variable measuring the size of the firm, as compatible with the high cost of the machinery, and the information index. In this case as well, the fit is quite good, when compared with other studies of this kind.

The export variable does not appear with a statistically significant coefficient, probably because of the multicollinearity, above all because it is highly correlated with the size variable. The level-of-education variable, measured by the presence of engineers, though important in the case of the conveyors, is weaker in the case of the ulsters, since practically all the firms use them to a similar degree, thus leaving no way to adjust and explain the residual variance.

The foundation variable, which also played an important role in the case of the conveyors, does not appear as important in the case of the ulsters, due to the high foundation age of the firms, possibly indicating that the firms have generally reached a critical level of experience making this variable of little use in explaining behavior.

In sum, these results seem to relegate importance to those variables which are consistent with the literature and which agree with the above study of conveyors.

11 — Discriminant analysis

a) Footwear Sector

Using discriminant analysis, we attempted to determine whether there were significantly differentiated characteristics between the group of firms that own conveyors and the rest of the firms in the sector. We also attempted to determine the degree to which the firms that own conveyors can be considered the more "modern" group, since, as was suggested to us by a technician of the sector, the conveyor is a key piece of machinery. [30] As tables 6 and 7 indicate, the division between firms that own conveyors can be made according to a vector which includes numerous variables, as the F values

---

[30] The notion that conveyors are a key machinery was suggested by an important technician of the sector. The principal arguments concern the demands for a more organized layout, requiring technical and administrative changes, in order to be fully exploited. Deficiency eliminates small firms, for whom the adoption of conveyors is not economically feasible, thus relegating them to the group of the non-modern firms, which is not strictly true.

on the zero level attest. However, due to the problem of multicollinearity, on the last step not all the variables appear with statistically significant values, both in the use of continuous variables and in the use of discrete values.

As can be observed in the table, the variables which proved most important in discriminating between the two groups were level of education and the firms' date of foundation, given their statistical weight and significance.

Table 5

Ulsters — Regression Analysis

Number of the Regression	Number of Observations	Independent Variables	Coefficients of Important Variables and Estimated (t)	R^2
1	29	SALC; EXP· ENG; INF· FUND	$-10.2813 + 1.4286$ (VDAC)$+$ (3.6154)[a] $+ 0.9042$ (INF) (2.1272)[b]	0.5189
2	29	KPTC; EXP· ENG; INF; FUND	$11.0539 + 1.2018$ (KPTC)$+$ (2.5265)[a] $+ 1.0796$ (INF) (2.3381)[b]	0.4196
3	29	EXP; SPIN; ENG; INF	$-17.0480 + 1.9270$ (SPIN)$+$ (4.1671)[a] $+ 0.9439$ (INF) (2.3903)[b]	0.5665

[a] Significant at 1%.
[b] Significant at 5%
Symbols used:
SALC = Sales
EXP = Exports
INF = Information
FUND = Foundation
KPTC = Capital
ENG = Engineers
SPIN = Spindles

b) Spinning Sector

The results of the discriminant analysis show that the variables which could be selected to separate the group of firms that own ulsters from the other firms are: a size variable, here represented by the number of spindles (which exhibited the best fit in the regres-

184

sion analysis), the information index and, further down, the value of exports that are associated with more demanding quality standards of the international market. These results are similar to those found in the regression analysis presented above, with the exception of the export variables which appears here in a more significant role. It should be noted, moreover, that even those variables which are not statistically significant enough to discriminate between the two groups of firms nevertheless present weights with the correct signs.

Table 6

Discriminant Analysis: With and Without Conveyors
Continuous Variables

Variable Names	Zero Level F Statistic	Final Level F Statistic	Weights of the Variables	Entry Level F Statistic
Sales	5.7601[b]	0.9610	0.90749	0.1421
Exports	3.3506	0.8311	—0.83891	0.8311
Foundation	10.2271[a]	2.8211[b]	0.76485	2.9716
Information	7.4760[a]	0.0012	. . . . .	. . . . .
Education	23.2913[a]	11.0610[a]	1.49085	23.2913[a]
Constant			0.41978	

$F_a = 6.809$ (significant at 1%).
See notations in table 4.

Table 7

Discriminant Analysis: With and Without Conveyors
Discrete Variables

Variable Names	(F_0)	Final Step F Statistic	Variables Weights	F to Enter
Exports	6.1455[b]	0.0425	0.10811	0.0425
Sales	10.6281[a]	0.3429	0.23234	0.2452
Information	1.1731	0.0670	—0.14815	0.0688
Education	23.2913[a]	6.7915[b]	1.38624	23.2913[a]
Foundation	16.4839[a]	4.7201[b]	1.00820	5.8305[b]
Constant			0.46722	

$F_a = 6.000$ (significant at 1%).
See notations in table 4.

Table 8

Discriminat Analysis: With and Without Ulsters

Variable Names	F to Enter	(F₀)	Final Step F Statistic	Weights
		(GL = 1.27)		
Exports	1.1992 (1.24)	4.6762[b]	1.2190	0.92952
Number of Spindles	7.4998 (1.26)[b]	10.1726[a]	0.9181	0.82643
Number of Engineers	0.7827 (1.23)	1.2648	0.7827	0.51734
Information	10.6484 (1.27)[a]	10.6484	8.1851	1.72154
Foundation	1.0635 (1.25)	1.2145	1.9253	0.83820
Constant				0.34198

Value of final step F Statistic = 4.754 (significant at 1%, with 5.23 degrees of freedom).
See notations in table 4.

12 — Summary and conclusions

We have been able to identify the major similarities and differences which appear among industries during the process of technological diffusion. Such differences are the velocity with which the diffusion takes place and the variables which determine the behavior of the firms in each sector. We have achieved this by tracing and comparing the process of technological diffusion of conveyors and ulsters in the footwear and textile industries, respectively.

In the case of the conveyors, we noted that the machinery was introduced in the footwear industry only after it had been in use for several years in the rest of the world. The introduction of this innovation depended upon the efforts of and the information provided by domestic producers, although there was a multinational firm which had experience with and produced the machinery in its main plant. (This firm was the United Show Machinery Corporation. It should be noted that, although it was familiar with the process, it specialized in a more advanced model, which has yet to be used in Brazil). Once the diffusion process is started, it spreads at a rapid rate. Owing to the high profitability of the new process, production increases and is oriented towards the international market. This, in turn, applies pressure for the utilization of the machinery, because foreign quality standards requirements are stricter and standardization is more rigid. The domestic industry promoted adaptations

in the process, since the machinery was relatively easy to produce and required a different plan for each factory. In this case, interindustry relations were important, since the first conveyors were ordered by a firm which specialized in a type of industrial transportation that had nothing to do with the footwear sector.

In the case of ulsters, the machinery arrived in Brazil a few years after it was put to use in other countries; the Brazilian industry still does not produce similar machinery. Although its introduction in Brazil has been rapid, its diffusion only accelerated with the growth of the domestic market and with expansion towards the international market (which also pressures the factories to use new equipment by requiring higher quality standards for textile threads) . In this case, there were no adaptations to be made for the domestic market, since the local market was not large enough to alter a machine as complex as the ulster.

The size of the firms was an important variable in explaining their behavior as a pattern of adoption of machinery, both in the case of the conveyors and the ulsters. This attest to the importance of indivisibilities in the technological diffusion process. It can be pointed out that the two types of machinery require a large operational scale (large in relation to the size of the establishment in each sector) . It seems to be clear from this analysis that the technological diffusion process is also a problem of information diffusion, information not being a static element, but rather generated during the diffusion process. This is verified by the emphasis that industrialists gave to the experience of other firms with the equipment. The information variable is especially important in the case of the ulsters.

In the case of the conveyors, two additional variables for the behavior of firms in the footwear sector are significant: the educational level of personnel and the experience of the firms, measured by the number of years having passed since their foundation. In the case of the ulsters, the variable that measures the exports of firms from the textile spinning sector also appears significant, along with the size and information variables.

As pointed out throughout this study, we did not explicitly consider the role of industrial structure in the diffusion process, as was done in other studies, such as that of Tavares, and others. [31] First, upon deciding to analyze the cotton spinning sector (chosen because the technological process is more precisely defined here) , from the outset, we excluded weaving and dyeing, etc. By definition, this eliminates the industrial integration variable. At the same time, we work with a nearly homogeneous product, which also excludes

[31] See Tavares (ed.) *et al.*, "Difusão de Inovações...", *op. cit.*

possibilities of product differentiation. [32] In addition (and this is true for spinning as well as for footwear production), the industrial sectors analyzed are relatively disconcentrated, even spatially, thus reducing the explanatory value of the variables. In sum, it seems that, in the cases studied, the characteristics of firms are relatively more powerful variables than those of concentration and industrial integration, without implying that the latter are irrelevant in other cases. For this reason, we opted to proceed in the Mansfield tradition, rather than follow Schumpeter.

Finally, some of the implications of the study as regards industrial policy must be discussed. The three most important points seem to be: (a) the impact of the diffusion of techniques upon the capital goods sector, (b) the role of exports, and (c) the significance of the information level upon technological performance.

With relation to the capital goods sector, it is worth noting that the diffusion of techniques is the first step in a process of import substitution. With diffusion, the size of the domestic market for machinery increases, thereby increasing the probability that minimum scales in the production of capital goods can be attained. Similarly, the larger the market, the greater the possibilities that a production line of equipment can be diversified enough to meet clients' needs. Finally, the diffusion process is also a learning process, where the use, maintenance, and, eventually, the production of the machine itself generate knowledge and specialized labor, which result in the viability of broader plans of import substitution. The case of the conveyors illustrates this point well.

Nevertheless, it should be pointed out that the above observations are not sufficient conditions for domestic production. In several cases, the technological complexity of the machinery is so far beyond the possibilities of local industry that a very successful diffusion process is not enough to result in domestic production, as the case of the ulsters attests. Actually, the experience with conveyors and ulsters represents a much broader situation in the context of Brazilian industry, that is, it may be applied to the relative sucess of the expansion of the mechanical sector (with mostly domestic firms) and the difficulties observed in the electronic sector. Although it is not the only important variable the differences in access to basic technology doubtlessly explain a good part of this experience.

The second point to be mentioned concerns exports. In the two cases analyzed, an intense process of technological renovation clearly

[32] It must also be considered that the use of ulsters is closely associated to the export of threads. This substantially reduces the importance of the demand from other segments of the firm for the diffusion process.

188

took place within two of the more "traditional" sectors of the Brazilian industry. And in both cases it was found that the commercial opening to the exterior was decisive in achieving this result. This gain, which is dynamic in character, partially qualifies the contention that exports of traditional manufactured products "benefit excessively" from the system of incentives to exports. This does not mean that the incentive system should be frozen over time, but simply that dynamic gains are added to the eventual economic losses which are identified by statistic criteria. The very increase in productivity, which results from technological modernization facilitates a revision of the incentive system initially established.

Finally, the importance of the generation of information is clearly conveyed in our analysis. As a corollary, it can be said that an industrial policy requires the creation of the largest possible number of information channels. It is worthwhile bearing in mind, as our field research proves, that despite all the technology of information, the most powerful channels today are still personal contact and direct observation.

Economic policy and the agricultural sector during the postwar period

Fernando B. Homem de Melo •

Summary

This article focuses on the Brazilian postwar economy. It analyzes the economic policy options implemented during this period and the repercussions they had, particularly upon the agricultural sector. The development strategy which characterized this period favored the industrial sector to the detriment of agriculture, thus causing significant changes in all of the country's economic sectors. Also discussed is the extent to which this option benefited society. Historical events are analyzed to facilitate a better understanding of current problems and future trends in the Brazilian economy.

1 — Introduction

During the period 1967-73, the Brazilian economy experienced high rates of economic growth, and since 1974, several important events have had a profound impact on the Brazilian economy. First, the petroleum crisis, which began in October of 1973, resulted in the deterioration of Brazil's balance of payments, and contributed to the considerable increase in the country's foreign debt. Second, the inauguration of the new federal government in March of 1974 marked the beginning of an still greater concern with income distribution, a theme which had already been intensely discussed since the early 1970's. Finally, there was the fresh outbreak of the inflationary process, with the situation worsening in 1976 and 1977, when inflation indices reached 45% and 40%, respectively.

191

In response to these new circumstances, several policies in effect were altered and new economic measures were implemented. These measures included more liberal wage readjustments in the private sector, the determination of ambitious import substitution projects for basic commodities and further incentives for the export of manufactured products. However, only since mid-1977 has the set of measures adopted to combat inflation been applied with greater consistency.

Today, the Brazilian economy is most likely in as critical a position as it was in the early 1950's with regard to its need to define development guidelines. Thirty years ago, Brazil was faced with a variety of economic problems and consequently selected the strategy of industrialization via the import-substitution of durable goods. The measures introduced to implement this strategy had profound effects on Brazilian society, both positive and negative; it is therefore expected that the new development parameters to be defined will exert much influence upon the performance of various sectors of the economy for many years to come. Hence the importance of studies concerning the options available to Brazilian policy-makers; such studies must take into account Brazil's development experience, especially with regard to those policies which have been implemented and which affect the agricultural sector in particular. It is in this context then that we propose to analyze the key elements of Brazil's economic policies over the last thirty years and also to analyze the role of the agricultural sector in the development strategy defined after World War II. We shall attempt to use historical events related to the Brazilian economy in order to better understand the problems of the country's agriculture. This section of the article, therefore, takes its lead from McCloskey's (1976) inquiry: From an economic point of view, is it useful to study the past? We believe that it is. since the historical facts are plentiful, precise and quite varied.

2 — The definition of the development strategy

Although several industrial sectors of the economy had evolved considerably since the beginning of this century, at the outbreak of World War II, Brazil was still a country predominantly engaged in primary sector activities; 1940 Census data revealed that 67.0% of Brazil's economically active population was employed in the primary sector, as compared to 14.8% and 18.5% in the secondary and tertiary sectors respectively. These proportions were essentially the same as those prevailing in 1920 (Baer, 1965). This situation existed for almost half the century, despite the significant development of certain industrial sectors, especially textiles, footwear, clothing and

food products. [1] Nonetheless, the industrialization that took place in Brazil until the end of World War II, resulted much more from external conflicts and depression, and the domestic market's natural development, than from anything resembling a deliberate strategy on the part of the Brazilian government. [2]

The literature on Brazilian development presents several explanations for Brazil's outstanding industrial achievement in the twentieth century, despite its still farily undeveloped industrial sector. First, the evolution of the Brazilian economy was hindered by the trade policy implemented by Portugal during the colonial period, since it restricted the Brazilian market to Portuguese and English manufactured goods (Baer, 1965). Second, the institutional social structure which developed did not facilitate an earlier and more accelerated industrialization process. The most important factor, however, was the influence of large agricultural landowners and coastal city merchants upon exchange, educational, labor and fiscal policies, since these groups were opposed to industrialization (Bergsman and Candal, 1969). [3] Finally, and partially in relation to the second factor, the highly profitable opportunities for certain agricultural exports caused a reallocation of resources (such as scarce entrepreneurial capacity) to these activities. It is interesting to observe that the coffee policy began to systematically discriminate against the manufacturing sector [4] only after World War II, following nearly half a century of support measures (Krasner, 1973).

The late 1940's marked the beginning of Brazil's industrialization, as a more clearly defined and high priority policy, [5] as in other countries of Latin America. During this period, these countries

[1] Brazil was an important textile exporter during the late nineteenth and early twentieth century, but did not maintain this position throughout the first half of this century (Bergsman and Candal, 1969).

[2] Investments in railroad construction, energy and coffee cultivation, as well as the increase in the demand for consumer goods resultant of the increased number of immigrants, are acknowledged as causes of this industrial growth in contraposition to the tariff policy, the effects of which apparently were not very important (Baer and Villela, 1973).

[3] Also see Baer (1965, chap. 2); Furtado's work should also be included in this context (1965). This type of influence is what Nicholls (1969) probably had in mind in comparing the potentiality of the agricultural surplus under different land occupancy systems.

[4] The case of coffee is, historically, the most significant example, for Brazil, of an important country in international trade and its consequent monopoly power in this market.

[5] With regard to this period of the economic history of Brazil, as well as that of Latin America see studies by Baer (1965), Grunwald (1970), Baer & Villela (1973), Bergsman (1970), and Wionczek (1973). It should be noted that incentives to Brazilian industrialization initially resulted from balance of payments problems.

experienced a slow growth in their exports of primary commodities, showed high demographic growth rates and faced problems related to labor migrations from rural to urban zones (Wionczek, 1973). An import-substituting industrialization policy was chosen, in the hope of attaining accelerated growth, decreasing dependency on developed countries and increasing employment opportunities. [6] Hirschman (1968) points out that it was hoped that such a strategy would help to remedy the economic, social and political backwardness predominant in Latin America.

One of the main supporters of this development strategy was Raul Prebisch, of the Economic Commission for Latin America. Among the economic policy measures supported by Prebisch were tariff protection against the competition of commodity imports and construction of the necessary infraestructure by the government, official assistance in breaking away from the culture and customs of the past and the establishment of an effective governmental planning program (Grunwald, 1970). With regard to the international market conditions for agricultural products and the conditions of the agricultural sector in Latin American countries, Prebisch did not leave many alternatives; he was quite sceptical with regard to technological advancement in export agriculture, since part of the resulting benefits would be transferred to other countries through the reduction of international prices [7] (Preibsch, 1959). Prebisch believed it to be extremely unrealistic to think of external demands having high price elasticity, therefore attempts to increase the rate of technological progress in export agriculture would result in a deterioration in the terms of trade for the exporting country.

At the close of the 1940's and in the early 1950's Brazilian industrialization was stimulated by measures introduced by the government, in an effort to combat the balance of payments problems which emerged in 1947. An import restriction policy was implemented in an attempt to diminish the demand for foreign exchange, through the use of a fixed rate of exchange system and direct rationing of imports by means of a licensing mechanism. Since 1953, this developed into an exchange category system for the different commodities, and an exchange auctions system replacing the licensing system. [8]

[6] The fluctuations in foreign exchange earnings was also emphasized at the time: also see Prebish (1959, 1964) and Grunwald (1970); the latter also summarizes the main aspects of the discussions.

[7] This point was made in the study be Lewis (1954) on economic development based on unlimited labor supply.

[8] Other details of this evolution can be found in Bergsman (1970), while Huddle (1972) does a comparative analysis of these exchange systems.

During the late 1950's, however, the Brazilian government undertook a deliberate strategy of industrialization, using a much broader set of instruments, as compared with the previous period. The principal instruments utilized were (Baer, 1972): a) tariffs and/or exchange controls; b) special preferences for Brazilian and foreign companies in the importation of capital goods; c) preferential exchange rates in the importation of industrial raw materials, petroleum and intermediary assets in general; d) development bank subsidies for preferred industries; e) the financing of infrastructure by the public sector, for the expansion of the industrial sector; f) direct participation of the government in industrial sectors (especially in heavy industry) in cases considered to be of strategic importance and in others where private sector resources were unavailable. [9]

To this description of Brazil and of Latin America after the postwar period, we can point to the long-term situation as illustrated by the more formal economic development models which appear in the specialized literature of the period, beginning with the study by Lewis (1954). To a certain extent, we should say that during the 1950's industrialization as an easy solution to the problem of underdevelopment was overemphasized, relegating the agricultural sector to a secondary position. This attitude may have been partially resultant of the two-sector model diagnosis which gives the marginal productivity of laobr as equal to zero for countries with high population growth rates. Given the population increase, the function of the public sector in these countries would be to develop institutions for the volunteer mobilization of the portion of the labor force with zero productivity, and to extract the productivity necessary (from the agricultural sector) to provide food products for the workers engaged in non-agricultural activities. Later, emphasis was given to the need for technological advancement in agriculture, so that the transformation of the economy could develop appropriately. [10]

It was anticipated that those countries without land area limitations would find it easier to solve the problem of underdevelopment. Although the population might have been growing rapidly, the first symptoms of unsatisfactory agricultural production could be confronted by incorporating new land into the productive process. Thus, the role of the public sector would be to facilitate the

---

[9] In Brazil, Volta Redonda dates back to 1946, The National Economical Development Bank 1952, and Petrobrás 1954 (Bergsman and Candal, 1969).

[10] Along this line of reasoning, we have the contributions of Ranis and Fei (1961) and Jorgenson (1961); the former clearly identified the deterioration in the terms of trade for the nonagricultural sector, as soon as the marginal productivity of labor shifted from zero to positive values, as an impediment to the continuation of the economic transformation.

settlement of the agricultural frontier, via investments in transport and warehousing infrastructure. [11]

Returning to the discussion of the Brazilian case, the development pattern adopted was based upon the growth of the industrial sector, especially through the domestic production of consumer gods which, until then, had been imported. As we propose to prove in this study, agriculture was expected to contribute only to the prevention of urban food supply crises, since such crises could hinder the achievement of Brazil's main objective: industrialization. [12]

The principal instruments used by the Brazilian government were concentrated in the financial fiscal and commercial exchange areas and were in many aspects, similar to those used in the United States and European countries around the middle of the last century (Wioczek, 1973). The main approach was capital accumulation by both the public and private sectors (domestic and foreign) without, however, giving much regard to development in areas such as technology and human resources. For instance, Bergsman and Candal (1969) point out that, between 1953 and 1960, public investments in physical infrastructure accompanied industrial growth, though they did not eliminate the initial gap; on the other hand, investments in social infrastructure, especially in education, lagged increasingly behind social needs, so that by the end of the 1960's, such needs constituted one of Brazil's most alarming indicators of underdevelopment.

The composition of industrial production within the import substitution model cannot be ignored. The emergence of new industries, resulting from tariff protection and from the other above-mentioned mechanisms largely reflected Brazil's importation pattern at the time. This pattern, however, was conditioned by the distribution of income resulting from the country's previous development strategy and by the initial distribution of the wealth. The industrial structure, thus formed, was not necessarily the most appropriate for Brazil in terms of efficiency in resource allocation.

[11] Nicholls' study (1963) goes beyond these considerations, as he attempts to analyze the determinants of the size and potential contributions towards economic growth of the agricultural surplus, under different conditions of population pressure and land tenure. The political aspect is always present in the discussion of specific cases, even with regard to investment decisions in education, rural extension, agricultural research, social infrastructure and the nonagricultural sector itself.

[12] Somewhat anticipating the discussion which appeared subsequently, the first serious problem with agricultural production and supply in the early 50's is illustrative of governmental thinking at that time: the solution proposed was based strictly on larger investments in transport and on a smaller scale, in ware-housing.

Upon analysing the Brazilian tariff structure, Bergsman (1975) revealed that the tariffs are higher for finished consumer goods, lower in the case of intermediary commodities and lower still on raw materials and producer goods; also according to Bergsman's study, some commodities do not require the protection given them, [13] other highy protected sectors are inefficient, while some of the commodities in which the country is seemingly efficient, or at least capable of becoming so, receive little or no protection.

The theoretical discussion of infant industry is generally presented as a justification for the model of import-substituting industrialization, including the 30-year period of Brazilian industrialization. Balassa (1970), in a very general way, interprets the case for infant industry as a reallocation of resources to increase the present value of future domestic income, without involving further sacrifices of labor or savings. This reallocation would lead to increases in productivity over time, [14] thereby compensating for the initial cost of protecting the domestic sector and contributing towards the attainment of a competitive position in the international markets for the protected industries. At that point, the infant industry should reach maturity in terms of international competitiveness and the initial, temporary protections could be removed. In this respect, the import-substitution industrialization policies adopted in Brazil and in Latin America differed in a number of ways from the theoretical discussion of infant industry. First, the above-mentioned information provided by Bergsman (1975) raises several questions with regard to the structure of the industrial sector which results from tariff protection. Second, the supposed temporary nature of the protection was largely disregarded with the exception of a brief period in the late 1960's (tariff reductions). Finally, the discussion of infant industry as applied to the exporting industries, was only considered near the end of the 1960's. [15]

[13] The effect of generalized protection would not be limited to authorizing domestic production unable to compete with imported commodities, but also authorizing the domestic production, at noncompetitive costs, of commodities that would be in a position to compete with those imported, in case such competition were necessary for survival (Bergsman, 1975).

[14] These earnings would be related to dynamic economies within the companies (training process) and to dynamic economies external to the companies (such as creating the proper atmosphere for an organized economic activity, scientific interests, etc.). Governmental intervention, through tariffs or subsidies, seeks to alter the production structure ove time. See chapter nine of Gorden (1974).

[15] The introduction of fiscal incentives for the exportation of manufactured goods, during this period, marks an important shift in Brazilian economy policy.

3 — Agriculture and economic policy

The growth of the Brazilian economy, which began at the end of World War II, proceeded despite the balance of payments difficulties which arose. Actually it had been anticipated that problems in this area, including those resulting from the fluctuation in foreign exchange earnings, would diminish as a result of import substitution. What actually took place, however, was an increase in the demand for imports of capital goods, raw materials and semimanufactured goods, at the beginning and throughout the industrialization process, in the consumer goods sector, while no measures were taken to encourage exports. [16] The absence of export incentives has been the case since 1946, when there was a balance of payments deficit. Quantitative restrictions were placed on imports through a system of licensing, the rate of exchange for exports remained fixed at ... Cr$ 0,0185 per dollar between September of 1946 and January of 1953, and domestic prices rose by 85%. [17]

The decline in the real rate of exchange since the end of the war, discouraged agricultural and industrial exports. Furthermore, agricultural exports were controlled by a previously established licensing system and, later, by quotas, taxes and even prohibitions. [18] Preibsch's pessimistic position (1959) with regard to the possibilities of an external market for agricultural products may have influenced Brazilian foreign trade policy. On the other hand, Leff (1967) reasons that the Brazilian government placed agricultural exports (especially food product exports) under an exportable surplus policy; that is, the country would export only the surplus, only after the domestic market had been adequately supplied. [19]

The first column of table 1 gives an estimate of the implicit taxation on the exports of agriculture commodities resulting from the exchange and trade policies adopted by Brazil; this measure of taxation was obtained as the result of the comparison between the effective rate of exchange in food exports, calculated by Von Doellinger et alii (1973) and the purchasing power parity estimated by

[16] Schydlowsky (1972) approaches this point in relation to several Latin American countries.

[17] Index 2 of *Current Economic Affairs* (Conjuntura Econòmica).

[18] Under some circumstances, including the balance of payments crises, certain commodities were excluded from the licensing requirement and bonuses in cruzeiros were granted: these, however, quickly lost their real value, due to internal inflation. See Veiga (1975).

[19] The instruments used were those already mentioned: licensing, quotas, taxes and prohibitions. Ever since that time, however, the government has been concerned with food price in the domestic market: adequate supply would take into account the domestic price level for agricultural commodities.

Fishlow (1974), taking as a base the nominal rate of 1938.[20] The annual dimensions of the implicit taxation on agricultural exports are so substantial that, even when the evolution of other variables is left aside, a favorable performance for the quantity and value exported is not suggested. In this regard, Leff (1967) showed that between the triennials 1947/49 and 1960/62, the value of Brazilian exports, except coffee, declined by 4%, while the quantity exported

Table 1

Comparison Between the Implicit Taxation of Agricultural Exports and the Implicit Subsidy in the Importation of Agricultural Inputs — (1953/66)

Year	Implicit Taxation	Implicit	Subsidy
	Exports	Fertilizers, Pesticides and Others	Tractors, Machinery and Others
1953	−0.55	+0.50	+0.50
1954	−0.52	+0.37	+0.37
1955	−0.34	+0.28	+0.24
1956	−0.35	+0.32	+0.19
1957	−0.38	+0.40	+0.32
1958	−0.29	+0.36	+0.25
1959	−0.26	+0.26	+0.16
1960	−0.08	+0.37	+0.24
1961	−0.05	+0.33	+0.25
1962	−0.14	+0.06	+0.05
1963	−0.04	+0.18	+0.18
1964	−0.04	+0.16	+0.22
1965	−0.16	+0.02	0.00
1966	−0.26	+0.09	+0.08

SOURCE: Rate of exchange of agricultural exports (Von Doellinger, 1973). Rate of exchange of the parity of purchasing power (Fishlow, 1974). Rate of exchange in the importation of inputs (Veiga, 1974).

[20] Fishlow's parity rate was constructed by taking 1938 as a base and using the rates of price increases in Brazil and in the USA. Several possible problems must be kept in mind in using this concept of relative parity: among them, the base period, the indices used, the length of the period under analysis (related to the structural change in the economy) and alterations in the trade barriers (Officer, 1976).

increased by only 7%; in worldwide terms, Leff's (1967) figures showed an increase of 49% in trade and a decline of 8% in prices. Overall, Brazilian exports remained highly concentrated on coffee; it was only in 1965 that this commodity came to account for less than 50% of the total foreign exchange earnings. During the 1950's and most of the 1960's, only cotton, cocoa and sugar were alternately among those products achieving earnings of over US$ 50 million. [21]

Keeping in mind the situation which prevailed during the initial period of Brazilian industrialization, it would not be surprising to encounter opposition to this type of development, especially on the part of the large agricultural exporting sector. [22] In their discussion of this phase of Brazil's development process, Bergsman and Candal (1959) claim that such opposition was debilitated by the governmental concession of subsidies for the importation of machinery, fertilizers, and other agricultural inputs, as well as by special policies for coffee, cocoa and sugar.

With the objective of verifying the validity of this position, we have sought, in table I, to compare the magnitude of subsidies for the import of agricultural inputs [23] with that of the implicit taxation of the agricultural exports already cited. Examination of the figures in table I reveals that Bergsman and Candal's observation (1969) was valid, since the two groups of agricultural inputs included in the table enjoyed substantial implicit subsidies for several years, the group of fertilizers in general, having a higher level than that of machinery. To a certain extent and for a specified period of time, therefore, the agricultural sector managed to obtain compensations, via the price reduction of several agricultural inputs, for the implicit taxation which predominated for exportable products, through the exchange and trade policies during the 50's. It should also be taken into account that during this decade there was an increase in the availability of rural credit for several years at subsidized rates, [24] and that this period may be considered as the beginning of a significant dependency of government agricultural policy on subsidies, through the price of agricultural inputs or credit.

With regard to subsidy policies, however, it does not seem to have been sufficiently emphasized that their consequences may have

21 See Homem de Melo and Zockun (1977).

22 It should be recalled that this period also marks the introduction of foreign exchange retaining in coffee exports, through a system of multiple rates of exchange (Krasner, 1973).

23 Same procedure used for exports, now using the rates of exchange in the import of basic commodities, computed by Veiga (1974).

24 See Smith (1959).

been extensive in relation to the use of factors in agriculture and to their differentiated impact among products, regions and the size of agricultural holdings. With regard to the last item, holdings can differ as to the composition of the production and factors employed, and since these differences can be related to size, economies of scale can vary through alterations in the prices of the production factors (Welch, 1973). For example, if the portion of the machinery factor in the total cost were to increase with the size of the agricultural enterprise, and if the prices of this factor were to decrease significantly (as occurred in Brazil during the 1950's) comparative advantages among companies will change, so as to benefit the larger companies more in cost reduction.[25]

The Brazilian agrarian structure is characterized by the latifudium-minifundium complex, the latifundium having conditions favorable for a more intensive use of machinery, due to the difficulties involved in the coordination of a large labor force (Mueller, 1976). The corroboration of the previous paragraph indicates the existence of important economic forces, originating in government policy and favoring the development of larger properties, by means of the subsidies granted to agricultural inputs and through rural credit.[26]

The same line of reasoning may be applied to discern the effects of such subsidies on regional production and on the cultivation of specific products. With regard to regional production, the Sanders study is of particular interest in that he blames the subsidies granted for agricultural machinery (including those related to public credit) for the regional disparities occurring since 1950 in the production of sugar cane and cotton in the Northeast and South of Brazil, especially São Paulo.[27] In 1950, São Paulo produced only 50% of the total amount of sugar-cane produced in the Northeast, by 1960 production was equally divided, and in 1965, São Paulo's production had surpassed that of the Northeast by 20%. Since production of

[25] For the USA, Welch (1973) points out that the larger holdings are more dependent on the machinery and fertilizer factors, while the smaller ones depend more upon the labor and land factors. Sanders (1976) also claims that in the case of the smaller holdings, comparative advantage should lie in labor-intensive commodities, in keeping with the cost differential or this factor between holdings by size.

[26] Even though aspects of the credit policy are to be discussed later, at this point we should mention Sayad (1977), according to whom subsidized credit programs accentuate the inequality in the distribution of wealth, distributing a disproportionate share of subsidized rural credit to the large landowners.

[27] One should not disregard, in this process of alteration of comparative advantages, the creation of new agricultural techniques including new sugar-cane varieties, achieved by the research institutes of São Paulo. See Pastore, Dias and Castro (1976).

sugar-cane in the Northeast was labor-intensive at that time, as compared to that of the Southern region, the government subsidies granted to mechanization must have altered the comparative advantages and favored the growth of São Paulo's sugar-cane production.

With regard to the composition of Brazilian agricultural production, the possibility of alterations cannot be disregarded, due to the subsidies granted to machinery and fertilizers; for instance, production cost data for several crops in São Paulo for the 1973/74 agricultural year, [28] show that the portion of the machinery category in the total cost per hectare is significantly higher for the cultivation of corn, cotton, sugar-cane, wheat, soybeans and coffee, than for beans, onions, peanuts and potatoes. The variation of this portion between products, was quite high, since the two highest corresponded to corn and cotton with 47.1% and 45.8%, respectively, and the two lowest to potatoes and peanuts with 15.6% and 18.1%, respectively. [29]

Finally, regarding the use of factors and respecting the possibility of a more significant production-effect, the subsidies granted to tractors and other machinery might have caused an absorption of agricultural labor smaller than would have been feasible during that decade: the elasticity-substitution between machinery and labor estimated by Sanders (1973), in the order of 1.50 and 1.90 in 1950 and 1960, respectively, is an indication that the substitution-effect could have been important. This point, together with the possible effects between holdings by size and in the composition of agricultural production, might have caused unfavorable effects in the labor market, in terms of remuneration, employment and acceleration of the rural-urban migration.

---

[28] The 1973-1971 data referring to production costs, published by the Institute Agricultural Economics (Instituto de Economia Agrícola) (1973), were used since they related to the agricultural year prior to the beginning of the petroleum problem; we recognize that it would be most appropriate to have access to information of this type for the 1950's and 1960's, but that was not possible. Whenever available, we used the data for the motomechanized traction technique (MT), but in its absence, we use motomechanized and animal traction (MAT), which undoubtedly obstructs the achievement of a more exact comparison. Furthermore, this production cost information is obtained from selected properties and, therefore, does not represent the whole.

[29] In decreasing order of this category we have: corn, cotton (1972-1973), coffee, soybeans, sugar-cane, wheat, beans, onions, peanuts and potatoes. On the other hand, for the category of fertilizers and pesticides, the variation between products is much smaller, almost all of them concentrated between 20 and 25%, wheat and soybeans being among the few with a larger portion. For soybeans, however, the main varieties used in the 70's were not yet available in the decade of the 50's.

To complete the picture of the policy during this initial period, it must be acknowledged that, although the development of the Brazilian industrial sector through the import substitution of consumer goods was given priority while the agricultural export sector was being de-emphasized, one could expect that at least the agricultural sector which produced food consumed in the domestic market would receive government incentives. This expectation originates from the dynamics of the pattern of the two sectors, later taken up more clearly by Ranis and Fei (1961), though also pointed out previously by Lewis (1954): in case food production did not increase as the labor factor was being transferred to the nonagricultural sector, there would be a deterioration in the terms of trade for the latter sector, an increase in food prices and upward pressure on wages, thus making it difficult to fulfill the foreseen economic trend.[30]

In this regard, it cannot be said that the government was unconcerned with supplying urban centers, especially when there were food price increases. What can be perceived, however, is that the main instrument used to guarantee a smooth change in this area was the development of the highway transportation infrastructure and, on a smaller scale, the warehousing infrastructure, in an effort to facilitate the simple expansion of the area under cultivation. Thus, the country relied upon the abundance of the land factor, in contraposition to the countries visualized in the two-sector models of Lewis and Ranis-Fei, and in the solution of several bottlenecks observed in the marketing process, as being sufficient for the continuous increase of food production for the domestic market, with no greater problems in regard to the trends in relative prices.

In this respect, Smith (1969) calls attention to a greater governmental concern with matters of transport and warehousing since the beginning of the 1950's principally as a reaction to the rise of food prices at that time.[31] The same author illustrates that investments in these areas were the principal instrument of action for agriculture in the Program of Targets (Programa de Metas) of the Kubitschek government. Nicholls (1975) is of the opinion that the main factor contributing to the increase in agricultural production during that decade was highway development. Smith's

---

[30] This line of reasoning, more automatic in the sense of the model itself, is Ranis and Fei's (1961), while Lewis (1954) stressed this deterioration as a function of the increased demand for food with the expansion of the economy. In broader terms, Nicholls (1963) emphasized the need for agricultural surpluses as basic in the process of economical development.

[31] See table 2, below.

(1969) study confirms this hypothesis upon identifying a declining trend in marketing margins in the Center-South region.[32]

With regard to price trends, table 2 summarizes the behavior of the relation of agricultural and industrial prices over time. This trend assumes greater importance when we recall that, as recently as 1971, food expenditures represented 43.5% of the family budget in estimating the cost of living index for the modal family income classe (2 to 6 minimum salaries) of the São Paulo Municipality.[33] In table 2, the division of agricultural commodities between those transacted in the domestic and external markets, was made taking into account that for the former the internal supply and demand were important forces in determining prices and quantities in an earlier phase.

The internal market group shown in table 2, clearly includes important food supply commodities. However, those of the external market are subdivided into two groups: in the first, cotton, soybeans, peanuts, castor bean and tea, while in the second, coffee, sugar, oranges and bananas are included. The first group, besides excluding the commodities for which regulatory agencies and specific policies were established (coffee and sugar), attempts to isolate those commodities which are traditionally directed to foreign trade, but which do not figure among the list of the principal export commodities. Furthermore, the external demand for this first group should be much more elastic than for the second, in relation to Brazil's modest participation in the international market for each one (perhaps with the exception of the castor bean).

On observing the price trend of food products in relation to industrial prices, in the first column of table 2, it is clear that in three subperiods food prices increased much more than industrial prices. The first subperiod, from 1950 to 1954, has already been highlighted above (Smith, 1969), while the second, covering the period from 1960 to 1963, has also been highlighted by Nicholls (1975). In both cases, the authors identified a governmental disregard for the agricultural sector as the main cause; during the third subperiod (1969 to 1974), Brazil found the international prices for agricultural products quite favorable, as indicated by the

[32] Pastore, Alves and Rizzieri (1974) confirm the point that Brazil's agricultural policy was designed to facilitate the settlement of the agricultural frontier.

[33] Cost of Living Index — Institute for Economic Research (Fundação Instituto de Pesquisas Econômicas).

201

other two columns shown in table 2.[31] In this case, the effect on the prices of commodities on the internal market occurs through substitution among products in the agricultural sector and in final consumption.

Table 3, on the other hand, shows the growth rates of Brazilian agricultural production for the majority of commodities included in the price indices shown in table 2, for the period 1947/76 and three subperiods of ten years. It is clear that, in order to be able to compare this information with the price trends of the internal market, we need to take into account population growth, the growth in per capita income and the income elasticities of these commodities. With several available estimates for these elasticities[35] and the evidence collected in the last few decades in regard to the growth in population and per capita income, the increase in the demand for food should be between 3.0% and 5.5% per year for the majority of commodities included in tables 2 and 3; the lower rates should include rice, beans and manioc, while the higher ones would be for milk, pork, potatoes and onions.

A review of the rates of increase shown in table 3 reveal that the performance of agricultural production was generally better in the 1960's than in the 1950's. Nevertheless, the subperiod 1967/76 reveals a significant decline for several basic food products, such as rice, corn, beans and manioc, the latter two even showing negative rates. The decade of the 1950's, which is of interest to us at the moment, corresponds to the period in which the strategy of import-substituting industrialization was defined. During this period, the growth rates of the production of several basic foodstuffs, such as rice, beans, manioc and corn, reached as high as 3%, approximating the increase in demand for these commodities.[36] The same occurred with regard to potatoes and onions, though these commodities showed higher rates of growth: approximately 5% per year. Among the commodities on the internal market, tomatoes exhibited the

[31] This point serves to recall the disadvantage of using São Paulo data in the elaboration of the indices; important commodities are excluded (cocoa, wheat and hemp) and the composition of São Paulo's production is not exactly representative of Brazil as a whole. In addition, at the close of the period, soybeans were very important in the overall exportation picture.

[35] Kirsten (1977) obtained the following values for the income-elasticities: rice, —0.06; beans, —0.035; bananas, —0.19; manioc, 0.25; eggs, 0.31; tomatoes, 0.20; pork, 0.79; potatoes, 0.61; sugar, 0.04; milk, 0.58; oranges, 0.56; onions, 0.54. Other estimates (Vieira, 1976) show the values of 0.12 and zero for rice and beans, even for the lower income classes.

[36] The case of corn is probably somewhat different since the elasticities of corn oil and pork are close to one, though Kirsten's (1977) estimates give a value of zero for the income-elasticity of corn flour: it is possible that the same occurs with other products which are made from corn.

Table 2

Trend in the Relation of Agriculture-Industry Exchanges: 1948-1976
(1948 = 100, movable triennial average) [1]

	Internal Market [2]	External Market [3]	External Market [4]
1949	94.08	98.54	127.33
1950	85.81	109.84	145.14
1951	85.88	111.13	152.36
1952	95.38	103.72	139.80
1953	105.76	86.05	140.29
1954	111.04	82.60	142.30
1955	109.86	82.56	141.11
1956	109.90	83.25	128.24
1957	108.46	78.47	108.42
1958	103.10	74.01	88.97
1959	102.53	76.51	76.92
1960	100.84	81.96	75.13
1961	114.12	85.74	79.83
1962	119.10	78.54	82.31
1963	119.70	79.75	95.13
1964	104.96	80.04	98.46
1965	103.94	81.06	94.54
1966	105.78	71.59	80.47
1967	107.13	68.59	74.82
1968	104.00	66.86	76.79
1969	98.34	67.41	81.16
1970	100.76	71.58	86.38
1971	103.12	76.72	93.51
1972	118.94	90.35	105.43
1973	130.60	97.95	114.88
1974	138.82	101.32	125.70
1975	137.86	102.19	147.18

SOURCE: Institute of Agricultural Economics and *Current Economic*.

Issues (Instituto de Economia Agricola e *Conjuntura Económica*).

1   Movable triennial average of the ratio between prices received by São Paulo farmers and the price index for industrial products (Index 18 of *Conjuntura Economica*) which includes the following industries: chemicals, metals and metallurgical products, hides and skins, textiles, clothing and footwear. Chain Index, Laspeyres' weighting.

2   Products: potatoes, manioc, rice, beans, tomatoes, onions, eggs, pork and milk.

3   Products: cotton, soybeans, peanuts, castor bean and tea.

4   Products: the five already mentioned (1) plus coffee, sugar-cane, oranges and bananas.

best performance in the 1950's, with a rate of production increase well above the probable increase of demand.[37] In general, therefore, these commodities (with the exception of tomatoes) could not have been contributing towards a declining trend in the price index of internal market commodities during that decade.

On the other hand, among the products of the first group of the external market, the production of soybeans and peanuts showed high growth rates, while cotton and castor bean production was quite low during the 1950's. In the second group, coffee and sugarcane had the highest rates; coffee, in spite of the additional taxation on exports, still enjoyed a quite favorable trend in prices paid the growers, while cotton, after a peak in prices in 1951, showed a marked decline during the 1950's.

On the other hand, the data shown in table 4 reveal that, for the decades of the 1950's and 1960's, Brazilian agricultural production depended greatly on the expansion of the under cultivation. In the 1950's, the only commodities which showed a more significant increase in earnings per unit of land used, were cotton, potatoes, peanuts and, to a lesser extent, coffee. They were, however, important commodities for the São Paulo agricultural economy during that period. Viewing the information gathered on the sources of growth of São Paulo's agricultural production during the 1950's (table 5), it is clear that these four commodities were those having the most significant rates of increased yield per hectare. In addition, soybeans, onions, sugar-cane and peanuts showed rates of increased yield of more than 1% in São Paulo, during that decade, in contrast with Brazil as a whole.

This differentiated situation between the patterns of agricultural growth in São Paulo and Brazil as a whole introduces an important aspect in the analysis of our agricultural policy, that is, the technological aspect. Until now, we have seen that, rather than an exchange policy which would have sacrificed the agricultural sector, the major compensations were subsidies for imported agricultural inputs and the development of highway transportation. It should also be noted that until the early 1960's, the governmental price guarantees were extremely limited, despite the existence of the Production Finance Committee (Comissão de Financiamento da Produção) since 1943. If we accept that one of the objectives of a minimum price guarantee program is the decrease in the price risk

[37] Actually, a trend of declining prices in real terms, at the producer's level, can be observed in São Paulo, in data of the Institute of Agricultural Economics.

faced by the grower, [38] efficiency during that period must be considered unsatisfactory, since, in most cases, prices were established and published after the annual crops had been sown, and there were very few subsequent interventions.

In relation to the technological aspect of Brazilian agriculture, Mueller (1976) states that, until quite recently, the Brazilian agricultural research structure was essentially nonoperative. At the federal level and until 1971, Schuh and Alves (1971) confirm this point, basing their conclusion on the discontinuity of research efforts, inadequate distribution of the units and inadequate communication between researchers and farmers. At the state level, Pastore et alii (1974) point out that only a few states, such as São Paulo, Rio Grande do Sul and Minas Gerais, had established and supported research institutions over the last 100 years.

A lack of federal investments (for the creation of new agricultural techniques and inputs) seems to have prevailed in the case of both export commodities and food products for the internal market. For the former, this situation coincided with the failure to consider the exporting sector as an important part of the Brazilian development strategy. With regard to food products, however, government inertia in agricultural technology, especially in the biological field seems to have resulted from overconfidence in the hypothesis that the expansion cultivated area would be sufficient for an adequate level of food production. Several crisis periods in this sector which were reflected in the real prices trend for food products (presented in table 2), and the absence of a tendency of real prices to drop during the longest period from 1948 to 1975, is an indication that such an expectation may have been exaggerated.

Given this background, the State of São Paulo's contribution in comparison with the other Brazilian regions is outstanding. It has probably even been underestimated in the results obtained for the state itself and for some of the nearby agricultural regions. Agricultural research in São Paulo, especially for coffee, cotton and sugar-cane, was recently emphasized by Pastore, Dias and Castro (1976), as sufficiently important to explain the rates of increase of yield per hectare which have taken place in the state. [39] On the

[38] See, for instance, Oliveira (1974) and Blanford and Currie (1975) for discussions on the uncertainty of prices in agriculture and Krishna (1967), for the different objectives of price guarantee policies between developed and underdevelopd countries. Smith (1969) is an excellent source for this policy in the Brazilian case until the mid-1960's.

[39] It is worth mentioning the case of sugar-cane in which the largest increase in yield per hectare occurred prior to 1948 and, therefore, was not included in the rates shown in table 5.

other hand, the research effort in São Paulo for basic food crops such as rice and beans, was at a considerably lower level. Hence, it is significant to observe that, while the exchange and trade policies introduced the implicit taxation discussed in this paper, the São Paulo producing sector for certain crops had the creation of new techniques and inputs as a compensating factor, [10] as well as the subsidies granted for fertilizers and machinery, as mentioned above. Furthermore, it is possible that the results of the agricultural research in São Paulo also benefited those nearby agricultural regions with similar climate and soil conditions, especially in the case of coffee, cotton and soybeans.

Table 3

Growth Rates of Brazilian Agricultural Production: 13 Commodities 1947/76 and Subperiods [1]

	Soybeans	Corn	Cotton	Rice	Manioc	Beans	Coffee
1947/76	20.68[a]	4.31[a]	2.61[a]	4.23[a]	3.60[a]	2.82[a]	0.63[b]
1950/59	8.18[a]	3.30[a]	1.31[b]	3.61[a]	3.33[a]	2.92[a]	6.62[a]
1060/69	16.39[a]	4.75[a]	1.61[b]	3.23[a]	6.07[a]	4.10[a]	—6.04[a]
1967/76	35.03[a]	3.55[a]	—1.90[b]	2.47[a]	—1.80[a]	—1.96[a]	—0.17[b]

	Sugar-cane	Potatoes	Onions	Bananas	Tomatoes	Peanuts
1947/76	4.43[a]	3.67[a]	4.48[a]	4.36[a]	8.23[a]	7.74[a]
1950/50	5.42[a]	4.84[a]	5.36[a]	4.56[a]	11.64[a]	10.36[a]
1960/69	3.63[a]	4.31[a]	3.48[a]	4.36[a]	8.23[a]	7.74[a]
1967/76	3.50[a]	1.34[b]	4.77[a]	—2.39[b]	5.11[a]	1.17[b]

SOURCE: Primary data, the Ministry of Agriculture and the Brazilian Institut Geography and Statistics (Fundação Instituto Brasileiro de Geografia e Estatística).
1 Coffee: 1947/75, soybeans: 1052/76.
a Significance at the 5% level.
b Non-significance.

[10] On a larger scale, this is the point Schuh (1974) emphasizes, in analysing the American exchange policy and the United States' investments in agricultural technology. In São Paulo, other crops cited for which a significant effort research has been conducted are corn, oranges, potatoes and soybeans; also see Paiva et alii (1973), p. 103.

Table 4

Breakdown of the Growth Rate of Brazilian Agricultural Production 1950/59 and 1960/69: Eleven Products

Commodities	1950/59			1960/69		
	Pro-duction	Area	Output	Pro-duction	Area	Output
Rice	3.61	4.04	—0.43	3.23	4.81	—1.58
Beans	2.92	3.14	—0.22	4.19	4.52	—0.33
Manioc	3.33	3.10	0.23	6.07	4.79	1.28
Potatoes	4.84	3.32	1.52	4.34	1.59	2.75
Onions	5.36	5.47	0.11	3.4S	2.79	0.69
Cotton	1.31	0.24	1.07	1.61	3.18	—1.57
Soybeans[1]	8.1S	9.96	—1.78	16.39	16.5S	—0.19
Sugar-cane	5.42	4.71	0.71	3.63	2.73	0.90
Coffee	6.62	5.40	1.22	—6.94	—6.86	0.08
Corn	3.30	3.34	—0.04	4.75	4.33	0.42
Peanuts	10.36	6.81	3.55	5.86	7.50	—1.64

SOURCE: Primary data, the Ministry of Agriculture and the Brazilian Institute of Geography and Statistics. (Fundação Instituto Brasileira de Geografia e Estatística).
1 Soybeans: 1952/59.

Table 5

Breakdown of the Growth Rate of São Paulo Agricultural Production 1950/59 and 1960/69, Eleven Products

Commodities	1950/59			1960/69		
	Pro-duction	Area	Output	Pro-duction	Area	Output
Rice	—3.53	1.17	—4.70	—1.12	3.98	—5.10
Beans	0.78	6.18	—5.40	—4.62	—5.80	1.18
Manioc	10.63	8.37	2.26	3.06	2.31	0.75
Potatoes	6.46	0.29	6.17	—1.78	—3.78	2.00
Onions	5.04	3.33	1.71	3.03	2.16	0.87
Cotton	—4.62	—12.91	8.29	0.49	—5.63	6.12
Soybeans[1]	24.48	21.65	2.83	29.09	26.00	3.09
Sugar-cane	10.56	9.49	1.07	4.41	5.11	—0.70
Coffee	6.80	2.44	4.36	—3.57	—9.38	5.81
Corn	2.26	4.03	—1.77	2.29	0.99	1.30
Peanuts	8.90	5.85	3.05	3.15	2.99	0.16

SOURCE: Primary data, São Paulo Institute of Agricultural Economics .(Instituto de Economia Agrícola de São Paulo).
1 Soybeans: 1952/59.

The disparity observed between regions and crops, in the availability of new technologies over time, together with a similar diversity in technical support services [41] and in educational level (the latter given in table 6), are indications that opportunities for income earnings, with technological changes, varied among regions and commodities, and were much more concentrated in the South and Southeast regions and in the cultivation of coffee, cotton, sugar-cane and perhaps soybeans. [42] Furthermore, recalling the subsidies granted for basic chemical inputs (fertilizers, pesticides), the same conclusion would be reached if we were to accept the existence of a positive relation between the quantity of biological innovations, the availability of information transmission mechanisms and the level of education [43] with the more intensive use of fertilizers. [44] Once again the basic food crops would be at a disadvantage in this particular matter.

The beginning of the 1960's was marked by another difficult stage with regard to the supply of food commodities, due to increases in the real cost of beans, rice, manioc, onions, corn, and animal products. [45] While the Brazilian government had responded to the agricultural production crisis of the early 1950's with the development of transportation infrastructure, wying to expand cultivated area, the governmental administration wielded two other instruments in the 1960's: increased availability of credit for the agricultural sector and more effective implementation of price guarantees policies. As we have already seen, during the 1950's there was a growth trend in agricultural loans relative to agricultural output, although the relation was initially quite smal. According to table 7, it seems that in the early 1960's an even more pronounced increase in the rural credit operations began (in 1962), although the anti-inflationary policy of the 1965/68 period interrupted this increase.

Since 1968, however, the increased correlation between agricultural credit and agricultural output has been quite pronounced. Table 8, however, indicates that this increase in agricultural loans occurred at a subsidized rate of interest, despite the fact that the

[41] For data on the number of extensionists in São Paulo and in Brazil, see Smith (1969) and Paiva et alii (1973), for a description of the institutions.

[42] For the history of the improvement of soybeans in São Paulo, see Cargill Foundation (1977).

[43] Since Welch's study (1970), the role of education in agricultural production has been considered as facilitating the acquisition, interpretation and appraisal of both technical and market information. For the Brazilian case, see studies by Patrick and Kehrberg (1973) and Thompson and Schuh (1975).

[44] Also see Pastore, Alves and Rizzieri (1974) for this line of reasoning.

[45] The figures in table 2, for internal market commodities, show this increase.

size of the subsidy had varied considerably, in relation to the variation in the inflation rates during that period.

The increased correlation between agricultural credit and agricultural output during the 1960's probably made a positive contribution to the growth of Brazilian agricultural production observed during this period (table 3, several commodities). This is especially true when taking into account the increased availability of credit as alleviation of the shortage which predominated until then. Nonetheless, Sayad's (1977) recent study endeavors to identify some of the problems involved in subsidized credit programs in general. [46] For example, during precisely the most recent period of expansion of agricultural credit (since 1968) the financial market has also developed, facilitating the replacement of private capital by capital supplied by the government. Another important result of the empirical part of Sayad's study, was a greater replacement per cruzeiro loaned in the larger sized holdings (total value of the assets). Furthermore, large borrowers benefited relatively more from the subsidized interest for agricultural loans, since a larger portion of their total expenditures was financed by the credit. [47]

With regard to price guarantee policies, however, during the 1960's there was an effort to render this instrument more efficient in terms of support to agricultural production. With this objective, in 1963 minimum prices for annual crops were established 60 days prior to the sowing season. In 1967, when the Commission for the Financing of Production was annexed to the Ministry of Agriculture, it became possible for producers to finance the marketing of the crops, in order to complement the existing plan of immediate acquisitions. A further innovation was the establishment of net minimum price for homogeneous production areas, facilitating the gathering of information by the producers.

The price policy for the principal inputs purchased by agricultural producers (i.e., chemicals and machinery) underwent important changes, in relation to the 1950's when import subsidies predominated. In the early 1960's, when the exchange policy was not as unfavorable to the agricultural sector, [48] the need for the continuation of import subsidies for agricultural inputs decreased. Furthermore, the Brazilian government more clearly defined a policy of domestic production of these inputs with the purpose of substituting the imports.

[46] In Brazil, besides agricultural credit, there were also important programs established for the exportation of manufactured products and for small and average enterprises.

[47] Also see Adams (1977).

[48] See the figures of Table 1 for this period.

212

Table 6

Educational Level of Individuals 5 Years of Age or More [a]

States and Regions	1960		1970	
	Urban Popu-lation	Rural Popu-lation	Urban Popu-lation	Rural Popu-lation
Rondônia	1.96	0.84	2.66	0.92
Acre	1.90	0.83	2.64	0.56
Amazonas	2.21	0.85	3.18	0.76
Roraima	1.91	0.78	3.73	1.14
Pará	2.13	0.87	3.16	1.01
Amapá	1.79	1.08	3.06	1.40
North Region	2.13	0.87	3.13	0.91
Maranhão	2.31	0.92	2.60	0.60
Piauí	2.35	0.76	2.26	0.44
Ceará	—	—	2.42	0.49
Rio Grande do Norte	—	—	2.29	0.70
Paraíba	—	—	2.20	0.59
Pernambuco	—	—	2.67	0.58
Alagoas	—	—	2.18	0.49
Sergipe	—	—	2.30	0.49
Bahia	—	—	2.62	0.51
Northeast Region	—	—	2.50	0.54
Minas Gerais	—	—	3.21	1.12
Espírito Santo	3.03	1.17	3.37	1.30
Rio de Janeiro	—	—	3.39	1.47
Guanabara	3.54	1.83	5.01	—
São Paulo	—	—	3.77	1.76
Southeast Region	—	—	3.78	1.38
Paraná	—	—	3.46	1.27
Santa Catarina	2.85	1.52	3.54	2.03
Rio Grande do Sul	—	—	4.16	2.24
South Region	—	—	3.82	1.74
Mato Grosso	—	—	2.86	1.03
Goiás	—	—	2.75	0.92
Federal District	—	—	4.00	1.88
Central-West Region	—	—	3.04	0.97

SOURCE: Demographic Census of Brasil (1960 and 1970).

[a] The level of education was obtained by multiplying the number of years of schooling completed by each group of individuals, by the total number of individuals of each group, then adding these subtotals and dividing the result by the size of the respective population. This index is, therefore, a weighted average of the years effectively completed by the rural and urban populations.

Table 7

Indicators of Agricultural Credit (Costs) in Brazil: 1951-74

Year	Agricultural Credit	Agricultural Credit
	Agricultural Output (%)	Total Credit (%)
1951	8.67	6.12
1952	9.67	6.78
1953	9.70	8.74
1954	12.39	8.54
1955	12.47	9.85
1956	12.46	8.91
1957	12.68	9.17
1958	15.16	10.09
1959	15.22	11.39
1960	15.20	10.21
1961	16.90	9.96
1962	15.89	9.35
1963	19.34	10.89
1964	19.55	10.96
1965	22.06	10.51
1966	20.14	13.42
1967	21.05	14.41
1968	22.39	20.78
1969	28.87	25.98
1970	36.62	26.54
1971	36.61	26.97
1972	38.78	27.44
1973	40.15	27.72
1974	41.75	29.40

214

*Conditions of Rural Credit in Brazil Estimated Nominal
and Real Rates, 1960-76*

Year	Rate of Inflation	Interest Rates (Estimated No-minal Average)	Interest Rates (Estimated Real)
1960	31	15	—16
1961	37	18	—19
1962	52	18	—34
1963	75	18	—57
1964	90	18	—72
1965	57	18	—39
1966	38	16	—22
1967	28	16	—12
1968	24	16	— 8
1969	21	16	— 5
1970	22	16	— 6
1971	20	15	— 5
1972	18	15	— 3
1973	16	15	— 1
1974	29	15	—14
1975	28	15	—13
1976	43	15	—28

SOURCE: Transcription from Adams (1977) until 1972; from 1973 to 1976 the nominal rate remained fixed at 15%, excepting credit for fertilizers, the rate of which was reduced to zero in 1975 and 1976. Therefore, overestimated rates must have been used for said years. For the rate of inflation, Adams used the general rate of overall price-bid, which we up-dated from 1973.

Faced with this situation, in 1961 the first step taken by the government was the cessation of the importation of fertilizers which benefited from the special rate of exchange of the 1950's. However, the exemption of taxes on these imports was maintained.[49] This contributed towards a significant increase in the prices paid by producers for nitrogen and potassium nutrients during the early

[49] In the previous system, domestic firms which produced raw material were benefited by an allowance paid by the government, computed by the difference between the rate of exchange for the import and that of the general category, plus an amount equivalent to the exemption of tariffs; see Homem de Melo (1975).

years of the decade. A second step was taken in 1966, when taxes on the importation of fertilizers were introduced, as well as a contingency system [50] on imports, initially applied to phosphates and subsequently to nitrogen products. Despite the introduction of these two measures, which raised the price of fertilizers for the Brazilian farmer, the price had been declining since the mid- 1960's, in relation to the quite pronounced declining trend in international prices. This sharp decrease in real prices, together with the increased availability of subsidized credit for the purchase of this commodity, were factors which contributed to the large increase in consumption which occurred in Brazil until 1973. It is clear, however, that the change in the manner of stimulating the domestic production of fertilizers was prejudicial to the agricultural sector which consumed this commodity. The farmers, however, were compensated by a special line of credit, as of 1966, for the purchase of fertilizer at zero interest, initially, and at 7% as of 1970.[51]

The other important change which occurred in the early 1960's with regard to agricultural input policy was the suspension of the exchange privilege in the importation of tractors and agricultural machinery. This measure was soon supplemented by others, including tariff protection, for the domestic production of tractors.[52] During the early years of this production, the sale prices of domestic tractors were higher than those of the corresponding imported model, therefore inverting the situation of subsidized prices for growers which had predominated during the entire previous decade.[53]

This unfavorable pattern of factor prices was progressively attenuated over the years. The exemptions from indirect taxes granted by the federal government at the close of the decade contributed to this trend. In 1968, for instance, the selling price of a 44 HP tractor made in Brazil, the most common one at the time, was only 3% over the price paid by American farmers for a similar tractor, with the exchange made at the official rate. With the decline in the real price of tractors, the availability of subsidized credit for their purchase and the beginning of a period or more

50 The contingency system establishes the amount of the domestic commodity that must be purchased by the mixer to be able to enjoy the right to import one ton at a preferential duty tariff.

51 Since 1966, by the Fund for Financial Incentives for the Use of Fertilizers and Mineral Supplements (FUNFERTIL); since 1970, by the Fund for Agricultural Development (FUNDAG).

52 See Sanders (1973) for information on this period.

53 The 44 HP Brazilian tractor; our estimates show that at the official rate of exchange, the largest difference was observed in 1965, that is, 21.3% over the Price paid by American farmers. Obviously, possible differences in quality were not considered.

favorable prices for agricultural products,[54] the tractor industry grew rapidly, increasing from a production of 9,548 units in 1969, to 57,041 in 1975.

Still in reference to the emphasis on the process of mechanization in agriculture in Brazil which began in the mid-1960's, we must mention the modifications made in labor legislation in 1963 and 1964 which affected rural areas, by means of the Statute of the Rural Laborer and the Statute of the Soil (Estatuto do Trabalhador Rural/Estatuto da Terra). Upon extending the minimum wage to agricultural activities and altering the work relations which predominated in the fields and upon increasing the employer's obligations, these laws stimulated greater mechanization in the sector.[55] It is also worth adding that during the period after 1970, the wages paid in the agricultural sector showed significant increases in real terms; for instance, in São Paulo, between 1970 and 1973, the remuneration of the resident day-laborer increased by 36%, while the average wage of permanent laborers in the Center-South region increased by 41% between the first half of 1970 and the second half of 1973.[56]

Finally, with regard to the federal public sector's endeavors in the area of agricultural research since the late 1960's, there has been greater concern for the generation and diffusion of technical knowledge in agriculture. This was confirmed early in this present decade with the creation of the Brazilian Cattle-Raising Research Company (Empresa Brasileira de Pesquisa Agropecuária) and subsequently, the Brazilian Company of Technical Assistance and Rural Extension (Empresa Brasileira de Assistência Técnica e Extensão Rural), both receiving considerable resources.

The data on growth rates in Brazilian agricultural production during the 1960's (table 3), generally indicate a more favorable performance of various commodities as compared to the previous decade. An important change also observed from those data, was the drastic inversion of coffee production; from a 6.62% increase per year during the 1950's, to a decrease of almost 7% per year in the total produced in the 1960's. The implications of this phenomenon, largely induced by government policies,[57] are important

54 See table 2, for price trends since 1968.

55 See Saylor (1974) for the effects of this legislation on the quantitative demand for labor in São Paulo agriculture. His estimate is a reduction of 240,000 laborers, after all the adjustments were made, as a result of the introduction of the minimum wage.

56 See Homem de Melo & Zockun (1977).

57 The intensification of the coffee producers' eradication programs occurred during the first half of the 1960's.

not only in terms of inventory build up but, especially, by the release of resources for other crops.

During the 1960's, prices increased for beans, manioc and corn and declined for rice, potatoes, tomatoes and onions on the domestic market, as compared to the previous decade. Nonetheless, even for the latter (except onions), the increased rates of production were not so unfavorable as compared to the probable increment in demand. Actually, the price index of commodities on the domestic market, indicated in table 2, following the initial unfavorable years (1960-1963), reveals a relative price stability from 1964 to 1971. Among the export crops, soybeans showed an extremely high rate of increased production, while cotton remained at quite a low rate. The production of castor beans showed a significant increase, while peanuts, in spite of their lower rate, continued to increase significantly, as well sugar-cane, on the other hand, had a smaller rate of increase in production during the 1960's, probably closer to the increase in internal demand.

During the 1960's, Brazil's agricultural policy most likely contributed to a more stable behavior of growth rates among commodities, as opposed to the greater concentration in coffee and sugarcane, observed during the previous decade. In addition to releasing resources from the coffee sector, agricultural policy had other favorable effects during this period. Besides being aided by the expansion of the transportation system, the agricultural sector benefited from the more effective implementation of the minimum price policy and by the greater availability of credit for costs and investments. Moreover, the prices of several inputs, such as fertilizers and machinery, began to develop favorably starting with the middle of the decade. Also, the trend in international prices for agricultural products, during these years, was not a factor of instability, in the sense of stimulating export crops in relation to those of the domestic market; on the contrary, the data shown in table 2 indicate a decline in the relative price of export commodities between 1965 and 1968.

Nonetheless, this situation did not last long after 1968. Table 2 indicates that, for the two groups of exportable commodities, there was a price trend more beneficial to producers. This trend became more significant in 1971. Among the products included in these two groups, the case of soybeans stands out due to its price increase as well as the increase of Brazilian production; from a 16% rate of increase per year during the 1960's, the production of soybeans reached a production increase of 35% per year during the 1967-1976 period. With such a sharp increase, even starting from a relatively small production, the other crops had to be affected through the competition for the use of factors.

The rates of increase of Brazilian agricultural production shown in table 3 reveal a significant decline in performance in relation to the 1960's, affecting a good number of commodities. Such was the case for corn, cotton, rice, beans, manioc, potatoes and peanuts. In the case of beans and manioc, the situation is much more serious: both products show negative growth rates of about — 2% per year. With such behavior in the domestic production of several important food crops, it is not surprising to observe (in table 2) a significant price increase in commodities on the internal market until 1974.

Actually, the situation described above is an accurate picture of the major conflict faced by the Brazilian economy at the present time, as well as the dual pressure to which the agricultural sector is subject. The economy must confront, on the one hand, the critical situation of the balance of payments which exists since 1974 and the need to increase exports, and on the other hand, the need to supply food products to the domestic market, keeping in mind the price trend aspect and its distributive consequences.

Since the late 1960's, a greater emphasis on foreign trade oportunities can be observed in Brazilian economy. The granting of larger incentives for exports, especially for manufactured goods, became a governmental concern, even with more frequent exchange readjustments (system of mini-devaluations); other measures included exemptions and fiscal credits for the export of manufactured goods which, in the same manner as the agricultural sector, remained until then, burdened by the indirect taxes incurred by the domestic market.[58] Hence, from a period which emphasized only the situation of imports, Brazil moved to another in which the exportation of industrial products was also regarded as important in the development strategy. On the other hand, Tyler (1976) reveals a reduction in the average level of import tariffs between 1965 and 1967, an increase in 1968 and a declining trend in this level from 1969 to 1974; this more liberal trade policy on imports also reflects an important change in relation to the policy of import substitution during the 1950's and the beginning of the 1960's. However, since 1974, due to the balance of payments crisis, the situation was reversed through a termendous increase in tariffs and the introduction of the compulsory deposit for imports.

4 — Final remarks

In this study, our major concern has been two functions generally acknowledged to be of importance for the agricultural sector dur-

[58] For details, see Zockyn et alii (1976).

ing the economic development process: the cultivation of food products and raw materials for domestic consumption and production for international trade and foreign exchange earnings. The latter is emphasized by Brazil's current balance of payments problem which is characterized by large, consecutive deficits revealed in the current transaction account and by extremely severe restrictions on the importation of a large number of products, as well as by the possibility for the agricultural sector to contribute towards overcoming this crisis. With these two concerns as background, we have sought to examine in greater detail some of the economic policies introduced during the post-war period and to thus identify the consequences for the agricultural sector. On this subject, we have discussed not only some of the policies more specific to agriculture, such as agricultural research, marketing, minimum prices, credit and agricultural inputs, but also more general items such as exchange and trade. We have also sought to emphasize the Brazilian development strategy of import-substituting industrialization.

In a long-term perspective, the more formal development models point to an economy much more directed to the urban-industrial sector, and an agricultural sector decreasing in relative importance. To a certain extent, it may be said that during the 1950's industrialization was overemphasized as an obvious and easy solution to the problem of underdevelopment, relegating the agricultural sector to a secondary position in this transformation process. For countries with high rates of population growth, the diagnosis of marginal productivity of labor equal to zero. seems to have contributed to this emphasis. For countries having no limitation imposed by a shortage of the land factor, even greater facility was foreseen in this process; though the population might grow at high rates, the first symptoms of unsatisfactory agricultural production could be confronted by incorporating new land into the productive process. The involvement of the public sector in this case, would have been in the role of facilitating the settlement of the agricultural frontier, through appropriate investments.

Furthermore, after World War II, various Latin American countries were pessimistic in the diagnoses for their economies: a slow increase in agricultural exports, high rates of demographic growth and massive migrations from rural areas to urban were foreseen centers. The introduction of new technologies in export agriculture was regarded skeptically in the face of the forecasted deterioration in the terms of trade.

It was in this dual context that, during the late 1940's, Brazil and other Latin American countries chose a policy of import-substituting as their major development strategy; the expectation placed

in the industrialization plans, in terms of structural transformation was quite high. In addition, they expected to alter the international division of labor which had been in existence during the first half of the century: that is, Latin America as a supplier of food products and raw materials, and an importer of manufactured products. In light of this, a series of economic policy instruments, especially in the exchange, fiscal and finance areas, was implemented by the Brazilian government in an effort to achieve the intended reallocation of resources.

Development of the industrial sector then became Brazil's first priority. It was essentially based upon the domestic production of consumer goods which had been previously imported. From that point on, nothing more was expected from agriculture than a contribution in avoiding food supply crises in the urban centers, since such crises could obstruct the achievement of the Brazil's main objective: industrialization. In this regard, the first problem which arose in the 1950's illustrates the government's predominant tendency of the period. The solution proposed was along the lines herein mentioned, i. e., public investments in transportation and, on a smaller scale, warehousing to facilitate the expansion of the cultivated area.

In concluding this study, it is not our intention to reiterate the individual economic policies analyzed in the text, precisely because we have attempted to discuss them in terms of the overall perspective of their probable effects. At this point, we shall only add a few brief comments, based upon the interpretation we have given of these policies.

First, with regard to the possibility of agriculture being able to meet the growth in demand for its products at constant real prices or, more ambitiously, at lower real prices for consumers, we would say that the set of policies adopted did not help to achieve this objective. After reviewing the price trend for agricultural products on the internal market and that of industrial prices since 1948, as well as the major external economic events affecting the agricultural sector and their consequences, we believe that the 1964-1971 period is the most reasonable one for the consideration of price behavior. Relative stability in trade relations can be observed. Although agricultural income was given little emphasis in the text, the data gathered in the 1960 and 1970 Consuses, indicated a 38% increase in the average income of the urban sector and only 14% in the primary sector; furthermore, only 20% of those economically active in agriculture in 1970 had an income above the minimum wage, whereas for those in the secondary and tertiary sectors, the figures were 60% and 70%, respectively. It was only after the beginning

of the decade of the 1970's that rural wages began to increase at a faster race, at least until 1974.

We believe that the policies discussed contributed substantially to the economic conditions which we have described. In attempting to respond to some of the serious supply crises, the policies adopted were excessively biased towards subsidies through rural credit, rate of exchange and the price of agricultural inputs. Over the years, governmental programs made inadequate levels of investments in agricultural research and education, and the minimum price policy became a reality only during the last decade. Despite the benefits of the highway system, the marketing infrastructure is deficient for current needs and exports. The distributive and regional effects of several of these policies may have been important during the period. In the field of basic food products, such as rice, beans, milk and several others, Brazil still has much to accomplish, if it is consciously seeking to benefit consumers as well by means of lower real prices.

Policies aiming at the appropriate development of the agricultural subsector (food products) tend to have a beneficial impact, not only for producers but for consumers as well; the substantial portion of most family budgets which is spent on food is an indication of the real consumer savings that could be achieved through lower retail food prices. However, in order to attain this important objective, the policies herein analyzed require reformulation.

First priority willl be given to agricultural tecnology, so as to continue and even increase, over time, government investments in technical know-how, information and inputs, for the agriculture of food commodities, taking into account the ecological diversities of the regions of Brazil. The success of a program of this kind will also tend to facilitate the settlement of the agricultural frontier still remaining, especially if this settlement process is redirected to give greater emphasis to the small family farm. This would also improve the pattern of labor absorption in the Brazilian economy and, consequently, the income levels of the agrarian population. Also important in this settlement process of new areas is the government's performance in providing minimum condition of infrastructure for the purpose of marketing corps in the more distant regions, especially throug transportation credit, warehousing and the necessary requirements for the effective operation of the policy of price guarantees.

Althouh it has become far more effective during the last five to ten years, the latter policy can have another important role, especially if a solution is sought for the problem of price instability and production of various food commodities. With regard to this last point, a program of regulating inventory supplies and, at least, on a short-term basis and when necessary, the more efficient importation of food products, would be important. With regard to factor

222

prices, self-sufficiency in fertilizers must be accomplished in such a way that the agricultural sector is not obligated to pay higher prices than those prevailing on the international market. Besides hurting the domestic consumer, high fertilizer prices also tend to restrict the adoption of varieties which might be developed by the agricultural research system.

Nevertheless, though the discussion of technological advancement in agriculture and the correction of the deficiencies in the marketing infraestructure may have implied the possibility of achieving increases in agricultural exports in the medium-run, if investments were to be made now, Brazil would still need to increase its exports in the short-run. Even though Brazilian exports reached US$ 10 billion in 1976 and with earnings of more than US$ 12 billion in 1977, the increases in relation to 1975 are, in part, due to the earnings obtained from coffee, the price of which was affected by events not subject to influence of government policies (frost in Brazil, war in Angola, etc.) .

It is important to recall that the high international price of coffee probably does not represent a permanent improvement in Brazil's terms of trade, due to the anticipated recovery in both the Brazilian and world production, as already witnessed in the early months of 1978. Therefore, it is quite clear, that the critical situation of Brazil's balance of payments beginning in 1974, was alleviated for this reason. It is fitting to recall this point, since there seems to have been a tendency in Latin America to regard as permanent any substantial increase in foreign exchange earnings and then launch programs of economic expansion only to have to make painful adjustments later on.

The importance of the agricultural sector in Brazil's foreign exchage earnings is so crucial that its potential as a permanent solution to the balance of payments problem cannot be disregarded. Nonetheless, the incentives required for the increase of agricultural exports have not been applied until now; it appears that Brazil is too dependent on increases in international prices for agricultural commodities, and does not take steps which may have more lasting internal effects.

A strategy of this kind, that is, simultaneously seeking increased food production both for the internal market and for export would probably require, in the short-run a redirection of the current incentives in the Brazilian economy which relate to the allocation of resources among the productive sectors. However, this might be the time to seriously consider the future consequences of the overall continuation of the industrialization policies and import substitution of basic inputs, when strictly based upon the criterion of gross savings of foreing exchange credits.

Abstract

This paper focuses on the post-war performance of the Brazilian economy. An analysis is made of economic policy alternatives and their effects, with emphasis on the agricultural sector. The development ment estrategy adopted during the period favored the industrial sector in detriment to agriculture.

This discussion is based on those historical events during the period which were associated with this policy option, and attempts to determine the extent to which society was benefited by this decision. The lessons learned from the analysis of past experience facilitate a better understanding of current problems and provide a perspective of trends in the Brazilian economy for the near future.

References

Adams, D. Rural Finacial Markets, Level of Agricultural Growth and Capital Formation in Brazil. In: Mendonça de Barros, I.R. & Graham, D.H. *Studies on the Modernization of Brazilian Agriculture.* 1977. (IPE Monographical Series, n.º 9).

Baer, W. *Industrialization and Economic Development in Brazil.* 1965.

———. Import Substitution and Industrialization in Latin America: Experiences and Interpretations. *Latin American Research Review,* 7 (1): 95-122, Spring 1972.

Baer, W. & Villela, A.V. Industrial growth and industrialization: revision in the stages of Brazil's economic development. *The Journal of Developing Areas,* v. 7, p. 217-34, Jan. 1973.

Balassa, B. Growth strategies in semi-industrial countries. *Quarterly Journal of Economics,* 84 (1) : 24-47, Feb. 1970.

Bergsman, J. *Brazil: Industrialization and Trade Policies.* London, Oxford University Press, 1970.

———. Foreign trade policy in Brazil. *Economic Studies,* 5 (2) : 51-104, 1975.

Bergsman, J. & Candal, A. Industrialization past success and future problems. In: Ellis, H.S. ed. *The Economy of Brazil.* Berkeley, University of California Press, 1968.

Blandford, D. & Currie, J.M. Price uncertainty — the case for government intervention. *Journal of Agricultural Economics*, 26 (1) : 37-51, 1975.

Corden, W.M. *Trade Policy and Economic Welfare*. Oxford, Clarendon Press, 1974.

Fishlow, A. *Foreign Trade Regimes and Economic Development: Brazil*. National Bureau of Economic Research, 1974, mimeogr.

Furtado, C. *Diagnosis of the Brazilian Crisis*. Berkeley, University of California Press, 1965.

Cargill Foundation. *Soybeans in Central Brazil*. 1977.

Grunwald, J. Some reflections on Latin American industrialization policy. *Journal of Political Economy*, 78 (2) : 826-56, July-Aug., 1970.

Hirschman, A. The political economy of import-substituting industrialization in Latin America. *Quarterli Journal of Economics*, v. 82, p. 1-32, Feb., 1968.

Homem de Melo, F.B. The Use of Fertilizers and the Modernization of São Paulo Agriculture. *Agricultura em São Paulo*, 22 (1-2) : 341-62, 1975.

Homem de Mello, F.B. & Zockun, M.H. Agriculture exports, balance of payments and supply of the internal market. *Estudos Econômicos, 7,* (2) : 9-50, 1977.

Hudle, D.L. The Brazilian system of floating rates of exchange. *Revista Brasileira de Economia*, 26 (4) : 149-69, 1972.
Institute of Agricultural Economics. *Prognóstico 1973-74*. São Paulo, 1973.

Jorgenson, D.W. The development of a dual economy. *Economic Journal*. June, 1961.

Kirsten, J.T. *Income-Elasticity of the Demand for Agricultural Commodities: an Econometric Essay*. USP, Instituto de Pesquisas Econômicas. April, 1977.

Krasner, S.D. Manipulating international commodity markets: Brazilian coffee policy, 1906 to 1960. *Public Policy*, 21 (4) : 493-523, Fall 1973.

225

Krishana, R. Agricultural price policy and economic development. In: Southworth, H.M. & Johnston, B.F. ed. *Agricultural development and economic growth*. New York, Cornell Univ. Press, 1967.

Leff, N.H. Export stagnation and autarkic development in Brazil, 1947, 62. *Quartely Journal of Economics,* 81 (2) : 286-310, Feb., 1967.

Lewis, W.A. *Economic Development with Unlimited Supplies of Labour*. Manchester School, May, 1954.

McCloskey, D.N. Does the past have useful economics? *The Journal of Economic Literature*, 14 (2) : 434-61, June, 1976.

Mueller, C. C. *The Relative Prices of Factors and the Adoption of Labor-saving Technologies in Agriculture,* São Paulo, ANPEC/ FIPE/ SOBER.

Nicholls, W.H. Agricultural surplus as a factor in economic development, *Journal of Political Economy*. Feb., 1963.

––––. Brazilian agricultural economics: recent policy and performance In: Contador, C.R. ed. *Agricultural Technology and Development*. IPEA, Série Monográfica, 1975.

Officir, L.H. The purchasing-power parity theory of exchange rates: a review article. *IMF Staff Papers,* 23 (1) : 1-60, March, 1976.

Oliveira, J.C. The role of minimum prices in agriculture. Estudos Econômicos, v. 4, n.º 2, 1974.

Paiva, R.M. et alli. *The Agricultural Sector of Brazil*. São Paulo, Secretaria de Agricultura, 1973.

Pastore, A.C., Alves, E.A. & Rizzieri, J.B. Induced innovation and the limits to modernization in Brazilian agriculture. *Paper for internal discussion n.º 25*, IPE-FEA, 1974.

Pastore, J., Dias, G.L., & Castro, M.C. Conditionings of the Productivity of Agricultural Research in Brazil. Paper presented at the 1st Technical Meeting on Agriculture. ANPEC/FIPE/ SOBER, Oct., 1976.

Patrick, G.F. & Kehrberg, E.W. Costs and Returns of the Education in Five Areas of the East Region of Brazil. In: Coord. Araújo, P.F.C. & Schuh, G.E. Desenvolvimento na Agricultura, Pioneira, 1975.

Prebisch, R. Commercial policy in the underdeveloped countries. *American Economic Review*, p. 251-69, May, 1959.

———. *Dynamic of the Latin American Development*. Editora Fundo de Cultura, 1964.

Ranis, G. & Fei, J.A. Theory of economic development. *American Economic Review*, v. 51, p. 533-65, Sept., 1961.

Sanders Jr. J.H. *Mechanization and Employment in Brazilian Agriculture*. Unpublished Ph. D. thesis, University of Minnesota, 1973.

———. Biased choise of technology in Brazilian agriculture. 1976. mimeogr., Sayad, J. Planning, credit and the distribution of wealth. *Estudos Econômicos*, 7 (1) : 9-34, 1977.

Saylor, R.G. Supply and demand of agricultural labor in the State of São Paulo. *Agricultura em São Paulo*, 21 (3) : 129-46, 1974.

Schuh, G.E. & Alves, E.A. *The Agricultural Development in Brazil*. Rio de Janeiro, ANPEC, 1971.

Schuh, G.E. The exchange rate and U.S. agriculture. *American Journal of Agriculture Economics*, 56 (1) : 1-13, 1974.

Schidlowsky, D.M. Latin America trade policies in the 1970's: a prospective appraisal. *Quarterly Journal of Economics*, 86 (2) 263-89, May, 1972.

Smith, G.W. Brazilian agricultural policy: 1950-67. In: Ellis, H.S. ed. *Essays on the Economy of Brazil*. University of California Press, 1969.

Thompson, R. & Schuh, G.E. *Sources of Regional Differences in Productivity in Brazilian Agriculture*. Ohio, Columbus, 1975, mimeogr.

Tyler, W.G. The industrialization and industrial policy in Brazil: a global perspective. *Estudos Econômicos*, 6 (2) : 113-59, 1976.

Veiga, A. The Impacts of Trade Policy on Brazilian Agriculture, 1947-67. Purdue University. Unpublished Ph. D. thesis, 1974.

———. Schuh, G.E. Exchange policy and agricultural exports in Brazil: 1947-68. *Agricultura em São Paulo*, 22 (1-2) : 1-50, 1975.

Vieira, J.L.M. *The Impact of Income on the Nutritional Status of Families in São Paulo*. Master's Thesis, FEA/USP, 1976.

Pesquisa e Planejamento Econômico

Brazilian Economic Studies

BES n.º 4 — Edited by Fernando Rezende

Brazilian Economic Policy in the Mid-Seventies, by Dionísio Dias Carneiro Netto — *Real Estate Investments and Financial Markets*, by João Sayad — *Dualism in the Urban Labor Market*, by Hamilton C. Tolosa — *Urban Unemployment in Brazil*, by David E. Goodman and Daniel R. Oliveira — *Brazilian Public Foreign Debt Policy, 1931-1943*, by Marcelo de Paiva Abreu — *Production, Employment and Agrarian Structure in the Cacao Regions of Bahia*, by Gervásio C. Rezende — Book Review: *Tyler, William G. — Manufactured Export Expansion and Industrialization in Brazil*, by Carlos von Doellinger.

BES n.º 5 — Edited by Fernando Rezende

Leading Indicators for the Industrial Sector, by Claudio R. Contador — *The Structure of Industrial Wages in 1970*, by Paulo Vieira da Cunha and Regis Bonelli — *Rapid Growth, Equity and the Size of the Public Sector*, by Rogério L. Furquim Werneck — *Public Employment and Economic Development*, by Fernando Rezende and Flávio P. Castelo Branco — *Inflation and the Balance of Payments in a Dependent Economy*, by Celso L. Martone — *Unplanned Settlement in the Amazon Region*, by Jean Hébette and Rosa E. Acevedo Marin — *Passenger Transportation in Metropolitan Areas*, by Josef Barat — *A Mixed-Integer Programming Model for the Brazilian Cement Industry*, by Christine Ann Assis — Book Review: *Syvrud, Donald — Foundations of Brazilian Economic Growth*, by Eustáquio J. Reis.