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## LAND DISTRIBUTION, INCOME DISTRIBUTION, AND THE PRODUCTIVE EFFICIENCY OF COLOMBIAN AGRICULTURE†

The most cursory observation indicates that inequalities in income distribution are a severe problem in Colombia. This paper presents the results of an attempt to quantify income distribution in the agricultural sector at the beginning of the 1960s (when the sector had about half of the active population), to ascertain its relationship with the distribution of land and other forms of wealth, and to trace and explain its changes over time. Evidence is also presented on the relative static efficiency of farms of different sizes, relevant to the question of whether the goals of growth of agricultural output and improved distribution are conflicting or complementary. Finally, the study tries to draw some tentative policy conclusions and to indicate which aspects of the agricultural sector would have to be better understood before firm policy conclusions could be drawn.<sup>1</sup> Since many relevant relationships are not touched on, no conclusive answers can be given. The analysis refers exclusively to Colombia, but evidence from some Latin American and other underdeveloped countries suggests that the questions raised here are of general interest and the Colombian data not atypical.

As background, some relevant characteristics of Colombia's agricultural sector should be borne in mind. First, land is quite unevenly distributed, both with respect to ownership and with respect to operation.<sup>2</sup> Second, income is unequally distributed. Third, there is evidence of some form of labor surplus, especially in the older highly populated Andean regions of the country where minifundia are very common. And fourth, there are relationships between size of farm and type of farming which are so significant as to make it plausible that farms of different size differ markedly in factor proportions and factor productivity. Depending on

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<sup>1</sup> As in so many parts of the world, income distribution was essentially neglected in most government policymaking in Colombia until recently. The nature of information available on the economy and the research carried out reflect this, and as a result the bases for statements about distribution in general and about more specific questions such as the complementarity or competitiveness of the output and distribution goals remain shaky.

<sup>2</sup> It appears that 10 percent of the agricultural families operate about 75 percent of the land measured in terms of value; the ownership of land appears to be somewhat more concentrated than its operation.

TABLE 1.—PERSONAL DISTRIBUTION OF INCOME FROM COLOMBIAN AGRICULTURE  
(NATIONAL ACCOUNTS CONCEPT) 1960, BY INCOME CATEGORIES:  
BASIC ESTIMATE\*

Income categories (thousand 1960 pesos) <sup>a</sup>	Percent of people		Percent of income	
	In category	Cumulative	In category	Cumulative
0-1	8.87	8.87	1.93	1.93
1-1.5	29.76	38.72	9.73	11.67
1.5-2.0	21.77	60.50	9.71	21.38
2.0-3.0	14.00	74.50	8.69	30.07
3.0-5.0	10.56	85.05	10.36	40.43
5.0-10.0	9.82	94.87	17.78	58.20
10.0-20.0	3.44	99.31	12.06	70.27
20.0-110.0	1.41	99.72	14.47	84.73
100.0-200.0	.21	99.93	8.19	92.92
Over 200.0	.07	100.00	7.08	100.00

\* Data from R. A. Berry and A. Padilla, "The Distribution of Agriculturally Based Income in Colombia, 1960" (1970, processed) with slight adjustments. This paper, which includes the figures underlying the above estimates and the details of methodology, involved calculations of average gross income accruing to the producers on each different size of farm integrated with an independent estimate of the distribution of labor income. (See Appendix: Statistical Note for brief description.) "People" excludes family workers, but includes hired labor.

Basic data are from Colombia, Departamento Administrativo Nacional de Estadística (DANE), *Directorio Nacional de Explotaciones Agropecuarias (Censo Agropecuario)*, 1960—*Resumen General (segunda parte)* (Bogotá, 1964) i.e., data by farm size on land use, persons living on farms, and area rented; unpublished figures calculated by DANE from its *Encuesta Agrícola Nacional*, 1966 for 1966 yields per hectare; and various others of the publications listed at the end of this article.

<sup>a</sup> Income per economically active person. Income per capita, including dependents, may be roughly approximated at one-third.

the factor(s) in question, productivity might be expected to differ in different ways. It is clear (see below) that small farms produce more per hectare and large farms more per worker; which have a higher total factor productivity depends on the relative social costs of factors, taking into consideration that the social cost of labor depends very much on whether and in what sense there is surplus labor.

#### THE PERSONAL DISTRIBUTION OF INCOME GENERATED IN AGRICULTURE IN 1960

The data presented below refer to 1960, and give a distribution of income corresponding to the earner's role in agricultural production, i.e., of the agriculture-based income defined by what we may call the "national accounts" concept. Although one is usually more interested in the distribution of potential consumption by individuals, data limitations often restrict analysis to distribution of earned income by families or by individuals; for Colombia only the latter is feasible. Unfortunately, the data also limit us to an estimate of income according to the national accounts concept,<sup>3</sup> though some data are presented on the distribution of wealth in land (probably the major source of capital appreciation income) and a guess is made as to how the inclusion of capital gains would affect the distribution.

Tables 1 and 2 present, in slightly different form, a best estimate of the per-

<sup>3</sup> The concept excludes increases in wealth which result from appreciation (in real terms) of various assets, physical or financial. This exclusion tends toward underestimation of the concentration of income in upper income groups.

TABLE 2.—PERSONAL DISTRIBUTION OF INCOME FROM COLOMBIAN AGRICULTURE, 1960, BY DECILES: BASIC ESTIMATE AND ALTERNATIVES\*

Decile <sup>a</sup>	Basic estimate		Low estimate of bottom deciles income		Low estimates of upper decile income (percent in category)		
	Percent of income (1)	Cumulative percent of income (2)	Percent of category (3)	Cumulative percent (4)	(A) (5)	(B) (6)	(C) (7)
1	2.24	2.24	1.18	1.18			
2	2.87	5.11	2.38	3.56			
3	3.34	8.45					
4	3.73	12.18					
5	4.21	16.39					
6	4.68	21.07					
7	5.78	26.85					
8	7.90	34.75					
9	12.77	47.52					
10	52.48	100.00			49.48	46.32	43.08

\* The basic estimate (i.e., best guess) is an adjusted version of that presented in Berry and Padilla, fully cited for Table 1, Appendix A-1, adjusted.

The lower estimate for the bottom two deciles (columns [3] and [4]) is designed to be downward biased with respect to each doubtful assumption which was made. It assumed, in particular, that the workers with the lowest wages work the smallest part of the year and do not own or operate any land.

The three estimates, designed to give various types of lower limits for the upper decile share, involve the following assumptions:

(A) There was no dispersion of incomes for farmers in a given size category. Our estimation technique involved calculating the average income accruing to farmers in a given size group, then assuming a certain dispersion around this mean; the share of the upper decile is an increasing function of the amount of dispersion assumed. To assume no dispersion is clearly unrealistic, so, with respect to this aspect of the methodology, estimate (A) is clearly downward biased.

(B) This estimate, further to (A), assumes twice as many laborers working on large farms (or more precisely twice as much salary payments to blue-collar workers) as the basic estimate. It seems almost sure that with such an assumption a downward bias is created in this respect as well.

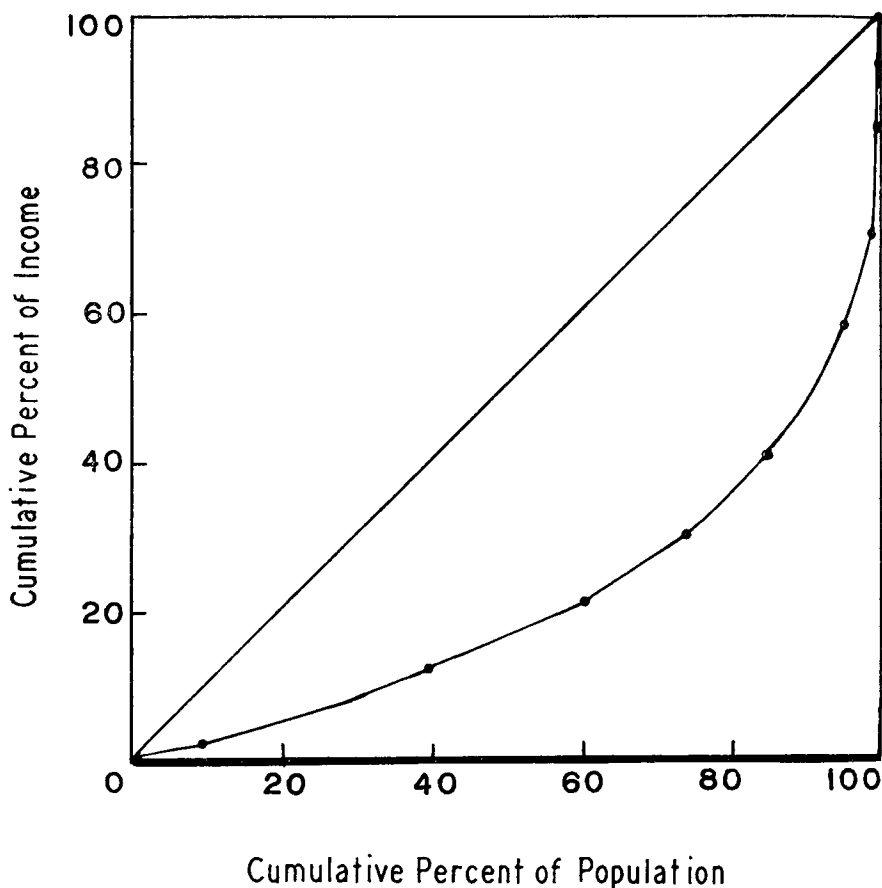
(C) Here it is further assumed that the basic estimate overstated value added in the large farms by 10 percent. Since we use 1966 data on relative yields by farm size, and these showed higher yields of many crops for larger than for small farms, if the former had risen relative to the latter in the period 1960-66 (which is possible) the basic estimate might have had an upward bias from this source. Note that this could well mean that the 1966 distribution would be more like the basic estimate presented here.

<sup>a</sup> Population ranked by size of income.

sonal distribution of income; family helpers are excluded. That the great majority of the agricultural labor force had an annual income from agriculture of below 5,000 pesos per economically active person (about \$700) is not open to serious question, and there is little doubt that the bottom half had less than 3,000 pesos (\$400). There is also little doubt that the top 15 percent had close to 60 percent of the income (say 55 to 65) and the bottom 85 percent had 35 to 45 percent. The major areas of doubt involve the distribution of income within these top and bottom groups respectively. For the bottom group the uncertainty results from our not knowing in detail which small producers worked on other farms, how much they worked, and what their wages were. The estimates are also in some doubt because of lack of information on the distribution of value added and certain input costs by farm size.

It should be emphasized that Tables 1 and 2 present the estimated distribution

CHART 1.—LORENZ CURVE OF BASIC ESTIMATE OF DISTRIBUTION  
OF INCOME FROM AGRICULTURE, 1960\*



\* Data from Table 1.

of income generated in agriculture, not the distribution of all income (from agriculture or other sources) of people involved in agriculture. Impressionistic evidence suggests that incomes earned in other sectors may be a particularly high share of total income for some of the people towards the top of the agricultural distribution (i.e., the absentee farmers and the partially absentee "commercial" farmers). Also, capital gains (not included in the tables), though hard to guess at, may be significant.<sup>4</sup> While not many people towards the bottom of the "income from agriculture" distribution are absentee, the pressure of very low agricultural incomes pushes them to earn incomes from other sources.<sup>5</sup> So the data for these

<sup>4</sup> The group of people constituting the upper decile of income earners probably owns something above 75 percent of all land by value (this is the only asset likely to produce secular capital gains). We estimate the value of land owned in the agricultural sector in 1960 at about 23 billion pesos; if land were to appreciate by say 5 percent in real terms each year, it would add another 20.7 percent to the incomes of the top decile.

<sup>5</sup> The findings of a study in the Rio Suarez Valley were consistent with this (see 23). On the other hand, data from municipalities not close to some significant nonagricultural activities show very low shares of income earned outside agriculture.

two groups (especially the first) could underestimate total income significantly.

As indicated in Table 2, the bottom decile could have anywhere between 1.2 percent (an estimate designed to be a real minimum) and 3 percent, and the bottom two deciles could have between 3.6 and around 6 percent (always disregarding income from nonagricultural sources). For the top decile, 50 to 55 percent seems the likely range; it seems very unlikely that less than 45 percent accrues to this group. If capital gains income is included, it is very unlikely that less than 50 percent goes to it. The basic estimate of distribution is represented by the Lorenz curve of Chart 1. The corresponding (Gini) coefficient of concentration is 0.58.

### *Determinants of the Skewness of the Distribution of Agricultural Income*

At a first level of discussion, the inequality of incomes in agriculture is explained by the unequal distribution of land. The high incomes correspond to people with large farms (see Table 3). As we see below, most of the incomes of the larger producers accrue to them in their role as owners of land and capital, not in their role as suppliers of labor. The distribution of income among salaried laborers, while showing substantial range (much of it due to wage differentials among different regions of the country), does not contribute much to the skewness of the overall distribution, since all these incomes come toward the bottom of it. Table 4 breaks down the roughly one million farm hands by estimated annual earnings in 1960.

The average incomes of different groups are revealing. Laborers earned an average of about 1,400 pesos per year; the earnings of operators of very small

TABLE 3.—AVERAGE INCOME OF PRODUCERS,  
BY FARM SIZE, 1960\*

Farm size (hectares)	Average income (1960 pesos)	Number of producers
1-2	1,300	191,350
2-3	1,900	117,000
3-4	2,320	92,000
4-5	2,640	58,200
5-10	3,670	169,150
10-20	5,580	114,200
20-30	6,710	44,050
30-40	8,170	26,500
40-50	9,980	16,240
50-100	12,500	40,000
100-200	23,350	22,300
200-500	44,930	13,700
500-1,000	103,500	4,140
1,000-2,000	186,100	1,975
Over 2,000	513,900	790
TOTAL	6,145	911,595

\* Data from R. A. Berry and A. Padilla, cited for Table 1, Appendix Table A-4, reproduced here as the Appendix Table.

Excluding farms of less than one hectare since most of the 300,000 people on those farms earned the major part of their income working for someone else.

TABLE 4.—DISTRIBUTION OF INCOME AMONG AGRICULTURAL WAGE EARNERS, BY INCOME CATEGORY, 1960\*

Category number	Average annual income of category (1960 pesos)	Percent of workers	
		In category	Cumulative
1	600	1.3	1.3
2	715	2.0	3.3
3	835	4.6	7.9
4	950	3.0	10.9
5	1,070	10.5	21.4
6	1,190	8.3	29.7
7	1,310	25.7	55.4
8	1,430	5.5	60.9
9	1,550	15.8	76.7
10	1,670	3.9	80.6
11	1,787	8.5	89.1
12	1,900	1.8	90.9
13	2,025	5.7	96.6
14	2,290	3.4	100.0
AVERAGE	1,400	...	...

\* Data from R. A. Berry and A. Padilla, "The Distribution of Agriculturally Based Income in Colombia, 1960" (1970, processed), Appendix Table A-5.

Based on wage statistics for each municipio from Colombia, Departamento Administrativo Nacional de Estadística, *Boletín Mensual de Estadística*. The number of wage earners used in this calculation corresponds roughly to the number of man years worked for remuneration. It was assumed that each worker was occupied 250 days per year. Most families have at least a small plot of land for their own use.

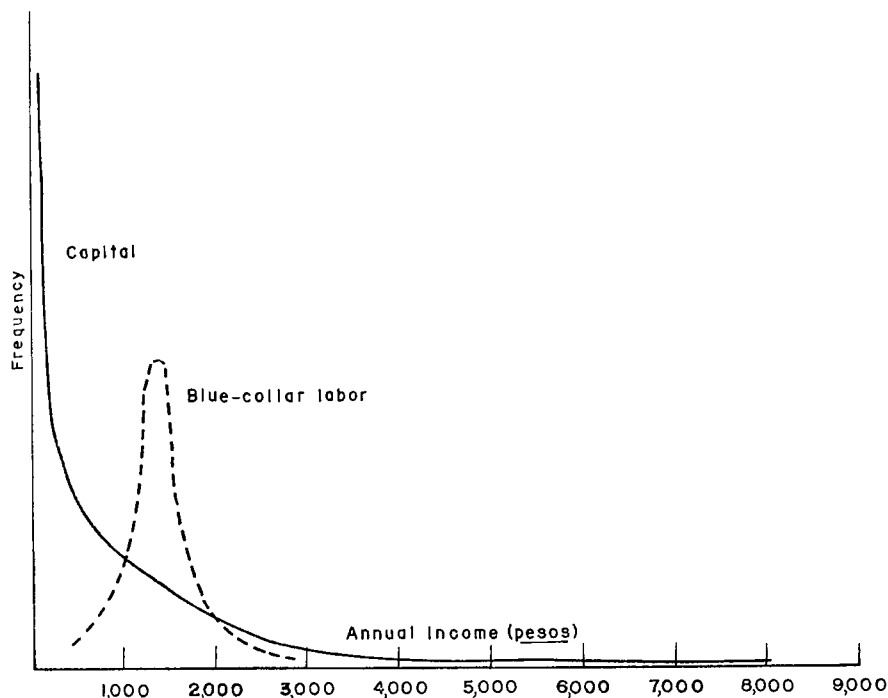
farms (less than 2 hectares) were similar and even up to 5 hectares they were very low. Colombia's "small farmers" may be thought of roughly as the group with 5 to 20 hectares, and with average income of around 4,500 pesos (of 1960). While hardly living in luxury, these nearly 300,000 farmers are relatively well off. The upper 10 percent of agricultural families are those with 20 hectares and up;<sup>6</sup> there is still a wide range of incomes in this category, which probably includes almost all of the few white-collar workers in agriculture as well as the producers.

If the market for factors were perfect (so that all units of a given factor earned the same), differences in personal or family incomes would depend only on differences in factors owned, and with knowledge of factor distribution and factor prices it would be possible to indicate how income distribution was related to the distribution of each factor. Although the assumption of perfect factor markets is untenable, and no information exists about the distribution of human capital, this exercise is still of some interest as a first step.<sup>7</sup> It is not too implausible to assume that control of human capital is proportional to control of physical capital. Treating land as a form of capital, we may think of overall variance of income from capital and labor in terms of the variance of income from each factor, the covari-

<sup>6</sup> There are about 170,000 such families, as indicated in Table 3. The total number of families in agriculture, including those with less than 1 hectare and the landless families (not shown in Table 3) is about 1.6 million.

<sup>7</sup> It may also give some indication of the imperfectness of factor markets.

CHART 2.—SIZE DISTRIBUTION OF BLUE-COLLAR LABOR INCOME  
AND OF CAPITAL INCOME, 1960\*



\* Drawn from data which underlies Table 6. Horizontal axis measures annual income in 1960 pesos; vertical axis measures either number of or percent of all persons per thousand pesos of income range (frequency or frequency density). Area under the curve sums to 100 percent.

ance of the income from the two, and the share of total income going to each; particular interest attaches to the question of whether unequal distribution of capital is the main determinant of the skewness of the distribution of income.

Chart 2 presents estimates of the size distribution of blue-collar labor income<sup>8</sup> and that of capital income under this assumption; labor revenue is much less skewed than income to capital. Table 4 suggests that only about 20 percent of hired blue-collar workers earned less than 1,000 pesos or more than 1,850; the average was 1,400<sup>9</sup> and the ratio of the standard deviation to the mean was 0.26. Average income from all factors was about 3,800 and the ratio "standard deviation/mean" was 0.35. Estimates of the functional distribution within each decile (Table 5) reinforce the conclusion, evident also in Chart 2, that it is income from capital which gives the overall distribution its skewness. The Gini coefficient of the distribution of labor income presented in Table 4 is 0.14; if capital were equally distributed, the Gini coefficient of total income would be considerably less than

<sup>8</sup> Probably more or less equal to pure labor income. (For definition, see fn. 10 below.)

<sup>9</sup> It should be noted that the variance tends to be underestimated in one respect by these figures, since they are based primarily on average wages of different municipalities, not wages of individuals. In fact, however, since geography is the main cause of the variation, it probably tends to be overestimated in another respect due to the probable correlation between wages and the cost of living.

Note also that these figures refer to males over 18. But this age group includes about 80 percent of the total agricultural population and probably almost as high a proportion of the workers.

TABLE 5.—INCOME FROM COLOMBIAN AGRICULTURE, 1960 (NATIONAL ACCOUNTS CONCEPT) BY DECILES, WITH SHARES ATTRIBUTED TO LABOR AND TO CAPITAL INCLUDING THE HUMAN CAPITAL OF FARM OPERATORS\*

Decile <sup>a</sup>	Average income (1960 pesos)	Percentage shares			
		Hired labor	Unpaid labor <sup>b</sup>	Total labor <sup>c</sup>	Capital <sup>d</sup>
1	865	72.3	13.9	86.2	13.8
2	1,108	70.2	14.9	85.1	14.9
3	1,290	80.8	9.6	90.4	9.6
4	1,441	80.6	9.7	90.3	9.7
5	1,626	81.9	9.0	90.9	9.1
6	1,807	57.7	21.1	78.8	21.2
7	2,232	30.3	34.8	65.1	34.9
8	3,060	7.5	40.4	47.9	52.1
9	4,940	10.7	25.3	35.9	64.1
10	20,270	6.9	5.7	12.5	87.5
TOTAL	3,830	23.2	14.4	37.6	62.4

\* Calculations by the author as shares of value added on farms in the respective size category, from value added as for Table 1, hired labor as for Table 4. For producers with incomes less than 2,800 pesos it is assumed that the income is attributable equally to capital and labor.

<sup>a</sup> Population ranked by size of income. As indicated in text the top tenth corresponds roughly to operators of farms of 20 hectares and more, plus some white-collar workers.

<sup>b</sup> Imputed pure labor share. For incomes over 2,800 pesos calculated as the number of unpaid workers times 1,400 divided by the value added on farms in the specified size category. For incomes less than 2,800, assumed to be one-half the producer's income.

<sup>c</sup> As indicated in note *b*, of imputed labor income, only that corresponding to pure labor services has been included. The figures in this column thus underestimate the total labor share (paid and imputed, pure labor and human capital payments) through the exclusion of imputed human capital payments to producers.

<sup>d</sup> Capital share including human capital income of farm operators: calculated as a residual.

this, i.e., the distribution of capital is seen to be the key factor in determining an actual coefficient of 0.58.

A more detailed view of the relation between a person's income and its sources is presented in Table 5, where an estimate is made of the relative importance of capital and labor in the total agricultural income of each decile, along with a distinction between the hired and non-hired pure labor shares.<sup>10</sup> A fairly plausible approximation of returns to pure labor—where an attempt is made to exclude the payment to human capital—is the average wage per agricultural worker; in 1960 this appeared to be about 1,400 pesos per year; applied to all of the active population in agriculture, it implies a pure labor share of about 36 percent.<sup>11</sup> Although the figures are only "best estimates," consideration of other assumptions than the ones used suggests that the general character of the functional distribution by deciles is not very sensitive to plausible alternatives. The conclusions which emerge clearly are the following:

<sup>10</sup> "Pure" labor is defined here as labor in which no investment (formal or via training) has been made. Each person's labor services are thought of as (a) the service he could provide had no investment in him nor relevant training been experienced, plus (b) the additional value of his service which is due to such investment or training. All occupied persons are thought of as receiving some part (possibly all) of their income as payment for their pure labor services, and some part (possibly none) as payment for their human capital, e.g., entrepreneurial ability, special skill, etc.

<sup>11</sup> We have not used the 38 percent total in Table 5 since this calculation is appropriate only if returns to labor are the same whether the wage is paid or imputed.

1. Approximately the bottom half of income earners receive by far the largest part of their income as paid blue-collar workers on other farms.<sup>12</sup> It seems unlikely that any of the first five deciles earn much less than 75 percent of their income in this way; the rest comes from production on land the farmer operates. Blue-collar wages remain important in the sixth and seventh deciles but essentially do not enter the top three.

2. While uncertainty as to the number of hired laborers on small farms makes the estimated producer share (unpaid family labor plus returns to capital) for them subject to error, for the bottom five deciles it is probably in the range of 15 to 30 percent; it rises rapidly to a level of probably around 90 percent for the upper three deciles.<sup>13</sup>

3. White-collar workers and administrators are found in the top two deciles.

4. The pure labor share accruing to employees and producers varies dramatically by decile; it is probably below 10 percent in the upper decile and in the range of 80 to 100 percent in the lower ones. It is impossible to be more precise since no definition of the pure labor share for lower deciles is conceptually convincing.<sup>14</sup>

5. The capital share is very high on the largest farms, possibly close to 90 percent but almost certainly above 70 percent. Note that the upper decile corresponds essentially to operators of farms of 20 hectares or more.

It has been noted that the skewness of distribution appears to be closely related to the distribution of land and capital, and it is worth considering how the interpretation and implications of this fact may differ under the assumption of market imperfections. In analysis of the relative efficiency of farms of different size and in policy prescriptions it is important to know whether the higher incomes of the large farmers are partly due to market imperfections which work in their favor.

### *The Assumption of Market Imperfections*

When groups of farms differ as much in factor proportions, single factor productivities, and total factor productivities as do the various size categories in Colombia (details are presented below) it is likely that some factor markets are imperfect.<sup>15</sup> The most obvious imperfections are in the labor market. Both impressionistic evidence and the data discussed below indicate that the marginal productivity of labor is unequal for farms of different sizes. There are also notable differences in the markets for some types of capital—some are more expensive or more difficult to purchase for one group of farmers than for others and credit is very unequally available.

When factor markets are imperfect, serious practical and conceptual problems

<sup>12</sup> It must be remembered that all of the agricultural labor force is included in the figures of Table 5; it would not be true that the bottom half of farm operators earned the bulk of their income on other farms. Most of the people in the bottom deciles are landless or nearly landless workers.

<sup>13</sup> Producer share as defined here is gross of machinery rental; the net figures would be a little below the ones cited.

<sup>14</sup> An argument can be made that the producer income on small plots is almost exclusively capital income, since the opportunity cost of the labor may be zero or close to it.

<sup>15</sup> The data are inconsistent with the same rate of return to labor and capital on all farm sizes unless (a) the return to labor is everywhere below the reported wage rate, or (b) an unmeasured factor (e.g., entrepreneurship) is highly complementary with land and capital and competitive with labor, or (c) some factor treated as homogeneous (e.g., labor) is in fact quite heterogeneous. Since one or more of these conditions may well hold, especially (b) and (c), the ratios referred to do not provide a proof of imperfections, but they constitute strong (though impressionistic) direct evidence to that effect.

may occur in the measurement of imputed labor and capital incomes. For a farm which hires all of its labor, the labor share is conceptually clear cut—it is the total wage bill. (The fact that the wage rate may be different in different regions or for different farm sizes, reflecting separate markets, still leaves the factor's total income a meaningful figure.) The problem arises in the case of separated factor markets when not all labor is hired.<sup>16</sup> Consider, for example, a small operator who, in applying his own labor and capital, earns an income below the average market rate of return to one or both factors but above what he would get if he sold the services of his labor and capital on the market. Here the return from the best alternative use of his factors is below their return on the farm, which in turn is below their average market remunerations. In this situation defining the return to capital (labor) as income minus the average market value of labor (capital) is incorrect. The average marginal productivity of capital<sup>17</sup> (labor) may be appropriately defined as income minus the potential income from the best alternative use of labor (capital); these productivities do indicate the effect of the individual's capital (labor) on his income, but with market imperfections the sum of these two figures normally exceeds total income. Whenever actual returns to a factor are not equal to average income of that factor in the market, a practical measurement problem arises. And when the production function does not show constant returns to scale, the concept of a factor's share loses precision; at best the share could be given lower and upper limits corresponding to  $Q_x P_x$  (where  $Q_x$  is the quantity of the factor and  $P_x$  is the price in the best alternative use) and  $Q_x MP_x$  (where  $MP_x$  is the average marginal productivity of the factor on the farm). Incomplete knowledge of the nature of factor market imperfections suggests that several alternative functional distributions of producer income be considered to see if the total labor and capital shares or their relationship to farm size and income category are sensitive to the assumptions. We have examined each of the following assumptions:

1. All producers earn the average hired annual labor wage of 1,400 pesos from their own labor; the rest of their income is from capital. This assumption is internally inconsistent unless (a) the rate of return to capital is very low and possibly negative for the smallest farms, or (b) we have overestimated the number of man-hours spent on small farms—with our best estimate of labor distribution by farm size the implied labor income would more than exhaust the total income generated. It may therefore be presumed that the assumption leads to an overestimate of the labor share for some range of smaller farms.

2. Labor income of producers is distributed in the same way as is the wage rate of hired laborers, with the smallest producers assumed to earn the smallest imputed labor incomes. The assumption that both producer labor income and paid labor income is smallest on the small farms gives what are probably the lowest plausible estimates of the difference in labor shares across different farm sizes.

3. The rate of return to capital is equal—at some specific rate—on all farms; after deducting labor payments an imputed rate of return to labor may be calculated for producers.

<sup>16</sup> If factor markets were perfect, the failure of some factors to enter the market would still not matter, since the appropriate imputation for any factor would be its market remuneration.

<sup>17</sup> That is, the average level of  $MP_x$  for all levels of  $K$  between 0 and the actual level, quantities of other factors being held constant.

TABLE 6.—LABOR AND CAPITAL SHARES OF INCOME FROM COLOMBIAN AGRICULTURE  
(NATIONAL ACCOUNTS CONCEPT), 1960 BY FARM SIZE\*  
(Percent)

Farm size (hectares)	Distribution A			Distribution B			
	Paid labor		Total (3)	Total labor (4)	Capital (5)	Total labor (6)	Capital (7)
	Blue- collar (1)	White-collar and technical (2)					
Under ½	9.4		9.4	54.7	45.4	67.7	32.3
½-1	14.4		14.4	57.2	42.8	71.6	28.4
1-2	20.7		20.7	60.2	39.8	71.8	28.2
2-3	21.3		21.3	60.6	39.4	68.6	31.4
3-4	21.9		21.9	60.9	39.1	66.7	33.3
4-5	22.2		22.2	61.2	38.8	65.0	35.0
5-10	22.6		22.6	51.7	48.3	57.4	42.6
10-20	23.0	2.5	25.5	43.9	56.1	49.2	50.8
20-30	25.7	2.6	28.3	42.8	57.2	42.7	57.3
30-40	26.1	7.6	33.7	45.3	56.7	39.3	60.7
40-50	25.8	8.0	33.8	43.7	56.3	36.5	63.5
50-100	22.0	8.1	30.1	37.3	62.7	30.1	69.9
100-200	17.3	6.9	24.2	28.2	71.8	21.9	78.1
200-500	13.0	10.0	23.0	26.3	73.7	15.7	84.3
500-1,000	9.8	10.0	19.8	20.5	79.5	12.4	87.6
1,000-2,500	8.3	9.3	17.6	18.0	82.0	9.2	90.8
Over 2,500	3.9	6.0	9.8	10.0	90.0	5.1	94.9
TOTAL <sup>a</sup>	18.2	5.0	23.2	37.6	62.4	37.9	62.1

\* Distribution A is calculated as for Table 5. Distribution B is based on the assumption that the imputed wage level for a given farm size equals 1,400 times the efficiency coefficient corresponding to that farm size. Efficiency coefficients for broader farm size categories are presented in Table 12. Those used were calculated in the same way.

<sup>a</sup> Differences in totals between columns (4) and (6) and between columns (5) and (7) are due to rounding.

4. The rate of return to capital varies proportionately to average labor productivity.<sup>18</sup>

For certain farm sizes functional distribution is relatively sensitive to which of these assumptions are used; two of the more plausible sets of estimates are presented in Table 6. By income classes this distribution is less sensitive to the assumptions since most of the individuals in the bottom half of the distribution are hired laborers. A lower limit estimate of the pure labor share is 30 percent or a little below; since total factor productivity appears to be lower on the smallest farms (less than 1 or 2 hectares), the estimate of 36 percent referred to earlier can be assumed to give an upper limit.<sup>19</sup> The paid labor share is probably a little above 20 percent and imputed pure labor income in the neighborhood of 10 to 16 percent. Where the labor share and changes in it are viewed as indicators of the earnings

<sup>18</sup> These alternatives do not include the possibility that the capital share be quite high on small farms, due to a very low opportunity cost of labor. In the extreme case of a small farm with surplus labor for which the market offers no alternatives at all, the labor share is zero, and all of the farm's income should be imputed to capital. Such a situation would imply that, if there were constant returns to scale, the rate of return to capital would be higher on the small farms, even though total factor productivity could not be.

<sup>19</sup> The labor share figures of Table 6 are greater than this, since they include returns to human capital for employed persons.

of the lower income groups, it is worth noting that under the circumstances of Colombian agriculture where much labor is applied on small farms with low returns, the pure labor share is particularly vulnerable to changes in the potential of these small farms and to rapidly diminishing marginal productivity on them.

### *Evidence on Changes in Income Distribution Over Time*

Since the distribution of 1960 (to which the above figures refer, as nearly as possible) might by now be somewhat obsolete, it is of interest to examine the more limited evidence on how distribution has changed over time and to consider possible causes of the apparent changes. Pertinent information is much scantier for the years before 1960 and it is also difficult to quantify subsequent developments. Although there have been sample surveys in agriculture following up the 1960 census, they have not been sufficiently parallel in concept to permit satisfactory comparisons.

The nature of the 1960 distribution does suggest that knowledge of the changes of the labor share over time would give some feel for changes in overall skewness. Using wage-rate data, collected on a municipal level for over 30 years—albeit with weaknesses and biases—one can compare estimates of the wage bill and value added to calculate an estimated labor share. The evidence is startling: real daily wage rates appear to have been about the same in the latter part of the 1960s as they were in the mid-1930s; they declined in the late depression years and the early 1940s, then rebounded and continued to increase till the early 1960s, when they leveled off. Over the same period, average income per person engaged in agriculture appears to have risen at an average rate of two to three percent per year. If it is legitimate to assume that daily wages are a reasonable indicator of “pure labor income,”<sup>20</sup> then since both land and capital have risen faster than labor over this period, the labor share must have fallen substantially. (A best guess time series is presented in Table 7.) Changes in land and capital inputs are hard to estimate accurately and direct information on their prices is scarce; what data we have does suggest that the rental price of one or both has risen over this period.<sup>21</sup> In any case, whether because of greater relative amounts of these factors or increases in their price, the share of agricultural income going to capital and land together has almost certainly risen substantially.

It is not possible to make a neat delineation between agricultural laborers and farm operators in Colombia, since many farmers have a little land but not enough to provide a full-time job or a subsistence income without working on someone else's land; frequently a small plot of land is made available to the worker by the owner of the farm, partly to tie down the desired labor supply. Since all combi-

<sup>20</sup> Perhaps the biggest weakness in the linking of these two variables is the possibility that average number of paid work days per year may change over time. There is some evidence of this in Colombia (also in Japan). For the wage share to have remained constant, however, assuming the figures on daily wages are accurate, the number of days worked per year would have to have increased by almost 70 percent over this 35-year period; this appears implausible.

<sup>21</sup> If we assume that between 1935 and 1965 the labor share fell from 60 percent to 40 percent and the real wage rate did not change, then if the real rental of land and capital were also to have remained constant the ratio of each to labor would have had to increase by 125 percent. In fact, the evidence suggests that the ratios rose about 50 percent over this period (capital/man a little more and land/man a little less). This would suggest that on average their prices must have risen by about one-third. Direct evidence, while scanty, would not contradict this. Land prices appear to have risen considerably (though this does not necessarily imply that land rent has).

TABLE 7.—“PURE” LABOR SHARE IN AGRICULTURAL VALUE  
ADDED IN COLOMBIA, SELECTED GROUPS OF YEARS,  
1935-64\*  
(Percent)

Years	Labor share	Years	Labor share
1935-39	66-84 <sup>a</sup>	1950-54	40-47
1940-44	56-79 <sup>a</sup>	1955-59	34-42
1945-49	46-57	1960-64	35-43

\* The author's calculation using agricultural value added and estimated labor force in agriculture from R. A. Berry, "The Development of the Agricultural Sector in Colombia" (Yale University Press, forthcoming); average male agricultural wage from Colombia, Departamento Administrativo Nacional de Estadística, *Anuario General de Estadística*, various issues. Labor calculated as wages times the total labor force in agriculture including unpaid labor.

<sup>a</sup> Undoubtedly too high reflecting errors in the basic data. However, for labor's share not to have fallen at all the errors would have to be bigger than suggested by consistency checks.

nations of operator-laborer (in terms of the share of income from each) exist, it is not clear for how many people the absence of a positive trend in the real wage rate over this period implies a failure of total income to rise. As of 1960, about 80 percent of the labor force earned most of its income from labor (paid or imputed), and probably one-half to two-thirds earned more than three-quarters of their income from labor on other people's land. While there is insufficient information to guess with any precision what percentage of the population has enjoyed little or no improvement, it must be substantial.<sup>22</sup>

For a fuller picture of distribution changes over time, it would be necessary to know how the distribution of land has changed; but there is almost no information on this; increasing concentration and decreasing concentration seem about equally probable. Continuing fragmentation of minifundia has been a frequent phenomenon in some parts of the country but breakup of large farms has occurred elsewhere, and the colonization of new lands tends to provide a partial safety valve against concentration. All in all, no easy balance can be drawn.

#### *Some Tentative Explanations of Changes in Distribution over Time*

To evaluate the likelihood that the apparent widening of the income distribution will continue (barring changes in exogenous determinants or in policy) into the 1970s, it is worthwhile considering some possible explanations for it. Explanations may be conveniently divided into those which take account of the interaction between agriculture and the rest of the economy and those which focus essentially

<sup>22</sup> It is true that the typical rural dweller probably has, in some respects, better alternative options than he had 30 years ago, e.g., working in small towns. Given the fact that communications and transportation have improved and the economy has become more integrated in general, one might hypothesize an improvement in off-farm employment opportunities, and correspondingly argue that although the lower half of the people in agriculture today are no better off than was the lower half 30 years ago, today's group is less dynamic, the people with more skill and motivation having emigrated. There is probably some truth to this. On the other hand, population census evidence indicates that between 1951 and 1964 rural industry stagnated, and various municipio studies suggest that income earned outside of agriculture is not an important component of total income for many people.

on intrasectoral events. The latter approach is more plausible the larger agriculture looms in the total economy and the fewer interactions (exchange of goods, movement of factors, and the like) it has with the rest of the system.

Although agriculture has always been the largest sector of the Colombian economy, even during the latter part of the period considered here, the level of interaction with the rest of the system has been substantial throughout the period in question.<sup>23</sup> It is therefore desirable to consider first the degree to which changes in the wage rate and in functional distribution in this sector paralleled those elsewhere; if they have, the search for causes might be found as much elsewhere as in agriculture itself, though given the importance of agriculture, it is unlikely that events within the sector would be unimportant as causal factors of the movements in question.

Relative movements of selected wage series for groups of agricultural and nonagricultural workers are generally consistent with the hypothesis that the agricultural labor market was closely linked to that of the nonagricultural sector. The decline in the real agricultural wage was paralleled by one in several manufacturing wage series (see 4). But in the nonagricultural sector, neither the pure labor share nor the paid labor share has paralleled that in agriculture; the paid labor share of gross domestic product has risen since 1950, from 34.8 to 45.4 (in 1969) while that in agriculture was falling from 27.4 to 22.7.<sup>24</sup> The pure labor share in nonagriculture remained about constant at 25 percent over the same period while that in agriculture was falling by over 5 percent.<sup>25</sup> This differential behavior would suggest that somewhat different factors were at work in the two sectors; coupled with the importance of agriculture, which implies that the nature of its evolution helps to determine factor shares in the economy as a whole, it would indicate the usefulness of an analysis of those events occurring within agriculture in understanding the development of functional distribution over time in that sector.

A useful way of classifying the subset of determinants acting directly on agriculture would be the following:

(1) Changes in factor proportions or factor price ratios. Changes in factor proportions and, more specifically, the extent to which increases in output have been due to increases in land under cultivation and to increases in produced capital may affect the path of income distribution. In general, one may expect increases in land use to be complementary with labor, i.e., to shift the demand curve for labor to the right, other things being equal. Capital might be either a complement or a substitute for labor, but it is more likely to be competitive; given the fairly low price elasticity of demand for agricultural products, an increase in capital inputs could lower the equilibrium wage.

With rather smoothly working markets, changes in factor proportions affect factor price ratios. These ratios can, of course, be affected also by policy, as noted below in connection with the ratio of machinery prices to wages.

(2) The nature of technological change. In particular, whether there is a

<sup>23</sup> As suggested, for example, by the fact that at present about 80 percent of agricultural output is sold in urban areas or exported; in 1935 the figure was about 50 percent (see 4, Chap. III).

<sup>24</sup> Calculations based on 2 and 3.

<sup>25</sup> The calculation for nonagriculture was made by the author using the same methodology as indicated in Table 7 for agriculture.

labor-saving or a capital-saving bias; the former tends to lower the labor share while the latter tends to raise it.

(3) Changes in the relative importance of different types and sizes of farms. If farms were homogeneous in terms of their factor proportions (given geographic and climatic conditions), one could consider—without further complications—the effects of capital formation, land expansion, and technological change on the demand for labor. But we have already seen that factor proportions among different farm sizes are anything but homogeneous; hence the labor/land ratio, for example, could change substantially as a result of a change in the relative importance of different farm sizes (a redistribution of land), all else remaining equal. This heterogeneity also implies that the effect of a given technological change on the demand for labor depends on its adaptation and implications with reference to the different farm sizes; a particular technological change could be a complement to labor on one group of farms and a substitute on another group.

(4) Changes in product composition of demand. Changes in product composition of demand tend to cause changes in the relative demand for the different factors, since different crops use different factor proportions. It is of particular interest to consider the implications of the increase and subsequent decrease in the importance of coffee. Since coffee appears at first glance to be a labor-intensive crop, its recent decline might be thought to have contributed to the falling labor share. The other major change in crop composition has been associated with the “commercialization” of agriculture beginning in the late 1940s and early 1950s with the expansion of cotton, rice, and sesame; the general impression is that these are capital-intensive crops.

Changes in composition of crop output (as opposed to composition of demand) are in part a response to new technologies and to capital formation; to this extent they are not a separate determinant of labor demand.<sup>26</sup> The changing importance of coffee is primarily a world demand phenomenon and should be treated as an exogenous factor separate from the others.

It is instructive to consider jointly the implications for income distribution.<sup>27</sup> In another study (4) we have argued that the growth of agricultural output up to around 1950 was largely explained by the growth of the traditional inputs. Increases in total factor productivity were not very important; it appears that from the late 1930s till around 1950 only 10 to 25 percent of output growth was due to increased total factor productivity. Since 1950, however, technological change appears to have become more important, accounting for 30 to 50 percent of output growth.

If in fact there was little technological change before 1945 or 1950 and if land and labor tend to be complementary in use, then, unless other important factors were affecting the wage rate, the behavior of wages over the pre-1950 period as a whole might suggest that capital was competitive with labor. During this period the real price index for agricultural commodities was rising; in the absence of any

<sup>26</sup> Nonetheless, looking at the problem from this angle may provide useful insights, even when only output composition can actually be observed.

<sup>27</sup> A labor force increase should be taken into account as well. Reasonably firm data are only available for censal years, but it seems that the agricultural labor force has been increasing rather systematically at one percent per year for some decades; if the violence interrupted this process somewhat, the interruption appears not to have been protracted.

technological change the increase in land per worker would have been expected to exert upward pressure on the wage rate; yet, during the period of the mid-1930s to the late 1940s, wages did not rise, but rather fell. If technological change was not important, the decrease in wages was presumably not due to labor-saving technological change—impressionistic evidence confirms this. The main forms of capital formation were investments in cattle, plantations, construction, and soil improvement, none of which appears as likely to be competitive with labor as, for example, machinery.

In fact, however, exogenous factors like the violent civil disturbances and sharp changes in the general price level may have been important determinants of wage movements. It has frequently been argued that the land law of 1936, which required that tenants be paid for their investments in the farm, led landlords to undertake to farm their land directly; this would have increased the supply of labor and helped decrease the wage rate in the late 1930s and early 1940s. Another possibility is that the wage rate of the early 1930s had been above its equilibrium level due to greater downward rigidity of wages than of prices. When inflation reappeared in the late 1930s and early 1940s the wage fell back to equilibrium. If this was so, its fall requires no explanation in terms of the real factors mentioned above. Between them, these two exogenous factors probably explain the decreasing wage and labor share of the period in question. The subsequent wage increase (1943–50) could have been a result of the general expansion of the agricultural sector in the absence of important labor-saving technological change; this interpretation suggests that capital was not sufficiently competitive with labor to have caused decreasing wage rates in the face of output growth.<sup>28</sup>

The explanation of changes in factor prices since 1950 has more current interest, but again no clear picture emerges from the information available. The rapid burst of mechanization from the late 1940s to about 1956 did not lead (at that time) to a lowering of the average wage rate, though its association with the advance of such low labor-demanding crops as rice, barley, sesame, and sugar for refining (corn and wheat when produced with machinery) suggests that it might have been expected to do so.

#### OUTPUT COMPOSITION, CHANGING FACTOR SHARES, AND CHANGING COMPARATIVE ADVANTAGE OF SMALL AND LARGE FARMS

It was noted earlier that an independent determinant of changes in factor shares over time would be changes in composition of demand among crops which (a) use different factor proportions or (b) have different adaptability to small and large farms.<sup>29</sup> In this section empirical evidence on factor proportions and factor shares corresponding to various agricultural commodities is presented, along with data on the relationship between farm size and product composition of output. It is necessary to note carefully that factor proportions used to produce the same crop may vary tremendously among farms, so that the only fully satis-

<sup>28</sup> Changes in land distribution could also have changed the demand for labor, but apart from possible movements between the categories "tenants" and "landless workers," there is little evidence of large scale changes. Certainly many people lost their lands during the *violencia*, but most large farms remained large.

<sup>29</sup> Changes in output composition which simply reflect changing factor proportions and factor prices would of course not be an independent determinant.

TABLE 8.—VALUE ADDED, LABOR INCOME, AND LABOR SHARE FOR SPECIFIED PRODUCTS, 1958 AND 1966, WITH COMPARISONS\*  
(Pesos per hectare, except as otherwise indicated)

Commodity	Value added <sup>a</sup>		Labor income		Labor share (percent) <sup>b</sup>			
	1958	1966	1958	1966	1958	1966	"Future"	Other <sup>c</sup>
PERENNIALS								
Coffee	1,950	3,340	475	1,380	24.5	40.0		
Cacao	...	...	270	790	...	...		
Bananas, export	3,700– 5,500	7,300– 10,900	290	840	8.0 <sup>d</sup>	11.5 <sup>d</sup>		
Plantains	...	...	250	730	...	...		
Sugar, for refining	3,100	10,000	500	1,100	16.1	11.0		
Sugar, for panela	1,100	2,650	530–810	1,540	45–65	55		
ANNUALS—RELATIVELY MODERN TECHNOLOGY								
Barley	870	1,900	80	240	10	12		
Cotton	1,340	2,300	380	1,100	28	48	15–30	
Rice	960	2,425	215	625	22	26	12	
Sesame	550	1,980	150	440	27	24	15–18	
ANNUALS—RELATIVELY TRADITIONAL TECHNOLOGY								
Beans	600	1,700	380	1,100	60	60	12	
Corn	425	1,030	200	580	47	50	13	
Potatoes	3,200	7,325	630	1,830	20	25		45, 54
Tobacco	2,890	7,630	1,960	5,700	63	68		
Wheat	510	1,350	135	390	26	29		33, 44
Yuca (manioc)	950	3,670	385	1,120	40	30		
ANIMAL PRODUCTS								
Cattle								25 <sup>e</sup>

\* Figures on value added per hectare were based on value of output per hectare figures from U.S. Dept. Agr., *Changes in Agricultural Production and Technology in Colombia* (For. Econ. Rept. 52, 1969), and a variety of sources from which estimates of the share of value of output corresponding to purchased inputs could be made or adjusted, including 6, 14, 20, and 22.

The data in the "Future" column are based on figures presented in 22 and correspond to what the study refers to as "future" technologies and cost structures.

<sup>a</sup> Labor income is calculated as man days times daily wage rates which vary from crop to crop based on differences in the type of work, the region in which the crops are grown, etc.

<sup>b</sup> Labor share is likely to be unstable, at least for commercial operations and for crops whose yields and/or prices fluctuate considerably.

<sup>c</sup> Other estimates come from crop studies and are designed for comparison with the author's estimates, which may be downward biased.

<sup>d</sup> Equal to or less than the indicated shares.

<sup>e</sup> Estimate for 1960 based on the author's estimate of the number of people engaged in cattle raising (about 380,000 in 1960) and Central Bank-based estimates of value added.

factory specification of the relationship among factor proportions, farm size, and crop would refer to the factor proportions for "crop *i* grown on type of farm *j*," this level of detail, unfortunately, is not available.

Despite the spotty and at times rather impressionistic nature of the information on factor shares for various crops and animal products, estimated shares differ so much among products that there is little danger in categorizing certain crops as labor intensive relative to others. Table 8 summarizes our estimates of labor's contribution to production of the major crops and of cattle. It seems clear that the labor-intensive crops (as defined by high labor share of income generated) are

tobacco, cane for panela,<sup>80</sup> corn, beans, and yuca (manioc). Potatoes also probably belong in this group of products with labor shares in the 40 to 70 percent range. In contrast are the relatively commercialized annuals (cotton, rice, barley, and sesame) all of which typically have labor shares below 30 percent.<sup>81</sup> The tree crops, including coffee during the period of high prices, generally have labor shares below 30 or 35 percent; with prices corresponding to the long-run average, coffee's labor share may well be above 35 percent<sup>82</sup> (our estimate for 1966 was 40 percent). The crops with high labor shares are also the ones with high labor income per hectare; coffee joins the ranks of the highest labor income crops, and potatoes surpasses some of those with higher labor shares (these two are, of course, among those having the highest value added per hectare).

For cattle (taking beef and dairy together), the labor share appears to be about one-quarter, making it lower than for all crops taken together (for which the figure is probably about 35 to 40 percent). The smaller livestock (pigs and poultry) probably have a higher labor share, so the share for all livestock would be a little higher, about 25 percent, since cattle is the most important animal industry.

The average labor share for any given crop depends on the proportion of it that is produced on large commercial farms; the commercial technology for barley implies about the same share as that for wheat; the same is true of the two traditional technologies, but the average share is lower for barley since it is a more commercialized crop. For many crops (e.g., wheat, barley, rice, corn, potatoes, sugar) the labor share is likely to vary by four or five times between the commercial and the traditional technologies. The former is likely to produce a higher yield per hectare and often a higher value added per hectare, while using much less (though sometimes higher cost) labor.

It is clear from the data of Table 8 that, at least as far as crops are concerned, changing composition of output partially explains the decreasing labor share over time in total agricultural income (Table 7). Most of the high labor share crops have had slow output growth over the last two decades or more; thus the average annual growth of output of panela, beans, tobacco, corn, and yuca over 1950-67 was about 2.4 percent; that of all crops was about 3.6 percent over the same period. Commercial crops (cotton, rice, barley, sorghum, sugar for refining, sesame, soybeans) had output growth of about 7.5 percent and raised their

<sup>80</sup> Panela is usually processed in rural areas or small towns where it provides considerable employment. The "trapiches" (presses) of which there were close to 60,000 in 1960-61 are scattered throughout much of the country. Many are small operations on small farms using family and other low cost labor. Processing and production of cane imply a very high labor income per hectare per panela (see 1).

Processing of coffee on the farm is also labor-using and causes the figures presented in Table 8 to understate somewhat the farm-labor income associated with one hectare of the product. But the share of all coffee-related labor associated with processing seems to be small, estimated at 15.2 man-hours per 100 kilograms of unthreshed coffee (coffee is normally threshed in industrial mills) in a study by the Economic Commission for Latin America (ECLA) and the Food and Agriculture Organization (FAO) (see 25, p. 64). This is only about 2 percent of the field hours. Almost 90 percent of the coffee farms in the ECLA-FAO sample had their own processing (depulping) plants and 88 percent of these were small and hand operated.

<sup>81</sup> The figure of 48 percent for cotton in 1966 does not seem to be typical of that crop; in several years other than the two considered here, it was below 30 percent.

<sup>82</sup> Theory would suggest that the labor share fall, in the short run at least, when coffee prices rise in a context where labor is not in short supply. The much lower labor share for 1958 (the last year for which internal coffee prices were maintained at a high real level) than for 1966 is consistent with this. (The ECLA-FAO study estimated a labor share of value of product of about 24 percent for 1955-56, consistent with our 1958 estimate.)

TABLE 9.—PERCENTAGE OF HARVESTED AREA OF SPECIFIED CROPS GROWN ON SMALL AND LARGE FARMS AND PLOTS, 1960 AND 1966\*

Crops	Farms of 5 hectares or less		Farms of 50 hectares or more		Plots of 5 hectares or less 1960	Plots of 50 hectares or more 1960
	1960	1966	1960	1966		
PERENNIALS						
Coffee	21.6	18.7	20.8	22.0	48.4	8.0
Cacao	16.5	15.0	29.4	29.8	63.5	3.8
Bananas, export	13.6	13.8	43.8	40.6	52.8	25.6
Plantains	21.8	19.9	24.2	28.5	78.2	1.6
Sugar	18.4	15.7	40.0	40.7	51.9	25.6
ANNUALS—RELATIVELY MODERN TECHNOLOGY						
Barley	21.2	31.3	39.1	41.8	44.5	23.6
Cotton	8.3 <sup>a</sup>	2.2	50.7 <sup>a</sup>	85.3	...	...
Rice	7.1	6.7	66.7	68.0	29.1	32.3
Sesame	22.2	22.5	36.3	44.0	35.1	16.6
ANNUALS—RELATIVELY TRADITIONAL TECHNOLOGY						
Beans	24.2	25.5	29.3	31.7	64.8	9.5
Corn	26.6	24.6	31.2	36.9	61.7	7.6
Potatoes	31.8	39.9	19.9	20.1	67.4	4.2
Tobacco	41.0	37.8	10.2	21.8	84.8	1.6
Wheat	30.6	33.7	16.9	24.7	64.9	5.7
Yuca (manioc)	24.7	19.8	24.2	35.2	87.7	.8

\* For all crops but cotton the 1960 figures calculated from Colombia, Departamento Administrativo Nacional de Estadística, *Directorio Nacional de Explotaciones Agropecuarias. (Censo Agropecuario), 1960: Resumen General (segunda parte)* (Bogotá, 1964). For cotton calculated from Instituto de Fomento Algodonero, *Colombia, Su Desarrollo Agrícola: Algodón y Oleaginosas, 1961–1962* (Bogotá, 1963). For 1966 all figures are based on U.S. Dept. Agr., *Agricultural Productivity in Colombia* (For. Agr. Rept. 66, 1970), pp. 24–26.

<sup>a</sup> Refers only to the interior of the country; probably large farms are somewhat more important on the coast; not comparable with 1966.

share of total crop output from about 10 percent in 1950 to about 25 percent in 1967.<sup>83</sup> This change in output composition must have contributed substantially to the lower average labor share.<sup>84</sup> And since the more rapidly expanding crops tend to be grown on large farms, it has also presumably lowered the small producer's capital income associated with a given output. Although there is no reliable time series data on factor proportions for given crops, it is plausible to assume that for many the labor share has fallen (holding size of farm on which it is grown constant). This might or might not explain a large part of the secular decline.

Table 9 contrasts crops according to whether they are typically produced on small farms, large farms, or both and according to the size of plot sown to them. The small farm crops are essentially the traditional technology annuals, especially tobacco, potatoes, and wheat, with beans and corn also ranking high in share of area cultivated on small units. The crops most characterized by being produced

<sup>83</sup> Based on the data in 27.

<sup>84</sup> If the labor share of each crop had remained constant over this period at the value observed in 1958, the labor share for the set of products mentioned here would have fallen from 41.3 in 1950 to 36.7 in 1967.

on large farms are cotton and rice. The concentration of production on large plots (as well as on large farms) indicates that for rice these were large operational as well as ownership units. Indirect evidence indicates that the same is true for cotton.<sup>85</sup>

*The Social Efficiency of Farms of Different Sizes*<sup>86</sup>

It is of interest, both to understand whether the increasing spread of income distribution in agriculture has been an inevitable result of the process which leads to increased output, and to evaluate future policies bearing on distribution, to see whether the source of the inequality of distribution (the concentration of land) appears to be a necessary condition for output growth. Part of the answer to this question involves a comparison of the relative efficiencies of farms of different sizes.

The concept of "efficiency" as applied to a producing unit is likely to have meaning only in the context of a specific policy or policies which would alter the distribution of factors among producing units. Before considering some of the complexities of drawing efficiency interpretations out of knowledge of the single and total factor productivities by farm size, we review the available data and the possible explanations for those differences which emerge.

The figures of Table 10 show that value added per effective hectare and per peso of capital (including land) decreases with farm size while output per person increases. The general nature of these results is by now common enough from work in other countries (e.g., India, Brazil) to warrant little comment;<sup>87</sup> however, the magnitude of the differences in output per worker and in output per hectare across farm sizes is striking. Output per worker is about ten times as high for the largest size category used here as for the smallest, while output per hectare is only 10 percent as high. Most of the difference in output per hectare seems to be due to the lower average quality of land on the larger farms (see value added per "effective hectare" in Table 10). According to our best estimate, the ratio of value added to either value of land or value of land and capital is only about twice as high on the farms of 0 to 5 hectares as on those with more than 500 hectares. These results, which are based on national aggregate data and therefore subject to the various weaknesses of such data, are corroborated by micro data collected by James Grunig.<sup>88</sup>

<sup>85</sup> For farms of given size which produce it, the average amount sown in cotton is greater than the parallel amount in the case of rice. While this does not prove that the average cotton operation is larger than that for rice, it suggests that it is unlikely to be much smaller (see 26, p. 25).

<sup>86</sup> Among the few studies which have given some attention to relative efficiency (in any terms—private or social) of different farm sizes are those by the Comité Interamericano de Desarrollo Agrícola (CIDA) (13), K. B. Griffin (17), and J. E. Grunig (19). The study by CIDA, while presenting much valuable and interesting information, introduced one untenable assumption into its methodology for calculating output per hectare, i.e., that yields for a given crop were not dependent on farm size. The use of the output/hectare ratio ignoring land quality as a measure of relative efficiency is also highly dubious. Both of these aspects of the CIDA methodology biased the results in favor of the small farms. Griffin presented a clear exposition of why factor ratios might differ by farm sizes but used the CIDA data (see 17).

<sup>87</sup> The decreasing output per hectare with farm size was mentioned in the cases of India, Brazil, and Mexico in 17. The same result holds also in Egypt, Taiwan, and in every country for which I have seen the calculation made, with the exception of Japan, where the variable output/hectare seems to be independent of farm size.

<sup>88</sup> Grunig's data on latifundios were from samples taken in Meta and Valle in which he tried to include all types of operators, from the most efficient to ones at or near the other extreme (19). The

TABLE 10.—FACTOR PRODUCTIVITY AND FARM SIZE IN COLOMBIA, 1960\*  
(Value figures in thousands of 1960 pesos)

Farm size (hectares)	Value of output per worker	Value added			Ratio to value of land and capital	Value of crop output per hectare of crops and fallow	Man years of labor per effective hectare <sup>a</sup>
		Per worker	Per effec- tive hectare <sup>a</sup>	Per hectare			
0- 3	1.83	1.67	.75	1.37	.35	1.05	.45
3- 5	2.37	2.08	.79	.86	.36	1.02	.38
5- 10	3.15	2.71	.50	.73	.33	1.04	.19
10- 50	4.15	3.47	.57	.44	.25	0.96	.16
50-500	7.66	6.18	.38	.23	.16	0.88	.06
Over 500	17.16	15.07	.35	.13	.14	0.89	.023
TOTAL	4.44	3.71	.462	.285	.204	0.953	.128

\* Calculations by the author; see Appendix: Statistical Note. Value of output, value added, and number of workers as for Table 1. Number of effective hectares based on Comité Interamericano de Desarrollo Agrícola, *Tenencia de la Tierra y Desarrollo Socio-Económico del Sector Agrícola en Colombia* (Union Panamericana, Washington, 1966), and adjusted for underenumeration which is believed to be more severe on large farms than on small farms. Value of land and capital is based on the CIDA publication cited above combined with author's estimate of farm size. Cropped hectares (including fallow but excluding land used for livestock production are from Colombia, Departamento Administrativo Nacional de Estadística, *Directorio Nacional de Explotaciones Agropecuarias (Censo Agropecuario)*, 1960: *Resumen General (segunda parte)* (Bogotá, 1964).

<sup>a</sup> An "effective hectare" represents land with a given value regardless of the actual number of hectares. In the present study it is arbitrarily defined as land with the same value as the average hectare held in farms of 4 to 5 hectares. Thus for land with half the value per hectare of that in farms of 4 to 5 hectares, an "effective" hectare would consist of 2 hectares.

The usual measure of efficiency of resource utilization is total factor productivity, i.e., value added divided by cost of resources. Where market prices of factors do not represent their social opportunity costs, the parallel measure (which might be called "total social factor productivity") is output (i.e., value added) divided by value of factors used, measured at their social opportunity costs. The assumption that product prices represent social value is not too far fetched, and the prices can be adjusted if that assumption can be improved on. The parallel assumption for factors is implausible, especially for labor, but it is not clear what social cost should be applied; the average wage rate is presumably an upward biased measure—zero is probably too low. Nor is it obvious what the opportunity cost of capital is. Hence it is advisable to test the sensitivity of the efficiency ranking of farms to alternative opportunity cost levels for capital and labor chosen.

In the present case, for almost all plausible assumptions about social opportunity cost of factors, total social factor productivity is higher for relatively small farms. Even when labor's annual opportunity cost is based on the recorded average wage rate (and assuming 250 days as a typical working year), the larger farms' productivity is only about equal to that of the smaller ones, i.e., the implicit rate of return to investment in land and capital does not vary significantly with farm size (see Case 1 of Table 11); the smallest farms (0 to 3 hectares) are relatively inefficient but the other groups are all close to average, with some suggestion that those in the 5 to 50 range are the most efficient. The use of other as-

minifundia data, from samples taken in Boyaca, Caldas, Meta and Valle, followed the same principle. His latifundia fell within the size range 50 to 60,000 hectares. (Average size was 573 hectares for the sample in the Cauca Valley and 2,742 in Meta.) Average sizes for different categories of minifundia ranged between 2.3 and 37.5 hectares; most of these farms were 10 hectares or less.

TABLE 11.—RELATIVE SOCIAL EFFICIENCY AND IMPLICIT RETURNS TO CAPITAL BY FARM SIZE WITH VARYING ASSUMPTIONS CONCERNING THE OPPORTUNITY COST OF LABOR\*

A: ASSUMED OPPORTUNITY COST OF LABOR (1960 pesos per year)

Labor category	Case 1	Case 2	Case 3
Non-white-collar	1,400	700	0
White-collar	8,000	8,000	0

B: CALCULATED INDICATORS

Farm size (hectares)	Case 1		Case 2		Case 3	
	Coefficient of efficiency	Implicit social rate of return to capital	Coefficient of efficiency	Implicit social rate of return to capital	Coefficient of efficiency	Implicit social rate of return to capital
0-3	.85	5.69	1.16	20.48	1.73	35.3
3-5	1.00	11.84	1.30	24.11	1.79	36.4
5-10	1.14	15.92	1.36	24.45	1.62	33.0
10-50	1.10	14.05	1.16	19.04	1.21	25.0
50-500	0.98	11.46	0.87	13.27	0.78	16.0
More than 500	1.00	11.82	0.81	12.47	0.69	14.0
TOTAL	1.01	11.98	1.01	15.82	1.00	20.4

\* Calculations by the author. In all these cases labor is assumed to be homogeneous except for employed white-collar workers, and product prices are assumed to equal marginal social benefit. The coefficient of efficiency is calculated as value added divided by  $w(L) + r(K)$  where  $w$  and  $r$  are the social opportunity cost of labor and the social opportunity cost of capital assumed. For a given set of assumptions, the same  $w$  and  $r$  are applied for all farm sizes;  $r$  is therefore the average rate of return to capital implied by the social opportunity cost of labor assumed. The implicit social rate of return to capital is calculated as the implicit social productivity of capital (value added minus the social opportunity cost of labor) divided by the value of capital (including land).

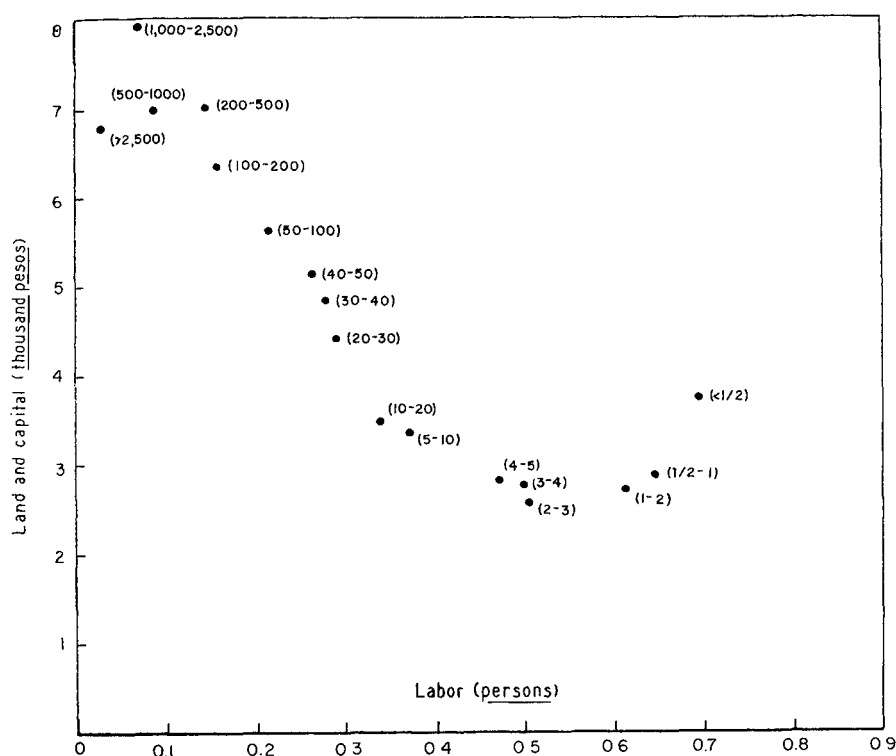
For further details and other cases see R. A. Berry, "The Development of the Agricultural Sector in Colombia" (Yale Univ. Press, forthcoming).

sumptions about the opportunity cost of labor (Cases 2 and 3 of Table 11), gives the smaller farms (especially those of 3 to 10 hectares) a clear-cut efficiency advantage, the relation being monotonic for groups over ten. The 5 to 10 hectare size group stands out as the most efficient over the full range of plausible assumptions.<sup>39</sup> A more detailed breakdown by size suggests that the smallest farms (those below 2 hectares) are dominated (see Chart 3).<sup>40</sup> The average labor and capital inputs for the other farm sizes suggest (roughly) that any size could be socially efficient, depending on the social opportunity cost ratio; in fact, the input combinations corresponding to a given production level (in terms of pesos of value added) lie almost along a straight line. It is interesting that this is what would be predicted if factor prices were the same for the different farm sizes.

<sup>39</sup> A set of assumptions about resource distribution extremely favorable to the large farms (relative to the best estimate) implies greater efficiency for them as long as the social cost of labor is 700 pesos per person or higher. It implies little relation between efficiency and size for a social cost of labor equal to zero. In other words, if a zero opportunity cost assumption for labor were valid, the chance that correctly measured factor inputs would indicate a greater efficiency to large farms than for small ones is infinitesimal. If the social cost were one-half the wage (700 pesos) it is possible, but quite improbable, that the large farms are more efficient than the small ones.

<sup>40</sup> That is, they use more of both factors per unit of output generated than do one or more other size categories; hence there is no factor price ratio at which they would be economically more efficient than those other size categories.

CHART 3.—LABOR AND CAPITAL INPUTS IN THE GENERATION  
OF THOUSAND PESOS VALUE ADDED  
(Farm size in hectares shown in parentheses)



Calculations presented in Table 11 are suggestive, but the efficiency coefficients and rates of return to capital should not be accepted as accurate (even abstracting from the statistical deficiencies) since the implicit assumption that the capital and labor on farms of various size are homogeneous cannot be taken seriously; its use provides only a set of benchmark estimates. Among the ways in which this assumption is probably invalid are: (a) failure to take account of the fact that the larger the farm the greater the educational level and therefore the human capital of the operator (though large farms managed by administrators may not fall into this pattern); (b) the social cost of a peso's worth of capital may differ among farm sizes; for example, the large farms—especially the medium-large farms involved in commercial-crop growing—use the bulk of the machinery, whose purchase price understates its social opportunity cost due to the overvaluation of the exchange rate; and (c) the market price of capital produced largely with surplus labor may overstate its social cost—this type of capital is characteristic of some small farms.

#### *Implications of Socially Inaccurate Product Prices*

Just as market prices of factors may not correctly measure social opportunity costs, product prices may not correctly measure social benefits of a given product. Probably the main discrepancies between market prices and marginal social bene-

TABLE 12.—INDICATORS OF RELATIVE SOCIAL EFFICIENCY OF FARMS BY SIZE:  
PRODUCT PRICES UNADJUSTED AND ADJUSTED\*

Farm size (hectares)	Product prices unadjusted		Product prices adjusted			
	Coefficient of efficiency	Implied social rate of return to capital	Coefficient of efficiency		Implied social rate of return to capital	
			Est. R	Est. S	Est. R	Est. S
0-3	1.16	20.5	1.09	1.07	15.9	16.2
3-5	1.30	24.1	1.17	1.15	17.7	18.2
5-10	1.36	24.5	1.18	1.16	17.3	17.8
10-50	1.16	19.0	1.06	1.05	14.5	15.1
50-500	0.87	13.3	0.92	0.93	12.1	13.0
Over 500	0.81	12.5	0.98	1.00	12.9	14.2
TOTAL	1.01	15.8	1.00	1.00	13.3	14.2

\* Calculations by the author. Columns 1 and 2 are Case 2 from Table 11. Product prices are adjusted in Estimate R on the assumption that social value/market price ratios are as follows: coffee 0.6; bananas, rice, sugar, and cotton 1.5; and all other products 1.0. Estimate S adjusts on the same assumptions as R except that the ratio for cattle is 1.2.

fits are for coffee and other export or potential export crops. The price of coffee is usually above that required to induce production of the amount that can be exported under the International Coffee Agreement, so the marginal social productivity of another bag is probably close to zero. For other export crops the overvaluation of the exchange rate means that domestic prices are likely to be underestimates of social productivity; here the important crops are bananas, rice, sugar, and cotton. If one applies shadow prices for these various crops, the social productivity of the large farms rises relative to that of the small ones, since coffee is grown primarily on small and medium-sized farms and the others are large farm crops. In Table 12 estimate R is based on the (guesswork) assumption of a ratio of social value to market price of 0.6 for coffee and 1.5 for bananas, rice, sugar, and cotton. This implies a better relative performance for the farms over 50 hectares, but still leaves them with substantially lower measured efficiency than the smaller farms. A second estimate (S) further assumes that the ratio of social value to market price for cattle was 1.2; this assumption decreases the relative efficiency difference further but leaves the 5 to 10 hectare category still 15 to 20 percent above the farms of over 50 hectares.<sup>41</sup>

#### *Explanations of Differing Social Efficiency of Farms by Size*

The most plausible explanations of the greater total social factor productivity of small farms are their lower price of labor and higher price of capital and the greater incentive associated with low income levels which shows up, according to some observers, in a higher average quality of entrepreneurship on smaller

<sup>41</sup> It is true, though, that if all of the product price adjustments referred to here are made, and the most favorable (to the large farms) assumption as to the distribution of land and capital is made and the most favorable assumption as to the social cost of unskilled labor (1,400 pesos per year) is made, then the efficiency coefficient is higher on the large than the smaller farms. The size category 500 and up is then up to 50 percent more efficient than the 5 to 10 category, with the advantage over the 0 to 5 range even greater. As the discussion has indicated, the likelihood that all these assumptions are valid is extremely small.

farms.<sup>42</sup> Factors most frequently hypothesized as working in the opposite direction are economies of scale and the greater ease of adoption of improved technology by the better educated and financed holders of large farms.

Colombian evidence suggests that most of these factors are at work, at least in parts of the agricultural sector. Technological advantage of the large farm is suggested by the greater average yields for specific crops, a differential which in 1966 apparently reached 2:1 or more for wheat, barley, sugar, and potatoes. For other crops there is little or no differential, but in no case does there appear to be a negative relation between farm size and yield. One index of the yield differential (specifically "value of produce on a hectare with the same crop composition as that of the crop sector as a whole") was a little over 50 percent higher for farms of over 500 hectares than for those under 2 hectares (see Table 13). When weighting did not allow differences in value of product per hectare to enter, the difference was slightly more marked.<sup>43</sup> The smaller differential measured by the first index reflects the tendency of the smaller farms to concentrate somewhat more on higher value crops; this tendency was not nearly strong enough to make the value of crop output per hectare harvested greater on smaller farms (Column 5) though value of output per hectare of cropped plus fallow land was greater on them. Value added per hectare is undoubtedly a less positive (more negative) function of farm size, since associated with the more modern technologies which produce the higher yields on the larger farms is a higher ratio of purchased inputs to value of output; we do not have figures adequate to permit quantification of this difference, however.

It may seem surprising that despite lower yields of most crops, the smaller farms have higher value added per unit of scarce resources (land and capital). The major proximate factors associated with this phenomenon appear to be their smaller use of fallow and the much greater proportion of their land directed to crops relative to livestock (more precisely, cattle). This is, however, difficult to substantiate statistically. The difficulty is due to the nonhomogeneity of land and the apparently substantial difference in average land quality by farm size. One would need detailed production function information to know for what share of all land cattle would be the most productive use with given relative prices of the other factors. The information at hand does not permit one to judge whether the average quality of cropped land is higher on large farms or on small ones; if, for example, it is lower on large ones but much good land is in pasture, the conclusion that low total factor productivity is due to misallocation between these two broad uses would clearly hold. If little good land is in pasture, and the average quality of cropped land is very high (remember that we do have a measure of

<sup>42</sup> The entrepreneurship question is a somewhat subtle one. If better entrepreneurship and the operation of small (or large, as the case may be) farms were not casually related but both were related to a third factor (e.g., wealth), then different factor productivities related to the entrepreneurial differences should not be ascribed to farm size. Failure to allow for the nonhomogeneity of the factor would, of course, imply a bias in the relative values of total factor productivity. If farm size over the short or the longer run is a determinant of entrepreneurial capacities, then it would be of interest to measure factor productivity in a way which took account of entrepreneurial differences only to the extent that these were not a result of farm size.

<sup>43</sup> The data (from 9) are not very trustworthy but are adequate for our purposes here. It is possible that they exaggerate yield differences by farm size since higher yields on large farms appear to have been expected by the technicians designing the sample and the interviews. But there is no doubt that the larger farms do have higher yields.

TABLE 13.—DIFFERENCES IN YIELD, BY FARM SIZE, FIRST SEMESTER OF 1966\*

Farm size (hectares)	Index No. 1. <sup>a</sup> Value of product per hectare cropped (1)	Index No. 2. <sup>b</sup> Weight of product per hectare cropped (2)	Index No. 1A. <sup>c</sup> Value of product per hectare cropped and fallowed (3)	Index No. 2A. <sup>c</sup> Weight of product per hectare cropped and fallowed (4)	Value of crop output		Cropped land as percent of	
					Per hectare cropped (thousand pesos) (5)	Per hectare cropped and fallowed (thousand pesos) (6)	Arable and pasture land (7)	Cropped and fallowed land (8)
0-2	94.2	94.1	80.5	80.4	1.23	1.05	.87	.85
2-5	96.8	97.7	81.6	82.4	1.22	1.03	.77	.84
5-10	96.7	98.7	79.4	81.1	1.27	1.04	.66	.82
10-20	100.0	100.0	78.5	78.5	1.34	1.05	.56	.78
20-50	96.8	96.4	68.1	67.8	1.25	.88	.44	.70
50-200	117.8	118.0	68.8	68.9	1.50	.87	.28	.58
200-500	140.3	140.0	70.7	70.5	1.79	.90	.18	.50
Over 500	147.4	153.5	67.3	70.1	1.99	.89	.06	.46

\* Calculations by the author. See Appendix: Statistical Note. Columns (1) and (2) are based on 1966 area and yield data by size of farm from U.S. Dept. Agr., *Agricultural Productivity in Colombia* (For. Agr. Rept. 66, 1970), and on unpublished data from Banco de la Republica [prices used in constructing the national accounts], "Cuentas Nacionales, 1950-1967" (Bogotá, 1968). Columns (3), (4), and (8) use fallow to cultivated land ratios based on Colombia, Departamento Administrativo Nacional de Estadística, *Directorio Nacional de Explotaciones Agropecuarias (Censo Agropecuario), 1960: Resumen General (segunda parte)* (Bogotá, 1964). Columns (5) and (6) are as for column (1) and Table 11, and column (7) is based on the 1966 census cited above.

<sup>a</sup> Average for farms of all sizes = 100. For each crop yields in kilograms per hectare by farm size are converted to pesos per hectare, and expressed as relatives to their average for all sizes of farms. These relatives for individual crops are combined weighting them by the share of all cropped land devoted to the specified crop. This assumes that the percentage distribution of crops in each farm size category is the same as that for all sizes of farms.

<sup>b</sup> Average for farms of all sizes = 100. Calculated as for Index No. 1 except that relative yields in kilograms per hectare are used instead of pesos.

<sup>c</sup> Same as Index 1 and 2 except that shares of all cropped land plus fallowed land are used as weights.

average land quality on each farm size), then misallocation may be rather unimportant and the real problem may be that there is low factor productivity within each of the crop and livestock subsectors.<sup>44</sup>

The other general question pertinent to the existence or nonexistence of a conflict between output maximization and distribution improvement is whether those technologies, forms of organizations, sizes of farm, or whatever which are optimal for achieving high output from the factors available tend to imply low labor utilization and hence unequal distribution of income. (We have already seen that average productivity of the scarce factors appears to be highest on the farms close to the low end of the size spectrum, so it is clear that economies of scale, if a positive factor, are insufficient to overcome other negative features associated with large size.) No general answer can be given, on the basis of existing empirical evidence, as to whether highly productive technologies are in general labor-using ones, but the available categorization of information by farm size—a categorization which as we have already seen is relevant for factor productivities—is also revealing with respect to relative labor utilization. Table 10 includes average "labor/effective hectare" ratios by farm size, and it is seen that the small farms are much more labor intensive.<sup>45</sup>

#### POLICY RELEVANCE OF THE ABOVE CONCLUSIONS

The fact that social factor productivity is higher on small farms than on large ones may suggest immediately that it should be rather easy to improve income distribution at the same time as output growth is successfully achieved. The fact, discussed earlier, that the skewness of the income distribution is closely related and primarily due to the concentration of land ownership and operation, would suggest that the obvious means of improving income distribution would be the redistribution of land, which should increase output as well. And it seems probable, though less certain, that increasing the access of smaller farmers to resources which are scarce for them would also have a favorable impact on distribution and output.

The existence of different factor returns on farms which differ in some way (e.g., size), coupled with the conclusion that groups may differ systematically in social efficiency, implies imperfect factor markets. Imperfect markets complicate the concept of social efficiency and may make impossible simple policy conclusions about which group of farms should be favored by public policy. To take the extreme case, if both labor and capital are more productive on one group of farms but the obstacles to moving those factors from other farms are insurmountable, then the differing efficiency has no policy implications. Or if total factor productivity is higher in one group but the productivity of the only mobile factor is lower there, output maximization will, paradoxically, dictate shifting that factor to the group of farms whose total factor productivity is lower. The figures of

<sup>44</sup> Under this interpretation the yield advantage of the larger farms would not necessarily imply a technical advantage even in the narrow one-crop context, since it could all be due to the higher land quality.

<sup>45</sup> There is some uncertainty with respect to the accuracy of the labor/land ratios, since there is no direct information applying to the country as a whole on labor distribution by farm size. But it is quite clear that the possible range of error does not imply the reversal of the relationship shown in the table.

Table 11 indicate that total social factor productivity varies with size, and suggest that factors probably receive differing returns according to farm size. Still, the existing situation could be "efficient" given the imperfections in the system. It is, then, of interest to draw out the policy implications of a given situation under varying assumptions as to which factors' allocations can be determined in part by public policy.

Broadly speaking, the information presented above might be relevant to two sorts of policy questions: (a) decisions affecting the size of farm units, e.g., the size chosen for the colonization of public or other newly settled lands, and the nature and extent of redistribution via agrarian reform; and (b) decisions involving the distribution (and possibly the pricing) of factors whose supply the government affects directly or indirectly, e.g., credit. The relevance of the figures presented above is perhaps clearer with respect to question (a). Table 11 indicates that, if the annual opportunity cost of labor is less than 1,400 pesos and the social opportunity cost of capital is equal for all farm sizes, then a given amount of land in small farms contributes more to national income than the same amount in large ones.<sup>46</sup> But this conclusion must be interpreted cautiously. First, it does not imply that taking land currently in large units and dividing it up will necessarily increase national income (or even agricultural output). There may, for example, be transitional costs associated with the movement of people who previously farmed smaller plots (or were landless) to the larger units and with the large operators moving to smaller units or out of agriculture entirely. If the entrepreneurial skills of operators are highly "size specific," when a farmer who now has 5 hectares is given 45 more he may be less efficient than the current 50-hectare farmer whose relatively inadequate performance is reflected in the data. The coefficients of efficiency of Table 11 refer essentially to *average* factor productivities across farm size; they do not represent, nor allow one to deduce, the relative marginal productivities of either factor or of both together.

Further, it must be remembered that relative social factor productivities reflect relative product prices. At present the composition of output on small farms is quite different from that of large ones, with each specializing in those products in which they have a "comparative advantage." The more land is redistributed from large units to small ones, the greater the output of the typically "small farm" products and the smaller the output of the typically "large farm" products; the resulting changes in relative product prices would tend to diminish the present differences in relative efficiency.

Given the political restraints on land redistribution, the central issue may more likely be the distribution of other factors and the key datum the relative marginal productivity of the "mobile" factors on different farm sizes. To consider the distribution of credit, a very realistic policy question, if it may be assumed that the impact of credit is to increase the capital stock (rather than to increase labor employed), then policy should be aimed at directing credit to those farms where the marginal product of capital is highest.<sup>47</sup> There is no necessary relation between a

<sup>46</sup> It also contributes more to agricultural output, since the "value of output/resource used" ratio is higher on the small farms, but this is not the more relevant question.

<sup>47</sup> Directly, of course, the objective is to allocate credit according to its own marginal productivity. For this, studies of that productivity itself are more useful than information about the marginal productivities of capital or labor.

high average productivity of capital and a high marginal productivity (though a low average productivity would more likely indicate a low marginal one), nor between a high total factor productivity and a high marginal productivity of any particular factor. Thus the higher coefficient of efficiency for 5 to 10 hectare farms does not necessarily imply that they be favored with more credit. The estimates of the rate of return to capital (cf. Table 11) are more relevant, but are based on arbitrary assumptions about the homogeneity of labor and its social cost, as well as being average rather than marginal values. Detailed and different information would be necessary to provide a basis for policy. Undoubtedly it would be necessary to consider land and capital separately, i.e., to think in terms of a three-factor production function. Suppose, for example, that due to imperfections in the factor markets a given farm category has much too much labor for the amount of capital, and as a result has a very low marginal (and average) product of labor and low overall efficiency. This is quite consistent with its having a very high marginal product of capital; unless production functions are substantially different across groups of farms, this is the natural expectation.

Despite the impossibility at this time of any very satisfactory interpretation of the interrelationship between size of farm and factor productivities, the data suggest strongly that unless a solution is found largely outside of the sector, there is no quick solution for the very unequal distribution of income in agriculture which does not involve land redistribution as an important and probably the major component. It seems unlikely that large farms will become more labor-intensive over time (the opposite is more likely),<sup>48</sup> and while there is no doubt that very small farms can be made more productive by improved technology and additional capital, it seems doubtful that over the short run (say 10 to 20 years) farms of less than 5 hectares can provide what might reasonably be considered a minimum income level in Colombia.<sup>49</sup>

The fact that large farms are relatively unproductive is in many ways less relevant than the fact that they generate a highly concentrated distribution of income via a very high land and capital share and a small hired labor share. For farms above 100 hectares, the share of total income going to blue-collar workers is probably not above 20 percent for any farm size and probably about 10 to 12 percent on average. The greater is the capital share, and the more uncertain is the future level and stability of demand for labor, the greater the advantages to having capital widely distributed so that a minimum of individuals depend exclusively on labor income.

#### CITATIONS

1 Asociación Nacional de Cultivadores de Caña de Azúcar, *Caña Tropiches y Panela en Cauca, Valle, Caldas: Colombia, 1964* (Bogotá, n.d.).

<sup>48</sup> Increasing renting could provide a vehicle whereby large farms could become more labor-intensive. But the current institutional context impedes such a solution; under agrarian reform law, a farm is more likely to be expropriated if it is operated by renters. A complete legal about-face would be required before the solution in question could offer much.

<sup>49</sup> This figure is, of course, a sort of average one; it would vary greatly according to region, soil, etc. Lauchlin Currie, in 16, used a figure of 3 hectares as defining a minimum reasonable income on coffee farms—but coffee is more productive than the average crop. In 1950, a farm of 5 hectares in the coffee zone (with say 2 to 3 hectares of coffee) provided an income of about 6,000 to 7,000 pesos on average, i.e., around \$1,000).

- 2 Banco de la Republica, "Cuentas Nacionales, 1950-1967" (Bogotá, 1968, mimeo.).
- 3 *Ibid.*, "1967-1969" (Bogotá, 1970, mimeo.).
- 4 R. A. Berry, "The Development of the Agricultural Sector in Colombia" (Yale Univ. Press, forthcoming).
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APPENDIX  
STATISTICAL NOTE

Key calculations central to both the estimates of income distribution among producers and to relative efficiency of farm size are presented in Appendix Table.

Estimates of value added by farm size were based on calculation of value of each product by farm size. The sources were as follows. Land use by crops, and as between crops and livestock, was based on the 1960 agricultural census (11). The only other source consulted in estimating the amount of land under each crop presented statistics on the distribution of farms on which cotton was grown in 1961 and 1962 (21). (DANE's agricultural census did not collect figures on cotton.) Proceeding from the figure on the amount of land dedicated to each crop by farm size in 1960, value of product was estimated taking into account (a) the relative yield by farm size calculated by DANE in its 1966 agricultural sample (12) and (b) a best estimate of the total output of each crop in 1960. This best estimate in most cases did not come from the agricultural census, which was not noted for accuracy in this respect. Thus the absolute yield figures applied to each farm size for a given crop were such that, given the relative yields of different farm sizes in 1966, they were consistent with the average yield implicit in (a) the best estimate of total output and (b) the land under the crop as measured in the agricultural census.

The agricultural census provided the basic information with respect to distribution of livestock by farm size. For cattle (by far the most important animal raised) it was clear that the census had severely underreported the total number of animals; and there was strong circumstantial evidence that the underreporting was primarily on the largest farms.<sup>1</sup> While the direction of bias in the census was therefore clear, its degree had to be estimated by rather arbitrary judgment. Some information was provided by cattle-pasture ratios observed in individual municipal studies, and information of *agronomos* with respect to the ratios typical for different regions of the country.<sup>2</sup> For hogs, sheep and goats, there was no evidence that the agricultural census contained a systematic bias, so its stock figures were used; for birds, eggs, and wool (based on the sheep population) the same was true. The estimates of value of production of animals and animal products were based on information on the age structure of the flocks or herds in question, and prices corresponding to different ages.<sup>3</sup> Where the estimate of total value of product for a given animal product built up from these stock and value change per year figures did not correspond to the Central Bank's independent estimate of the value of that product, figures were adjusted upward or downward to match the Central Bank's figure, unless there was independent reason to believe that it was weak. This was so only for milk (where an independent estimate was made) and for wool, birds, and eggs where the figures estimated by Jay Atkinson (27) were judged to be more accurate. With respect to these products the impact on the total of differences between the estimates finally used and those of the Central Bank would be quite small.

Limited information was available to estimate the ratio of value added to value of product by farm size. As of 1960, the Banco de la Republica estimated a ratio of almost .9 (for national accounts purposes) but other information suggested that this was too high, and the ratio calculated here was .84. No aggregate information for the country

<sup>1</sup> For example, those cattle regions characterized primarily by large farms were the ones in which the livestock estimate was low both with respect to contemporary estimates of the Banco Ganadero (unpublished) and with respect to the more accurate surveys which DANE has effected in more recent years, beginning in 1964. Discussion with people involved in the census was consistent with this conclusion.

<sup>2</sup> But only with final publication of the 1970 census—assuming that it has been more accurate in the estimate of this variable—will it be possible to double check the accuracy of the assumptions made here.

<sup>3</sup> For cattle and hogs the census made some distinction between sexes and among age categories. Prices were available from the unpublished statistics of the Banco de la Republica, used in the national accounts, and from data on prices of cattle of various ages sold at the fairs around the country and reported in the *Revista del Banco de la Republica*.

as a whole was available on purchase of inputs by farm size,<sup>4</sup> though statistics from various samples were available.<sup>5</sup> Some information was available on purchased inputs to specific crops, such as cotton, rice, and a few of the other commercial crops; and since the production of these by farm size was known, estimates of purchased inputs corresponding to part of the production of farms of a given size could be made with relative accuracy. Sources such as Thirsk (24) and unpublished statistics of the Banco de la Republica presented the ratio in question separately for crops and livestock. While there were many pieces of information, they could not be put together by any simple formula, so considerable judgment had to be applied in calculating the final ratio of value added to value of product for each farm size.

In order to calculate output per worker and total factor productivity by farm size it was necessary to estimate total labor use by farm size; and to estimate income of operators, it was necessary to have figures on the cost of hired labor. The total labor force in agriculture for 1960 was estimated at the figure recorded in the 1964 population census; while the average annual growth of the agricultural labor force in the intercensal period 1951-64 was about 1 percent per year, it appeared that the 1964 census had underenumerated rural adult population by at least 3 to 5 percent. The population census provided a breakdown of people into employers, independent operators, and employees (the latter distinguished as between white collar and blue collar, with the great majority falling in the latter category). The estimate of blue collar workers was the basis for an estimate of man-years worked by individuals on someone else's farm; the cost of this labor was assumed to be man-days (assuming 250 days per year) times the daily wage rate.

Distribution of the labor force by farm size (explained in more detail in 5) made use primarily of information in the agricultural census indicating the number of people living on farms within each size category, plus a variety of sample surveys—although none at anything near the national level—which indicated man days or man years on farms of different sizes. Grunig's data already referred to was one such source; the other major source was a series of ten municipal studies cited in 13. The two approaches produced quite similar distributions of the labor force by farm size. The distribution of non-hired labor was based essentially on the assumption of one producer per farm, with the exception of those farms managed by an administrator (this figure was available from the agricultural census). Hired labor on each farm size was therefore calculated as a residual between the estimate of total labor force and operator labor.<sup>6</sup> In the calculations of output per worker, family helpers were included in proportion to the number of operators; in calculations of labor cost, these individuals were not taken into account, since they did not represent a money outlay for the operator.

Rental payments by farm size were estimated on the basis of number of hectares in each farm size on which rent was paid (available from the agricultural census) and a ratio of .15 for rent to value of land.<sup>7</sup> Estimates of rental receipts by farm size were based entirely on impressionistic evidence to the effect that usually the rentor operates a larger farm than the rentee. It was assumed that one-half of all rental payments went to persons outside the agricultural sector, so only the other half was assumed as income of farmers.

The distribution of income for wage earners was based on the DANE figures on average wages in agriculture in each municipio of the country.

<sup>4</sup> Although the agricultural census presented data on which farms used fertilizers, no quantities were reported.

<sup>5</sup> For example, Thirsk's calculations (24) presented information for small and large crop and cattle farms based on surveys originally undertaken by James Grunig (see 18).

<sup>6</sup> The final estimate of hired labor by farm size, derived in this residual fashion, was checked against the survey information just cited, and the reasonably close fit again suggested the figures were not too far out. In the samples referred to, both figures were available.

<sup>7</sup> This ratio, above our best estimate of the rate of return to all capital in agriculture, took account of the fact that where land is rented some other factors are frequently also rented, so the implicit rental/value ratio for those factors rented would be between .1 and .15. The final results are quite insensitive to variation of this coefficient within a plausible range.

The overall income distribution was based on an integration of the distribution of income of producers and that of wage earners. For that range of individuals who had fairly equal shares of their income from both sources it was necessary to make arbitrary assumptions as to whether individuals receiving relatively high wages tended to have smaller or larger plots than those with lower wages. The lack of information on this score introduces an uncertainty with respect to the distribution among the bottom two or three deciles. Since the estimating technique for producers generated only an average income for those producers in a given size category, some assumption with respect to variance around that average had to be made; this was done arbitrarily, although it was ascertained that only at the very top of the income distribution were the results somewhat sensitive to variation of this coefficient within a plausible range.

Estimates of capital stock by farm size were made for machinery and livestock; in both cases the stock quantities came from the agricultural census, though as explained above, the figures for cattle were adjusted, due to the evidence of relatively greater underreporting for the larger farms. Statistics for the age structure of machines, and their average historical cost came from DANE (8). Since the estimate of value of land from the Geographic Institute Agustin Codazzi (7) conceptually includes such forms of capital as land improvements and plantations, a total estimate of value of land and capital corresponds to a summation of that Agustin Codazzi estimate plus the just mentioned estimates for machinery and livestock. The weaker link in this calculation is the land and improvement figure, since there is evidence of relatively different treatment by farm size; an attempt was made to correct for this on the basis of CIDA observations on this matter (13), but it is difficult to judge whether the correction produces a reasonably accurate figure.

Inevitably there is ambiguity as to what the major data weaknesses underlying the calculations are, but in the judgment of the author the most problematic areas are: (a) the value of land figures, (b) the distribution of salary payments across farm sizes, and (c) the relationship between income earned off the farm and amount of land held for the small operators. The percent error in these estimates is probably no greater than for some of the other variables, but some of the results are more sensitive to them.

APPENDIX TABLE.—INCOME OF PRODUCERS BEFORE DEPRECIATION OF FIXED CAPITAL, BY FARM SIZE\*  
(Millions of 1960 pesos except as otherwise indicated)

Farm size (hectares)	Value added (1)	Salaries paid to workers (2)	Income before rental payments (3)	Rental payments (4)	Rental receipts (5)	Gross income to producers (before depreciation)		Number of producers (thousand) (8)
						Total (6) = (3) - (4) + (5)	Per producer (thousand) (7) = (6) ÷ (8)	
Under ½	148.8	14.0	134.8	9.6	—	125.2	.7560	165.6
½-1	145.8	21.0	124.8	9.2	—	115.5	.8724	132.4
1-2	337.4	70.0	267.4	19.0	—	248.4	1.2980	191.3
2-3	295.7	63.0	232.7	15.3	4.8	222.2	1.8991	117.0
3-4	286.4	62.7	223.5	15.0	4.6	213.3	2.3185	92.0
4-5	198.6	44.2	544.0	10.2	9.5	153.3	2.6426	58.2
5-10	844.5	190.5	654.0	41.8	7.6	619.8	3.6665	169.2
10-20	895.7	228.4	667.3	40.7	7.5	634.1	5.562	114.2
20-30	432.3	122.3	310.0	19.4	5.1	295.7	6.712	44.050
30-40	313.6	105.7	207.9	12.5	20.9	216.3	8.166	26.500
40-50	226.3	76.5	149.8	8.1	20.4	162.1	9.981	16.240
50-100	735.8	221.5	514.3	23.7	9.7	500.3	12.507	40.000
100-200	706.1	170.8	535.3	20.7	6.3	520.9	23.354	22.300
200-500	821.7	189.0	632.7	21.2	4.0	615.5	44.927	13.700
500-1,000	533.3	105.6	427.7	10.9	11.9	428.7	103.53	4.140
1,000-2,500	441.6	77.7	363.9	6.8	10.4	367.5	186.07	1.975
Over 2,500	427.2	41.9	385.3	2.2	20.8	403.9	513.87	.786
TOTAL	7,790.9	1,804.8	6,047.2	286.4	143.5	5,843.2	4,883.600	1,209.700

\* See text for derivation of data. This is a revised version of Appendix Table A-4 in R. A. Berry and Alfonso Padilla, "The Distribution of Agriculturally Based Income in Colombia, 1960" (1970, processed).