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AUTHOR Neves, Jorge A.; Haller, Archibald O.; Fernandes, Danielle C.

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ABSTRACT

This paper examines the process of earnings determination in the agricultural sector of Brazil. Among the main causal factors analyzed are human capital (education and work experience), labor market segmentation, gender, social class position, level of development/modernization, and concentration of land ownership. Data on individuals employed in the agricultural sector (including livestock production) were drawn from Brazilian National Household Sample Surveys for 1973, 1982, and 1988. Contrary to previous reports, the impacts of both schooling and work experience on the earnings of the farm labor force were found to be positive and very large. Level of development or modernization did not affect the relationship between human capital and earnings. However, structural variables such as agricultural modernization and social class did have direct and independent effects on earnings. Up until 1982, the positive effect of agricultural modernization on earnings was greater than the negative effect of concentrated land ownership; after 1982, the latter exceeded the former. With regard to public policy, the findings suggest that investment in the rural labor force's human capital would increase agricultural productivity, and that agricultural land distribution may be useful in Brazil for purely economic reasons, if not others. Contains references in notes and 12 statistical tables. (SV)

HUMAN CAPITAL, SOCIAL CLASSES, AND THE EARNINGS DETERMINATION PROCESS IN BRAZILIAN CULTURE

AGRI

JORGE A. NEVES

Faculty of Administration
Federal University of Pernambuco
Recife, Brazil
(formerly at the Fundação Joaquim Nabuco)

ARCHIBALD O. HALLER

University of Wisconsin–Madison

DANIELLE C. FERNANDES

Catholic University of Pernambuco
Recife, Brazil
and
University of Wisconsin–Madison

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Human Capital, Social Classes, and the Earnings Determination Process in Brazilian Agriculture

Jorge A. Neves
Departamento de Ciência Política/Fundação Joaquim Nabuco

Archibald O. Haller
Department of Rural Sociology/University of Wisconsin–Madison

Danielle C. Fernandes
Department of Rural Sociology/University of Wisconsin–Madison

I. Introduction

This paper explores the earnings levels of farm people in Brazil in three recent years—1973, 1982, and 1988, together with analyses of the increments or decrements to income attributable to variables permitting tests of a number of theoretic hypotheses flowing from two apparently conflicting, but actually compatible, theories.

Brazil is one of the most studied cases among the so-called *Newly-Industrialized Countries* (NICs). With a population of about 160 million people, it is the fifth largest country (in terms of both population and territory), and its economy is about the 9th or 10th largest in the world (the largest among the NICs). On the other hand, its per capita income is not very high.[1] It also has, according to the World Bank, one of the highest rates of income inequality in the world, as well as high levels of land concentration, and a considerable amount of its population still lives below the poverty level.[2]

The process of industrialization in Brazil began at the end of the XIX century and beginning of the XX century. It was, at first, financed by the exports of agricultural commodities, in particular coffee. The process of *Import Substitution Industrialization* (ISI) began with the manufacturing of nondurable consumption goods, especially textiles. At the end of the 1930s and the beginning of the 1940s, however, the first efforts to advance the process of industrialization by establishing a subsector of industrial production to manufacture intermediary goods, in particular steel and petrochemicals, were initiated by the foundation of the first large steel mill in Brazil, the Companhia Siderúrgica Nacional–CSN. This stage of Brazilian economic development also

inaugurated *heavy* direct intervention of the State in the economic activities of the country. Not only was CSN founded during this period, but so also was the Brazilian National Company for Petroleum Extraction and Refining (PETROBRAS). Both companies were owned by the Brazilian federal government,[3] and have thereafter played important roles in the development strategies carried on by the different governments. The manufacturing of intermediary goods made it possible for Brazil to attract foreign investments in the area of durable consumption goods, especially in the automobile industry, which began with the arrival of a German company in the 1950s.

The final stage of the ISI strategy in Brazil began during the so-called *economic miracle* at the end of the 1960s and beginning of the 1970s. This period was marked by the establishment of many industrial plants to produce capital goods. This phase was of particular importance for agriculture, because it was also marked by the beginning of the production of industrialized agricultural inputs, such as fertilizers, pesticides, and machinery. This made possible the acceleration of the process of technical modernization of Brazilian agriculture. Up to the 1960s the process of growth of agricultural production in Brazil was mostly limited to the *extension margin* (opening new lands). After this the rise in agricultural outputs resulted from both the expansion of the agricultural frontier and the newer technologies. The process of technical change in Brazilian countryside has been believed to be responsible for many important structural changes in the country. For example, P. Singer, as well as C. Wood and J. Carvalho, argue that the very fast process of urbanization experienced by Brazilian society has been much more a consequence of *pushing factors* in the agricultural economy than *attracting factors* in the manufacturing sector.[4] The main *pushing factor* in agriculture is what they call *change factors*, i.e., the technical changes undergone in agriculture have destroyed many jobs in the countryside, forcing people to migrate to urban areas. This has been indeed one of the main causes—probably not the only one—of the rural–urban migration patterns existing in Brazil.

Brazilian agriculture has always played an important role in the country's economy. Brazil is a big producer and exporter of agricultural staples. It is the largest producer of coffee, the third largest producer of soy beans, the second biggest producer of poultry, and the second largest producer of oranges, among others. Although manufacturing and services have become dominant in Brazilian economy, agriculture is still a strategic sector with a promising future in terms of growth.[5] Therefore, analyses of the development potential of Brazilian agriculture—and socioeconomic factors associated with it—may provide important information for future planning. Similarly, they may contribute to a better understanding of the socioeconomic processes associated with agricultural production in other developing countries. Thus the present study of the process of earnings determination in Brazilian agriculture seeks to contribute to both social science knowledge and public policy.

The present investigation is an application to agriculture of a previous analysis of income in the nation as a whole by A. Haller and H. Saraiva.[6] The objective is to determine the role of human capital and structural variables as factors in the process of earnings determination in the agricultural sector of Brazilian economy. We would hope that this research would provide information that may be useful in the future to help guide public policy and agricultural development strategies by public agencies and private

corporations. It is important to notice that the few published studies of the relationship between human capital and earnings in Brazilian agriculture reported low rates of returns to schooling.[7] These findings are contrary to those from studies on other sectors of Brazilian economy, and those on the country's labor force as a whole,[8] which have found large income increments to each additional year of education. This reinforces the importance of the analyses reported herein.

II. The Research Problem

The theoretical debate about earnings determination has been dominated by two general approaches: the individualistic and the structuralist. The former is represented by human capital theory and status attainment theory.[9,10] The structural approach includes two main theories, class analysis and labor market segmentation (or dual labor market, or dual economy) theory.[11,12]

On the one hand, the individualistic approach proposes that earnings vary with individual attributes, i.e., education, occupational status, training, age, experience, etc. On the other, the structuralists propose that the relationship between individual attributes and income is mediated and modified by structural variables (social class and economic segmentation).

The Individualistic Approach

Mincer proposes that there are two main determinants of the distribution of earnings: a) differences in accumulated human capital, i.e., length of schooling, quality of education, job training, experience, investment in health and nutrition, etc.; and b) differences in rates of return to human capital.[13] While the first factor consists unambiguously of individual attributes, the second is not necessarily an outcome of individual will or choice, or even inheritance. Thus, even in the human capital theory we can find room for a degree of structural or societal influence on earnings or income. Much of the research on earnings determination and distribution has been concentrated on differences in rates of return to human capital. Within the individualistic framework, D. Treiman proposes that level of development (or industrialization) influences the respective effects of the occupational level of one's parents on one's own education.[14] In the same way, C. Langoni proposed that Brazil's rapid economic development during the second half of the 1960s was the main factor responsible for the increase of income inequality between 1960 and 1970.[15] His argument is that the process of development in Brazil comes along with more investment in capital intensive technologies, and that capital and skilled labor are complementary. Thus, he concluded that Brazil was experiencing a rising rate of earnings returns to the investment in human capital, and that this was the main cause of the growing level of income inequality.

The human capital framework may also supply us with other relevant predictions. For example, there is another possible variation in the rate of economic returns to education which may play an important role in the agricultural sector in Brazil. F. Welch divided the effect of education on earnings into two: the *worker* or *direct* effect; and the *allocative* effect.[16] The first suggests that schooling makes the individuals more productive, and so increases their earnings. The second is represented by the prediction

that a portion of the income returns to schooling would be reflected in an efficient allocation of resources. This suggests that decision makers will have the highest earnings returns to the investment in human capital.

The Structuralist Approach

For the structuralist approach, the central point is not only whether the structural variables have significant and independent influences on earnings, but whether they constrain the way human capital influences earnings. About the social class' influence on income, in the words of E. Wright and L. Perrone, the problem can be stated as follows:

> "If class position is a critical mediating variable between social background and income, then it would be expected that class position would affect the ways in which background characteristics get transformed into income. That is, we hypothesize not only that class position has an independent impact on income from occupational position, but also it affects the extent to which background characteristics themselves can be 'cashed in' for income. In particular, the expectation is that class position will have a strong influence on the extent to which education influences income."[17]

The same question can be stated for the labor market segmentation theory, by using labor market segment (or economic sector) as the intervening variable.

In a few words, the main research problem concerning earnings determination has been to determine how economic returns to human capital (especially education) vary in a society. In agriculture, not only the previous variables (level of development, class position, and labor market segmentation) but also certain factors specific to this sector (e.g., land concentration) might play an important role as mediators of the relationship between human capital and earnings. For example, it can be hypothesized that the higher the rate of land concentration yields the lower the earnings return rate to human capital factors: in areas with high levels of land concentration, it would be more difficult for agricultural laborers to achieve relatively higher rewards for their investments in human capital than in areas where agricultural land is distributed among small operations. This is because where wide areas are divided into a few large properties, the owners are in a strong position to control wages.

Hence, the main goal of the present research is to analyze the specifics of the process of earnings determination in the agricultural sector in Brazil. In other words, to identify the factors that play important roles in the returns to the investment in education experience (another human capital variable) in the agricultural sector in Brazil. The research is based on an analysis of the Brazilian farm labor force in 1973, 1982, and 1988. In terms of the analysis of changes over time, we should call attention to the fact that Brazilian agriculture has experienced relatively stable trends of growth, and a rising degree of land concentration.[18,19]

III. Hypotheses

Based on the theoretical approaches described above, we specified our main research hypotheses as follows:

- Hypothesis 1: From the individualistic approach, we will test the hypothesis that human capital factors have significant effects on earnings.

- Hypothesis 2: From modernization theory (C. Langoni), we will test the hypothesis that the rate of earnings return to human capital is higher in areas with higher rates of capital inputs in the agricultural sector, and that the rate of return to human capital increases as a consequence of the process of modernization experienced by Brazilian agriculture.

- Hypothesis 3: From the proposed allocative effect of human capital on earnings, we will test the hypothesis that decision makers have the highest rates of earnings returns to human capital.

- Hypothesis 4: From the structuralist approach, we will test the hypothesis that social class and labor market segmentation have significant independent effects on earnings.

- Hypothesis 5: From the structuralist approach, we will test the hypothesis that the rate of earnings returns to human capital varies among social classes—and thus among the labor market segments they represent.

- Hypothesis 6: From the structuralist approach, we will test the hypothesis that the average rate of economic returns to schooling rises as the levels of land concentration falls.

IV. Data

The data for this research come from three data sets of the Brazilian National Household Sample Survey (PNAD). The three PNADs used here—1973, 1982, and 1988—were designed especially for analyses of social stratification, mobility, education, and the labor market. PNAD–1982 has the largest sample (more than 1 million individuals for the country as a whole), followed by the 1973 sample (more than 300 thousand), and the 1988 sample (about 290 thousand). All the three data sets derive from stratified, multistage cluster samples of households. However, given that our intention is to analyze the process of earnings determination of the labor force in the agricultural sector in Brazil, only those individuals who were economically active and were employed in the agricultural sector (including livestock production) appear in our analysis. As a consequence, the sizes of the subsamples applied in our present analyses are: 32,178 (1973), 69,561 (1982), and 19,089 (1988). These figures reflect the fact that the percentage of employed agricultural labor force in Brazilian population decreased over time, from more than 10 percent in 1973 to about 7 percent in 1982, and 6.6 percent in 1988.

Given that PNADs do not include data about land concentration and capital inputs in agriculture, this information was obtained from the agricultural censuses of 1970, 1980, and 1985. The level of aggregation of the agricultural censuses data that we used is by state. Therefore, to each individual employed in agriculture we attribute the value of the level of agricultural land concentration of the state he/she works in, as well as the average rate of capital input (Intermediary Consumption Rate) in the same state. The data of the agricultural census of 1970 are used for the individuals of the PNAD data set of 1973, the 1980 agricultural census for the individuals in the PNAD of 1982, and the agricultural census of 1985 for the individuals of the PNAD of 1988.

These data sets are known to be of high quality. Much research has been done using the PNAD and census data sets produced by Instituto Brasileiro de Geografia e Estatística (the Brazilian Bureau of Census), and all social scientists who have used these data sets have pointed out their high quality. However, for the purposes of this research the PNAD data sets have a possible limitation: they do not include individuals from the rural areas of the Brazilian Amazon Frontier, due to the enormous difficulties of access into the interior of this region. Nevertheless, the Brazilian Amazon, even though representing more than half of the country's territory, holds only about 11 percent of the Brazilian population, and its level of urbanization is quite high—over 50 percent. Besides that, our samples also include observations from persons living in the Amazon region, inasmuch as some of the urban people sampled by the PNADs hold jobs in the agricultural sector. This is a bit of a problem of sample selectivity bias, but it is not great enough to invalidate our study.

Another problem is that some methodological analyses seen to have shown conclusions from stratified, multistage cluster samples cannot be interpreted as if they were simple random samples.[20] The best remedy for this has been said to be the one proposed by A. Goldberger and G. Cain, and employed by many researchers.[21] Goldberger and Cain argue that statistical estimations from stratified, multistage cluster samples in general understate the standard errors. Thus, they propose that we should use *t* ratio greater than 3.00 in statistical analyses based on data coming from this type of samples in order to achieve more reliable conclusions. This is the method employed in the present study.

V. Variables

Earnings

This is our dependent variable. The *original data of this variable are in units which are not comparable among the three years*. But such comparisons are not essential to this analysis. *What is essential is the increment in earnings that can be attributed statistically to a unit increase in each independent variable*. Accordingly, the earnings data were calculated as the natural logarithm (ln) of monthly individual earnings, divided by the number of hours worked per week. More specifically, in the PNADs of 1982 and 1988 individual earnings were presented in denominations of the official currency of Brazil in each year, but in the PNAD of 1973 this variable was presented in a group of 20 intervals. So, following the strategy of A. Haller and H. Saraiva, i.e., we used the mean of each interval as an estimator for monthly earnings of each individual.[22] This introduced a little

error in the 1973 data, but it was inevitable given the circumstances. All regression coefficients were transformed by the formula [(e^b - 1) X 100] to yield the percentage of increment of earnings (PIE) attributable to a unit increase in the independent variable. That is, our actual dependent variable is the PIE per unit increase in any given independent variable.

Education

The variable education is the number of years of education successfully completed.[23] For the PNAD of 1982, we have the actual number of years of education, varying from 0 to 16 years (for the agricultural labor force). For the PNAD of 1988, the variation goes from 0 to 17 years of schooling. For the PNAD of 1973, however, data on the *exact* number of years of education are not available. The original data on schooling for the 1973 sample were coded in the following way: I- no schooling at all; II- incomplete elementary school; III- complete elementary school; IV- incomplete middle school; V- complete middle school; VI- incomplete high-school; VII- complete high-school; VIII- incomplete college education; IX- complete college education. Here, we followed the strategy of D. Bills and A. Haller, i.e., to use the following numbers to represent years of schooling: 0 (no schooling); 2 (incomplete elementary school); 4 (complete elementary school); 6 (incomplete middle school); 8 (complete middle school); 9.5 (incomplete high school); 11 (complete high school); 13 (incomplete college education); 15 (complete college education).[24] We are aware that this scheme incorporates a little unreliability of measurement, but less than the use of the original categorical coding would. (It can easily be shown that the degree of unreliability due to the imposition of crude categories falls off rapidly as the number of categories increases. For a 2 X 2 imposition, such unreliability is quite high. For a nine-category imposition, unreliability is very low.)

Experience

This variable was constructed by subtracting the age of the individual in the year he/she started to work from his/her age when he/she was interviewed.[25] We had to make a choice between using experience or age, in order to avoid multicolinearity. Experience was chosen because it best represents the human capital approach in the statistical models.[26]

Experience Squared

This variable was introduced as a control variable, due to the fact that, on the average, experience yields positive earnings returns up to around age 50, diminishing after that.[27] In order to avoid multicolinearity, due to the high correlation between experience and experience squared, we transformed the variable experience, and than squared it to form the experience squared variable. In other words, our statistical models are *polynomial regression models*, i.e., the mean of experience will be subtracted from the variable experience for each individual. Both variables, experience and experience squared, will be presented in this way in our statistical models. This strategy reduced the correlation between the two variables from more than 0.95 to around 0.55, but kept the same correlation between them and the other variables.[28]

Migration

The variable, migration, is dichotomous. It was constructed in the following way: a) if the individual was living in the same state where he/she was born, the value for the variable is 0; b) if the individual is living in a different state from the one where he/she was born, or if she/he was born outside Brazil, the value for the variable is 1. Unfortunately, the PNAD of 1982 does not provide data on birthplace. Because of this, in all relevant tables we present two types of models for 1973 and 1988: with and without migration as one of the regressors.

Gender

This is also a dichotomous variable. Its values are: 0 for women, and 1 for men. In our samples, the proportions of women were 24.2 percent in 1973, 20.0 percent in 1982, and 19.6 percent in 1988.[29]

Social Class and Labor Market Segmentation

In the analysis, we combined concepts from two seemingly different structural approaches (class analysis and labor market segmentation), to construct what we believe to be the best available representation of both the class structure and the segments of Brazilian farm labor force. We divided this labor force into five social classes: **unprotected agricultural workers** (nonmanagerial-level employees who were not eligible for job security and other benefits); **protected agricultural workers** (nonmanagerial-level employees who were eligible for such benefits); **family farmers** (self-employed farmers); **farm managers** (managerial-level employees), and **large farmers** (employers).[30] The distinction between the first and the second group is based on labor market segmentation theory, while the distinction between these two groups and the other classes, as well as between the other class groups themselves, is based on class analysis approach. This class structure model appears in the multivariate regression analysis as four *dummy* variables. Unprotected agricultural workers form the reference group; each class is represented by a *dummy* variable.

These categories can be labeled *classes of farmers*, or *classes*, for short. A few words about each may be useful. Let us take the two classes called *agricultural workers*. In Brazilian labor law, once a employee has been with a certain employer for more than three months, the employee is guaranteed an income at least equal to the legal minimum wage, plus fringe benefits—access to health services and freedom from arbitrary dismissal, among others. *Permanent* personnel are those who are employed at least three months with a given farm or with a company of farm enterprises, whether the individual has or does not have a written contract. Many do not. Those who are permanent are called *protected agricultural workers*, those who are not permanent are called *unprotected agricultural workers*. Many of the latter are day laborers. The class of *family farmers* consists of those who own or rent a farm and whose family members provide the labor. *Large* farmers are defined here as those farm owners who employ nonfamily labor. *Farm managers* are employees who supervise a farm's labor force, overseeing the routine work of the farm.

Land Concentration

This variable is represented by the *Gini Coefficients (X 100) of Land Concentration* for each state. We multiplied each figure by 100, in order to make it easier to interpret the regression coefficients.[31] Each individual is attributed to the score of his or her state. Gini coefficients presented in our study are calculated from data presented in the agricultural censuses of 1970, 1980, and 1985. They are all based on the *establishment* (or unit farm). (These figures understate the real degree of land concentration because any one owner may be the proprietor of more than one establishment—a common phenomenon in Brazil.)

Level of Modernization

Many different indicators have been used as indicators of the level of modernization of agriculture in the Brazilian literature.[32] However, the most often used is also the most frequently supported as having the highest levels of validity. It is the *Intermediary Consumption Rate*.[33] This index is constructed in the following way: a) the first step is to sum the total expenditures in intermediary industrialized goods (seeds, fertilizers, pesticides, livestock meals and medicines, machinery, manufactured wrappings, bags and boxes, etc.); and b) the second step is to divide the result of the summation by the total value of production. As in the case of the Gini coefficients, we multiplied the *Intermediary Consumption Rate* figures by 100, in order to make easier to interpret them. So the resulting coefficients, like our Gini figures, vary from 0 to 100. These state-level scores—like those of the Gini's—are attributed to members of the sample in the corresponding state.

VI. Descriptive Statistics and Specification of Models

Descriptive Statistics

In this section we provide descriptive statistics for all our variables, as well as the zero-order correlations among them. Tables 1, 2, and 3 show the descriptive statistics.[34] Tables 4, 5, and 6 present the zero-order correlation matrixes of all the variables to be included in our regression models. The correlation matrixes show that the transformation of the variable experience really reduces its correlation with experience squared to reasonable levels. They also show that among our independent variables education and some of the social class *dummy* variables have the highest correlation coefficients with our dependent variable (lnEarnings). Gender and intermediary consumption rate always show positive correlation coefficients with the natural log of earnings. Some variables, however, show some overtime variations in their correlation with the dependent variable. Migration has a positive correlation with the natural log of earnings in 1973, but a negative correlation in 1988. On the other hand, the Gini coefficient of land concentration exhibits a positive correlation with the natural log of earnings in 1973, but negative coefficients in 1982 and 1988.[35]

Models

Our models are based on OLS regression. As said before, the dependent variable is the natural logarithm of monthly earnings. The cross-sectional analysis will be mainly based

on the tests of the interaction terms between education and each of the contextual variables (class, land concentration, and level of agricultural modernization). For overtime changes, *t-tests* are applied to test the equality between parameters of the earnings functions of the three different years. A t ratio greater than 3.00 will be used as the criterion.

Table 1: Descriptive Statistics for each Variable, Brazil–**1973**

Variable	*Mean*	*Std. Deviation*	*Lowest*	*Highest*
Education	1.57	1.66	0.00	15.00
Experience	20.90	16.64	0.00	60.00
Experience(b)	0.00	16.64	-20.90	39.10
$Experience^2$	713.70	912.96	0.00	3600.00
$Experience(b)^2$	276.77	316.92	0.01	1528.81
Migration	0.17	0.37	0.00	1.00
Gender	0.76	0.43	0.00	1.00
UnAgr. Worker	0.58	0.54	0.00	1.00
Pr.Agr. Worker	0.03	0.18	0.00	1.00
Family Farmer	0.32	0.46	0.00	1.00
Manager	0.01	0.08	0.00	1.00
Large Farmer	0.06	0.24	0.00	1.00
Gini * 100	78.13	6.83	61.00	93.00
Int. Con. * 100	15.15	7.22	3.00	38.00
Earnings	7.13	13.55	.13	896.00
lnEarnings	1.58	0.77	-2.04	6.80

Source: **PNAD-1973.**

Note: Education: Successfully Completed Years of Education.

$Note_2$: Experience: Years of Experience.

$Note_3$: Experience(b) represents the variable in the way it appears in the regression equations, given that they are polynomial regression equations [experience(b) = experience - experience / n].

$Note_4$: Migration: Did not Migrate = 0; Migrated = 1;

$Note_5$: Gender: Women = 0; Men = 1.

$Note_6$: Protected Laborer: Unprotected Laborer = 0; Protected Laborer = 1.

$Note_7$: Family Farmer: Non-Family Farmer = 0; Family Farmer = 1.

$Note_8$: Manager: Non-Manager = 0; Manager = 1.

$Note_9$: Large Farmer: Non-Large Farmer = 0; Large Farmer = 1.

$Note_{10}$: Intermediary Consumption Rate: The Sum of all Industrial Inputs in the Agricultural Production (Index of Modernization) Divided by the Total Production Value (Multiplied by 100).

$Note_{11}$: Land Concentration: Gini Coefficient of Land Distribution (Multiplied by 100).

$Note_{12}$: Earnings: Individual Earnings.

$Note_{13}$: lnEarnings: The Natural Log of Individual Earnings.

Table 2: Descriptive Statistics for each Variable, Brazil–**1982**

Variable	*Mean*	*Std. Deviation*	*Lowest*	*Highest*
Education	1.76	2.28	0.00	16.00
Experience	23.27	16.33	0.00	60.00
Experience(b)	0.00	16.33	-23.27	36.73
Experience^2	808.11	962.49	0.00	3600.00
Experience(b)^2	266.77	300.52	0.07	1349.00
Gender	0.80	0.40	0.00	1.00
UnAgr. Worker	0.60	0.66	0.00	1.00
Pr.Agr. Worker	0.05	0.22	0.00	1.00
Family Farmer	0.30	0.46	0.00	1.00
Manager	0.01	0.09	0.00	1.00
Large Farmer	0.04	0.19	0.00	1.00
Gini * 100	80.01	6.47	65.00	93.00
Int. Con. * 100	27.57	8.84	10.00	72.00
Earnings	523.67	1459.38	1.67	66666.67
lnEarnings	5.78	0.83	0.51	11.11

Source: PNAD-1982.

Note$_1$: Education: Successfully Completed Years of Education.

Note$_2$: Experience: Years of Experience.

Note$_3$: Experience(b) represents the variable in the way it appears in the regression equations, given that they are polynomial regression equations [experience(b) = experience - experience / n].

Note$_4$: Migration: Did not Migrate = 0; Migrated = 1;

Note$_5$: Gender: Women = 0; Men = 1.

Note$_6$: Protected Laborer: Unprotected Laborer = 0; Protected Laborer = 1.

Note$_7$: Family Farmer: Non-Family Farmer = 0; Family Farmer = 1.

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Note$_{11}$: Land Concentration: Gini Coefficient of Land Distribution (Multiplied by 100).

Note$_{12}$: Earnings: Individual Earnings.

Note$_{13}$: lnEarnings: The Natural Log of Individual Earnings.

Table 3: Descriptive Statistics for each Variable, Brazil–**1988**

Variable	*Mean*	*Std. Deviation*	*Lowest*	*Highest*
Education	1.92	2.50	0.00	17.00
Experience	23.72	15.75	0.00	60.00
Experience(b)	0.00	15.75	-23.72	36.28
Experience^2	810.71	935.39	0.00	3600.00
Experience(b)^2	248.17	284.88	0.078	1316.20
Migration	0.34	0.47	0.00	1.00
Gender	0.80	0.40	0.00	1.00
UnAgr. Worker	0.57	0.65	0.00	1.00
Pr.Agr. Worker	0.07	0.25	0.00	1.00
Family Farmer	0.32	0.47	0.00	1.00
Manager	0.01	0.12	0.00	1.00
Large Farmer	0.03	0.18	0.00	1.00
Gini * 100	81.56	6.57	62.00	93.00
Int. Con. * 100	24.08	10.39	9.00	61.00
Earnings	747.77	3240.83	4.15	200,000.00
lnEarnings	5.93	0.98	1.42	12.21

Source: **PNAD-1988**.

Note$_1$: Education: Successfully Completed Years of Education.

Note$_2$: Experience: Years of Experience.

Note$_3$: Experience(b) represents the variable in the way it appears in the regression equations, given that they are polynomial regression equations [experience(b) = experience - experience / n].

Note$_4$: Migration: Did not Migrate = 0; Migrated = 1;

Note$_5$: Gender: Women = 0; Men = 1.

Note$_6$: Protected Laborer: Unprotected Laborer = 0; Protected Laborer = 1.

Note$_7$: Family Farmer: Non-Family Farmer = 0; Family Farmer = 1.

Note$_8$: Manager: Non-Manager = 0; Manager = 1.

Note$_9$: Large Farmer: Non-Large Farmer = 0; Large Farmer = 1.

Note$_{10}$: Intermediary Consumption Rate: The Sum of all Industrial Inputs in the Agricultural Production (Index of Modernization) Divided by the Total Production Value (Multiplied by 100).

Note$_{11}$: Land Concentration: Gini Coefficient of Land Distribution (Multiplied by 100).

Note$_{12}$: Earnings: Individual Earnings.

Note$_{13}$: lnEarnings: The Natural Log of Individual Earnings.

Table 4: Zero-Order Correlation Matrix of all Variables, Brazil–1973

Variables	*Variables*												
	Education	Exper.(b)	Exper.(b)2	Migration	Gender	PA. Worker	F. Farmer	Manager	L. Farmer	Gini * 100	ICon. * 100	Earnings	lnEarnings
Education	1.0000												
Exper. (b)	-.2315	1.0000											
Exper. (b)2	-.1132	.5653	1.0000										
Migration	.0379	.1011	-.0032	1.0000									
Gender	.0662	.0723	.0394	.0228	1.0000								
PA. Worker	.0165	.0027	-.0399	.0126	.0662	1.0000							
F. Farmer	-.1291	.4116	.1309	.0515	.1829	-.1257	1.0000						
Manager	.0623	.0415	-.0025	.0275	.0411	-.0150	-.0548	1.0000					
L. Farmer	.1409	.1831	.0460	.0368	.1244	-.0475	-.1741	-.0207	1.0000				
Gini * 100	-.2552	.0155	.0264	-.1111	-.0517	.0036	.0849	.0018	-.0121	1.0000			
ICon .* 100	.2997	-.0114	-.0338	.2181	.0579	.1472	-.1234	.0336	.0208	-.3633	1.0000		
Earnings	.2471	.1239	.0360	.0983	.0728	-.0248	.0100	.0247	.3325	-.0737	.1191	1.0000	
lnEarnings	.2900	.2555	.0380	.1518	.1588	.0046	.2316	.0491	.3957	-.1308	.2024	.6341	1.0000

Source: **PNAD-1973**.

Note$_1$: Education: Successfully Completed Years of Education.

Note$_2$: Experience: Years of Experience.

Note$_3$: Experience(b) represents the variable in the way it appears in the regression equations, given that they are polynomial regression equations [experience(b) = experience - experience / n].

Note$_4$: Migration: Did not Migrate = 0; Migrated = 1;

Note$_5$: Gender: Women = 0; Men = 1.

Note$_6$: Protected Laborer: Unprotected Laborer = 0; Protected Laborer = 1.

Note$_7$: Family Farmer: Non-Family Farmer = 0; Family Farmer = 1.

Note$_8$: Manager: Non-Manager = 0; Manager = 1.

Note$_9$: Large Farmer: Non-Large Farmer = 0; Large Farmer = 1.

Note$_{10}$: Intermediary Consumption Rate: The Sum of all Industrial Inputs in the Agricultural Production (Index of Modernization) Divided by the Total Production Value (Multiplied by 100).

Note$_{11}$: Land Concentration: Gini Coefficient of Land Distribution (Multiplied by 100).

Note$_{12}$: Earnings: Individual Earnings.

Note$_{13}$: lnEarnings: The Natural Log of Individual Earnings.

Table 5: Zero-Order Correlation Matrix of all Variables, Brazil–1982

Variables	*Variables*											
	Education	Exper.(b)	Exper.(b)2	Gender	PA. Worker	F. Farmer	Manager	L. Farmer	Gini * 100	ICon. * 100	Earnings	lnEarnings
Education	1.0000											
Exper. (b)	-.2745	1.0000										
Exper. (b)2	-.1017	.5653	1.0000									
Male	.0075	.0380	.0317	1.0000								
PA. Worker	.0305	.0044	-.0626	.0525	1.0000							
F. Farmer	-.0775	.3625	.1280	.1297	-.1499	1.0000						
Manager	.0801	.0302	-.0080	.0444	-.0217	-.0626	1.0000					
L. Farmer	.1857	.1415	.0672	.0823	-.0438	-.1264	-.0183	1.0000				
Gini * 100	-.2270	.0390	-.0098	-.0019	-.0208	.1663	.0102	-.0369	1.0000			
ICon .* 100	.2228	-.0434	-.0040	.0650	.0912	-.1704	.0399	.0515	-.4029	1.0000		
Earnings	.2419	.0659	.0205	.0568	-.0030	-.0130	.0623	.3246	-.0554	.0728	1.0000	
lnEarnings	.3077	.1491	.0022	.1975	.0933	.0476	.0979	.4091	-.1364	.1873	.5219	1.0000

Source: **PNAD-1982.**

Note$_1$: Education: Successfully Completed Years of Education.

Note$_2$: Experience: Years of Experience.

Note$_3$: Experience(b) represents the variable in the way it appears in the regression equations, given that they are polynomial regression equations [experience(b) = experience - experience / n].

Note$_4$: Migration: Did not Migrate = 0; Migrated = 1;

Note$_5$: Gender: Women = 0; Men = 1.

Note$_6$: Protected Laborer: Unprotected Laborer = 0; Protected Laborer = 1.

Note$_7$: Family Farmer: Non-Family Farmer = 0; Family Farmer = 1.

Note$_8$: Manager: Non-Manager = 0; Manager = 1.

Note$_9$: Large Farmer: Non-Large Farmer = 0; Large Farmer = 1.

Note$_{10}$: Intermediary Consumption Rate: The Sum of all Industrial Inputs in the Agricultural Production (Index of Modernization) Divided by the Total Production Value (Multiplied by 100).

Note$_{11}$: Land Concentration: Gini Coefficient of Land Distribution (Multiplied by 100).

Note$_{12}$: Earnings: Individual Earnings.

Note$_{13}$: lnEarnings: The Natural Log of Individual Earnings.

Table 6: Zero-Order Correlation Matrix of all Variables, Brazil–1988

Variables	*Variables*												
	Education	Exper.(b)	Exper.(b)2	Migration	Gender	PA. Worker	F. Farmer	Manager	L. Farmer	Gini * 100	ICon. * 100	Earnings	lnEarnings
Education	1.0000												
Exper. (b)	-.1915	1.0000											
Exper. (b)2	-.1111	.55525	1.0000										
Migration	-.0505	-.3394	.0808	1.0000									
Gender	.0378	.0377	.0377	.0138	1.0000								
PA. Worker	.0505	-.0228	-.0669	-.0283	.0598	1.0000							
F. Farmer	-.0068	.3564	.1124	-.1977	.1280	-.1860	1.0000						
Manager	.1436	.0160	-.0167	.0036	.0536	-.0320	-.0796	1.0000					
L. Farmer	.2229	.1347	.0600	-.0413	.0660	-.0501	-.1248	-.0214	1.0000				
Gini * 100	-.2698	.0086	.0073	.0162	-.0109	-.0817	.1151	-.0026	-.0527	1.0000			
ICon .* 100	.2263	-.0215	-.0241	.2100	.0819	.0820	-.0614	.0598	.0423	-.2315	1.0000		
Earnings	.2275	.0483	.0136	.0114	.0270	-.0147	-.0142	.0298	.3025	-.0449	.0546	1.0000	
lnEarnings	.3848	.1252	-.0117	-.0200	.1636	.1038	.0618	.1197	.3772	-.1908	.2041	.4218	1.0000

Source: **PNAD-1988**.

Note$_1$: Education: Successfully Completed Years of Education.

Note$_2$: Experience: Years of Experience.

Note$_3$: Experience(b) represents the variable in the way it appears in the regression equations, given that they are polynomial regression equations [experience(b) = experience - experience / n].

Note$_4$: Migration: Did not Migrate = 0; Migrated = 1;

Note$_5$: Gender: Women = 0; Men = 1.

Note$_6$: Protected Laborer: Unprotected Laborer = 0; Protected Laborer = 1.

Note$_7$: Family Farmer: Non-Family Farmer = 0; Family Farmer = 1.

Note$_8$: Manager: Non-Manager = 0; Manager = 1.

Note$_9$: Large Farmer: Non-Large Farmer = 0; Large Farmer = 1.

Note$_{10}$: Intermediary Consumption Rate: The Sum of all Industrial Inputs in the Agricultural Production (Index of Modernization) Divided by the Total Production Value (Multiplied by 100).

Note$_{11}$: Land Concentration: Gini Coefficient of Land Distribution (Multiplied by 100).

Note$_{12}$: Earnings: Individual Earnings.

Note$_{13}$: lnEarnings: The Natural Log of Individual Earnings.

Regression Models Estimated:

Model 1

$\ln\text{Earnings} = \alpha + \beta_1\text{Years of Education} + \varepsilon;$

Model 2

$\ln\text{Earnings} = \alpha + \beta_1\text{Years of Experience} + \beta_2\text{Years of Experience Squared} + \varepsilon;$

Model 3

$\ln\text{Earnings} = \alpha + \beta_1\text{Years of Education} + \beta_2\text{Years of Experience} + \beta_3\text{Years of Experience Squared} + \varepsilon;$

Model 4

$\text{LnEarnings} = \alpha + \beta_1\text{Migration} + \varepsilon;$

Model 5

$\ln\text{Earnings} = \alpha + \beta_1\text{Years of Education} + \beta_2\text{Years of Experience} + \beta_3\text{Years of Experience Squared} + \beta_4\text{Migration} + \varepsilon;$

Model 6

$\ln\text{Earnings} = \alpha + \beta_1\text{Years of Education} + \beta_2\text{Years of Experience} + \beta_3\text{Years of Experience Squared} + \beta_4\text{Gender} + \beta_5\text{Protected Agricultural Worker} + \beta_6\text{Family Farmer} + \beta_7\text{Farm Manager} + \beta_8\text{Large Farmer} + \beta_9\text{Gini Coefficient of Land Concentration} + \beta_{10}\text{Intermediary Consumption Rate} + \varepsilon;$

Model 7

$\ln\text{Earnings} = \alpha + \beta_1\text{Years of Education} + \beta_2\text{Years of Experience} + \beta_3\text{Years of Experience Squared} + \beta_4\text{Migration} + \beta_5\text{Gender} + \beta_6\text{Protected Agricultural Worker} + \beta_7\text{Family Farmer} + \beta_8\text{Farm Manager} + \beta_9\text{Large Farmer} + \beta_{10}\text{Gini Coefficient of Land Concentration} + \beta_{11}\text{Intermediary Consumption Rate} + \varepsilon;$

Model 8

$\ln\text{Earnings} = \alpha + \beta_1\text{Years of Education} + \beta_2\text{Years of Experience} + \beta_3\text{Years of Experience Squared} + \beta_4\text{Gender} + \beta_5\text{Protected Agricultural Worker} + \beta_6\text{Family Farmer} + \beta_7\text{Farm Manager} + \beta_8\text{Large Farmer} + \beta_9\text{Gini Coefficient of Land Concentration} + \beta_{10}\text{Intermediary Consumption Rate} + \beta_{11}(\text{Education} * \text{Gender}) + \beta_{12}(\text{Education} * \text{Protected Agricultural Worker}) + \beta_{13}(\text{Education} * \text{Family Farmer}) + \beta_{14}(\text{Education} * \text{Farm Manager}) + \beta_{15}(\text{Education} * \text{Large Farmer}) + \beta_{16}(\text{Education} * \text{Gini Coefficient of Land Concentration}) + \beta_{17}(\text{Education} * \text{Intermediary Consumption Rate}) + \beta_{18}(\text{Experience} * \text{Gender}) + \beta_{19}(\text{Experience} * \text{Protected Agricultural Worker}) + \beta_{20}(\text{Experience} * \text{Family Farmer}) + \beta_{21}(\text{Experience} * \text{Farm Manager}) + \beta_{22}(\text{Experience} * \text{Large Farmer}) + \beta_{23}(\text{Experience} * \text{Gini Coefficient of Land Concentration}) + \beta_{24}(\text{Experience} * \text{Intermediary Consumption Rate}) + \varepsilon;$

Model 9

$$\ln Earnings = \alpha + \beta_1 Years\ of\ Education + \beta_2 Years\ of\ Experience + \beta_3 Years\ of\ Experience\ Squared + \beta_4 Migration + \beta_5 Gender + \beta_6 Protected\ Agricultural\ Worker + \beta_7 Family\ Farmer + \beta_8 Farm\ Manager + \beta_9 Large\ Farmer + \beta_{10} Gini\ Coefficient\ of\ Land\ Concentration + \beta_{11} Intermediary\ Consumption\ Rate + \beta_{12}(Education * Gender) + \beta_{13}(Education * Protected\ Agricultural\ Worker) + \beta_{14}(Education * Family\ Farmer) + \beta_{15}(Education * Farm\ Manager) + \beta_{16}(Education * Large\ Farmer) + \beta_{17}(Education * Gini\ Coefficient\ of\ Land\ Concentration) + \beta_{18}(Education * Intermediary\ Consumption\ Rate) + \beta_{19}(Experience * Gender) + \beta_{20}(Experience * Protected\ Agricultural\ Worker) + \beta_{21}(Experience * Family\ Farmer) + \beta_{22}(Experience * Farm\ Manager) + \beta_{23}(Experience * Large\ Farmer) + \beta_{24}(Experience * Gini\ Coefficient\ of\ Land\ Concentration) + \beta_{25}(Experience * Intermediary\ Consumption\ Rate) + \varepsilon.$$

VII. Results

Direct Effects: Linear Combinations of Human Capital Variables

In the first part of the analysis of our empirical findings, we check the acceptability of three of the theoretical hypotheses presented above (Hypotheses 1, 2, and 4); the test of Hypothesis 3 is deferred and will follow that of Hypothesis 5, in the next section of the paper for the case of Brazilian agriculture. Hypothesis 1 will be assessed by the observation of different regression models containing a varying number of human capital variables. These models will be basically the same for the three different years (1973, 1982, and 1988). Hypothesis 2, on the other hand, will be assessed by comparisons among the three different years. If this hypothesis is true, the rates of return to human capital variables would increase over time. We apply *t-tests* for the equality between parameters of the effect of human capital variables on earnings in the three different years. Hypothesis 4 tests whether the regression coefficients of the structural variables are significant in the three years.

Tables 7, 8, and 9 show the regression coefficients and percentage increments to each additional year of education and of experience. These provide the tests of these hypotheses. *Every regression equation in these three tables is statistically significant.* They show that the earnings returns to education in all years, for each model, are positive, statistically significant, and high. The figures for education vary from a return of about a *9 percent increment* to income for each year of additional schooling (in Model 6 of Table 7) *to about 18.5 percent* (in Model 5 of Table 9). These findings are very similar to those from previous analysis based on the Brazilian labor force as a whole and for the urban labor force (see note number 6 for citations); and they are *markedly different* from the few previous analyses of earnings returns to schooling in Brazilian agriculture (see note number 7 for citations). These previous studies for Brazilian farm people *found no significant returns to additional years of education.* The enormous differences between our findings and those from the previous studies are probably due to three reasons. First, such studies cover only a few localities of the country. Second, they contain only family

farmers. Their omission of agricultural workers and managers is very serious, given that these two groups of people presumably have their earnings completely determined by factors other than ownership of physical capital or land. Third, their samples are too small for detailed statistical analysis. Our own study is based on nationwide household probability samples taken at three points in time (1973, 1982, and 1988), and includes five different class/segment categories, as well as other key variables, each of which is statistically controlled.

However, the rates of earnings returns to schooling for the farmers' class groups—family farmers and large farmers—may have been slightly overestimated in the present study, given that we do not have any information about the amount of physical capital and land that each farmer owns. Hence, our guess is that the *real* rates of earnings return to education in Brazilian agriculture might be a trifle lower than estimated here, but considerably higher than had been previously estimated. In other words, though they might be a little lower than our findings indicate, *the impact of schooling on the earnings of the farm labor force is positive, statistically significant, and very large.*

Paralleling the above, our estimates of the earnings *returns to work experience* of the agricultural labor force in Brazil are also impressive. They *vary from about 1 percent per year* (Model 7 of Table 7) to about 2.5 percent (Model 3 of Table 8) *for each additional year of experience.* These figures are all statistically significant and possibly higher than those for the urban labor force. Considering that the number of years of experience ranges up to 60, 1 percent per year could amount to a great deal. This indicates that work experience plays a very important role in Brazilian agricultural economy.

Thus our first hypothesis is clearly supported by the empirical evidence. Human capital obviously has a substantial effect on the earnings levels of the farm labor force in Brazil.

About the temporal variations in the rates of return to human capital, we see that our findings provide little, if any, support for Hypothesis 2. The estimates of earnings returns to schooling tended to increase a little bit as time passed and the level of modernization/development rose. The regression coefficients of education in 1988 are, in general, significantly higher (at $|t| > 3.00$) than those from 1973 and 1982.[36] However, the figures from 1982 are not significantly higher than those of 1973. Concerning experience, we find that the earnings returns to each additional year of experience was highest in 1982. The support for the temporal aspect of second hypothesis is too equivocal to permit its acceptance. It is rejected (we shall check the *regional* aspect later).

This even under conditions of extraordinarily tight statistical control, the percentage increments to income of each additional year of human capital accumulated (education and experience) was found to be high in each of the three years, and the increments noted for any one year are about the same as those noted for any other.

The evidence prescribed so far has assumed linear effects of the combination of human capital variables. But these are not the only ones predicted by current theory.

Table 7: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variable, and Standardized Regression Coefficients, Brazil–1973

Independent Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
Education	.13669*		.16823*		.16547*	.08707*	.08766*
	(14.647%)		(18.321%)		(17.995%)	(9.097%)	(9.162%)
	[.28995]		[.35654]		[.35070]	[.18454]	[.18578]
Experience		.02010*	.02366*		.02291*	.00994*	.00964*
		(2.030%)	(2.394%)		(2.317%)	(.999%)	(.969%)
		[.42567]	[.50101]		[.48510]	[.21047]	[.20408]
Experience^2		-.00054*	-.00056*		-.00054*	-.00027*	-.00026*
		(-.054%)	(-.056%)		(-.054%)	(-.027%)	(-.026%)
		[-.25083]	[-.26102]		[-.25106]	[-.12750]	[-.12310]
Migration				.30393*	.20292*		.11330*
				(35.517%)	(22.497%)		(11.997%)
				[.15184]	[.10106]		[.05642]
Gender (Male)						.13138*	.13147*
						(14.040%)	(14.050%)
						[.31358]	[.05606]
Protected Agricultural Worker						.31358*	.31727*
						(36.831%)	(37.337%)
						[.08978]	[.09084]
Family Farmer						.60398*	.59904*
						(82.939%)	(82.037%)
						[.39185]	[.38865]
Farm Manager						.56066*	.55135*
						(75.182%)	(73.559%)
						[.07189]	[.07069]
Large Farmer						1.18710*	1.18200*
						(227.76%)	(226.09%)
						[.44948]	[.44755]
Gini Coefficient of Land Concentration						-.00310*	-.00290*
						(-.310%)	(-.290%)
						[-.02601]	[-.02435]
Intermediary Consumption Rate						.01881*	.01735*
						(1.899%)	(1.750%)
						[.17673]	[.16307]
Intercept	1.38449*	1.63379*	1.38383*	1.52273*	1.34905*	.90971*	.89674*
R^2	.0841	.0992	.2216	.0231	.2316	.4245	.4275
Adjusted R^2	.0840	.0992	.2215	.0230	.2316	.4243	.4273
N	32178	31567	31567	32178	31567	31567	31567

Source: **PNAD-1973**.
Note$_1$: *| t | > 3.00.
Note$_2$: Percentage Increment = (e^b - 1) X 100.
Note$_3$: Numbers Between Brackets Are Standardized Regression Coefficients.
Note$_4$: Dependent Variable: lnEarnings.
Note$_5$: Education: Successfully Completed Years of Education.
Note$_6$: Experience: Number of Years Since Started to Work.
Note$_7$: Migration: Did not Migrated = 0; Migrated = 1.
Note$_8$: Educati*Experien: Interaction Term of Education and Experience.

Table 8: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–**1982**

Independent Variables	*Model 1*	*Model 2*	*Model 3*	*Model 6*
Education	.11245*		.15328*	.09379*
	(11.902%)		(16.565%)	(9.833%)
	[.30774]		[.41948]	[.25667]
Experience		.01383*	.02485*	.01650*
		(1.393%)	(2.516%)	(1.664%)
		[.26846]	[.48194]	[.32006]
$Experience^2$		-.00044*	-.00068*	-.00053*
		(-.044%)	(-.068%)	(-.053%)
		[-.17792]	[-.27819]	[-.21484]
Gender (Male)				.32780*
				(38.791%)
				[.12856]
Protected Agricultural Worker				.41888*
				(52.026%)
				[.12891]
Family Farmer				.22247*
				(24.916%)
				[.13305]
Farm Manager				.62222*
				(86.306%)
				[.08400]
Large Farmer				1.31968*
				(274.222%)
				[.34330]
Gini Coefficient of Land Concentration				-.00419*
				(-.418%)
				[-.03185]
Intermediary Consumption Rate				.00923*
				(.927%)
				[.10014]
Intercept	5.58335*	5.84247*	5.59485*	5.28888*
R^2	.0947	.0396	.2069	.3456
Adjusted R^2	.0947	.0396	.2069	.3455
N	68607	69561	68607	68607

Source: **PNAD-1982.**
Note$_1$: * | t | > 3.00.
Note$_2$: Percentage Increment = $(e^b - 1) \times 100$.
Note$_3$: Numbers Between Brackets Are Standardized Regression Coefficients.
Note$_4$: Dependent Variable: lnEarnings.
Note$_5$: Education: Successfully Completed Years of Education.
Note$_6$: Experience: Number of Years Since Started to Work.
Note$_7$: Educati*Experien: Interaction Term of Education and Experience.

Table 9: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–**1988**

Independent Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
Education	.14659*		.16837*		.16947*	.10281*	.10400*
	(15.788%)		(18.337%)		(18.468%)	(10.828%)	(10.960%)
	[.38481]		[.44199]		[.44489]	[.26990]	[.27301]
Experience		.01497*	.02220*		.02382*	.01411*	.01485*
		(1.508%)	(2.245%)		(2.411%)	(1.421%)	(1.496%)
		[.23848]	[.35371]		[.37938]	[.22475]	[.23663]
Experience^2		-.00053*	-.00059*		-.00065*	-.00046*	-.00048*
		(-.053%)	(-.059%)		(-.065%)	(-.046%)	(-.048%)
		[-.17034]	[-.19013]		[-.20908]	[-.14711]	[-.15592]
Migration				-.04423*	.13415*		.06017*
				(-4.327%)	(14.356%)		(6.202%)
				[-.02004]	[.06078]		[.02726]
Gender						.28768*	.28990*
(Male)						(33.333%)	(33.629%)
						[.09597]	[.09671]
Protected						.49056*	.49269*
Agricultural						(63.323%)	(63.671%)
Worker						[.14681]	[.14745]
Family Farmer						.28855*	.28998*
						(33.449%)	(33.640%)
						[.14613]	[.14686]
Farm Manager						.70641*	.70154*
						(102.67%)	(101.69%)
						[.09665]	[.09600]
Large Farmer						1.52787*	1.52479*
						(360.84%)	(359.42%)
						[.31864]	[.31800]
Gini Coefficient of						-.01120*	-.01133*
Land						(-1.114%)	(-1.127%)
Concentration						[-.07295]	[-07378]
Intermediary						.00852*	.00773*
Consumption Rate						(.856%)	(.776%)
						[.09101]	[.08263]
Intercept	5.64439*	6.00785*	5.67631*	5.93684*	5.64790*	6.00701*	6.01984*
R^2	.1481	.0318	.2166	.0004	.2199	.3378	.3385
Adjusted R^2	.1480	.0317	.2164	.0003	.2197	.3375	.3381
N	19087	19089	19087	19089	19087	19087	19087

Source: **PNAD-1988**.
Note$_1$: * | t | > 3.00.
Note$_2$: Percentage Increment = (e^b - 1) X 100.
Note$_3$: Numbers Between Brackets Are Standardized Regression Coefficients.
Note$_4$: Dependent Variable: lnEarnings.
Note$_5$: Education: Successfully Completed Years of Education.
Note$_6$: Experience: Number of Years Since Started to Work.
Note$_7$: Migration: Did not Migrated = 0; Migrated = 1.
Note$_8$: Educati*Experien: Interaction Term of Education and Experience.

Direct Effects: Linear Combinations of Social Class/Labor Market Segmentation Variables

Hypothesis 4 is tested by data presented in Models 6 and 7 of Tables 7, 8, and 9. The test of Hypothesis 3 is deferred to the next section. Each of the statistical models shows that all the *dummy* variables that together define class structure and labor market segmentation show large and statistically significant direct effects on earnings. This is consistent support for the fourth hypothesis. Specifically, each of the four categories had higher average earnings than the reference group (Unprotected Agricultural Workers).

But their positions appear to have changed over the 1973–1988 period. While in 1973 the Family Farmer category was the second highest earnings group (just below the Large Farmer category), in 1982 and 1988 it was the second lowest (higher only than the reference group). In other words, in the 1980s the average earnings of those who belonged to the classes of Protected Agricultural Workers and Farm Managers gained higher average earnings (relative to the day laborers we have called "unprotected") than those who belonged to the Family Farmers class category. This is probably a result of the recent formation of a corps of skilled and semiskilled agricultural laborers, who now occupy positions as Protected Agricultural Workers and Farm Managers.[37] A possible explanation is that these more skilled workers have been becoming more and more necessary, and so the higher demand for them would explain the rising level of their earnings. On the other hand, the steep increase in the difference between the average earnings of the Family Farmer category and the reference group (from about 8 percent in 1973 to around 30 percent in the 1980s) may mean that the relative productivity of family-sized farms had fallen. Or it may mean that the prices for food for domestic consumption have been kept low and are produced by small operators, while the prices for export products produced by large operators and those specialized labor respond to the more profitable demands of the world market.[38]

Migration's income increment was around 11 percent in 1973 but half that in 1988.

Other structural variables yield more or less predictable findings. Concerning gender, the average earnings of males were always higher than those of females. The difference, about 14 percent in 1973, rose to about 40 percent in 1982, and fell back a bit to around 30 percent in 1988.

The Gini Coefficient of Land Concentration's effect on earnings was negative in each year, and this negative effect increased from 1973 to 1982 (from about -0.3 percent to more than -0.4 percent), and had more than doubled by 1988 (about -1.1 percent). Finally, concerning the level of temporal modernization (Intermediary Consumption Rate), we see that its effect on earnings decreased from around 1.8 percent in 1973 to around 0.9 percent in 1982 and 0.8 percent in 1988. Thus land concentration increasingly depressed worker's earnings over the period, on-farm technological modernization tended increasingly to raise them.

The impact of each of the latter two variables is quite large: recall that their ranges are from zero to 100, e.g., when an increase of one point on a 101-point scale yields an increase increment of a quarter of a percent, one is observing a large impact indeed.

Effects of Nonlinear Combinations of Human Capital and Structural Variables

In the previous section, we analyzed the direct effects (i.e., linear combinations) of human capital and structural variables on earnings, using statistical models which included both sets of variables. In the present section, we will analyze the interaction between human capital and structural variables. In other words, we will observe whether or not the structural variables modify the relationship between human capital and earnings.

The first hypothesis to be tested in this section is Hypothesis 5, which predicts that the rate of earnings returns to human capital varies between social classes/labor market segments, i.e., the social class/labor market positions modify the relationship between human capital variables and earnings. More specifically:

a) Farm managers have a higher rate of earnings returns to human capital than agricultural workers.
b) Farmers (both groups) have a lower rate of earnings returns to human capital than farm managers.
c) Protected agricultural workers have a higher rate of earnings returns to human capital than unprotected agricultural workers.

Hypothesis 3 is to be tested next. From the conjecture on the allocative effect of education on earnings, we predict that decision makers (farmers and managers) will be found to have higher rates of earnings returns to human capital than will other classes.[39]

The next prediction is from Hypothesis 6. From the structuralist approach, we test the hypothesis that the average rate of earnings returns to schooling is higher in areas with lower levels of land concentration. We will then reassess Hypothesis 2 (the *Modernization Theory Hypothesis*) using regional, rather than temporal, variations.

Hypothesis 5 generates three predictions. The first prediction states that farm managers should show higher rates of earnings returns to human capital than agricultural workers, in that human capital reinforces managers' authority over workers. The second prediction states that farmers (both family and large) should have lower rates of return to human capital than managers, given that their earnings, unlike managers, should be more a function of the amount of land and physical capital they own than their stock of human capital. Finally, the third prediction states that protected agricultural workers should show higher rates of return to human capital than unprotected agricultural workers, due to labor market segmentation, i.e., the former are employed in a more technologically advanced, skills-demanding, and unionized farming systems; the latter more often employed low-technology, low-skills-demanding, nonunionized farming systems.

Hypothesis 3 predicts that decision makers should obtain higher rates of return to human capital than nondecision makers, given that they benefit twice from human capital: unlike the better educated and more experienced of the working class, they not only have this advantage but also a position that permits than to exercise their expertise. Thus, we should expect family farmers, managers, and large farmers to show the highest rates of return to human capital. This prediction is in agreement with the first expectation (a) of Hypothesis 5, but not with the second (b).

We assess Hypotheses 5, then 3, by testing the statistical significance of the interaction terms between education and the social class variables, and between experience and the social class variables. Tables 10, 11, and 12 present the necessary information.

Our findings are that:

a) The first prediction from Hypothesis 5 is supported by the empirical data, wherein education is the human capital factor under consideration. Managers have net earnings returns to a year of additional schooling at least 5.62 percent higher than those both unprotected and protected classes of agricultural workers. However, when experience is the human capital factor under consideration, the first prediction from Hypothesis 5 does not find any empirical support. In none of the three years is the interaction term of experience and the farm manager *dummy* variable significant. This does not represent a problem for class analysis theorists for they have only applied it to education. We ourselves decided to extend the hypothesis to experience. But it is perfectly consistent with class-analytic logic. Therefore, we can conclude that one of the class analysis predictions is partially supported by our findings—strongly as concerning education; not at all as concerning experience.

b) The second prediction from Hypothesis 5 finds no empirical support from our figures. When we look at Tables 10, 11, and 12, we see that, with the exception of 1973, the interaction terms of education and the farm manager variable, and education and the large farmer variable are not significantly different.[40] Concerning experience, we see that family farmer and large farmer classes both have higher rates of earnings returns to experience than managers in each of the three samples. These findings might indicate that the prediction from Hypothesis 3 is strongly supported by our data, i.e., the rates of earnings returns to human capital for decision makers are higher than for nondecision makers. (This would explain why we do not find much difference in the rates of returns to education for farmers and for farm managers.) However, the fact that the rate of returns to experience is so much higher for farmers may just be a consequence of the fact that as farmers become older they are able to buy more land and accumulate more physical capital. In the same way, similar rates of returns to education for farmers and managers may also be untrue. High rates of return to education for farmers might only be a consequence of the association between education and amount of physical capital and land owned by the farmer, which could be causing spurious results. Indeed, there is no way for us to estimate which explanation is more reliable, given that we do not have information about amount of physical capital and land owned by each farmer. Therefore, we conclude that our findings do not support the second prediction of Hypothesis 5 (managers have higher rates than farmers), but appear to support Hypothesis 3 (decision makers have higher return rates), although this conclusion is not certain, due to the lack of information about important control variables.

Table 10: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–**1973**

Independent Variables	*Model 8*	*Model 9*
Education	.09739*	.08630
	(10.229%)	(9.013%)
	[.20641]	[.18290]
Experience	.01826*	.01761*
	(1.843%)	(1.777%)
	[.38666]	[.37293]
Experience^2	-.00032*	-.00031*
	(-.032%)	(-.310%)
	[-.14863]	[-.14508]
Migration		.10574*
		(11.153%)
		[.05266]
Gender (Male)	.11883*	.11957*
	(12.618%)	(12.701%)
	[.05067]	[.05098]
Protected Agricultural Worker	.31617*	.31796*
	(37.186%)	(37.432%)
	[.09052]	[.09104]
Family Farmer	.59520*	.59092*
	(81.339%)	(80.565%)
	[.38616]	[.38338]
Farm Manager	.31246*	.31233*
	(36.678%)	(36.661%)
	[.04006]	[.04005]
Large Farmer	.92355*	.92518*
	(151.821%)	(152.232%)
	[.34969]	[.35031]
Gini Coeffcient of Land Concentration	-.00217	-.00223
	(-.217%)	(-.223%)
	[-.01822]	[-.01872]
Intermediary Consumption Rate	.01779*	.01654*
	(1.795%)	(1.668%)
	[.16716]	[.15537]
Education*Gender	.01314	.01253
	(1.323%)	(1.261%)
	[.02780]	[.02652]
Education*Protected Agricultural Worker	.00451	.00509
	(.452%)	(.510%)
	[.00319]	[.00361]
Education*Family Farmer	.00361	.00315
	(.362%)	(.315%)
	[.00549]	[.00480]

(Page 1 of 2)

Table 10: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–1973—Con.

Independent Variables	*Model 8*	*Model 9*
Education*Farm Manager	.08755*	.08454*
	(9.150%)	(8.821%)
	[.04580]	[.04423]
Education*Large Farmer	.06624*	.06417*
	(6.848%)	(6.627%)
	[.08939]	[.08659]
Education*Gini Coefficient of Land Concentration	-.00073	-.00055
	(-.073%)	(-.550%)
	[-.11953]	[-.09054]
Education*Intermediary Consumption Rate	.00080	.00075
	(.080%)	(.075%)
	[.03703]	[.03463]
Experience*Gender	.00262*	.00254*
	(.262%)	(.254%)
	[.05178]	[.05010]
Experience*Protected Agricultural Worker	-.00447*	-.00453*
	(-.446%)	(-.452%)
	[-.01894]	[-.01918]
Experience*Family Farmer	.00210*	.00216*
	(.210%)	(.216%)
	[.03145]	[.03235]
Experience*Farm Manager	.00546	.00531
	(.547%)	(.532%)
	[.01133]	[.01103]
Experience*Large Farmer	.01208*	.01191*
	(1.215%)	(1.198%)
	[.08490]	[.08373]
Experience*Gini Coeffcient of Land Concentration	-.00015*	-.00015*
	(-.015%)	(-.015%)
	[-.25851]	[-.24489]
Experience* Intermediary Consumption Rate	.00002	.00001
	(.002%)	(.001%)
	[.00730]	[.00286]
Intercept	.89701*	.90133*
R^2	.4321	.4347
Adjusted R^2	.4317	.4342
N	31567	31567

Source: **PNAD-1973**.
Note1: *| t | > 3.00.
Note2: Percentage Increment = $(e^b - 1) \times 100$.
Note3: Numbers Between Brackets Are Standardized Regression Coefficients.
Note4: Dependent Variable: lnEarnings.
Note5: Education: Successfully Completed Years of Education.
Note6: Experience: Number of Years Since Started to Work.
Note7: Educati*Experien: Interaction Term of Education and Experience.

(Page 2 of 2)

Table 11: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–**1982**

Independent Variables	*Model 8*
Education	.09224*
	(9.663%)
	[.25242]
Experience	.02936*
	(2.980%)
	[.56930]
Experience^2	-.00058*
	(-.058%)
	[-.23907]
Gender	.30442*
(Male)	(35.584%)
	[.11939]
Protected Agricultural	.44189*
Worker	(55.564%)
	[.13599]
Family Farmer	.11213*
	(11.866%)
	[.07304]
Farm Manager	.44407*
	(55.904%)
	[.05995]
Large Farmer	.99858*
	(171.442%)
	[.25977]
Gini Coeffcient of Land	-.00186
Concentration	(-.186%)
	[-.01414]
Intermediary	.00815*
Consumption Rate	(.818%)
	[.08843]
Education*Gender	.00327**
	(.328%)
	[.00881]
Education*Protected Agricultural Worker	-.00166
	(-.166%)
	[-.00161]
Education*Family Farmer	.03933*
	(4.011%)
	[.07124]

(Page 1 of 2)

Table 11: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–**1982—Con.**

Independent Variables	*Model 8*
Education*Farm Manager	.06463*
	(6.676%)
	[.04821]
Education*Large Farmer	.06133*
	(6.325%)
	[.08967]
Education*Gini Coefficient of Land Concentration	-.00044
	(-.044%)
	[-.09476]
Education*Intermediary Consumption Rate	.00031
	(.031%)
	[.02781]
Experience*Gender	.00625*
	(.627%)
	[.11412]
Experience*Protected Agricultural Worker	-.00550*
	(-.548%)
	[-.02363]
Experience*Family Farmer	.00760*
	(.763%)
	[.10084]
Experience*Farm Manager	.00156
	(.156%)
	[.00326]
Experience*Large Farmer	.01351*
	(1.360%)
	[.00684]
Experience*Gini Coeffcient of Land Concentration	-.00029*
	(-.029%)
	[-.45648]
Experience* Intermediary Consumption Rate	.00009*
	(.009%)
	[.04762]
Intercept	5.20085*
R^2	.3560
Adjusted R^2	.3557
N	68607

Source: **PNAD-1982**.
Note$_1$: *| t | > 3.00.
Note$_2$: Percentage Increment = (e^b - 1) X 100.
Note$_3$: Numbers Between Brackets Are Standardized Regression Coefficients.
Note$_4$: Dependent Variable: lnEarnings.
Note$_5$: Education: Successfully Completed Years of Education.
Note$_6$: Experience: Number of Years Since Started to Work.
Note$_7$: Educati*Experien: Interaction Term of Education and Experience.

Table 12: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–**1988**

Independent Variables	*Model 8*	*Model 9*
Education	.04268	.04702
	(4.360%)	(4.833%)
	[.11204]	[.12344]
Experience	.02000*	.02082*
	(2.020%)	(2.104%)
	[.31866]	[.33161]
Experience^2	-.00052*	-.00054*
	(-.052%)	(-.540%)
	[-.16694]	[-.17296]
Migration		.04417*
		(4.516%)
		[.02002]
Gender (Male)	.29550*	.29778*
	(34.380%)	(34.687%)
	[.09858]	[.09934]
Protected Agricultural Worker	.55790*	.55963*
	(74.700%)	(75.002%)
	[.16696]	[.16748]
Family Farmer	.21086*	.21395*
	(23.474%)	(23.856%)
	[.10679]	[.10836]
Farm Manager	.52103*	.52309*
	(68.376%)	(68.723%)
	[.07129]	[.07157]
Large Farmer	1.27963*	1.28506*
	(259.531%)	(261.488%)
	[.26687]	[.26800]
Gini Coeffcient of Land Concentration	-.01183*	-.01187*
	(-1.176%)	(-1.180%)
	[-.07705]	[-.07733]
Intermediary Consumption Rate	.00833*	.00783*
	(.836%)	(.786%)
	[.08904]	[.08371]
Education*Gender	-.01465	-.01495
	(-1.454%)	(-1.484%)
	[-.03797]	[-.03875]
Education*Protected Agricultural Worker	-.02389	-.02445
	(-2.361%)	(-2.415%)
	[-.02491]	[-.02548]
Education*Family Farmer	.03073*	.02992*
	(3.121%)	(3.037%)
	[.05776]	[.05622]

(Page 1 of 2)

Table 12: Unstandardized Regression Coefficients, Percentage Increments of Earnings Attributed to Unit Increments of Independent Variables, and Standardized Regression Coefficients, Brazil–1988—Con.

Independent Variables	*Model 8*	*Model 9*
Education*Farm Manager	.05312*	.05175*
	(5.456%)	(5.311%)
	[.05071]	[.04940]
Education*Large Farmer	.05203*	.05040*
	(5.341%)	(5.169%)
	[.07243]	[.07017]
Education*Gini Coefficient of Land Concentration	.00071	.00069
	(.071%)	(.069%)
	[.14877]	[.14340]
Education*Intermediary Consumption Rate	-.00015	-.00017
	(-.015%)	(-.017%)
	[-.01250]	[-.01416]
Experience*Gender	.00487*	.00477*
	(.488%)	(.478%)
	[.07299]	[.07160]
Experience*Protected Agricultural Worker	-.00764*	-.00791*
	(-.761%)	(-.788%)
	[-.03207]	[-.03320]
Experience*Family Farmer	.00626*	.00600*
	(.628%)	(.602%)
	[.06800]	[.06519]
Experience*Farm Manager	.00103	.00049
	(.103%)	(.049%)
	[.00205]	[.00098]
Experience*Large Farmer	.00764*	.00734*
	(.767%)	(.737%)
	[.02984]	[.02869]
Experience*Gini Coeffcient of Land Concentration	-.00017	-.00017
	(-.017%)	(-.017%)
	[-.22019]	[-.21776]
Experience* Intermediary Consumption Rate	.00008**	.00007**
	(.008%)	(.007%)
	[.03265]	[.02915]
Intercept	6.09578*	6.09769*
R^2	.3445	.3448
Adjusted R^2	.3437	.3440
N	19087	19087

Source: **PNAD-1988**.
Note1: *| t | > 3.00.
Note2: Percentage Increment = (e^b - 1) X 100.
Note3: Numbers Between Brackets Are Standardized Regression Coefficients.
Note4: Dependent Variable: lnEarnings.
Note5: Education: Successfully Completed Years of Education.
Note6: Experience: Number of Years Since Started to Work.
Note7: Educati*Experien: Interaction Term of Education and Experience.

(Page 2 of 2)

c) The third prediction of Hypothesis 5 also fails to gain support from our statistical analysis. Our figures from Tables 10, 11, and 12 show that the rates of return to education for protected agricultural workers are not significantly higher than the rates of return to education for unprotected agricultural workers, in any of our three samples. Concerning experience, we see that the regression coefficients for the interaction term between experience and the *dummy* variable of protected agricultural worker are always negative and statistically significant (at $| t | > 3.00$). This indicates that earnings returns to *experience for protected workers is considerably lower than for unprotected workers.* This is the opposite of what we expected, when based on the prediction from the labor market segmentation theory. It was hypothesized that due to the fact that protected workers are unionized while unprotected workers are not, the former group would be able to impose recognition of seniority by employers while the latter would not. This prediction finds no support from our data. Indeed this negative evidence is so striking that it may suggest an examination of the value of unionization.

We will assess Hypothesis 6 in the same way we did for our two previous hypotheses. The difference is that now we will test whether the interaction term between human capital factors (education and experience) and the Gini coefficient of land concentration is negative. That is, we expect the earnings returns to human capital to decrease as the level of land concentration increases. The rational for this hypothesis is that in areas with high levels of land concentration there are relatively few *buyers* of labor. In such instances, it would be easier for management to depress wage increases linked to human capital improvements. Our figures from Tables 10, 11, and 12, however, show that this hypothesis does not find any support from our data samples, despite the appeal it may have. The interaction terms between education and Gini coefficient are never significant (at $| t | > 3.00$). Concerning the interaction between experience and Gini coefficient, the findings are mixed, i.e., the figures from 1973 and 1982 show significant coefficients, but the numbers for 1988 are not significant. Hence, we conclude that Hypothesis 6 is not supported by our analysis.

Finally, in order to reassess the *Modernization Theory Hypothesis*—which states that the rate of return to human capital should increase as the level of technological modernization rises—we test whether the interaction terms between human capital factors (education and experience) and the Intermediary Consumption Rate for agricultural production is positive in our three data samples. The figures in Tables 10, 11, and 12 do not support this hypothesis. Most interaction terms between human capital factors (education and experience) and the Intermediary Consumption Rates are not significant (at $| t | > 3.00$).[41] Hence, we are now able to come to a more general judgment about the validity of the *Modernization Theory Hypothesis.* Like previous research which assessed this hypothesis for Brazilian labor force as a whole, our analysis finds very little empirical support for it.[42] Probably, the main problem with this prediction is that it does not take under consideration that the demand for skilled labor might be higher where the production system is dominated by more capital intensive technologies, but that the supply of skilled labor is also much higher in these regions. In other words, as the demand for skilled labor increases we also see a rise in the investments in human capital—more specifically, in education and vocational training.

VIII. Conclusions and Policy Implications

The main goal of the present study was to analyze the process of earnings determination in the agricultural sector in Brazil. Among the main causal factors analyzed here, we have: human capital, labor market segmentation, gender, class position, level of development, and land concentration. We not only observed the direct effects of each variable on earnings, but also estimated the interactions between variables, in particular the ways structural factors might mediate, and thus modify, the relation between human capital and earnings.

The first important finding from this study is that (contrary to previous reports) the earnings returns to the human capital of the agricultural labor force in Brazil are positive and high. This has important theoretical and policy implications, given that the impact of human capital investments on agricultural development appears to have been grossly understated in earlier, but less definitive, research.

Our second finding is related to the relationship between development/modernization and the rate of earnings returns to human capital. The overall conclusion about this is that development/modernization does not seem to be an important modifier of the relation between human capital and earnings. Both types of analysis conducted here—cross-state and over-time change analyses—have provided little if any empirical support for the *Modernization Theory Hypothesis*. The main reason may be that, even though capital and skilled labor may be complementary, the demand and the supply for skilled agricultural laborers vary together. In other words, in locations and years in which the demand for skilled labor is higher—due to more intensive use of capital—the educational and vocational training systems are also more able to provide a supply sufficient to fill the existing demand.

Besides human capital factors, we found that certain structural variables present very significant effects on earnings in Brazilian agriculture. We treated class division and labor market segmentation as a single variable. We found that it has direct and independent effects, net of all other variables, on earnings. More specifically, our findings show that: a) large farmers always have the highest earnings levels, and that this grew over the years; b) farm managers, with the exception of 1973, had the second highest levels of earnings; c) family farmers had the second highest level of earnings in 1973, but had fallen down to the fourth position in 1982 and 1988; d) protected agricultural workers, with the exception of 1973, had the third highest level of earnings; and e) unprotected agricultural workers were always found in the bottom of the earnings stratification system.

Agricultural modernization of regions is another structural variable which was found to have a significant and independent effect on earnings, as was land concentration. However, while the former had a positive net effect (i.e., the higher the level of modernization the higher the average level of earnings) the latter had a negative net effect (i.e., the higher the level of land concentration the lower the average level of earnings). Even more important, given that we can compare the unstandardized regression coefficients for these two variables, we can say that up to 1982 the positive effect of agricultural modernization was greater than the negative effect of land concentration. However, by 1988 the negative effect of land concentration on earnings had become

greater than the positive effect of agricultural modernization. This implies that in the process of socioeconomic change, Brazilian agriculture experienced forces acting in opposite directions on the earnings of the agricultural labor force. In turn this suggests that, on the whole, this process might no longer be improving the quality of life of that population.

In addition to the present strong evidence of direct and independent effects of structural variables on earnings, net of human capital variables, we also found that most structural factors do not seem to work very well as modifiers of the relationship between human capital and earnings. Even though protected agricultural workers earn substantially more than unprotected workers, the average percentages of earnings returns to one additional year of education or experience are not significantly different between the two groups. In the same way, the earnings returns to human capital are not much different between farm managers and farmers. The only prediction of class analysis (social class' modification of the relationship between human capital and earnings) which is well supported by our data analysis is that farm managers really have earnings returns to education that are higher than those of agricultural workers. However, given that farmers do too, we could say that this finding provides even more support for the analysis of the allocative effects of education on earnings, which predicts that decision makers should have higher earnings returns to schooling than nondecision makers. In the same way, land concentration and agricultural modernization levels do not seem to mediate the relationship between human capital factors and earnings.

These conclusions have implications that might be considered by policy makers in Brazil and perhaps other developing nations. They may be summarized as follows:

1- The most important of our conclusions is that human capital definitely exerts a strong and consistent positive economic impact on the earnings of the farm labor force in Brazil, independent of level of development/modernization, land concentration, gender, and social class. This includes both education and experience. To the extent to which earnings and productivity vary together, as is often assumed in the literature, this implies that investment in the rural labor force's human capital should increase agricultural productivity. Strategies for agricultural development in Brazil should include proposals for the improvement of the human capital stock of the rural labor force.

2- Agricultural land redistribution may be useful in Brazil—and for purely economic reasons, if not others. For 1973 to 1988, at least, the negative impact of the high levels of land concentration in Brazil overcame the positive effects of agricultural modernization. Therefore, one policy would apply a comprehensive agrarian reform program accompanied by a strategy of agricultural modernization. However, our findings also suggest another strategy that could be implemented side by side with a land reform program: a policy to encourage the creation of additional protected jobs in agriculture. We found here that, during the 1980s, protected agricultural workers tended to earn more than family farmers. So a policy program for judiciously cutting part of the high costs of protecting workers could encourage the creation of good quality jobs, generating substantial income, with lower political and economic costs than agrarian reforms.

These are, in summary, the main policy implications of our study. We hope our findings can influence somehow future projects for socioeconomic development of Brazilian agriculture, given that it is probably the most complete analysis to date of the process of earnings determination in the Brazilian agricultural economy.

Notes

1. It was still less than US$ 5,000.00 in 1996, according to figures released by the Brazilian Institute of Geography and Statistics (IBGE), and reported in some Brazilian newspapers. This figure is not a *Purchase Power Parity* statistic, i.e., it is based only on exchange rates. *Purchase Power Parity* figures about Brazilian per capita income show considerable improvement. Calculated only by the exchange rate though, the Brazilian per capita income is lower than those from many other NICs, such as Argentina, Mexico, Chile, South Korea, and Taiwan.

2. For a general analysis of Brazilian Economy, see W. Baer, *The Brazilian Economy: Growth and Development* (Westport: Prager, 1995).

3. CSN was privatized in the beginning of the 1990s. PETROBRAS, however, is still owned by the federal government and—even though, two years ago it lost the monopoly for oil extraction in Brazil— it is still basically the only company doing so. Part of the reason is probably that Brazil produces only about 50 percent of the oil it consumes, and almost all the internally produced oil comes from very deep offshore reserves. This type of oil extraction is very expensive and also requires exclusive technologies—which have been developed by PETROBRAS.

4. P. Singer, "Migraçãoes Internas: Considerações Teóricas Sobre o seu Estudo," in *Migrações Internas e Desenvolvimento Regional*, ed. CEDEPLAR (Belo Horizonte: CEDEPLAR, 1973). C. Wood and J. Carvalho, *The Demography of Inequality in Brazil* (Cambridge: Cambridge University Press, 1988).

5. Brazil, nowadays, has not only most of its GDP production coming from the industrial and service sectors, but also has more than 50 percent of its external market revenue coming from manufactured goods.

6. A. Haller and H. Saraiva, "The Income Effects of Education in a Developing Country: Brazil—1973 and 1982," *Research in Social Stratification and Mobility* 11 (1992): 295–336.

7. G. Patrick and E. Kehberg, "Costs and Returns of Education in Five Agricultural Areas of Eastern Brazil," *American Journal of Agricultural Economics* 55 (1973): 145–153; R. Singh, "Underinvestment, Low Economic Retorns to Education, and the Schooling of Rural Children: Some Evidence from Brazil," *Economic Development and Cultural Change* 42 (1992): 646–664.

8. L. Ramos, *Distribuição de Rendimentos no Brasil* (Rio de Janeiro: IPEA, 1993); A. Haller and H. Saraiva (number 5 above).

9. On human capital theory see: G. Becker, *Human Capital* (New York: Columbia University Press, 1964); J. Mincer, *Schooling, Experience and Earnings* (New York: NBER/Columbia University Press, 1974). Concerning status attainment theory see: P. Blau and O. Duncan, *The American Occupational Structure* (New York: John Wiley & Son, 1967); W. Sewell, A. Haller, and A. Portes, "The Educational and Early Occupational Attainment Process," *American Sociological Review* 34 (1969): 82–92; W. Sewell, A. Haller, and G. Ohlendorf, "The Educational and Early Occupational Attainment Process: A Replication and Revision," *American Sociological Review* 35 (1970): 1014–1027; A. Haller and A. Portes, "Status Attainment Processes," *Sociology of Education* 46 (1973): 51–91; W. Sewell and R. Hauser, *Education, Occupation, and Earnings: Achievements in the Early Carrier* (New York: Academic Press, 1975); D. Featherman and R. Hauser, *Opportunity and Change* (New York: Academic Press, 1978).

10. Although there are important differences between human capital and status attainment theories, both represent individualist approaches to earnings determination. In the status attainment line the focus of empirical analysis has usually been on occupational status rather than earnings, although the theory clearly holds earnings as an important dependent variable. See A. Haller and A. Portes (number 9 above); A. Haller, "Reflections on the Social Psychology of Status Attainment," in *Social Structure and Behavior: Essays in Honor of William Hamilton Sewell*, eds. R. Hauser et al. (New York: Academic Press, 1982). Earnings or income appear explicitly as a dependent variable, among others, in W. Sewell and R. Hauser (number 9 above); D. Featherman and R. Hauser (number 9 above); L. Otto and A. Haller, "Evidence for a Social Psychological View of the Status Attainment Process: Four Studies Compared," *Social Forces* 57 (1979): 887–914; A. Haller and H. Saraiva (number 6 above); A. Haller and H. Saraiva, "Ascription and Status Transmission in Brazil," in *Status Influence in Third World Labor Markets: Caste, Gender and Custom*, ed. J. Scoville (Berlin: Walter deGruyter, Inc., 1991).

11. Concerning class analysis: see P. Singer, *Dominação e Desigualdade: Estrutura de Classes e Repartição da Renda no Brasil* (Rio de Janeiro: Paz e Terra, 1981); E. Wright and L. Perrone, "Marxist

Class Categories and Income Inequality," *American Sociological Review* 42 (1977): 32–55. E. Wright, *Class Structure and Income Determination* (London: Academic Press, 1979). About labor market segmentation theory see P. Doeringer and M Piore, *Internal labor Markets and Manpower Analysis* (Lexington: Heath Lexington Books, 1971); P. Osterman, "An Empirical Study of Labor Market Segmentation," *Industrial and labor Relations Review* 28 (1975): 503–528; E. Beck, P. Horan, and C. Tolbet II, "Stratification in a Dual Economy: A Sectoral Model of Earnings Determination," *American Sociological Review* 43 (1978): 704–20; P. Horan, E. Beck, and C. Tolbert II, "The Market Homogeneity Assumption: On the Theoretical Foundations of Empirical Knowledge," *Social Science Quarterly* 61 (1980): 278–292; A. Kalleberg, M. Wallace, and R. Athauser, "Economic Segmentation, Worker Power, and Income Inequality," *American Journal of Sociology* 87 (1981): 651–683; L. Tigges, "Age, Earnings, and Change within the Dual Economy," *Social Forces* 66 (1988): 676–698.

12. As for the individualistic approach, there are important theoretical differences between the structuralist or new structuralist theories (including class analysis). However, their structural element permits to put them together in the same classification.

13. J. Mincer (number 9 above).

14. D. Treiman, "Industrialization and Social Stratification," in *Social Stratification: Research and Theory for the 1970s*, ed. E. Laumann (Indianapolis: Bobbs Merril, 1970).

15. C. Langoni, *Distribuição de Renda e Desenvolvimento Econômico no Brasil* (Rio de Janeiro: Expressão e Cultura, 1973).

16. F. Welch, "Education and Production," *Journal of Political Economy* 78 (1970): 35–59.

17. E. Wright and L Perrone (number 11 above), p. 37.

18. G. Schuh and A. Brandão, "Latin American Agriculture: The Crises of the 1980s and the Challenges of the 1990s," in *Latin America: The Crisis of the Eighties and the Opportunities of the Nineties*, eds. W. Baer, J. Petry, and M. Simpson (Champaign: BEBR/University of Illinois, 1991). Schuh and Brandão show that, unlike the urban sector of Brazilian economy, agriculture kept growing by sustainable rates during the so-called *lost decade* of the 1980s. Indeed, the performance of Brazilian agriculture did not seem to be much affected by the 1980s crisis. Schuh and Brandão show that while the average annual growth rate in the agricultural sector was of 3.8 percent in the period of 1965–80, it was of 3.5 percent in the period of 1980–88. According to them, there are three main reasons for the relatively good performance of Brazilian agriculture during the 1980s: the expansion of soy production in the *cerrado* area of the central region of the country; the *pró-álcool* program, which employed sugarcane-based alcohol as substitute for gasoline as a fuel for automobiles; and the improvement of agricultural research, especially by the Brazilian national organization of agricultural research (EMBRAPA). We would add another reason. With the debt crisis of the 1980s, Brazil needed to export as much as possible in order to achieve trade surplus. As a consequence, Brazilian Federal Government made several currency devaluations, in order to improve exports. The most efficient sectors of Brazilian agriculture strongly benefited from this process.

19. W. Thiesenhusen and J. Melmed–Sanjak, "Brazil's Agrarian Structure: Changes From 1970 Through 1980," *World Development* 18 (1990): 393–415. Thiesenhusen and Melmed–Sanjak show a continuous trend for an increase in the Gini coefficients of land distribution in Brazil. It grew from 0.825 in 1940 to 0.838 in 1970, and to 0.853 in 1980. This was not only due to consolidation of small holdings. The opening of huge tracts in formerly origin lands of the North and West accounts for part of it. Note that most analyses of land inequality are based on "establishments." Because many owners possess more than one establishment, even those high Gini coefficients may underestimate the true level of inequality.

20. R. Mare, "Social Background and School Continuation Decisions," *Journal of the American Statistical Association* 75 (1980): 295–305; C. Hasenbalg and N. Valle Silva, "Raça e Oportunidades Educacionais no Brasil," in *Desigualdade Racial no Brasil Contemporâneo*, ed. P. Lovell (Belo Horizonte: UFMG/CEDEPLAR, 1991).

21. A. Goldberger and G. Cain, "The Causal Analysis of Cognitive Outcomes in the Colleman, Hoffer, and Kilgore Report," *Sociology of Education* 55 (1982): 103–122; A. Gamoran, "The Stratification of High School Learning Opportunities," *Sociology of Education* 60 (1987): 135–155.

22. A. Haller and H. Saraiva (number 6 above).

23. Successfully completed years of education in the case of Brazil is not the same as the number of years one has attended school. In the Brazilian educational system, if a student does not achieve a

predetermined standard, he/she will fail. As a consequence, there are in Brazil, for example, children who have been attending school for five or six years but who have successfully completed only two years of education. In these data, they are recorded as having completed two years of schooling.

24. D. Bills and A. Haller, "Socioeconomic Development and Social Stratification: Reassessing the Brazilian Case," *Journal of Developing Areas* 19 (1984): 59–69.

25. The PNADs of 1973, 1982, and 1988 include information on individuals who are 10 years or older. Given that in Brazilian agriculture the use of young children in the labor force is frequent and is found in all regions of the country, we decided to select all individuals from 10 through 70 years old in our subsamples.

26. It is important to notice that we have avoided using a *"proxy"* for experience—like age, or age minus years of schooling minus 6—as has been the case in many other studies.

27. In other words, the rate of earnings return to experience tends to decrease as the level of experience rises, becoming negative after some point. See A. Haller and K. Spenner, "Occupational Income Differentiation in Status Attainment," *Rural Sociology* 42 (1977): 517–535.

28. For more details about *polynomial regression models*, see J. Neter, W. Wasserman, and M. Kutner, *Applied Linear Regression Models* (Boston: IRWIN, 1989).

29. It is important to notice the fall in the proportion of women in the agricultural labor force. However, we have not found any explanation for this in the literature.

30. The class category of family farmers includes tenant farmers. Regarding farm managers, a good way to construct this category might be by using information about supervision (as recommended in the class analysis approach; see E. Wright and L. Perrone, number 11 above), i.e., to find out whether or not the employee has other employees under her/his supervision. This information is not available in the PNADs; we identified managers from the occupational information, which is probably just as valid.

31. Gini coefficients vary from 0 to 1. As used herein, they will vary from 0 to 100.

32. See J. Graziano da Silva, *A Irrigação e a Problemática Fundiária do Nordeste* (Campinas: UNICAMP/PRONI, 1989).

33. See S. Ribeiro and B. Ghentever, "Consumo Intermediário na Agricultura," *Revista Brasileira de Economia* 37 (1983): 77–109.

34. The values for earnings and ln earnings vary substantially across years as a consequence of high rates of inflation, which forced constant changes in the official currency of the country.

35. We should note that land concentration and agricultural modernization always show a negative correlation. This happens in Brazil because some of the more backward regions of the country have many traditional large estates with agricultural activities of very low productivity.

36. To save space, we do not provide the tables with the *t-tests* for the equality of the differences between the regression coefficients of human capital factors in the three different years.

37. See D. Goodman, B. Sorj, and J. Wilkinson, "Agroindústria, Políticas Públicas e Estruturas Sociais Rurais: Análises Recentes sobre a Agroindústria Brasileira," *Revista de Economia Política* 5 (1985): 31–56.

38. This second possibility seems less likely, given that the difference between the earnings levels of all other class categories in the reference group increased from 1973 to the 1980s. However, it is possible that all class categories have experienced an increase in their earnings levels, but the inequality between the groups has increased even more markedly.

39. See F. Welch (number 15 above).

40. The differences between them are not significant at $|t| > 3.00$.

41. The only exception is the interaction term between experience and intermediary consumption rate in Table 11 (1982) which is positive and statistically significant.

42. See A. Haller and H. Saraiva (number 6 above).

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