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SURPLUS LABOR AND ECONOMIC DEVELOPMENT: THE GUATEMALAN CASE

by

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I. Introduction

This study deals with the economic development of the traditional sector of the Guatemalan economy. It focuses primarily on the subsistence sector and its problems of modernization.

One major objective of the research is to determine whether a situation of surplus labor now exists in Guatemalan Highland subsistence agriculture. Another important objective is to measure the degree of efficiency in the use of resources by the farmers of that region.

The study consists of two parts. Part I explains the theoretical framework within which the research was done and briefly analyzes the history of Guatemala's labor problems. Part II studies the allocative efficiency of the Guatemalan Indian farmers through an analysis of the data collected in intense field interviews.

Review of the Literature and Setting of the Problem

Modern Western theories of economic development treat problems of economic growth in very much the same way as did English Classical economists. Economic dualism, a particularly useful concept in studying today's problems of development, was first introduced by the English Classicists to contrast industries with increasing and decreasing returns.

A modern version of dualism--technological dualism--was elaborated in 1955 by R. S. Eckaus,[1] who incorporates the factor proportion problem (the limitations of technical substitutions among the factors of production) and emphasizes the imperfections in the market of the factors of production.[1] Benjamin Higgins has a version of technological dualism similar to Eckaus', but incorporates demographic considerations.[2] A third version of technological dualism is that of Harvey Leibenstein.[3] According to Leibenstein, one sector of the economy stagnates while the other grows. The growing sector is that which exhibits high capital-labor ratio in its production processes. Technical innovations, according to Leibenstein, are more likely to be adopted in activities where capital is abundant relative to labor, and not in activities where labor is the most important factor of production. The traditional sector, then, becomes stagnant due to its inability to adopt capital intensive production functions.

The theory of technological dualism is particularly relevant in the study of underdevelopment because it helps explain the problem of labor employment. Following is a short outline of the process by which an economy becomes dual, in accordance with the versions of dualism described above.

Labor employment problems in underdeveloped countries stem from both the use of different production functions in the advanced sector and in the traditional sector, and from the slow growth of the modern sector in the face of rapid population growth in the traditional sector.

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[1]R. S. Eckaus, "The Factor Proportion Problem in Underdeveloped Areas," American Economic Review (September, 1955).

[2]Benjamin Higgins, Economic Development (New York: 1959).

[3]H. Leibenstein, "Technical Progress, The Production Function, and Dualism," Banca Nationale del Lavoro Quarterly Review (December, 1960).

The Modern Sector, composed of large scale industry, plantation agriculture, mines, etc., is characterized by the following features:

1. The production function used in this sector offers very limited or no range of technical substitution among the factors of production. Production is carried out with fixed technical coefficients. That is, the isoquant map is made up of rectangular isoquants. (This assumption of fixed technical coefficients of production is a very debatable assumption.)

2. The technology applied to this sector is, in most cases, capital intensive.

3. The rate of capital accumulation in this sector is slower than the rate of population growth in the traditional sector.

4. This sector usually does not affect the demand in the traditional sector for industrial products. That is, the modern sector fails to create an effective demand for its output in the traditional sector.

The Traditional Sector, engaged in traditional agriculture and handicrafts, or very small industries, shows these characteristics:

1. The production function for this sector offers a wide range of substitution among the factors of production. That is, production is carried out with variable technical coefficients. The isoquant map is made of isoquants that are convex towards the origin.

2. The techniques used in this sector are usually labor intensive.

3. The rate of capital investment going into this sector is usually lower than that required to maintain the level of productivity. The proportion of investments made in this sector by the modern sector is very small.

4. This sector not only remains stagnant but very often deteriorates because:

   a. Some of its small industries are unable to compete with the modern industry of the advanced sector.

   b. The growth of commercial agriculture increased the number of landless peasants or made necessary the cultivation of marginal poor lands by the displaced peasants.

5. The rate of population growth is very high in this sector.

Given these important characteristics of the modern and traditional sectors, we can outline how, according to the theory of technological dualism, unemployment appears in this type of economy.

As indicated, dual economies frequently have a high rate of population growth. This additional population must find work in either the advanced or traditional sector of the economy if unemployment is to be avoided. However, in dual societies, the modern sector uses methods of production that are not only capital intensive, but have fixed technical methods of production; hence, this sector is unable to absorb the increases in population of the traditional sector. These increases in population must remain in the traditional sector. This sector, as shown, uses labor intensive methods of production with variable technical coefficients; hence, can absorb the increases in population by making production still more labor intensive and by cultivation of all the available land.[4] As more and more people are absorbed into the traditional sector, the marginal productivity of labor decreases until it becomes zero or even negative; disguised unemployment appears.

This concept of disguised unemployment has been the center of great debate among theoreticians of economic development and we will return to it later. At this point it is important to explain how the excess labor (labor whose marginal productivity is zero or negative) in the traditional sector can live while they produce nothing. The answer to this question is found in the internal organization of the household. Each member of the farm receives a portion of the total output which is more or less equal to the average product and not proportionate to his marginal contribution to the total output. Hence, as long as the average product does not fall below a minimum subsistence level, all members of the farm can survive, even if the marginal contribution of some of them is zero. The average product that each member receives need not be equal to the subsistence level when the marginal productivity of labor is zero or negative. Furthermore, when the average output each member of the household receives is very low, members tend to

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[4]Given the labor surplus there is no incentive in the traditional sector to produce with high capital-labor production techniques. As long as the relative price of labor with respect to capital is low, maximization of output is done along the labor intensive portion of the isoquant. Technological change does not help if we accept Leibenstein's thesis that technological advances are usually adopted in the capital intensive production process--in the advanced sector and not in the traditional one. Hence the more capital intensive the modern sector becomes due to technological change, the more difficult it is for it to absorb the excess labor from agriculture.

seek employment outside the subsistence sector. They perform odd jobs in the adjacent towns or they temporarily migrate to plantations of the commercial agricultural sector.

The belief that conditions of duality--characterized by excess supplies of labor in the agricultural sector--existend in some Asian and African countries gave rise to a theory of development described in W. A. Lewis' pioneer paper, "Economic Development with Unlimited Supplies of Labor." Probably the central idea of that paper concerns the possibility of transferring, without reducing agricultural output, unproductive labor in the agricultural sector to productive uses in the modern sector at minimal or no cost, thereby creating an economic surplus to be used in creating new capital.

More recently, Ranis and Fei complemented Lewis' model by implicitly introducing in their writings the workings of the agricultural sector in the process of development of a dual economy.[5] They also attempted to combine Lewis' model with the notion of the critical minimum effort of Leibenstein.[6] The idea associated with the critical minimum effort is that if the rate of population growth is larger than the rate of growth of the industrial labor force, the economy will be trapped in a kind of Malthusian equilibrium that is

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[5]J. C. Fei and G. Ranis, "A Theory of Economic Development," in C. Eicher and L. Witt (eds.), Agriculture in Economic Development (New York: 1964), p. 181; and also Ranis and Fei, Development of the Labor Surplus Economy (New York: 1964).

[6]H. Leibenstein, A Theory of Economic-Demographic Development (Princeton: 1954), and Economic Backwardness and Growth (New York: 1959).

stable for small change in income. In order to get out of the "low level equilibrium trap" massive infusions of capital are required. The need for huge doses of capital investments is also associated with the "big push" and "unbalance" growth theories which are not discussed here.

The assumption of excess supply of labor in the agricultural sector of a dual economy--which is probably the most important assumption of the Lewis and the Ranis and Fei models--has been challenged on both empirical and theoretical grounds. The empirical work testing this assumption, as evaluated by Kao, Anschel, and Eicher, does not seem to support it.[7] The consistency and theoretical construction of the theory of disguised unemployment as a valid and useful approach to the problem of economic development of dual economies also has recently been questioned by D. W. Jorgenson.[8]

The controversy among these authors really amounts to whether the economies of the underdeveloped countries function according to the principles put forward by the Classical and Neoclassical school of thought. We will examine the assumptions of both theories, their differences and similarities. We will examine the Classical

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[7] C. H. C. Kao, K. R. Anschel, and C. K. Eicher, "Disguised Unemployment: Survey," in Agriculture in Economic Development, op. cit., p. 129.

[8] D. Jorgenson, "The Development of a Dual Economy," Economic Journal (1961); "Subsistence Agriculture and Economic Growth," paper presented to the conference of Subsistence and Peasant Economies, Honolulu, March 5, 1965; and "Testing Alternative Theories of the Development of a Dual Economy," in Irma Adelman and E. Thorbeck (eds.), The Theory and Design of Economic Development (Baltimore: 1966), p. 45.

position as explained in the works of Lewis and Ranis and Fei, and Neoclassical thought as put forward by Jorgenson.

The Supply of Labor

Classical approach --Agricultural labor force, after a certain level, is considered redundant. That is, marginal productivity of labor becomes zero or negative, and hence disguised unemployment appears in the traditional sector.

Neoclassical approach --Labor is never redundant. That is, marginal productivity of agricultural labor is assumed to be always positive. There is no such thing as disguised unemployment.

Wages in the Economy

Classical approach --As long as disguised unemployment exists in the traditional sector, the real wage rate, measured in agricultural goods, is assumed to be fixed "institutionally."

Neoclassical approach --The real wage is assumed to be variable rather than fixed. That is, since the marginal productivity of labor is always positive and variable, and since labor is always positive and variable, and since labor is paid according to its marginal productivity, the real wage rate also varies. It is also assumed that at very low levels of income, the rate of population growth depends upon the level of income.

Changes in the Size of the Labor Force

Classical approach --Before the phase of disguised unemployment ends, the labor force engaged in agriculture must decline absolutely.

Neoclassical approach --There is no unique behavior of the agricultural labor force during the process of development. The agricultural labor force may rise, fall, or remain constant.

We should point out that in the Classical approach, for the growth process to take place, it is neither necessary nor sufficient that the marginal productivity of labor be zero or simply less than the real wage. What is required is that labor productivity be relatively low in the traditional sector and that the demand for labor in the modern sector be smaller than the supply of labor. That is, what is required is the existence of an excess supply of labor.[9]

The Classical Approach

The dual economy, according to the Classical approach, goes through three more or less well-defined phases. In the first phase, labor can be supplied to the industrial sector without reducing agricultural output. In the second phase, the transfer is made at the cost of some reduction in agricultural output. In both phases, if the terms of trade between agriculture and industry remain constant, and if the rate of population growth is equal to the rate of agricultural output growth, then labor is supplied to the industrial sector at a fixed real wage. The surplus created in the advanced sector is assumed to be reinvested. As the industrial sector grows, redundant labor in

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[9] Ranis and Fei make a distinction between the case where marginal productivity is zero (they call this "redundant labor") and where the marginal product of labor is less than its average product (they call this "disguised unemployment").

the traditional sector decreases and eventually disappears. This marks the end of the phase of development with unlimited supplies of labor. The supply of labor that the industrial sector now faces is upward sloping. After this point the marginal productivity of labor in the traditional sector is positive, but less than the real wage-rate measured in agricultural goods. This process continues until the marginal productivity of labor in the agricultural sector is equal to the real wage-rate. This point marks the beginning of the third phase. Real wages in agriculture and industry are the same. "When capital catches up with the labor supply, the economy enters the /third/ phase of development. Classical economics ceases to apply; we are in the world of Neoclassical economics, where all the factors are scarce, in the sense that their supply is inelastic."[10]

The Neoclassical Approach

The Neoclassical approach to the problem of development of a dual economy has been expressed in rigorous mathematical models. The following outline of the Neoclassical approach is the model developed by Jorgenson.[11] The assumptions of this approach in relation to the supply of labor, the determination of wages, and the growth of the labor force are explained above. We will now outline the way that economic growth takes place according to this approach. This

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[10] W. A. Lewis, "Unlimited Labor: Further Notes," The Manchester School (1958), pp. 26-27.

[11] Jorgenson (1961), op. cit., and "Surplus Agricultural Labor and the Development of a Dual Economy," Oxford Economic Papers (1967), pp. 288-312.

approach also uses the idea of an agricultural surplus. This surplus is expressed as an agricultural surplus per head and is defined as the difference between agricultural output per head and a calculated critical value of this output per head.[12] If the difference between these two outputs per head is positive, then part of the labor force may be transferred from the agricultural sector. The emergence of the agricultural surplus is essential for the process of development. Within the Neoclassical framework there is no stationary situation for an economy as long as an agricultural surplus and an "economically viable" advanced sector exist. Provided there is a positive and growing agricultural surplus, the advanced sector must continue to grow. The pattern of growth of the advanced sector is determined by the size of the total population at the time growth begins and by the size of the original capital stock. This approach also argues that sustained economic growth of the economy depends not on the initial level of capital stock but on the economic viability of the advanced sector, which is itself only viable if there is a positive and growing economic surplus. As explained above, the existence of the agricultural surplus and its rate of growth depends upon the rate of population growth and the growth of agricultural output.

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[12]The critical value of output per head is defined in the following way. At the beginning of the process of growth, as agricultural output per head increases, all output is consumed. This process continues until agricultural output per head reaches a level at which further increases in output per head take the form of consumption of manufactured goods. This critical value is a kind of saturation level of consumption of agricultural goods.

Under these circumstances, agricultural technology increases agricultural output per head; increases in the rate of population growth decrease it. Hence, the greater the rate of population growth, the greater the rate of advances in agricultural technology required in order to have a positive and growing agricultural surplus. If advances in agricultural technology are not possible, some kind of population control is required in order for the agricultural surplus to exist and grow.

As we have said, the Classical approach reduces to the Neoclassical one after redundant labor disappears--after the phase of disguised unemployment ends. It seems, then, that the two approaches have different implications only for situations where disguised unemployment exists. Hence, the evaluation of the Classical versus the Neoclassical theory of development of dual economies has meaning only when they are compared in economies where disguised unemployment is said to exist. Here lies the relevancy of conducting empirical research on the existence of disguised unemployment.

Empirical Tests

Empirical research to measure the existence of disguised unemployment has been conducted in many countries using different approaches.[13] The evidence presented to support the existence of a high percentage of disguised unemployment in underdeveloped countries is numerous, but often not very convincing. The same

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[13] See Rao, Anschel and Eicher, op. cit., pp. 135-141.

can be said of research conducted to reject the existence of disguised unemployment.

Research followed what have been called the "direct" and "indirect" methods of measuring disguised unemployment.[14] The direct method consists of: (a) studies in which labor requirements to produce the present level of agricultural output and the present level of agricultural labor force are calculated. The difference between what is available and what is required is regarded as disguised unemployment; (b) studies that examine historical cases in which by some event or calamity a portion of the agricultural labor force has been removed from the agricultural sector; whether agricultural production decreases or does not decrease after this event or calamity is taken as evidence that disguised unemployment was not or was present in the agricultural sector; and (c) anthropological works which consist of budget analysis, the study of the household behavior, and the way in which individuals make economic decisions.

The indirect method used in measuring disguised unemployment and the implications[15] of the Classical approach consists in the analysis of time series in order to test: (a) whether historically the supply of labor faced by the industrial sector has ever had the characteristics claimed by the Classical or Neoclassical theory; that is, whether the

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[14] Ibid., p. 135.

[15] For the source of these implications (c, d, and e), derived from the Classical approach, see Jorgenson (1965, 1966), op. cit.

supply of labor has been perfectly elastic and if the real wage has been fixed institutionally during the time when disguised unemployment is said to have existed; (b) if the absolute size of the agricultural labor force has declined (Classical approach) or did not follow a definite pattern (Neoclassical approach) during the process of disguised unemployment; (c) whether labor productivity in the advanced sector remained constant during the period of disguised unemployment (Classical approach) or was always rising (Neoclassical approach); (d) if in the advanced sector the rate of growth of output and employment increased over time (Classical) or the rate of growth of both variables declined over time (Neoclassical); (e) whether in the advanced sector of the economy the capital-output ratio declines through the phase of disguised unemployment and the rate of growth of capital increases over time (Classical) or the capital-output ratio and the rate of growth of capital become constant as the process of development advances (Neoclassical).

We think it very important to know if the economic variables of a given economy behave according to the Classical or Neoclassical postulates. The policy implication of knowing or not knowing the magnitude and behavior of these variables can hardly be overemphasized.

We have outlined the main features and assumptions of the two modern approaches to the development of a dual economy in order to establish a framework of reference for the study of the Guatemalan economy. Guatemala has the characteristics of a dual economy: a modern sector (industries in Guatemala City, Quetzaltenango, etc., and a market-oriented agriculture in the Lowlands); and a traditional sector (subsistence agriculture in the Highlands and small handicraft Indian industries). The Highlands are briefly described below.

Description of the Guatemalan Highlands

Population

According to the 1964 Census, Guatemala continues an overwhelmingly rural country. In 1964, 71 percent of the total population was resident in rural areas, only a slight reduction from the figure of 75 percent in 1950. The total population of the Republic is reported to have increased by 53.5 percent in the 14-year intercensal period, at an annual rate of increase of 3.1 percent per year. The 1964 Census data suggested increases of 33 percent in the rural population and 105 percent in the urban population for the entire country between 1950 and 1964. However, the definition of urban population in the recent census differed from that used in 1950, thus invalidating direct comparison of the Census data. Adjustment of the 1964 data, using the 1950 definition of urban residence, suggests increases of 45.7 percent in the rural population and 77.1 percent in the urban population (see Table 1).

The Highlands, as here defined, include all the lands that lie at altitudes ranging from one thousand to three thousand meters in the seven departments of Chimaltenango, Quiche, Totonicapan, Huehuetenango, Quezaltenango, San Marcos, and Solola. These seven departments are the most thickly populated region of Guatemala, with a population density of 178.1 inhabitants per square mile, compared

Table 1. Rural and Urban Population Change, Guatemala, 1950 to 1964

Region	Rural	Urban	Total
	1950		
Highlands	933,025	162,546	1,095,571
Other	1,161,385	533,912	1,695,297
Total	2,094,410	696,458	2,790,868
	1964		
Highlands	1,212,886	335,323	1,548,209
Other	1,633,526	1,102,738	2,736,264
Total	2,846,412	1,438,061	4,284,473
	1964 (adjusted)[a]		
Highlands	1,301,284	246,925	1,548,209
Other	1,749,422	988,842	2,738,264
Total	3,050,706	1,235,767	4,286,473
	Percent Increase (adjusted)		
Highlands	39.5	51.9	41.3
Other	50.6	84.8	61.4
Total	45.7	77.1	53.5

[a]The 1964 census data were made comparable with the 1950 data by considering as urban only those population clusters which had 2,000 inhabitants or more, or had been considered as urban in 1950, even though they had fewer inhabitants. (Data supplied by L. Schmid of the Land Tenure Center, University of Wisconsin.)

to 109.2 for the entire country, or to 155.3 for all Guatemala if the Spanish settled department of Peten is excluded. The Highland region accounts for 36 percent of the population of Guatemala.

The population of the Highlands region increased by 41.3 percent in the period 1950-64, an annual rate of increase of 2.5 percent. The Highlands urban population increased by 51.9 percent whereas the rural population increased by 39.5 percent. All the departments in the region participated in the large urban increase except for Totonicapan, where the urban increase was only 3.3 percent.

Land Concentration

Guatemalan agriculture is characterized by a concentration of land in a few large farms. According to the 1950 Agricultural Census, there were 348,687 farms in Guatemala which occupied an area of 3,720,833 hectares. The average size of farms was 10.68 hectares. The Census data indicated that farms which were 45 hectares or larger (0.31 percent of total number of farms) contained 50.35 percent of the land; farms of less than 7 hectares in area (88.35 percent of the total number of farms) contained only 14.33 percent of the farmland.

At the time of the 1950 Census the Highlands of Guatemala contained 162,289 farms (46.54 percent of the nation's farms), and they occupied 992,000 hectares (26.62 percent of the total farmland), so the average farm area in the region was 6.11 hectares. The Highlands contained a larger proportion of the nation's small farms than did other regions, but proportionally fewer large farms--54.17 percent of the farms less than 0.70 hectares, but only one farm larger than 9,020 hectares.

According to the 1964 Census, the Highlands contained 27 percent of Guatemalan farmland and 47 percent of the farms. The average farm size in the Highlands was 6.1 hectares, compared with the national average of 10.7 hectares. The Census also indicated that in the Highlands, 31 percent of the farmland was controlled by 0.2 percent of the farmers; a slightly less concentrated pattern of land distribution than for the nation as a whole where 50 percent of the farmland was controlled by 0.3 percent of the farmers. The concentrated nature of land distribution in the Highlands can be illustrated another way--50 percent of the farms were less than 1.4 hectares in 1964.

Climate and Cultural Characteristics

In general, the Highlands have a temperate climate, which in the highest zones becomes relatively cold in December, January, and February. Like the remainder of the country, it has two distinct seasons of about equal length. The wet season (winter) lasts from May until November; the dry season (summer) occurs during the remainder of the year.

There is little level land in the mountainous terrain, so most of the crops are planted on slopes, some at extremely precipitous angles. The fields are usually divided into strips, separated by narrow margins marking individual holdings. Much of this land has been under cultivation for many centuries.

From a cultural viewpoint, the homogeneity of the region is readily observable. All the inhabitants are descendants of the

Mayan Indians. Most people still converse in one of the many Mayan dialects, and the women, particularly, dress in traditional costumes. With few exceptions, these people follow the planting and cultivating practices handed down through many generations.

In an economic and social sense, the region is equally homogeneous. Poverty is the general rule. The few centavos that the Indian makes when he is able to find work away from home are needed to buy more corn. Corn is the mainstay of his diet but his farm is not sufficiently large to provide enough for sustenance. The rate of illiteracy is overwhelming: two-thirds of the heads of families in this study could neither read nor write. The population of the area has little or no voice in the government of the country.

The purpose of the study can be stated very simply: it intends (a) to see if the traditional sector of the Guatemalan economy has had and continues to have the characteristics of, and functions according to, the postulates put forward by the Classical and Neoclassical theories of growth; and (b) to analyze the policy implications of the results.

Through analysis of the data collected from a sample of traditional Highlands farmers, the hypothesis of disguised unemployment in the traditional sector of today's Guatemalan economy is tested. Efficiency in the use of resources by the traditional Highlands farmer is also measured.

II. Design of the Survey and Specification of the Production Function

Analysis of the Guatemalan Agricultural Census of 1950 indicated that 21.3 percent of the nation's farms were less than 0.7 hectares (micro-fincas), 67.1 percent were between 0.7 and 7.0 hectares (sub-familiares), 9.5 percent were between 7.0 and 45 hectares (fincas familiares), and the remaining 2.1 percent were over 45 hectares (fincas multi-familiares). There was a higher concentration of small farms in the western Highlands, the area of this study: 24.8 percent were micro-fincas, 64.8 percent were fincas sub-familiares, 9.1 percent were fincas familiares, and only 1.3 percent were fincas multi-familiares.

Since this study is concerned with traditional agriculture, the sample was chosen from farms of family size or smaller.

A series of municipios (counties) were selected in the Highlands which were believed to yield a representative sample of traditional agriculture as practiced in the region. Three municipios were chosen from the Department of Chimaltenango, and two from the Department of Solola, but all of these within the Cakchiquel linguistic area. Three were chosen in the first department because it has a more heterogeneous system of agriculture than the others in the study, with greater variation in soil, altitude, and other factors. Two municipios were selected in the Department of Quiche, two in Totonicapan, one in Quezaltenango, and one in Solola--all representing the Quiche linguistic area. In order to include the linguistic area of the Mam, two municipios in the Department of Huehuetenango and two in San Marcos were also selected, The Cakchiquel, the Quiche, and the Mam are the three major linguistic groups of the Maya who inhabit the Western Highlands. To complete the sample, three additional municipios were also selected from Huehuetenango to represent minor linguistic groups: two for the Kanjobal and one for the Agucateca.

Since the Agricultural Census of 1964 had been completed only a few months before this work began, its lists of farmers and farm sizes were used. From these lists a random sample in each aldea was drawn. This method yielded approximately 400 farms, from which about 348 interviews were obtained.

The Production Function and Its Properties

The method used in studying the allocative efficiency of resources among Guatemalan Highland farmers was to fit Cobb-Douglas single equations to cross-sectional data collected by intensive questionnaire interviews of 348 randomly chosen farmers.

The functional form of the Cobb-Douglas production function is:

$$Y = AX_1^{b1} \quad X_2^{b2} \; . \; . \; . \; . \quad X_i^{bi} \quad . \; . \; . \quad X_n^{bn} \qquad (1)$$

where Y is output, X_i the inputs, A is a constant and b_i refers to the transformation ratio when X_i is at different magnitudes.

The Cobb-Douglas function becomes linear in the logarithms, hence:

$$\log Y = a + b_1 \; \log X_1 + . \; . \; b_i \log X_i + b_n \log X_n \qquad (2)$$

The marginal productivity of the factors of production indicate the returns that might be expected, on the average, from the addition of the various resources. The marginal physical product of a given input, then, is the partial derivative of the output with respect to that input, all other inputs held constant. Hence differentiating equation (1) with respect to X_i we write:

$$\frac{\partial Y}{\partial X_i} = b_i \, AX_1^{b_1} \ldots X_i^{b_i - 1} \ldots X_n^{b_n} = b_i \frac{Y}{X_i} \qquad (3)$$

In order to obtain the elasticity of production of a factor, we use the concept of marginal product. The elasticities of production indicate the percentage change in output with respect to a percentage change in input. Hence, from (1) and (3) we can write:

$$\epsilon_{YX_i} = \frac{\partial Y}{\partial X_i} \frac{X_i}{Y} = \left(b_i \frac{Y}{X_i}\right) \frac{X_i}{Y} = b_i \qquad (4)$$

Therefore, in the Cobb-Douglas function, the elasticities of production are given directly by the respective input exponents and they are constant over the entire input-output curve.

Production functions of the Cobb-Douglas type permit observation of the phenomenon of returns to scale. The sum of the estimated input coefficients is taken as an indication of the returns to scale. If this sum is smaller than one, it indicates decreasing returns to scale; if it is larger than one, there are increasing returns to scale; while if the sum of exponents is equal to one, there are constant returns to scale.

Under conditions of perfect markets, the optimum allocation of resources is achieved when the marginal productivity of each factor is equal to its real wage. Hence we can write:

$$\frac{\partial Y}{\partial X_i} = b_i \frac{Y}{X_i} = \frac{W_i}{P}$$

where W_i is the money wage of factor i and P is the price of the product.

Under the situation of perfect markets, then, we can directly compare the marginal productivity of a factor to its opportunity cost in order to detect the degree of efficiency in the allocation of resources. If the ratio of marginal productivity of a factor to its opportunity cost is less than one, too much of the given resource is being used. If the ratio of marginal productivity to opportunity cost is more than one, too little of the given factor is being used. Maximum efficiency occurs when marginal productivity of a factor is equal to its opportunity cost.

The next sections specify the variables, and estimate the production elasticities, marginal productivities, and efficiency ratios for the sample of farmers in the study.

III. Agricultural Output and Sources of Income

Maize--the Basis of the Enterprise

Maize is the principal food of every Indian so its culture predominates in the Highlands. Preparation of the land for planting, actual planting, and the first, second, third, and sometimes the fourth cultivation to control weeds and to repair storm damage, and then finally harvesting, shelling, and storage extend the process to a year round operation. Only a few weeks after the seed ears have been stored, it is time to start clearing the dried stalks and accumulated vegetation in the fields so that they can be burned.

Beans are another important item in the indigenous diet. Planting techniques vary between localities, partly because of cultural determinants which many anthropologists have described, and partly because of the dictates of experience. While "large" farmers will plant whole fields of corn and beans separately, hoe culture permits combining both in the same field, with corn, pole beans, and lima beans in the same planting hole.

Potatoes are planted between the rows and when that is done, lesser amounts of other crops are planted, so that here and there will be a squash, a pumpkin, and frequently a lima bean stalk. If the farmer has a special field of potatoes, even though it measures only two or threee cuerdas in size, he has reached a level above the average peasant's described here, because he has land and enough money to take a risk on a cash crop in addition to the milpa which he plants elsewhere to insure his family's subsistence. Storage facilities being deficient and crude, and harvests from the plots not large, every advantage that nature might provide has to be seized if tortillas are to be on the table regularly; otherwise the peasants will suffer a long dearth of food before harvest.

Completion of the third and final round of cultivating winter fields varies within the region from late July to September.

Occasionally, the hill farmer has to cultivate still again very late in the season. After the cultivation cycle has been completed, the farmer is free to look for work away from home--he may spend one or two months picking coffee in the cafetales that abound below the altiplano and on the Pacific slopes. With the advent of cotton as a major export crop following World War II, some of the Highlanders began to work in its harvest during the months of November, December, and January.

Principal Crops and Yields

From the preceding description, any breakdown of the farm enterprise into precise units by crops is obviously difficult. All of the farms had some corn plantings (see Table 2), with an average of 1.03 hectares of "sole" corn plantings per farm. Corn yields ranged from 14.4 quintals per hectare in Huehuetenango to 24.4 quintals in Quezaltenango, with a regional average of 18.96 quintals per hectare (see Table 3). The high yield in Quezaltenango may have been obtained because most of the farmers used chemical fertilizer; such use did not occur much in the other departments. In Huehuetenango not a single operator had used any.

Wheat was cultivated on 130 farms. The total area planted was 128.1 hectares, about 36 percent of the area planted to maize. Two of the departments, Quiche and Huehuetenango, planted little or no wheat. The highest concentration of wheat farmers was found in Solola and San Marcos. Solola had the highest yield, 27.9 quintals per hectare, and since a large portion of the farmers in that

Table 2. Principal Crops Cultivated, Distribution by Farms

Department	Corn	Wheat	Potatoes	Beans	Beans-Corn	Lima Beans Corn	Potatoes Corn	Total Number of Farms
Chimaltenango	100	31	5	4	70	55	22	100
Solola	70	43	3	21	25	42		70
Totonicapan	44	22	19		15	16		44
Quiche	65	8	5		54	22	9	65
Quezaltenango	22	10			9	12		22
San Marcos	20	16	10			11		20
Huehuetenango	27				12	4		27
Total	348	130	42	25	185	162	31	348

Table 3. Area Cultivated (Hectares) and Yield (Quintals) of Principal Crops

Department	Corn		Wheat		Potatoes		Beans	
	Area	Yield per Hectare	Area	Yield per Hectare	Area	Yield per Hectare	Area	Yield per Hectare
Chimaltenango	119.4	20.4	18.3	18.3	1.2	235.9	0.8	8.6
Solola	104.2	16.4	53.3	27.9	0.5	134.7	8.2	11.0
Totonicapan	14.8	17.6	7.6	17.3	2.7	60.0		
Quiche	58.3	21.3	5.8	13.0	0.6	145.2		
Quezaltenango	15.0	24.4	30.1	22.4				
San Marcos	18.5	20.7	13.0	18.3	0.9	210.0		
Huehuetenango	29.2	14.4						
Total	359.4	19.0	128.1	23.0	5.9	134.0	9.0	10.8

department grew wheat, the overall regional yield is unduly influenced--it amounted to 23.0 quintals per hectare. Without Solola, the regional average would drop to about 19 quintals per hectare, closer to that found in the other departments.

Potatoes represent an insignificant part of the farm enterprise, and the crop was included separately only to indicate its scarcity in the subsistence economy. A total of 42 farms reported they had separate potato plantings, but the total area planted amounted to only 5.9 hectares. Even if the area of land in which potatoes were interplanted with corn is added to this, the total is only 10.6 hectares, or less than three percent of the amount of land in corn. If the department of Totonicapan is removed from the total, the average yield would be about 197 quintals per hectare, demonstrating the production possibilities for this crop in the Highlands.

Frijoles de suelo were grown as a separate crop on only 25 of the 348 farms studied, whereas frijoles de milpa, or frijoles de vara, were intertilled on 54 percent of the milpas and occupied about 45 percent as much land as did corn. However, the yields of the two varieties of beans were radically different; the first yielded 10.8 quintals per hectare, while the other yielded only 1.7 quintals.

The haba (similar to the lima bean) was another crop often interplanted with corn, appearing on 162 farms. Yields with such beans were slightly higher than for the other varieties, averaging 2.0 quintals per hectare, with no marked variation between departments.

Value of Agricultural Output and Complementary Income: Migratory and Non-Migratory Farmers

There are three principal sources of income for the people of the Highlands: farming on their own where a substantial part of the production is consumed directly; supplementary employment within their home communities; and earnings received as a migratory farm laborer in commercial agriculture, mostly in the coastal region.

The gross value of annual production per farm varies, as would be expected, directly with the size of farm. The average value of production per farm in this study was Q207.55 (see Table 4).[16] Of this amount about one-half was sold and the other half consumed by the family. If the area cultivated per farm is considered, the farms with smaller cultivated areas sell a smaller proportion of the total product than do the larger farms (see Table 5). Although the proportion of the crop sold is not correlated precisely with the area cultivated, farms under 1.5 hectares in size, about two-thirds of the total number, sell less than 40 percent; while farms over 1.5 hectares in size sell about 56 percent of the crop. The net value of farm production, after deduction of cash costs, was Q155. Thus the average gross value of farm output per person was Q42, while the corresponding figure per man unit was approximately Q84.

Since the Highland area is a low income farming area from which a considerable number of campesinos migrate annually to the

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[16] One Quetzal = One U.S. dollar.

Table 4. Average Value (Quetzals) per Finca of Gross Annual Production Classified According to Area Cultivated (Hectares)

Department	Under 0.5 (Ha.)	0.5-0.9	1.0-1.4	1.5-1.9	2.0-2.4	2.5 Ha. and over	Average
Chimaltenango	37.70	118.35	197.95	248.30	242.00	498.50	208.00
Totonicapan	37.95	73.15	99.35	92.00	339.50	--	69.90
Quezaltenango	66.55	72.60	75.00	719.00	--	1,190.00	382.70
Quiche	67.05	106.40	169.75	231.65	468.50	496.25	145.95
Solola	62.90	60.75	194.90	183.75	238.60	621.05	308.35
Huehuetenango	33.55	49.30	207.00	97.00	211.35	420.65	108.05
San Marcos	--	69.00	148.20	271.50	446.80	757.50	297.20
Average	50.95	93.70	179.40	239.45	299.20	629.55	207.55

Table 5. Value of Annual Gross Production Sold per Finca (Quetzals)

Hectares Cultivated	Number of Fincas	Average Value Gross Annual Production per Finca	Average Value Product Sold per Finca	Percentage Product Sold per Finca (By Value)
Under 0.5	83	50.95	17.30	34.0
0.5 - 0.9	92	93.70	33.40	35.7
1.0 - 1.4	53	179.40	70.00	39.0
1.5 - 1.9	46	239.45	120.35	50.3
2.0 - 2.4	27	299.20	125.30	41.9
2.5 and over	47	629.20	393.30	62.5
Total	348	207.55	102.35	49.3

coastal region for employment as agricultural laborers, the net family incomes of the campesinos interviewed were calculated separately according to whether or not they were migrant farm laborers. Twenty percent of the respondents were migrant workers (see Table 6).

The net farm income of the migrant was smaller in all departments than the net farm income of the cultivator who did not migrate, although the difference was negligible in Totonicapan. For the departments as a whole, net farm income of all migrants was Q99.63, compared with Q169.90 for those not migrating--70 percent higher for non-migrants.

Farm incomes were also supplemented by incomes earned in the local communities by working as hired laborers, craftsmen, or petty traders. Incomes so earned were again not evenly distributed. Migrant farm workers were less successful in earning extra incomes locally than were those who did not migrate. In the departments as a whole, the average annual supplementary earnings received locally were Q27.93 for the migratory laborers and Q98.81 for those who did not migrate (see Table 6).

As noted in Table 7, the average combined incomes earned locally by the respondents was Q239.22 per family. Again the incomes of non-migrants were much larger, more than twice as large on the average as the migrants', Q268.71 compared to Q127.56.

The source of these supplementary earnings varied greatly among communities. In the communities where raw cotton was available, and in some cases wool, spinning and weaving provided a supplement to farm earnings, especially in the villages studied in San Marcos,

Table 6. Annual Family Incomes of Migratory and Non-migratory Farmers in their Home Communities

Department	Number of Farmers Interviewed	Net Agricultural Income[a]	Other Income in Community	Total Income in Community
Chimaltenango				
Migratory	31	$115.26	$ 20.88	$136.14
Non-migratory	69	215.15	50.50	265.50
Totonicapan				
Migratory	7	44.43	55.85	100.28
Non-migratory	37	45.48	154.46	199.94
Huehuetenango				
Migratory	11	61.58	23.55	85.13
Non-migratory	16	106.16	55.07	161.23
Quiche				
Migratory	7	44.37	46.89	91.26
Non-migratory	58	96.31	138.90	235.21
Solola				
Migratory	8	120.25	33.61	153.86
Non-migratory	62	259.48	89.86	349.34
San Marcos				
Migratory	7	205.76	12.86	218.62
Non-migratory	13	269.28	58.75	328.03
Quezaltenango				
Migratory[b]	-	-	-	-
Non-migratory	22	170.00	131.86	301.86
Average of Total				
Migratory	71	98.00	32.00	130.00
Non-migratory	277	166.00	97.00	263.00
Total	348	132.00	64.50	196.50

[a]Net agricultural income calculated by deducting all farming costs from the gross value of production.

[b]No cuadrilleros were interviewed in Quezaltenango in this study.

Quiche, and Totonicapan. Not only were the returns profitable, but these supplementary tasks also provided the basis for a permanent cottage industry. This situation allowed the families who participated a permanent residence; they did not become exposed to the problems that plague migrant labor families.

As noted above, only one-fifth of the 348 family heads had participated the preceding agricultural year in the annual migration of harvest workers to the coffee and cotton haciendas of the Pacific Coastal slopes. The migrant workers did not come from all departments in equal proportions. Moreover, workers seemed to come from certain caserios within departments, while not from other communities in the same department. For example, among those interviewed in the department of Chimaltenango, none who lived in Chimazat participated in the migrant movement; those who went were from the farms in the Comalapa and Sta. Apolonia municipios. The same was true of Solola--the campesinos of Las Canoas, an aldea of San Andres Semetabaj, stayed home, while almost all among those interviewed from the department who went were from Santa Catarina Ixtahuacan.

As would be expected, the lower income farms contributed most of the migrants. The data suggest that 25.0 percent of operators of farms with less than one hectare of cropland participated in the migrant stream to the coast, along with 22.0 percent of the operators of farms with more than one but less than two hectares of cropland, and only 14.0 percent of operators from farms with more than two hectares of cropland.

Contrary to expectations, there was but slight difference in the average age of the "migrant" and the operators as a whole--40.2 years and 42.7 years, respectively. Generally migratory laborers come from the younger age groups, but here the low average farm income operated as a "push" factor, causing the migrants to come from all age groups.

The average migrant returned home with Q31.55 cash in his possession, an average of approximately Q15.00 per month for the two months sojourn on the coast; compared to prevailing farm wages in the Highlands, this figure is only a little over the highest daily rate paid in the area, which was 50 centavos.

When incomes from all sources are combined, the average income reported per family for non-migrants was Q263.00 and for migrants Q161.55, with an overall average of Q228.05 (see Table 7). Clearly the migrants are poorer by far. Although the net cash earnings reported from such employment were only Q31.55, the workers did have some sort of subsistence while they were so employed.

Table 7. Comparison of Total Incomes for Migrants and Non-Migrants

	Non-Migrants	Migrants	Total
Average net income from agricultural production	166.00	98.00	132.00
Income from employment in community	97.00	32.00	64.50
Net income from employment as migrant farm worker	-	31.55	31.55
Total	263.00	161.55	228.05

IV. Land, Labor and Capital Inputs

Land Input

Land Use and Size of Farm

Land has only two major use classifications in the Highlands--cropland and woodlot. The average area of land among the sample farms allocated to pasture, woodlot and cultivation was 0.21, 1.08, and 1.49 hectares, respectively. Woodlots were found on 58.6 percent of the farms. Pasture lands (accounting for 8 percent of all land in farms) were found only at the highest altitudes--over 2,500 meters in altitude--and then only in the extreme western part of the region. Only 14.6 percent of the farms contained pasture, and only in Totonicapan and San Marcos was there a significant incidence of pasture land.

The sample population was classified according to farm area and also by area cultivated. The average farm area for the sample was 3.00 hectares, while cultivated area was 1.49 hectares (see Table 8). The average farm area and cultivated area was computed for each of the six farm size classes used in the classification of the sample data (see Table 8). This analysis indicates that as the farm area increases, the proportion of the farm cultivated diminishes. Farms less than 0.50 hectares in size cultivated 79.3 percent of the land, while those in excess of 2.49 hectares cultivated 41.6 percent of the land.

The largest farm in the sample was 42.24 hectares; two farms had an area in excess of 20 hectares and only 18 (5.2 percent) had

Table 8. Sample Farms Classified by Total Farm Area and by Cultivated Area

Area Class (Hectares)	Classification by Total Area: No. of Farms	Percent- age	Average Total Farm Area	Average Cult. Farm Area	% of Farm Area Cult.	Classification by Cultivated Area: No. of Farms	Percent- age	Average Cult. Farm Area
0.00 - 0.49	54	15.5	0.29	0.23	79.3	83	23.6	0.28
0.50 - 0.99	65	18.7	0.73	0.56	76.7	92	26.7	0.72
1.00 - 1.49	42	12.1	1.24	0.92	74.2	53	15.2	1.25
1.50 - 1.99	47	13.5	1.75	1.18	67.4	46	13.2	1.73
2.00 - 2.49	30	8.6	2.20	1.66	75.5	27	7.8	2.18
Over 2.49	110	31.6	7.11	2.96	41.6	47	13.5	4.80
Total	348	100.00	3.00	1.49	49.7	348	100.00	1.49

more than 10. At the other end of the distribution, 54 of the 348 had less than 0.5 hectares of land, with the highest concentration of farms of this size in Totonicapan. On the other hand, Solola holds the highest percentage of farms with an area of 2.5 hectares or more (see Table 9).

Individual and Communal Ownership

As one would expect in a traditional society where property is mainly acquired through inheritance, the bulk of the operators were owners. In all, 329 of the 348 informants (94.5 percent) owned all or part of their farms. The remaining 5.5 percent rented, paying rent in cash or kind (see Table 10).

Because individual ownership of land was imposed relatively recently upon the Indians by the Spanish culture, and because communal ownership has centuries of tradition, repeated governmental decrees of the nineteenth century have not yet abolished communal ownership.

Table 9. Distribution of Sample Farms Cultivated According to Departments and Area Cultivated

Department	Under 0.5		0.5 - 0.9		1.0 - 1.4		1.5 - 1.9		2.0 - 2.4		2.5 and		Total
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Chimaltenango	8	8	34	34	24	24	20	20	4	4	10	10	100
Totonicapan	23	52	13	30	3	7	3	7	2	4	-	-	44
Quezaltenango	9	40	5	23	1	5	2	9	-	-	5	22	22
Quiche	25	39	19	29	9	14	6	9	2	3	4	6	65
Solola	8	11	9	13	10	14	9	13	11	16	23	33	70
Huehuetenango	11	41	7	26	1	4	2	7	3	11	3	11	27
San Marcos	-	-	4	20	5	25	4	20	5	25	2	10	20
Total	84	24	91	26	53	15	46	13	27	8	47	14	348

Table 10. Tenure Status of Sample Families

Tenure Status	Number	Percentage
Owner	247[a]	71.0
Renter	8	2.3
Owner and renter[b]	58	16.6
Renter and Owner[c]	24	6.9
Sharecropper	11[d]	3.2
Total	348	100.00

[a]Nine owners also had rights to use of land in communal properties.

[b]Owned the major part of landholdings.

[c]Rented the major portion of their landholdings.

[d]Seven sharecroppers also owned land which they had acquired through inheritance.

Labor Input

In the sample as a whole, 42 percent of the family heads reported that they were the only ones employed on their farms; family head and wife constituted the labor force on 11.5 percent of the farms. At another 27.6 percent, the labor force consisted of the head and his sons; in another 17.5 percent the entire family worked (see Table 11). Thus the farms in the Western Highlands may appropriately be called family farms.

Table 11. Composition of Family Labor Force Employed on the Home Farm

Department	Total	Head Alone		Wife and Head		Head, Wife and Sons		Head and Sons		Other	
		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Chimaltenango	100	53	53.0	11	11.0	8	8.0	25	25.0	3	3.0
Totonicapan	44	19	43.2	4	9.1	8	18.2	12	27.3	1	2.2
Quezaltenango	22	12	54.5			4	18.2	6	27.3		
Quiche	65	14	21.5	17	26.2	18	27.7	16	24.6		
Huehuetenango	27	13	48.2	2	7.4	7	25.9	5	18.5		
Solola	70	28	40.0	4	5.7	10	14.3	27	38.6	1	1.4
San Marcos	20	7	35.0	2	10.0	6	30.0	5	25.0		
Total	348	146	42.0	40	11.5	61	17.5	96	27.6	5	1.4

Of the 58 percent of farms where the head was not the sole person occupied, half employed peons. As might be expected, 64.3 percent of the hired labor was at farms cultivating a land area of more than two hectares; the percentage dropped to 28.6 at farms with a cultivated land area averaging between one and two hectares, while only 16.2 percent were at those having less than one hectare of cropland.

Estimating the labor input on the family farm presents serious problems; however, this study made the following estimates:

We first estimated the total labor potential of the household (see Table 12), by calculating the weighted contribution of each family member according to his sex and age. In this way labor of the family was transformed into homogeneous man-month units. One man-month is defined as the labor input of a male adult for 26 days, each day being of nine hours duration.

Male members of the family whose ages were between 16 and 55 were given a weights of 1; female members of the household within the same age range were given 0.5; children under 16 and men and women older than 55 were given 0.3.

A man-month figure was also calculated called labor available for farm activities. This figure gives an estimate of the number of man-months that the family could have used on the farm, calculated by subtracting from the labor potential figure the number of man-months employed in off-farm activities (time spent in the coast as migrant workers, commerce, etc.). Labor available could have been spent (a) on the farm, (b) in occupations not

Table 12. Labor Supply and Labor Utilization by Farm Size (By Man Months)

Hectares Cultivated (1)	Number of Farms (2)	Labor Potential (3)	Labor Used in Off Farm Activities (4)	Labor Available for the farm (5)	Labor Input[a] (6)	Labor Input[b] (7)	Ratios 6/5 (8)	Ratios 7/5 (9)
Under 0.5	81	20.40	4.40	16.00	1.0	1.7	.062	.10
0.5 to 0.9	86	24.38	4.78	19.60	1.85	3.18	.095	.16
1.0 to 1.4	52	26.38	4.08	22.30	2.96	4.98	.13	.22
1.5 to 1.9	43	28.61	4.86	23.75	3.14	6.69	.13	.28
2.0 to 2.4	26	29.69	4.14	25.55	3.34	6.73	.13	.26
2.5 + over	41	34.48	5.38	29.10	4.51	11.74	.15	.40
Total	329	27.32		22.72	2.80	5.83	.12	.26

[a]Labor provided by the head of the family only.

[b]Labor provided by the head of the household and his family.

recorded in the interview, or (c) the time that the farmers remained unemployed.

In order to obtain data relating to labor units, each farmer was asked how many man-days of labor were used in land preparation and how land was prepared. He was asked about the labor inputs in planting and cultivation, including the time spent on herbicidal weed control and insect control with pesticides, harvesting, threshing, shelling, and winnowing. This line of questioning was repeated for each of the major crops--corn, frijoles, wheat and potatoes.

By this procedure two estimates of the labor input on the family farm were obtained--labor input of the head of the family alone, and labor input of the head of household and his family (see Table 12). These two estimates are a measure of the actual farm labor input.

The remarkable difference between labor available and labor input can be observed in Table 12.

On the average, labor input is 12 percent of labor available when only the labor force of the head of the household is considered. The corresponding figure for the head of the household and his family is 24 percent.

Table 12 shows that family labor used on the farms increased from 1.70 man-months on holdings of under 0.5 hectares (average 0.27 hectares) to 11.74 man-months on farms of 2.5 hectares or more. Of this, one man-month of the total 1.7 man-months was supplied by the operator on the smallest farms; on the largest farms the operator supplied 4.5 man-months.

Table 13 shows that the intensity of labor used on the farm does not vary significantly among various departments, suggesting a high degree of homogeneity among the peasants in the Guatemalan Highlands regarding the use of labor in farm activities.

Table 13. Average Man-Months of Labor of the Operator and Other Family Workers in Production of Principal Crops by Departments

Department	Average Ha. Per Farm	Average Man-Month Employed[a]	Average Man-Month Employed[b]
Chimaltenango	1.41	2.81	4.80
Totonicapan	0.64	1.74	4.13
Quezaltenango	2.06	1.71	3.37
Quiche	1.00	1.85	3.90
Solola	1.11	1.96	4.00
San Marcos	2.46	3.02	7.29
Huehuetenango	1.74	2.16	5.23
Total	1.49	2.17[c]	4.67[c]

[a]Labor provided by the head of the family only.

[b]Labor provided by the head of the household and his family.

[c]The present average was calculated from 329 instead of 340 observations.

Mobility of the Highland Farmers

No great degree of mobility was found in the population. Among sample households, 80.2 percent of the household heads were still living in the communities of their birth, 18.4 percent in another community but in the same department, and only 1.4 percent in other departments.

In San Marcos 90 percent of the heads of families lived in the communities of their birth. The corresponding figures for Solola and Quiche were 91 and 94 percent, respectively, while in both Quezaltenango and Huehuetenango the figure was 96 percent.

Family heads in the Department of Chimaltenango were the most mobile: 56 percent still lived at their birthplace while 42 percent lived in an adjoining municipio.

The immobility of the Highlands population can be further demonstrated: the children and siblings of 76.7 percent of household heads still lived in the community of their birth at the time of the interviews. In some departments, none of the adult children have migrated from their home communities; and only 4.3 percent of sample families reported that one or more of their adult children had migrated. Most of the migration that occurred was accounted for by siblings of the family head. The heaviest migration of siblings, which occurred in Quezaltenango, can be explained by the location of the area studied--less than three kilometers from the capital city of this department. The migration rate of siblings in the other departments was much less than it was in Quezaltenango.

Capital Input

Land constitutes the main capital investment of the Guatemalan Indian farmer. Taking the owners' estimates of current market values for their land, buildings, livestock and tools, gives an average value of Q1,370 per farm (see Table 14). Dividing the value of land alone by the average area of farm (3 hectares), the average value of one hectare of land in the study region is Q363.

Omitting the atypical department of Quezaltenango, the estimates are reasonably uniform among departments, the difference between the lowest and the highest values being only Q500, or about one-third the average value. Two main factors influenced the variation.

One was the proximity of the sample aldea to a large urban concentration; the sample community in Quezaltenango, less than three kilometers from the capital of the department, clearly demonstrates this factor's influence. This sample aldea is really a part-time farming community where many of the farmers work in the factories, commercial establishments and service industries of the city in the morning, and tend their lands in the afternoon. Consequently, land values are high. Rentals, for example, were found to be as high as Q1.25 per cuerda per year for the best land, but since much of the land is hilly and stony, prevailing rentals were around Q.0.75 per cuerda (a cuerda varies in size depending on region, but officially equals 0.044 hectares).

Table 14. Average Value per Finca of Land, Buildings, Livestock, and Equipment

Department	Land	Buildings	Stock and Equipment	Total
Chimaltenango	877	136	63	1,076
Totonicapan	702	111	135	948
Quezaltenango	4,367	441	244	5,052
Quiche	951	214	141	1,306
Huehuetenango	925	100	85	1,110
Solola	1,008	175	89	1,272
San Marcos	599	104	196	899
Average	1,089	170	111	1,370

The second factor which influenced average farm values was proximity to an all-weather road. If this happened to be the paved Inter-American Highway, as was the case for part of the sample drawn in the department of Totonicapan and for the aldeas of Chimazat in Chimaltenango, or San Andres de Semetabaj in Solola, obviously the estimated values reflect this proximity. In contrast, to mention only a few communities where isolation held down values, are the cases of Pamumus, Zeabaj and Chipata. All these are in the department of Chimaltenango and depress the average farm values in that state. Since the only means of reaching the local market was on foot or pack horse, land values were low.

Capital investment in stock and equipment was influenced by the type of farming, with livestock the most influential component. Most farmers owned a machete and hoe, and a few also possessed hand sprayers and cross-cut saws. In the group composed of Totonicapan, Quezaltenango, Quiche, and San Marcos, the average investment was Q.179 per farm; in the group composed of the other three departments, the average was Q.79, or about half as large. The higher figure for Quezaltenango is caused by the presence of some fairly flocks of sheep on some farms. Sheep were almost totally absent in Chimaltenango.

Livestock population for the sample as a whole is small indeed. Table 15 shows the number of head per livestock category.

Table 15. Livestock Population on Survey Farms

Category	Number of Head	Number of Farms
Sheep	1,085	65
Cattle (dairy)	80	45
Fowl	2,668	290
Pigs	175	125

V. The Statistical Estimation of the Production Function

When estimating a production function one faces, among others, the following problems: (1) the choice of the algebraic form of the production function; (2) the kind of variables to be included in the function and the units in which they should be measured; and (3) the way in which the coefficients of the production function should be estimated.

We chose the unrestricted Cobb-Douglas form of production function which is linear in the logarithms because of (1) its computational attractiveness, (2) its ease of interpretation, and most importantly, (3) because it fits the data well. The coefficients of the production function were estimated using the "least squares regression techniques" applied to the logarithms of the variables.

As indicated in the preceding chapters, the difficulty of obtaining information and the chances of making serious errors in the specification, measurement, and aggregation of economic data from traditional peasant agriculture are very great. Hence the kind of variables included in the production function were largely determined by the availability and reliability of the data. The variables used and their units of measurement are described below.

The Production Function

The Cobb-Douglas production function fitted to our data can be written:

$$Y = AX_1^{b_1}X_2^{b_2}X_3^{b_3}E \quad \text{- - - - - - - - -} \quad (1)$$

where Y is output; A is a constant; X_1 is land; X_2 is labor; X_3 is capital; b_1, b_2 and b_3 are their respective production elasticity coefficients, and E is a stochastic term.

In its logarithmic form the Cobb-Douglas production function can be written as

$$y = \alpha + b_1x_1 + b_2x_2 + b_3x_3 + \varepsilon$$

where $y = \log Y$; $\alpha = \log A$; $x_1 = \log X_1$; $x_2 = \log X_2$; $x_3 = \log X_3$; and b_1, b_2 and b_3 their respective regression coefficients.

The Data

Output

Aggregate value of farm production is taken as a measure of output. This aggregate value of farm production consists of the value of the products sold plus an estimate for the value of farm products consumed in the household. The most important crops are corn and beans, which in most cases are cultivated in the same field. Wheat is cultivated to a lesser extent on some farms. Sometimes corn, beans, and potatoes are planted in the same field, making the problem of desegregation of the value of agricultural output and the use of a production function for each crop very difficult. The output of each crop was weighted by the average price paid in the area.

Inputs

Land was measured in hectares and also in monetary terms. There is reason to believe that land in the area under study is fairly homogeneous in quality, in which case measurement in physical units is a good approximation of land inputs. In some of the production functions the estimated values of land, according to market value, were used as land inputs in order to obviate the problem of aggregating non-homogeneous land.

Labor inputs were provided mainly by the members of the family; and were estimated by calculating the weighted contribution of each family member according to his sex and age. In this manner labor potential os the family was transformed into homogeneous man-month units. The estimated man-months inputs were weighted by the average wage rate prevailing in the area and hence transformed into monetary labor units, and used in some of the calculated regressions.

Capital among the Guatemalan Highland Indians consists mainly of very primitive farm implements like machetes and hoes. In the unusual cases where cattle and horses were found, they were included as part of the capital used in farm production. The problem of adding non-homogeneous capital inputs was solved by substituting capital values for physical capital. Themmarket value of agricultural implements and live capital inputs at an undepreciated replacement cost was used as an index of capital inputs. However, the use of capital stocks--either in physical terms or in monetary values--generally does not provide the most appropriate estimate of capital inputs to use in a production function. Capital inputs must be introduced in terms of current service flows rather than in terms of capital stocks.[17] The use of capital stocks instead of capital flows in this case does not introduce a significant source of error. The information obtained in the questionnaires indicates that the life expectancy of the farm implements used by the Guatemalan Highland farmers is seldom more than a year, the duration of the production period. In this case the use of the value of capital stock is a good approximation of the value of the flow of services of that stock of capital for a given period of time. However, due to the lack of more specific information about the appropriate rate of discount and life expectancy of live capital, we did not estimate the flow of services derived from live capital like horses or mules, but used instead the stock value of them. However, the error introduced for using this measurement of capital is thought to be very small, since, as explained above, seldom were farmers found who owned this kind of capital.

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[17] Zvi Griliches, "Measuring Inputs in Agriculture, A Critical Survey," Journal of Farm Economics, Proceedings, Vol. 42, No. 5 (December 1960), pp. 1411-33; Griliches, "Capital Stock in Investment Functions: Some Problems of Concept of Measurement," in Measurement in Economics, Studies in Mathematical Economics and Econometrics (in memory of Yehuda Grunfeld) (Stanford, California: Stanford University Press, 1963), pp. 115-37. Also see Pan A. Yotopoulos, "From Stock to Flow Capital Inputs for Agricultural Production Functions: A Microanalytic Approach," Journal of Farm Economics, Vol. 49, No. 2 (May 1967), pp. 476-91, and the discussion by Richard H. Day in the same volume.

Production Elasticities

Production elasticities indicate the changes in output relative to changes in the inputs of the factors of production.

Table 16 shows production elasticities calculated for regressions that include the total number of farms in the sample. Thus, for R1.0, a one percent increase in the land input would lead to a 0.71 percent increase in the total value of agricultural output. An increase of one percent in the labor input would increase the total value of agricultural production by 0.10 percent. An increase of capital input, on the other hand, would increase the value of agricultural output by 0.18 percent. Similar interpretations can be given to the other coefficients.

The sum of the estimated production coefficients in a Cobb-Douglas production function measures the phenomenon of returns to scale. These data strongly suggest the presence of constant returns to scale in the *minifundia* agriculture of the Guatemalan Highlands. For the sample as a whole (see Table 16), one of the sums of elasticities is significantly different from one at a probability level $\leq$ 1 percent.

Production functions were also estimated for each of the departments studied. The land production elasticities coefficients indicate that land is the most important factor of production. The relative contribution of land to agricultural production seems, however, to vary considerably among departments. The relative contribution of labor and capital inputs to agricultural production show less variation among departments than do land inputs.

Table 16. Production Elasticities and Related Statistics

Item	Regression							
	R1.0[a]	R1.1[b]	R1.2[c]	R1.3[a]	R1.4[b]	R1.5[c]	R1.6[a]	R1.7[b]
No. of Farms	340	330	330	340	330	330	340	330
R^2	.69	.69	.69	.65	.65	.65	.69	.69
Elasticities								
b_1 (land)	.71	.72	.76	.82	.80	.85	.77	.76
	(.04)	(.04)	(.03)	(.04)	(.05)	(.03)	(.03)	(.03)
b_2 (labor)	.10	.04**	.005**	.10	.08*	.05**		
	(.05)	(.04)	(.05)	(.05)	(.05)	(.05)		
b_3 (capital)	.18	.18	.18				.18	.18
	(.02)	(.02)	(.02)				(.04)	(.02)
Sum of Elasticities	.99	.94	.94	.92	.88##	.90	.95	.94

Non-starred coefficients are significantly different from zero at a probability level $\leq$ 5%.

*Starred coefficients are significantly different from zero at a probability level $\leq$ 10%.

**Starred coefficients are not significantly different from zero at a probability level $\leq$ 10%.

( ) Numbers in parentheses refer to the standard error of the regression coefficients.

[a]Labor inputs of head of family alone

[b]Labor inputs of head of household and his family.

[c]Labor inputs computed as the difference between total labor available and labor spent off the farm.

Sums with no ## symbol are not significantly different from one at a probability level $\leq$ 5%.

##Sums are significantly different from one at a probability level $\leq$ 1%.

The sum of the elasticities coefficients in each department, except in Totonicapan, suggests again the presence of constant returns to scale in the agricultural enterprises of the Guatemalan Highland Indians.

Marginal Value Productivities and Efficiency in the Use of Resources

Production elasticities indicate changes that take place in the value of output when we change the level of a given input. Would these changes increase the efficiency in the use of the factors of production?

In order to answer this question an index of efficiency must be found; this index is obtained by comparing the value of the marginal product of a given resource to its opportunity cost. Maximum efficiency occurs when the value of the marginal product of a resource is equal to the unit cost of that resource. If the ratio of marginal product to opportunity cost is more than one, it means that too little of that resource is being used at a given price level. If the ratio is less than one, too much of that resource is being utilized. This criterion of maximum efficiency is valid, of course, only when perfect competition exists in the resource and product markets. It is further assumed that if the efficiency conditions exist in all sectors of the economy, the economy is in a situation of Pareto optimality. If disequilibria exist in the agricultural sector, then a correction of these through a decrease or increase in the use of the factors may (but not necessarily) lead to a situation of Pareto optimality.

Hence, in order to obtain an index of efficiency in the use of a given resource, there must be an estimate of that resource's marginal productivity and its opportunity cost.

From the estimated production elasticities, one can obtain their corresponding marginal productivities. The marginal productivity for a resource X_i is given by

$$\frac{\partial Y}{\partial X_i} = b_i \frac{Y}{X_i}$$

where Y is output, X_i a given resource and b the production elasticity that corresponds to resource i, other factors of production being held constant. Marginal productivities can be computed at any combination of input and output levels that lie within the range of the sample observations. All the estimated marginal productivities were estimated at the geometric mean levels of inputs and outputs. The use of the geometric (rather than the arithmetic) mean levels seems more appropriate within the context of a Cobb-Douglas production function.

As a measure of the opportunity cost of one unit of land, we took the average land rent of a unit of land in the area. The average monthly salary earned by a farm laborer was taken as the opportunity cost of one man-month unit of labor. The opportunity cost of capital was more difficult to determine. No organized financial market exists in the area and the rates of interest charged by local money lenders vary greatly among villages and departments. In some cases, money lenders charge different rates of interest to different customers. The estimated opportunity cost of capital is an average of the different rates of interest on loans as recorded in the interviews.

Marginal Productivity of Land

Since the estimated marginal productivities were calculated at the geometric mean of the variables Y_i and X_i they relate to the "average geometric farm"--whatever that means.

The estimated marginal productivities for land, for the sample as a whole, using different kinds of labor inputs and different units of measurement for land and labor inputs, are given in Table 17. The estimated marginal productivity of land ranges from Q 86.80 to Q 103.00 per hectare of land. But even if the productivity of land is as high as Q 103.00 per hectare, it is not possible for farmers to bring more land under cultivation, since most of them use all the cultivable land they control.

Table 17. Marginal Products Estimated at the Sample Means and Efficiency Ratios

Item	Regression R1.0	R1.1	R1.2	R1.3	R1.4	R1.5	R1.6	R1.7
Sample Geometric Means								
Output (#)	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00
Land (Ha) and ($)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Labor (Man-month) and ($)	1.84	3.16	17.50	1.84	3.16	17.50	1.84	3.16
Capital ($)	50.00	49.50	49.50	49.50	49.50	49.50	50.00	49.50
Marginal Products (at Geometric Means)								
Land ($/Ha)	86.80	88.00	92.90	100.00	97.80	103.00	94.10	92.90
Labor ($/Man-month)	6.00	-	-	6.00	2.80	-	-	-
Capital ($/$)	.40	.40	.40	-	-	-	.40	.40
Marginal Return to Opportunity Cost Ratio								
Land	5.5	5.6	5.9	6.3	6.2	6.5	5.9	5.8
Labor	.51	-	-	.51	.24	-		
Capital	1.25	1.25	1.25	-	-	-	1.25	1.25

A dash (-) indicates that production elasticities were not significant and hence the corresponding marginal productivities were not calculated.

Table 18. Marginal Productivities at Different Input Levels for Selected Regressions

Input	Regression	Above the Mean			At the Mean	Below the Mean		
		+50%	+20%	+10%		-10%	-20%	-50%
Land	R1.0	78.40 (1.35)	82.60 (1.08)	84.50 (.99)	86.80 (.90)	89.60 (.81)	93.10 (.72)	112.00 (.45)
	R1.3	94.00 (1.35)	97.00 (1.08)	98.40 (.99)	100.80 (.90)	102.00 (.81)	104.50 (.72)	118.00 (.45)
	R1.4	91.30 (1.35)	94.50 (1.08)	96.00 (.99)	97.80 (.90)	100.00 (.81)	102.70 (.72)	117.40 (.45)
Labor	R1.0	4.20 (2.76)	5.10 (2.20)	5.50 (2.02)	6.00 (1.84)	6.60 (1.65)	7.30 (1.47)	11.14 (.92)
	R1.3	4.20 (2.76)	5.10 (2.20)	5.50 (2.02)	6.00 (1.84)	6.60 (1.65)	7.30 (1.47)	11.14 (.92)
	R1.4	1.90 (4.70)	2.40 (3.80)	2.60 (3.48)	2.80 (3.16)	3.14 (2.85)	3.45 (2.50)	5.40 (1.60)
Capital	R1.0	.29 (75.00)	.34 (60.00)	.37 (55.00)	.40 (50.00)	.44 (45.00)	.48 (40.00)	.73 (25.00)

Numbers in parentheses are the corresponding input levels above and below the geometric means.

Table 18 gives the marginal product of land at different input levels for regressions R1.0, R1.4, R1.5 and Figure 1 plots their corresponding productivity curves.[18]

The average opportunity cost of one hectare of land for the sample as a whole was estimated to be Q 15.80. The efficiency ratios as measured by the ratios of the marginal productivity of land to its opportunity cost vary from 5.5 to 6.5, and indicate that farmers are

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[18]The relevant estimates of the marginal productivities were made in the following way (See Pan A. Yotopoulos, Allocative Efficiency in Economic Development, Athens: Center of Planning and Economic Research, 1967, p. 199):

We know that the marginal productivity of resource X_i is given by

$$\frac{\partial X}{\partial X_i} = b_i \frac{Y}{X_i}$$

where Y is the output and X_i the ith input and b_i the production elasticity of resource i. By letting $\overline{m}$ denote the value of the marginal product, we can rewrite the above equation as

$$\overline{m} = b_i \frac{Y}{X}$$

For an input level of 10 percent above the mean, we can write

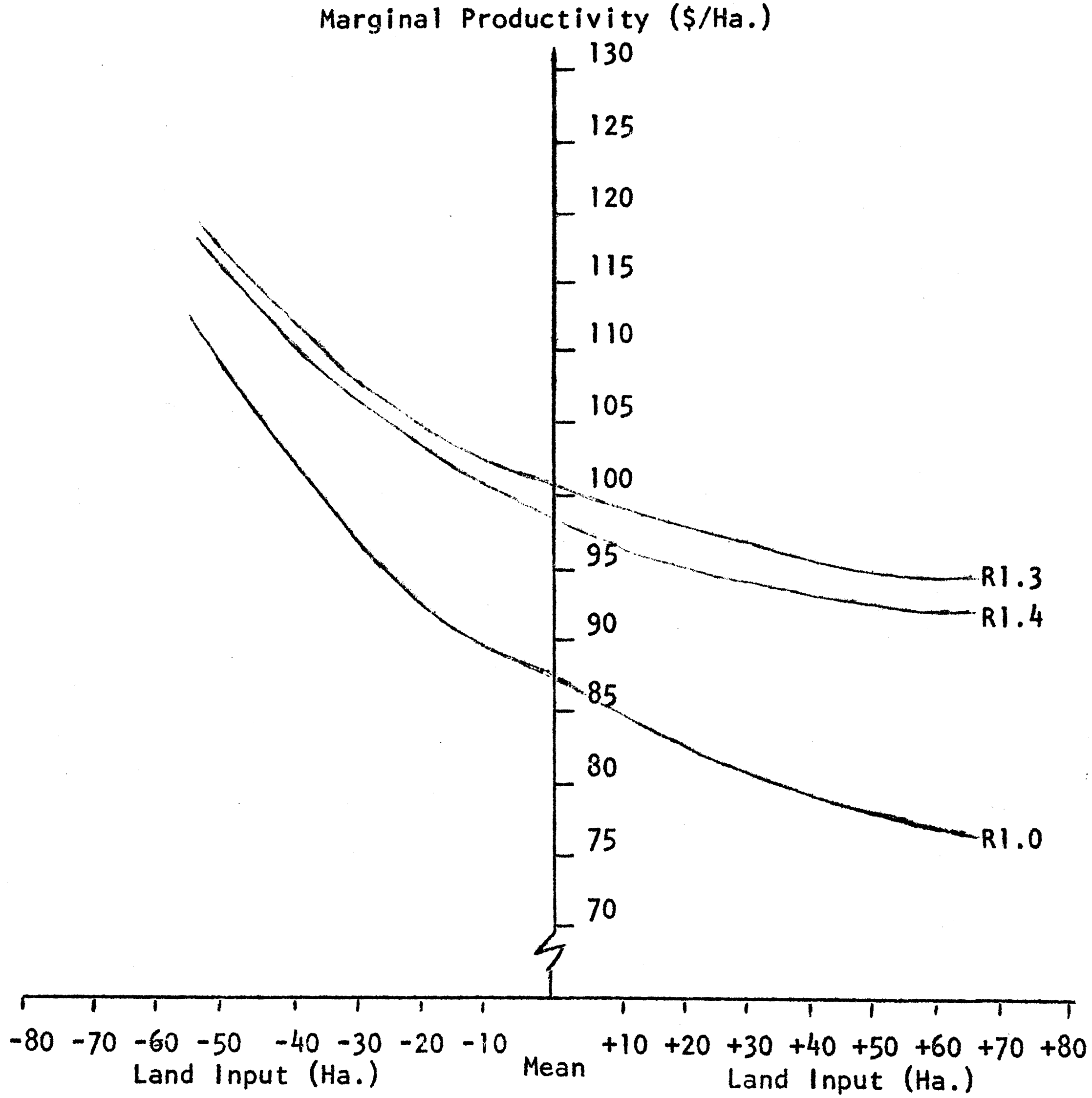
$$m_{+10} = b_i \left[\frac{1 + .10b_i}{1.10}\right] \frac{\overline{Y}}{\overline{X}}$$

Since $\overline{m} = b_i \frac{\overline{Y}}{\overline{X}}$ hence we have

$$m_{+10} = \overline{m} \left[\frac{1 + .10b_i}{1.10}\right]$$

A similar method was used to estimate marginal productivities at different input levels.

Figure 1. Marginal Productivity of Land, Regressions R1.0, R1.4, R1.3



using too little land inputs. However, land shortages and institutional constraints imposed on the farmers limit their ability to use more land inputs in their farm activities. The consequences of this situation and its policy implications are discussed in the next section.

Marginal Productivity of Labor

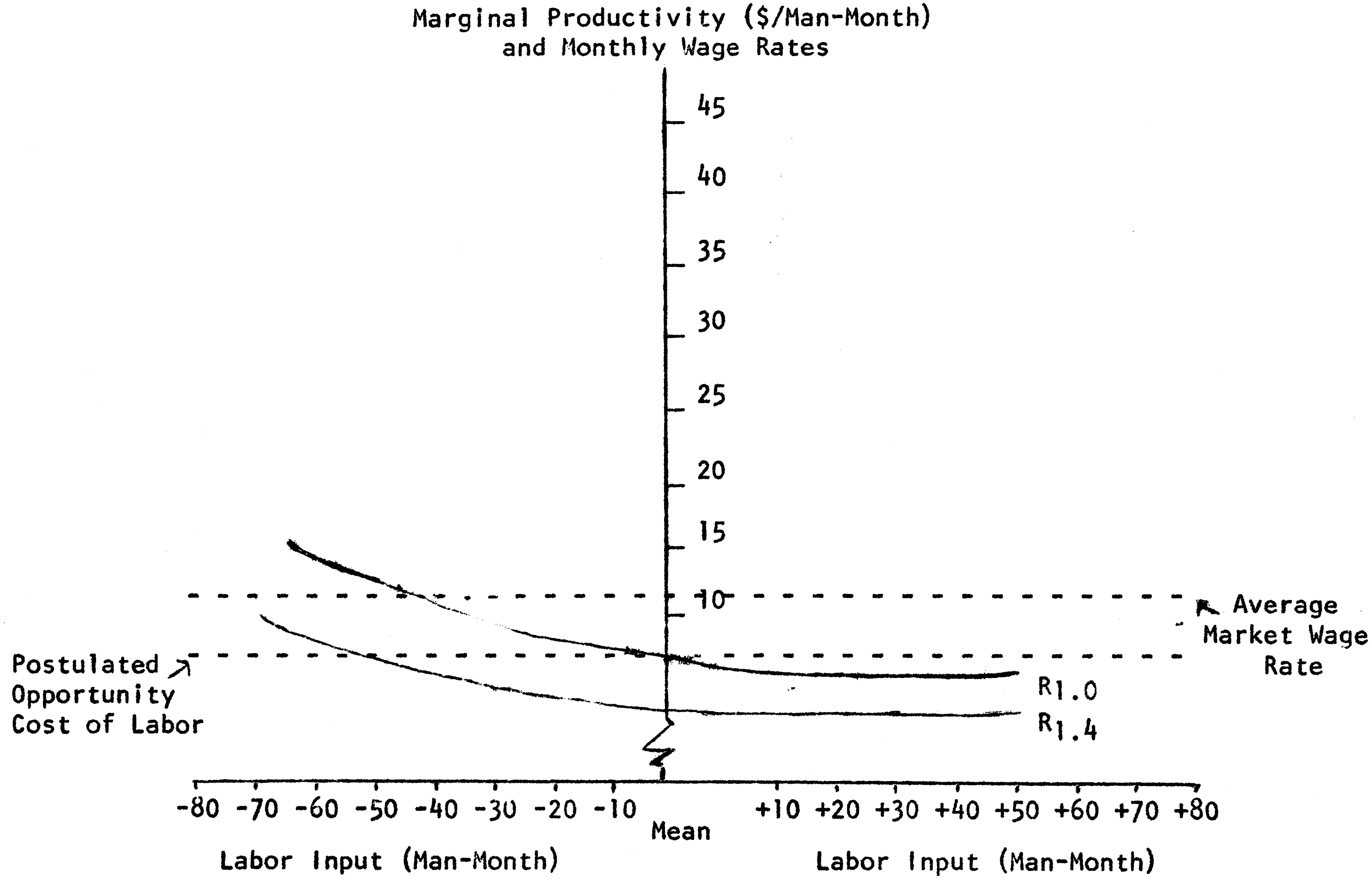
The estimated marginal productivities of labor for the regressions of the sample as a whole are given in Table 17. Among the regressions computed, the marginal productivity of one man-month unit of labor ranges from Q 2.80 to Q 6.00. Table 18 shows the marginal productivities for regressions R1.0 and R1.4, and Figure 2 plots their productivity curves.

How does the marginal product of labor compare to its opportunity cost? A lack of data regarding employment opportunities prevented estimation of the year-round level of unemployment among the Guatemalan Highland farmers, and hence estimation of the true year-round opportunity cost of labor. However, three different estimates of the opportunity cost of labor were made in order to compare them to the marginal productivity of labor in the area. The average of these three estimates was used for calculating the efficiency indexes for the sample as a whole, shown in Table 17.

The three estimates of the opportunity cost of labor are the following:

(1) The average wage rate for the area as a whole, as recorded in the questionnaires, was Q 0.50 per day. Assuming that labor is fairly homogeneous (a reasonable assumption since no great differences were

Figure 2. Marginal Productivity of Labor, Regressions R1.0, R1.4



found in education and special skills among farmers) and that the daily wage rate does not vary during the year, the average monthly (26 days) salary came to Q 13.00. This monthly salary was taken as a proxy for the opportunity cost of one man-month of labor in the area as a whole. Using this figure, the ratio of the marginal productivity of labor to its opportunity cost was found to be significantly below unity for all regressions. This suggests that when the opportunity cost of labor is calculated to be Q 13.00, our findings indicate inefficiencies in the use of family labor inputs by the Guatemalan Indian farmers. Too much labor is being used in the production process.

(2) If, on the average, the Highland farmers spend about three months of the year in the Lowlands of the country as migrant workers and make an average of Q 0.88 a day; and if for the rest of the year they can earn Q 0.50 a day working in the Highlands as farm laborers and at miscellaneous activities, then the estimate of the opportunity cost of one man-month of labor can be set at Q 15.50. With this estimate of the opportunity cost of labor, the ratio of marginal product of labor to its opportunity cost is, as above, less than one for all regressions. This result again suggests that, given the opportunity cost of labor, too much labor is being put into farm activities by the Guatemalan Highland Indians.

(3) If the opportunity cost of labor is zero for the seven months a year that the farmers neither work in the Lowlands as migrant workers nor as self-employed farmers, then a different estimate of the year-round opportunity cost of labor results. This approach would probably capture the seasonal unemployment during which surplus

labor might exist. Weighing the monthly wage rate of Q 15.50 by the proportion of the year in which the opportunity cost of labor is zero, a year-round monthly opportunity cost of labor of Q 6.45 is obtained. With this new estimate of the monthly opportunity cost of labor, an efficiency index very close to unity results (except for regression R1.5, which includes the labor inputs of the head of the household and his family). This approach would suggest that Guatemalan Indian farmers are using their family labor force in farm activities up to a nearly optimum level.

However, when the average of the three estimates (Q 11.65) is taken as the opportunity cost of one man-month of labor (see Table 17), one may observe, on the whole, indications of inefficient use of family labor among Guatemalan Highland Indians. The efficiency indexes suggest that too much family labor is being used in farm activities.

Little can be said about the marginal productivity of labor in each department. Most of the elasticity coefficients for labor were not significant and hence the respective productivities were not calculated.

Marginal Productivity of Capital

The estimated marginal productivities of capital inputs for the sample as a whole are shown in Table 17. The marginal productivity of capital was 0.40 for all regressions. The marginal productivity of capital is a pure number, since it is expressed in Quetzales of output per Quetzales of capital; this number expresses the increment of output in Quetzales with the use of one additional Quetzal of capital input. If capital inputs are measured in flow of capital services rather than in capital stocks, then this number cannot be directly compared with the opportunity cost of capital as measured by the rate of interest.[19] However, since capital inputs in the production function were measured as stocks of capital, we can meaningfully compare the marginal productivity of capital with the opportunity cost of capital as measured by the rate of interest.

According to the data collected in our questionnaires, several market rates of interest prevail in the area under study. Of all the farmers interviewed, the small number (19 percent) who had obtained an average annual credit of Q 16.00 obtained this credit at interest rates varying from 8 percent a year up to 60 percent a year. Based on these rates of interest, the average opportunity cost of one Quetzal of credit for agriculture is estimated at 32 percent.

The ratio of the marginal product of capital to its opportunity cost for the regressions of the sample as a whole are given in Table 17. The efficiency ratios greater than one, indicate inefficient use of capital inputs among Guatemalan Highland farmers.

The observed differences in marginal productivities among departments suggest the possibility of increasing agricultural output by reallocating existing capital resources among departments.

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[19] Yotopoulos (1967), op. cit., p. 206.

The Optimum Level of Inputs

From the computed marginal productivities we can obtain the quantity, with other inputs held at their mean levels, necessary to equate the marginal productivity of a factor to its opportunity cost.

When land, labor and capital are included, our Cobb-Douglas production function is written as:

$$Y = A\, X_1^{b_1}\, X_2^{b_2}\, X_3^{b_3} \qquad (1)$$

where Y is output; A is a constant; X_1 is land; X_2 is labor; X_3 is capital, and b_1, b_2, b_3 are the corresponding production elasticities.

In order to find the level of, for example, input X_2 at which the marginal product of that input is equal to its opportunity cost, the first derivative or marginal product of (1) is set equal to the opportunity cost of X_2:

$$X_2 = \left[\frac{P_2}{A\, b_2 \bar{X}_1^{b_1}\, \bar{X}_3^{b_3}}\right]^{\frac{1}{b_2 - 1}} \qquad (2)$$

where P_2 is the opportunity cost of factor X_2 and $\bar{X}_1$, $\bar{X}_3$ the geometric means of inputs X_1 X_3. A similar procedure applies in finding the optimum levels of other inputs.

For the sample as a whole, the estimated level of labor input at which the marginal productivity of labor equals the postulated opportunity cost of Q 6.35 is 1.55 man-months for regression R1.0 and 1.19 man-months for regression R1.5. If the average market wage rate of Q 11.65 is used, the optimum level of labor inputs for the sample as a whole is only 0.85 man-month for regression R1.0.

On the other hand, for the sample as a whole the actual average level of labor inputs used by the Guatemalan farmers was 1.83 man-months in regression R1.0 (including the labor force of head of household only) and 3.16 man-months in regression R1.5 (including labor force of head of household and his family). Hence, according to the estimated optimum levels of labor inputs, Guatemalan Highland farmers must reduce family labor inputs by 16 percent according to regression R1.0 and by 63 percent according to regression R1.5, when the estimated opportunity cost of one man-month of labor in the area is Q 6.35. If, however, the true opportunity cost of one man-month of labor is Q 11.65, farmers must reduce their family labor inputs by 53 percent according to regression R1.0. A graphic solution to the problem of finding optimum labor input levels is shown in Figure 2, which is based on Table 18.

A word of caution is needed about the method of estimating marginal productivities and optimum input levels. The extrapolation of the marginal productivity values above and below the mean input values becomes less and less reliable as we move away from the mean of the range observed. Hence, even if, as in this case, the estimated optimum input levels fall well within the range of observations, the results should be interpreted with caution.

When equation was applied (2) to find the optimum levels of land inputs, we obtained less satisfactory results than in the case of labor. If Q 15.80 is a good approximation of the opportunity cost of one hectare of land, the optimum level of land inputs for the average Guatemalan Highland farmer was estimated at 269 hectares in regression R1.0 and 5,937 hectares in regression R1.5.

On the other hand, the actual average level of land inputs for the sample as a whole is 0.9 hectares for both regressions. This means that, given the marginal productivity of land and its prevalent opportunity cost, farmers should, in order to make efficient use of land, increase the area under cultivation from less than one hectare to about 269 hectares according to regression R1.0 and to about 5,937 hectares according to regression R1.5. The estimated necessary land input increases are highly unrealistic for the type of agriculture under consideration.

The unrealistic results obtained regarding the optimum level of land inputs point out the limitations of this kind of analysis and of the use of Cobb-Douglas production functions in the study of traditional agriculture. The optimum levels of land inputs estimated by equation (2) are sensitive to changes in the opportunity cost of land and particularly to the size of the land production elasticity coefficient. Larger values for the opportunity cost of land and smaller land production elasticity coefficients give smaller (more realistic) optimum levels of land inputs.

Table 19 shows the estimates of the optimum levels of land and labor inputs for regression R1.5 holding the opportunity cost of land (Q 15.80) and labor (Q 11.65) constant but varying simultaneously the size of their respective production elasticity coefficients.

Table 19. Optimum Levels of Land and Labor Inputs in Regression R1.5 when Varying their Production Coefficients and the Opportunity Cost of Land[a]

Input	Production Elasticity Coefficients				
	I	II	III	IV	V
	b_1= .80 b_2= .08	b_1= .70 b_2= .18	b_1= .60 b_2= .28	b_1= .50 b_2= .38	b_1= .40 b_2= .48
X_1 (land in hectares)	5,937 (255)	339 (54)	82 (16)	27 (9)	12 (8.7)
X_2 (labor in man-month)	.66	1.68	3.41	8.5	15.4

[a]Figures in parentheses refer to the optimum levels of land inputs when the elasticity coefficients were varied and the opportunity cost of land was doubled from Q15.80 to Q31.60. The other numbers refer to the optimum input levels estimated when only the production elasticity coefficients were varied, holding the opportunity cost of land and labor constant at Q 15.80 and Q 11.65 respectively.

The effect that small changes in the size of the land elasticity coefficient have on the level of land inputs needed to achieve optimum efficiency is remarkable. A reduction of about 13 percent (from 0.80 to 0.70) in the size of the land elasticity coefficient brings about a reduction in the optimum level of land input of about 96 percent (from 5,937 hectares to 339 hectares). Further reductions in the size of the land production elasticity coefficients, accompanied by similar increases in the size of labor coefficients (III, IV and V in Table 19) have less dramatic impact on the estimated optimum land input levels.

The effect that a simultaneous increase in the labor coefficients and reduction in the land coefficients have on the optimum level of labor inputs are less marked than the effects that similar changes have on the optimum level of land inputs (see Table 19). An increase of 125 percent (from 0.08 to 0.18) in the size of the labor coefficient increases the level of labor inputs needed to achieve efficiency by 154 percent (from 0.66 man-month to 1.68 man-months).

The use of different estimates of the opportunity cost of land also affects the equilibrium levels of land inputs. A doubling of the value of the opportunity cost of land (from Q 15.80 to Q 31.60) reduces the optimum level of land inputs by about 94 percent (from 5,937 hectares to 255 hectares). This reduction to 255 hectares in the optimum level of land inputs is very close to the 236 hectares (not shown in Table 19) obtained when the land coefficient is reduced by 13 percent (from 0.80 to 0.70) without simultaneously increasing the labor coefficient, as is done in II. The important point to notice here, however, is that these very similar results were obtained in one instance by increasing the value of the opportunity cost of land by 100 percent and in the second case by only reducing by 13 percent the size of the land coefficient. The function used to estimate the optimum levels of land input seem to be far more sensitive to variations in the size of the land production elasticities than to changes in the value of the opportunity cost of land.

When we increase the opportunity cost of land and simultaneously reduce the size of the land coefficient (see figures in parentheses in Table 19), the optimum levels of land inputs come out considerably lower than when only the production coefficients are varied (see figures without parentheses in Table 19).

The use of equation (2), as by Heady and Dillon[20] and Yotopoulos,[21] might, as shown above, lead to serious errors when predicting optimum levels of resource use. The over-sensitiveness of equation (2) to variations in the size of the production elasticity coefficients imposes serious limitations on its use. Specifically, (2) might yield extremely large optimum values for a given input when that input is considerably more important than the other inputs in the production process. In other words, unrealistic optimum values for a given input are obtained when the production elasticity coefficient of that input is very large--say above 0.5--as compared with the elasticity coefficients of the other inputs accounted in the production function. Unfortunately this is the case for the traditional agriculture of the Guatemalan Highlands. Land, as suggested by the size of the land production elasticity coefficients, is by far the most influential input, with labor and capital playing a secondary, although statistically significant, role.

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[20]Earl O. Heady and John L. Dillon, Agricultural Production Function (Iowa State University, 1962), p. 631.

[21]Yotopoulos (1967), op. cit., p. 199.

Comparison with Studies Made in Other Countries

Table 20 displays the results of several cross-sectional production functions of farms around the world. All these studies are based on Cobb-Douglas, single equation models. All non-land and non-labor inputs were collapsed in the "other services" category, because of the lack of agreement on the definition of capital among the various studies.

The elasticity coefficients, and the ratios of marginal product to opportunity costs are indicated in Table 20. These ratios, as explained, provide a measure of the efficiency in the use of resources.

The estimated annual rent of one unit of land is taken in all studies as a proxy of the opportunity cost of land. The market wage rate was considered a good approximation for the opportunity cost of labor. The opportunity cost of a monetary unit of capital was estimated as that monetary unit plus the annual cost of borrowing it.

The sum of the elasticities of the factors of production in most cases is one, or very close to one, indicating the remarkable fact that, according to the studies made, world agriculture is characterized by constant returns to scale.

As indicated above, an efficiency ratio of less (or greater) than one indicates that too much (or too little) of a given resource is being utilized. The less than one efficiency indexes in most of the countries, but particularly in India and Guatemala, indicate marked inefficiencies in the use of agricultural resources.

Table 20. Production Elasticities and Ratio of Marginal Product to Opportunity Cost for Selected Cross-Sectional Production Function Studies

Location of Sample	Type of Farming	Elasticity of Production[a]				Ratio of Marginal Product to Opprotunity Cost			Reference
		Labor	Land	Other Services	Sum	Labor	Land	Other Services	
Guatemala	Mixed	.10	.77	.18	1.05	.51	5.5	1.25	Present study (1968)
India	General arable land	.56	.08	.25	.89	n.a.	n.a.	n.a.	Sarker (1957)
Greece, Epirus	Mixed	.44	.10	.11	.65	.87	.90	.91	Yotopoulos (1967)
India, Uttar Pradesh	Wheat, sugar cane	.43	.23	.35	1.01	.68	.95	2.13	Agrawal and Foreman (1959)
U.S.A.	Crop	.33		.60	.93	n.a.		n.a.	Heady (1952)
Taiwan Tainan	Cereals	.33	.44	.31	1.08	2.84	.58	.99	Wang (1959)
U.S.A. Alabama	Crops	.32	.39	.46	1.17	.38	4.01	1.01	Heady and Shaw (1954)

India, Andhra Pradesh	Mixed	.26	.14	.13	.53	.21	.05	.35	Agrawal and Foreman (1959)
Austria	Mixed	.26	.13	.61	1.00	.54	.92	1.50	Tintner (1958)
Israel	Mixed	.12	-.01	.67	.78	.86	n.a.	1.09	Mundlak (1964)
Canada, Alberta	Wheat, beef	.20	.39	.34	.93	1.21	2.58	1.01	Darcovich (1958)
International	General	.28	.39	.33	1.00	n.a.	n.a.	n.a.	Bhattacharjee (1955)
International	(Hypothesized)	.70	.10	.20	1.00	n.a.	n.a.	n.a.	Tinbergen and Pelak (1950)

[a]For all functions the elasticities are significantly different from zero at a probability level $\leq$ 5 percent. The only exception is the elasticity of land for the Israel function.

Source: Pan A. Yotopoulus, Allocative Efficiency and Economic Development (Athens: Center of Economic Planning, Research Monograph Series, 1967), p. 212.

VI. Surplus Labor, Disguised Unemployment, and the Marginal Productivity of Labor

The findings so far presented offer insight into some issues of development economics and provide grounds on which to outline policy recommendations for the traditional sector of Guatemalan agriculture.

As explained in Section II, one of the most important differences between the Classical (Lewis, Ranis and Fei, etc.) and Neoclassical (Jorgenson, Schultz, etc.) theories of economic growth is their assumption about the marginal productivity of labor in the traditional sector of a dual economy. The Classical approach maintains that after a certain level, labor in the traditional sector becomes redundant with a marginal productivity of zero or negative. This situation is characterized as "disguised unemployment." On the other hand, the Neoclassical approach maintains that labor in the traditional sector is never redundant. That is, the marginal productivity of the agricultural sector is assumed always to be positive and thus no "disguised unemployment" exists in the traditional sector of a dual economy.

This study's statistical findings bring some evidence to this controversy. However, before discussing this problem, this section will attempt to define more precisely the meaning of "disguised unemployment."

The concept of "disguised unemployment" is sometimes identified with one of the several interpretations given to a surplus or excess supply of labor. The literature reveals at least seven different interpretations of excess supply of labor.[22] An excess supply of labor is said to exist when:

(a) A low output per worker ratio is found in a region or country.

(b) Output can be produced with fewer workers if factors of production are recombined. Marginal productivity of labor is, in this case, thought to be positive although probably very low.

(c) The same output can be produced with fewer workers, the quantity of other resources remaining unchanged--equivalent to marginal productivity of labor equalling zero.

(d) Workers are seasonally employed.

(e) Workers are unemployed.

(f) "Too many" workers are in one sector so that wages are lower for a certain class of employment in some sectors than in others.

(g) The marginal productivity of labor is positive but less than the average product.[23]

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[22]Simon Rottenberg, "The Meaning of 'Excess Supply of Labor,'" Scottish Journal of Political Economy (February 1961). A modified version of his classification is used here.

[23]Ranis and Fei call "disguised unemployment" that situation where the marginal productivity of labor is less than the average product. On the other hand, they call "redundant labor" that situation in which the marginal productivity is zero (see c above). See Ranis and Fei, "A Theory of Economic Development," American Economic Review (September 1961), p. 537.

If disguised unemployment means that situation of surplus labor in which the marginal productivity of labor, although very low, is positive (interpretations b and g above), then the present findings are at least consistent with these interpretations. The size of the elasticity coefficient of land relative to those of labor indicates that Guatemalan agriculture is land and not labor intensive. On theoretical grounds one expects to find the highest values of elasticity coefficients for the factor that is used more intensively.[24] Hence labor intensive agriculture must show labor elasticity coefficients higher than those for land. In this type of agriculture it is expected that labor would be used at levels which yield large additions to agricultural output. Hence high labor elasticity coefficients which indicate labor intensive agriculture are inconsistent with the hypothesis of disguised unemployment which maintains the existence of labor working but adding little to output. Under conditions of labor intensive agriculture (shown by high labor elasticity coefficients relative to land), labor is not redundant; it is necessary in producing a given output, and cannot be removed without decreasing the volume of agricultural output.

On the other hand, land intensive agriculture would be characterized by land elasticity coefficients higher than those for labor. Under this type of agriculture land is expected to be used at levels that yield large additions to agricultural output,

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[24]Yotopoulous (1967), op. cit., pp. 215-216; and Heady and Dillon, op. cit., p. 631.

and labor to be used at levels yielding only small additions to output. Land intensive agriculture is then consistent with the existence of a situation in which labor adds little to output--disguised unemployment.

In all regressions given here the estimated elasticity coefficients for land are higher than those for labor, indicating the land intensive character of Guatemalan Highland agriculture. Since land intensive agriculture is consistent with the existence of disguised unemployment, as defined above, these findings suggest that at least one of the necessary conditions for the existence of disguised unemployment is present in the Guatemalan Highlands. Furthermore, the marginal productivity of labor was found to be positive (see Table 21). These data then bring evidence to support the hypothesis of disguised unemployment when defined as in b and g above. It is important to notice that although the marginal productivity of labor is positive, it is considerably smaller than the average wage rate in the area. As shown in Table 17, the marginal productivity of labor of the head of the household for the sample as a whole was estimated at Q 6.00, and the average postulated wage rate at Q 11.65. Thus the marginal productivity of labor in the area is only about 51 percent of the average wage rate.

The existence of surplus labor identified with the marginal productivity of labor being zero (c above) has been discussed by

Nurkse, Lewis, Georgescue-Rogen and Ranis and Fei, among others;[25] in this form it has been attacked by Haberler, Viner, Shultz, Jorgenson, and others.[26]

It is clear that our findings do not bring direct evidence as to whether or not surplus labor (defined as that situation where the marginal productivity of labor is zero) exists in the Guatemalan Highland traditional agriculture. When we use a Cobb-Douglas production function we implicitly assume that the marginal productivity of labor is not zero. The mathematical properties of the function are such that its first partial derivative does not intersect (but approaches asymtotically) the axes. Hence the marginal productivities, estimated using a Cobb-Douglas production function, are either positive

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[25] R. Nurkse, Problems of Capital Formation in Underdeveloped Countries (Oxford: Basil Blackwell, 1953); W. A. Lewis, "Economic Development with Unlimited Supplies of Labor," Manchester School of Economic and Social Studies (May 1954); N. Georgescue-Rogen, "Economic Theory and Agrarian Reforms," Oxford Economic Papers (February 1960); G. Ranis and J. C. H. Fei, Development of the Labour Surplus Economy: Theory and Policy (Homewood, Illinois: Richard D. Irwin, Inc., 1964).

[26] G. Haberler, "Critical Observations on Some Current Notions in the Theory of Economic Development," L'Industria, Vol. II (1957); J. Viner, "Some Reflections on the Concept of 'Disguised Unemployment,'" in G. Meier, Leading Issues in Development Economics (New York: Oxford University Press, 1964); T. W. Schultz, Transforming Traditional Agriculture (New Haven, Conn.: Yale University Press, 1964); Jorgensen (1961, 1966, 1967), op. cit.

(when the production coefficients are positive) or negative (when the production elasticities are negative), but they are never zero. Incidentally, the same restriction occurs in a C. E. S. production function[27] with positive elasticity of substitution, since the marginal product of labor in this function never falls to zero either.[28] Therefore, we could not have tested the hypothesis that the marginal productivity of labor is zero by fitting a Cobb-Douglas production function to our cross sectional data.

On the other hand, negative marginal productivities for labor can be shown to exist by fitting a Cobb-Douglas production function to cross sectional data. This study did not find the marginal productivity of labor to be negative in the Guatemalan Highlands. For the regressions of the sample as a whole, none of the estimated elasticities are negative (see Table 16). Only a few of the regression coefficients estimated in each department were negative, and none of them were statistically significant. Therefore, these findings do not support the hypothesis of disguised unemployment (defined as that situation where the marginal productivity of labor is negative) in the traditional agriculture of the Guatemalan Highlands.

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[27] K. J. Arrow, H. B. Chenery, B. S. Minhas, and R. M. Solow, "Capital-Labour Substitution and Economic Efficiency," Review of Economics and Statistics, Vol. 63 (1961).

[28] Amartya K. Sen, "Peasants and Dualism With or Without a Surplus Labor," The Journal of Political Economy (October 1966), p. 432.

Summarizing, then, these data support the hypothesis that the marginal productivity of labor is positive. These results, however, were obtained by a method that allows the estimated marginal productivities to be either positive or negative but not zero. This imposes certain restrictions on the results.

Does the existence of labor with positive marginal productivity imply that there is no surplus labor? In a recent paper it has been argued that "the assumption of zero marginal productivity is neither a necessary nor a sufficient condition for the existence of surplus labor."[29] If true this statement implies that even if the marginal productivity of labor was found to be different from zero, it does not follow that there is no surplus labor. A situation of surplus labor is consistent with the existence of positive, zero, or negative marginal productivity of labor.

If positive marginal productivity of labor does not conflict with a situation of surplus labor, what other indications about the existence of surplus labor can be found in our study?

Table 12 shows estimated labor potential (the weighted contribution of each family member measured in man-month units) and also the labor available for farm activities (man-month units obtained by subtracting from the labor potential figure the number of man-months employed in off-farm activities) in each household. Table 12 also estimated the labor inputs of the head of the family alone and of the head of the household and his family to the family farm.

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[29]Sen, op. cit.

If we add to the number of man-month units employed in off-farm activities the number of man-months used in farm activities, this figure estimates the number of man-month units that family labor was employed. Hence the average household in the Guatemalan Highlands, which has a labor potential of 27.3 man-months, actually uses only 10.4 man-months (man-months employed off farm activities plus labor input used on the farm), or about 38 percent of the total labor potential. Household labor is thus employed only about 4.5 months of the year.

Similar estimates can find the year-round level of employment of the head of the household alone. Table 12 indicates that the average farmer in the Guatemalan Highlands uses about 2.8 months per year working on his farm. Adding to this figure the average three months (not shown in Table 12) that he spends in the Lowlands as a migrant worker or working in the community, we obtain 5.8 months. Notice that we did not add to the man-month figure of 2.8 the difference between labor potential and labor available, since this difference refers to the off-farm work of all the family and not to the head of the household alone.

Accordingly, the average farmer in the Guatemalan Highlands is employed on his farm, as a salaried farm laborer, or as a migrant worker only 5.8 months a year.

This study found in the Guatemalan Highlands substantial evidence of a situation of surplus labor in which the marginal productivity of labor is positive, and considerably smaller than the average wage rate that prevails in the area. Regarding the Classical versus Neoclassical controversy, the findings support the Neoclassical thesis that the marginal productivity of labor in the traditional sector of a dual economy is positive. However, the strongest Neoclassical position--that because labor has a positive marginal productivity, labor is never redundant--is not supported by these data.[30] There was evidence of excess or redundant labor (with a positive marginal productivity) in the traditional agriculture of the Guatemalan Highlands. On the other hand, the Classical argument--that there is a point in the second phase of development after which the marginal productivity of labor is positive but less than the wage rate--is supported by our findings.[31]

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[30]See Jorgenson (1966), op. cit., p. 46.

[31]See Ranis and Fei (1961), op. cit., p. 537.

VII. Efficiency, Poverty and Economic Development

The basic problem of economic development lies in the creation of an agricultural surplus that can be used to initiate the process of industrialization.

The problem of creating an agricultural surplus can be approached through the demand and/or supply sides.

Given the production function and the existing allocation of agricultural resources, an agricultural surplus can be obtained by reducing the level of consumption of the agricultural population, i.e., through taxation, which can be compulsory (forced delivery of goods to the non-agricultural sector), or non-compulsory (through a policy of low agricultural prices).

The problem of creating an agricultural surplus is tackled from the supply side by emphasizing the role of production instead of consumption. The problem of creating an agricultural surplus, according to this approach, can be solved through increasing production by improving the efficiency of the use of agricultural resources. Two variants of the "improving efficiency approach" can be distinguished.[32]

The first version has been called "the allocative efficiency approach." In its orthodox, static form, it concentrates on marginal

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[32]For the distinction between allocative and structural efficiency, see: Hla Myint, "Economic Theory and the Underdeveloped Countries," Journal of Political Economy, Vol. 73, No. 5 (October 1965), pp. 477-491; and Myint, "Economic Theory and Development Policy," Economica, Vol. 34, No. 134 (May 1967), pp. 117-130.

adjustments to correct disequilibria in the use of existing resources. In other words, this approach assumes that the agricultural sector finds itself in a position inside the production possibility curve, and that through marginal adjustments in resource use the agricultural sector can be pushed outwards on the production possibility frontier. Through these allocative efficiency adjustments, agricultural production can be increased and the surplus needed for industrialization be created.

In its dynamic form the "allocative efficiency approach" focuses on the introduction of "non-conventional" inputs and new technology in the agricultural sector so as to shift the agricultural production possibility curve outwards. An implicit assumption of the "allocative efficiency approach," and a necessary condition for its successful use, is that farmers respond to the economic incentives offered by the market mechanisms.

The dynamic version of the "allocative efficiency approach" is associated with the hypothesis that farmers in traditional agriculture are "poor but efficient"; that is, farmers are poor, but they make the right economic decisions; they use the resources at hand efficiently and they are responsive to price incentives.[33] If farmers of traditional agriculture are "poor but efficient," the reasoning goes, all that is needed is to provide them with suitable economic incentives to modernize

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[33]Schultz, op. cit.

their agriculture, and production will increase. Further, farmers allegedly respond to economic incentives and continuously look for alternative uses for their resources, so they may equate their marginal productivity with their opportunity costs. Traditional agriculture, according to this hypothesis, is only circumstantial. The methods of production and the inefficient use of certain inputs exist only because there are no other alternatives open.

Hence, this hypothesis asks, if traditional farmers are efficient, why are they poor? The answer is found in the role that "non-conventional" inputs play in production: new methods of doing things, organization, entrepreneurship, etc.

The attractiveness of this "poor but efficient" hypothesis lies in the fact that, if this view is correct, economic theory is fully applicable to the problem of transforming traditional agriculture. The "non-conventional" inputs needed to modernize agriculture and increase production can be introduced by the simple automatic market mechanism. The role of the state is minimized. Price theory, then, offers the necessary insights to formulate policies for modernizing traditional agriculture.

The second version of the "improving efficiency approach" is that which has been associated with the concept of "structural efficiency." This version argues for a new and dynamic approach to the economic development of agriculture, stressing new technology and the structural transformation of the production function. The static, one-at-a-time marginal adjustments are not held sufficient for correcting the disequilibrium that exists in the use of the factors of production.

Associated with this argument is the hypothesis that farmers in traditional agriculture are "poor but inefficient." That is, they do not make efficient use of their resources at hand nor do they respond to economic incentives. Their economic decisions are made according to long-established traditions, and not according to rational economic principles. Traditional agriculture subsists outside the market system.

The "structural efficiency" argument, like the dynamic form of the "allocative efficiency" argument, relies heavily on the introduction of new technology in order to increase production in traditional agriculture. The "structural efficiency" version, however, does not rely on the automatic market mechanism to inject the "non-conventional" inputs into traditional agriculture. Since farmers in traditional agriculture do not react to price incentives, structural transformation of their production methods is required. In order to accomplish this, the state plays a very important role in the implementation of development programs.

The most important implication here is that if traditional farmers are not responsive to market incentives, then price theory is not applicable to the problems of transforming traditional agriculture and creating the agricultural surplus needed for industrialization.

This study of the traditional sector of the Guatemalan Highlands brings empirical evidence to the "poor but efficient" versus "poor but inefficient" controversy.

Should the economic policies designed to increase agricultural output in Guatemala be taken along the lines of allocative efficiency and/or along those of structural efficiency?

Can the agricultural output of traditional agriculture in the Guatemalan Highlands be increased through marginal adjustments in the use of resources? Are Guatemalan Indians efficient farmers? Can the traditional agriculture of Guatemala be modernized by new technology introduced through economic incentives and the market mechanism? What is the role of the state in the process of the modernization of traditional agriculture in Guatemala?

The estimated efficiency indexes presented here suggest that Guatemalan Highland farmers do not make the best use of their resources. Specifically, their inefficiency lies in their use of too little land and capital and too much labor on their farms.

The word "inefficient" as applied to the Guatemalan farmers needs to be qualified--maximum efficiency conditions assume perfect competition and perfect product and resource markets, but this is not the case in the Guatemalan Highlands where strong monopolistic and oligopolistic elements are present in both markets. Particularly imperfect is the market for land. The individual farmer in the area does not face a perfectly elastic supply of land, but a very inelastic one. Institutional constraints exist in the area, distort the perfect market situation, and impose serious restrictions on conclusions regarding the inefficient behavior of the Guatemalan Highland farmers.

Nevertheless, with the above qualification, these data suggest that Guatemalan Highland farmers make inefficient use of their resources. They are "poor and inefficient," but this characterization of the Guatemalan Highland farmer should be distinguished from the "poor but efficient" and the "poor but inefficient" hypotheses. The "poor but efficient" hypothesis implies that, if farmers are found to be poor, their poverty cannot be attributed to economic inefficiencies. We have to look for the causes of poverty somewhere else. On the other hand, the thesis "poor but inefficient" implies that if farmers are poor it is because of inefficiencies in the use of their resources. Our hypothesis, "poor and inefficient," implies that if farmers are poor it is not because they are inefficient. Other factors besides their inefficiency explain their poverty; one of these factors might be poverty itself. That is, the Guatemalan farmers are inefficient because they are poor and not vice versa.

Judging solely from the indexes of efficiency, we are tempted to conclude that Guatemalan Highland farmers are not responsive to market stimuli. The efficiency indexes indicate marked differences between marginal productivities of resources and their opportunity costs, suggesting that Guatemalan farmers, not having corrected these disequilibria, are not responsive to market stimuli. However, attempts to seek employment in the Lowlands as migrant workers, and efforts to complement their incomes from miscellaneous activities, show a certain degree of responsiveness to price stimulus.

If it is accepted that inefficiency in the use of resources characterizes Guatemalan Highland traditional agriculture, then it follows that significant increases in agricultural output can be obtained by reallocating the existing factors of production--that is, through "allocative efficiency" policies.

However, two considerations limit the effectiveness of the "allocative efficiency" approach: the magnitude of the adjustments needed to restore equilibrium and the limited resources the farmers own (i.e., their minifundia farms, their few capital resources, and low education). The limitations of a policy of reallocating existing resources are apparent in that the differences between marginal productivities of land, labor and capital and their respective opportunity costs are very large indeed. Small increases in output would be gained by marginal adjustments in factor reallocation. Thus, the problem in Guatemalan agriculture is not one of achieving a combination of resources that pushes Highland agriculture from a position inside the production possibility curve to a position on the curve. It must be remembered that Guatemalan Highland farmers are very poor and inefficient; if they were only inefficient and not poor (i.e., if their resources were not so limited), then allocative efficiency policies would bring about considerable increases in agricultural output. This is not the case with the Guatemalan Highland farmers. Policies to move Guatemalan Highland agriculture from an inefficient situation inside the agricultural production possibility curve to a position on the curve, even if they were sucessful, would not bring about substantial increases in total agricultural output.

Economic policies relevant to the problem of economic development of Guatemala--the problem of increasing the agricultural surplus needed for the country's industrialization and the formation of a dynamic and modern agricultural sector to sustain industrialization--must be formulated along the lines of the "structural efficiency" approach to economic development.

The problem, as we see it, is to push the agricultural production possibility curve of Guatemalan Highland agriculture outwards, which can be accomplished through a policy of introducing "non-conventional" inputs and new technology into their methods of production in order to increase productivity, and through policies that would increase their economic resources.

Again, Guatemalan Highland farmers are poor and inefficient; increasing efficiency alone won't accomplish much. We are, in short, recommending the formulation and implementation of policies to increase efficiency and to redistribute wealth.

Because of the traditional character of Guatemalan Highland farmers, we do not think the market mechanism should be the main instrument to inject the "non-conventional" input and new technology into that sector of the Guatemalan agriculture.

The state, through well designed extension service programs and credit facilities, should be the most important agent in the implementation of these policies.

Policies for redistribution of wealth (attacking the poor aspect of the "poor and inefficient" situation) call for a serious program of agrarian reform in the country. The size of the land production elasticity coefficients (see Table 16) and the high value of the marginal productivity of land (see Table 17) suggest that considerable increases in agricultural output can be gained along the lines of increasing farm size. Comparison of the marginal productivity curve of land to that of labor (see Figures 1 and 2) suggests that the marginal product of land is more elastic to changes on the input level. Thus land programs should have priority as a policy instrument over population and labor programs. The minifundia problem of the Guatemalan Highland cannot be divorced from the latifundia problem of other regions of the country. Programs designed to distribute the idle Lowland latifundia (not the Peten jungles) may prove the most fruitful policies of land redistribution.[34]

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[34]For description of the idle Lowland latifundia see Jose Luis Paredes Moreira, Reforma Agraria; Una Experiencia en Guatemala, (Guatemala: Imprenta Universitaria, Guatemala, 1963), pp. 69-70.