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RURAL WAGES, LABOR SUPPLY AND LAND REFORM:
A THEORETICAL AND EMPIRICAL ANALYSIS

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The primary objective of this paper is to ascertain both theoretically and empirically the effects of a redistribution of land holdings on agricultural wage levels and sex/age wage differentials. Land reform is one of the most mentioned of the theoretical policy instruments discussed in the development literature, yet relatively little attention has been paid to the wage rate consequences of such a program, despite the fact that perhaps more than one half of rural families in a developing country receive over 50 percent of their income from wage earnings in agriculture.[1] One reason for this lacuna may be that the determination of wages and _family_ labor supply in the agricultural sector of LDCs has also been somewhat neglected, particularly in the context of a heterogeneous labor force.[2] The subsistence or institutional wage models of Lewis, Fei and Ranis and Rodgers, for instance, offer no theory of how wage levels or differentials are set and thus provide little guidance on how wage rates would be affected by changes in land ownership patterns. More recently, Bardhan and Srinivasan, Newbery, and Bell and Zusman, who formulate general equilibrium market or bargaining models determining endogenously the rental share paid by tenant sharecroppers have assumed that agricultural wage rates are exogenous. In particular, Bardhan and Srinivasan suggest that rural wage levels are influenced only by non-agricultural factors.

Another reason why the potential wage impact of a land reform program may have received little attention is that models of "peasant" family behavior, such as those of Sen, Mazumdar, and Mabro, typically embody two restrictive assumptions which would tend to make the

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equalization of landholdings appear wage-augmenting, although this implication has never been formally derived. These assumptions are that (1) agriculture is 'dualistic', with small-farm families facing lower shadow prices of labor (leisure) than large-farm landlords because of impediments to labor mobility and (2) agricultural households are 'dichotomous' -- "small" farmers employ family labor and maximize utility while "large" farms only utilize wage labor and maximize profits. As will be shown below, however, when this latter assumption is dropped, as appears consistent with data from India, the theoretical impact of a change in the distribution of landholdings on wage rates becomes ambiguous with the possibility that wage rates may fall as a consequence of a land reform despite dualism and/or decreasing returns to scale in agricultural production.[3]

In section I we show that there is a spatial distribution of agricultural wages and wage differentials for males, females and children across Indian districts which does not appear consistent with the institutional wage hypothesis or with the assumption that labor is homogenous. We also present descriptive data on the labor force characteristics of rural Indian households by land size which indicates that Indian agriculture is neither extremely dualistic nor dichotomous. In section II, a competitive, three-sector general equilibrium model of a dualistic agricultural labor market with two kinds of labor, consistent with the features of Indian agriculture discussed in section I, is formulated and the stability and other properties of the equilibrium are described. In section III, the necessary and sufficient conditions for a land reform having neutral, positive or negative wage effects are derived and parameterized with respect to economies of scale, the extent of agricultural 'dualism,' differential income-leisure effects on large and small farms, and the relative disparity in landholdings. The relationship between the distribution of land and wage rates in a monopsonistic labor market is considered in section IV. Section V contains an empirical analysis based on the theoretical framework in which the parameters of a six-equation simultaneous equations system describing the determination of rural wage rates and labor supply for the three age-sex groups are estimated. The results do not support the institutional or exogenous wage hypotheses, indicating that rural wages are influenced by shifts in demand and supply within the agricultural sector. Reduced-form coefficients derived from the structural estimates suggest that rural wage levels and a measure of landholding inequality are negatively associated, but that an equalizing land redistribution would exacerbate agricultural wage differentials between males and females.

I. Characteristics of the Rural Labor Market

To analyze the effects of a redistribution of landholdings on wage rates it is necessary that the units participating in the labor market and their behavior be specified in at least rough accord with the important characteristics of rural LDC markets. One of the salient features of the Indian agricultural labor force is its heterogeneity. There are (at least) three sex-age groups -- male, female and child --

who appear to perform different agricultural tasks and who receive different wage rates even for the same category of work.[4] The distribution of annual average daily agricultural wage levels and wage differentials by sex and age are displayed for 159 Indian districts from 13 states, 1960-61, in Tables 1 and 2.[5] While the inter-district variance in levels might be explained away by differences in consumer prices, the variation in inter-group wage ratios cannot. Wage levels for each sex-age group do not appear to be "pushed up" against some subsistence level, although the number of observations does not allow the standard Kolmogorov-Smirnov test to discriminate among different hypothesized distributions. Thus, as Hansen has demonstrated for rural Egypt, there does not appear to be either one institutional wage or a 'law of institutional wage differences' in India.

Few systematic attempts have been made to explain wage differentials in rural agriculture based on endogenous or within-agriculture factors. Rodgers tries to account for differences in wage levels across the villages he studied, based on a nutrition-productivity linkage, by hypothesizing that employers pay higher wages to males whose wives, because of religious beliefs or caste restrictions, were not participating in the labor market in order to maintain the male workers' consumption standard. Boserup, taking a market view, has hypothesized that rural male-female wage differentials are smaller where women participate less in the labor market, thereby implying that wage levels respond in some way to differences in labor supply. None of these hypotheses are formally derived or tested.

Table 3 displays various labor-force characteristics of rural households in India by gross cropped area, computed from an all-India survey of 5115 rural households collected by the National Council of Applied

Table 1 Distributions of Districts by Sex-Age Groups
and Size of Daily Wages, 1960-61
(annual averages)

Rupees per day	Men		Women		Children	
	Number	Percent	Number	Percent	Number	Percent
.25-.50					16	9.0
.50-.75			24	12.9	68	38.4
.75- 1.00	8	4.1	67	36.0	51	28.8
1.00-1.25	55	28.4	34	18.3	21	11.9
1.25-1.50	46	23.8	25	13.7	14	7.9
1.50-1.75	28	14.5	20	10.8	4	2.3
1.75-2.00	14	7.3	9	4.8	1	0.6
2.00-2.25	13	6.7	5	2.7	1	0.6
2.25-2.50	18	9.3	2	1.1	1	0.6
2.50-2.75	5	2.6				
2.75-3.00	3	1.6				
3.00-3.25	2	1.0				
3.25-3.50						
3.50-3.75	1	0.5				
Total Districts	193		186		177	
Mean Wage	1.54		1.13		0.86	

Source: Agricultural Wages in India 1960-61, Directorate of Economics and Statistics, Delhi, 1965.

Table 2 Distributions of Districts by Wage Differentials for Women and Children, 1960-61 (annual averages)

Percent of men's wages	Women Number	Women Percent	Children Number	Children Percent
10-15	5	3.1	2	1.2
15-20				
20-25			1	0.6
25-30			1	0.6
30-35			6	3.8
35-40			7	4.4
40-45	3	1.9	26	16.4
45-50	6	3.8	23	14.5
50-55	5	3.1	26	16.4
55-60	13	8.2	22	13.8
60-65	14	8.8	12	7.5
65-70	15	9.4	10	6.3
70-75	38	23.9	12	7.5
75-80	24	15.1	4	2.5
80-85	15	9.4	3	1.9
85-90	8	5.0	1	0.6
90-95	7	4.4		
95-100	6	3.8	3	1.9
Total Districts	159		159	
Mean	79.6		55.9	

Source: See Table 1

Table 3 - Labor Force Characteristics of Rural Households by Land Size

1970-71 Household Data

Gross Cropped Area (hectares)	Percent Reporting Agricultural Wage Income (1)	Mean[a] Agricultural Wage Income (2)	Percent Reporting Payments to Labor (3)	Mean[a] Payments to Labor (4)	Percent Reporting Wages or Salary Earnings (5)	Mean[a] Wage and Salary Earnings (6)	Percent Reporting Family Workers[b] (7)	Number of Households (Sample Weight x 10^{-3}) (8)
<1.5	55.1	485.3 (551.3)	87.7	64.5 (83.2)	79.0	1397.26 (1562)	19.9	3.4 (20.1)
1.5 - 3.0	70.5	522.7 (555.7)	83.7	101.4 (139.5)	83.6	925.0 (1040)	33.3	281 (16.0)
3.0 - 4.5	54.3	389.9 (500.1)	78.3	138.7 (214.1)	71.4	812.5 (1171)	42.7	199 (15.2)
4.5-- 6.0	52.7	355.2 (460.2)	82.7	213.8 (413.2)	72.0	843.2 (1074)	45.0	207 (14.8)
6.0 - 8.0	37.2	236.6 (394.7)	85.8	269.8 (381.1)	58.0	792.8 (1276)	53.4	188 (10.7)
8.0 - 10.0	30.0	216.3 (414.8)	85.8	367.3 (506.3)	56.4	923.4 (1430)	63.6	140 (9.6)
10.0 - 15.0	19.7	163.3 (428.0)	90.3	429.4 (589.5)	39.3	714.7 (1585)	69.4	223 (6.7)
15.0 - 20.0	14.6	92.5 (285.4)	94.5	501.5 (657.1)	31.0	417.2 (881)	73.2	151 (5.1)
20.0 - 25.0	12.8	108.6 (314.6)	91.9	639.0 (837.9)	35.1	579.9 (1002)	69.4	94 (5.6)
25.0 - 30.0	6.9	87.8 (360.8)	96.0	884.7 (1100.8)	32.8	754.6 (1509)	73.0	58 (4.5)
30.0 +	3.4	25.3 (148.3)	96.0	1316.7 (1609.8)	21.6	431.3 (995)	79.6	88 (3.4)
Total	40.4	294.3	87.0	418.7	59.3	794.6		1943

[a] Standard errors in parentheses

[b] Excludes household work

Source: NCAER, Additional Rural Income Survey (ARIS), Third Round.

Economic Research for the periods 1968-69, 1969-70 and 1970-71.[6] The data in the table refer to cultivating households in 1970-71 who provided information on all of the characteristics displayed, approximately two-thirds of the total number of cultivators sampled. One advantageous feature of this data set is that higher-income households were over-sampled so that more statistically reliable information on large landowners is provided than in most sample surveys.

Columns 1 and 3 of Table 3 indicate that almost all cultivator households, large and small, participate actively in the labor market as either buyers or sellers of labor services, with almost 88 percent of households cultivating a gross-cropped area less than 1.5 hectares utilizing some hired labor. Seventy-nine percent of these small farm households had some family members who participated in the labor market (Column 5) with 55 percent reporting household members earning agricultural wages. While Column 4 suggests that the purchase of hired labor by the smallest farms is evidently a seasonal phenomenon only, Column 2 indicates that the total number of days in the year spent in agricultural market (off-farm) employment by all members of households with a gross cropped area less than 1.5 hectares, given on average daily agricultural wages in 1970-71 of about 2 rupees, is about 240 or an average of 100 days for each household member over ten years of age.[7] Average days of off-farm agricultural work per potential household earner drops, as expected, with (effective) land size, with only 3.4 percent of households with gross cropped area exceeding 30.0 hectares reporting agricultural wage income. Thus these data, while not inconsistent with the existence of seasonal or even year-round underemployment, do not appear to support the assumption that agriculture in India is dualistic in the sense that family members on small farms cannot find substantial amounts of market work as hired agricultural laborers.

Moreover, Column 7 indicates that modelling large farms as profit rather than as utility maximizers is unrealistic, at least in India. While almost 96 percent of the largest farms hire labor, 85 percent also utilize family workers, where a family worker is defined in the survey as an individual over 10 years of age who spends the major part of the year working his (her) own land. The proportion of farms reporting family laborers declines, as expected, with farm size, with less than 20 percent of the smallest farms reporting family workers.

The purchase of labor by almost all farms regardless of size and the extensive use of family labor by the largest farms suggests that the "dichotomization" of cultivating households by objective function, small farm households maximizing utility, large farm owners maximizing profits and using only hired labor, would appear not only counterfactural but less useful than merely distinguishing large and small farms according to whether they are net importers or exporters of labor services.

Such a distinction is particularly useful in the context of assessing the income distributional impact of a land reform program because it identified who benefits and who loses from a change in agricultural wages. A comparison of Columns 2 and 4 of Table 3 indicates that the cross-over point, where payments to hired labor begin to exceed total agricultural wage earnings, is somewhere around 6-7 hectares. Table 4, which gives the actual distribution of landholdings (acres) in India, 1961-62 suggests that almost 90 percent of all farm households are net exporters of agricultural labor to the market. Thus, for instance, if a land reform program which transferred land held by the top 10 percent of landholders to landless laborers were to cause wage rates to fall, almost all land-owning households would be made worse off, with the magnitude of the decline in real net income for each household being inversely related to farm size. The wage effects of a land redistribution which is only partial (not fully equalizing) may thus play a larger role in changing the distribution of incomes than the change in the wealth positions of the recipients and "donors" of the transferred land.

Table 4 - Distribution of Land-Holdings, 1961-62

Size of Land-holding (acres) (1)	Mean Farm Size (2)	Percent of Total Farms (3)	Percent of Total Area Operated (4)	|(3) - (4)| (5)
0 - 1.0	0.40	18.26	1.29	16.97
1.0 - 5.0	2.64	44.06	17.74	36.32
5.0 - 10.0	6.89	19.33	20.33	1.00
10.0 - 15.0	11.81	7.79	14.03	6.24
15.0 - 25.0	18.56	5.94	16.80	10.96
25.0 - 50.0	32.88	3.58	17.93	14.35
50.0 +	74.24	1.05	11.83	10.82
Total	6.56	100.00	100.00	96.66

Source: B. Sen, "Opportunities in the Green Revolution," Economic and Political Weekly, March 28, 1970, A33-A40.

II. The Competitive Market Model and Properties of Equilibrium

To capture the essential features of rural agriculture highlighted in section I and to maintain tractability, we assume a labor market composed of two types of labor, 'male' and 'female', and three agricultural households -- a landless household and two households with different size plots, small and large, of quality-standardized land producing a homogeneous agricultural commodity. The market is initially assumed to be competitive so that all households are price-takers, but wage rates are determined endogenously. There are, however, fixed costs per unit of labor time spent on the land owned by other households which are assumed to be borne entirely by workers.[8] Each household contains two persons, one of each labor type, each owning a unit of labor time. The two types of labor are imperfect substitutes in agricultural production but labor of each type from different households are perfectly substitutible.[9]

The landless household supplies $\ell_{fM}^{N} = 1 - \ell_{M}^{N}$ and $\ell_{fW}^{N} = 1 - \ell_{W}^{N}$ amounts of labor to the market, where ℓ_{M}^{N} and ℓ_{W}^{N} are the quantities of leisure time of the 'husband" and "wife" in the landless household. Total consumption of the landless family, assuming no saving and a unit price for the composite consumption commodity, is thus

$$X^{N} = \ell_{fM}^{N} \Pi_{M}^{N} + \ell_{fW}^{N} \Pi_{W}^{N} \qquad (1)$$

where $\Pi_{K}^{N} = W_{K} - \rho_{K}$ ($K = M,W$), W_{K} are the market wages paid to (hired) male and female labor and ρ_{K} is the fixed cost per unit of labor time supplied to the market.

The small farm household owns A^S units of land and is by definition a net exporter of the labor services of both the husband and wife. The large farm household owns θA^S units of land, where θ is a scalar chosen such that the household is an importer of labor. Denoting L_M^i and L_W^i, $i = S,L$, as the total amounts of male and female labor utilized on the land owned by each land-owning household, the quantities of male and female labor supplied (exported) to the market by the small household, λ_M^S and λ_W^S, and the amounts of labor hired (imported) by the large landowning family, λ_M^L and λ_W^L are given by

$$(2) \qquad \lambda_K^S = \ell_{fK}^S - L_K^S > 0$$

$$(3) \qquad \lambda_K^L = L_K^L - \ell_{fK}^L > 0 \qquad K = M,W$$

where ℓ_{fK}^i is the total work time of family member K on the farm of size i.

The quantities consumed by the land-owning households, X^S and X^L, are thus

$$(4) \qquad X^i = F(L_M^i, L_W^i, \theta^j A^S) + \lambda_M^i \Pi_M^i + \lambda_W^i \Pi_W^i \qquad i = S,L \qquad j = \begin{matrix} 0 \text{ for } i = S \\ 1 \text{ for } i = L \end{matrix}$$

where $\Pi_K^L = W_K$, $\Pi_K^S = W_K - \rho_K$ and F is a twice, continuously differentiable strictly concave production function with positive cross-partials.

Each of the three households maximizes an identical, twice differentiable family utility function, given by (5), with respect to the consumption commodity X^i and the leisure of the two household members, each of which is assumed to be non-inferior, subject to the relevant budget constraints in (1) and (4).

(5) $U = U(X^i, \ell^i_M, \ell^i_W)$ $i = N,S,L$

If only interior solutions are considered, the necessary conditions for each household, in addition to those implied by the budget constraints, are given by equations (6) through (8):

(6) $U^i_X - \Psi^i = 0$ $i = N,S,L$

(7) $U^i_{\ell_k} - \Psi^i \Pi^i_K = 0$ $i = N,S,L$

(8) $F^i_{L_K} - \Pi^i_K = 0$ $i = S,L$

where Ψ^i is the Lagrangean multiplier for household i.

Equations (7) and (8) give the standard utility and profit maximizing results describing the optimal quantities of leisure and total labor use, if any, for each household. With $\rho_K > 0$, the market is dualistic in the sense that small landowing households utilize more labor per acre than large landowners because of the differential shadow prices of labor: $F^S_{L_K} < W_K$, $F^L_{L_K} = W_K$. Each member of the small landowning household allocates his (her) labor on the family's land up to the point where the value of his (her) marginal product just equals the net wage he (she) receives in the market, $W_K - \rho_K$. Members of the large landowning households devote all their work time to their own land and hire each type of labor up to the point at which the marginal value product of that labor type is equal to the appropriate market wage, W_K.

To derive the partial-equilibrium comparative static properties for the three households we first write the matrix:

$$\beta^i = \begin{bmatrix} U^i_{XX} & U^i_{X\ell_M} & U^i_{X\ell_W} & -1 \\ U^i_{X\ell_M} & U^i_{\ell_M\ell_M} & U^i_{\ell_W\ell_M} & -\Pi^i_M \\ U^i_{X\ell_W} & U^i_{\ell_M\ell_W} & U^i_{\ell_W\ell_W} & -\Pi^i_W \\ -1 & -\Pi^i_M & -\Pi^i_W & 0 \end{bmatrix} \qquad i = N,S,L$$

Differentiating equations (1), (6), and (7) for $i = N$, we get

$$(9) \qquad [\beta^N] \begin{bmatrix} dX \\ d\ell_M \\ d\ell_W \\ d\Psi^N \end{bmatrix} = \begin{bmatrix} \\ \Psi^N \, dW_M - \Psi^N \, d\rho_M \\ \Psi^N \, dW_W - \Psi^N \, d\rho_W \\ -\ell^N_{fM} \, dW_M - \ell^N_{fW} \, dW_w \; \ell^N_{fM} \, d\rho_M \; \ell^N_{fW} \, d\rho_W \end{bmatrix}$$

β^N is thus the bordered Hessian matrix for the landless household. Denoting the determinant of β^i as ϕ^i and the cofactor of row r and column c of β^i as ϕ^i_{rc}, we obtain the standard Slutsky equations for the landless household's labor supply:

$$(10) \qquad \frac{d\ell^N_{fK}}{dW_K} = -\frac{\phi^N_{nn}}{\phi^N} - \ell^n_{fK}\frac{\phi^N_{4n}}{\phi^N} = \sigma^N_{KK} - \ell^N_{fK}\,\sigma^N_K \qquad K = M,\; n = 1$$

$$K = W,\; n = 2$$

$$(11) \qquad \frac{d\ell^N_{fK}}{dW_h} = -\frac{\phi^N_{23}}{\phi^N} - \ell_{fn}\frac{\phi^N_{4n}}{\phi^N} = \sigma^N_{Kh} - \ell^N_{fh}\,\sigma^N_K$$

Second-order conditions constrain the first term in equation (10), the compensated substitution effect, to be positive, since $\phi^N < 0$ and $\phi^N_{nn} > 0$. The normality assumption, however, implies that the income effect on work time, σ^N_K is negative so that equation (10) is consistent with either a backward-bending or positively sloped supply curve for landless laborers of either sex. The sign of (11) depends on whether the leisure time of the husband and wife are complement or substitutes, being unambiguously negative if the leisure time of spouses are substitutes. Total differentiation of equations (4) and (6) through (8) for i = S,L yields:

$$(12)\quad \begin{bmatrix} U^i_{XX} & U^i_{X\ell_M} & U^i_{X\ell_W} & 0 & 0 & -1 \\ U^i_{X\ell_M} & U^i_{\ell_M\ell_M} & U^i_{\ell_M\ell_W} & 0 & 0 & -\Pi^i_M \\ U^i_{X\ell_W} & U^i_{\ell_M\ell_W} & U^i_{\ell_W\ell_W} & 0 & 0 & -\Pi^i_W \\ 0 & 0 & 0 & F^i_{L_ML_M} & F^i_{L_ML_W} & 0 \\ 0 & 0 & 0 & F^i_{L_ML_W} & F_{L_WL_W} & 0 \\ -1 & -\Pi^i_M & -\Pi^i_W & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} dX^i \\ d\ell^i_M \\ d\ell^i_W \\ dL^i_n \\ dL^i_W \\ d\Psi^i \end{bmatrix} = \begin{bmatrix} \\ -\Psi^i dW_M \\ -\Psi^i dW_W \\ -dW_M \quad -F_{L_MA^i}\, dA^i \\ -dW_W \quad -F_{L_WA^i}\, dA^i \\ (L^i_M - \ell^i_{fM})\, dW_M \; (L^i_W - \ell^i_{fW})\, dW_W \\ -\, F_{A^i}\, dA^i \end{bmatrix}$$

Noting that β^i is the second bordered principal minor of the bordered Hessian matrix in (12), and must be negative, we obtain the following results for the two landowning households, employing Cramer's rule:

$$(13)\quad \frac{d\ell^i_{fK}}{dW_K} = -\frac{\phi^i_{nn}}{\phi^i} - (L^i_K - \ell^i_{fK})\frac{\phi^i_{4n}}{\phi^i} = \sigma^i_{KK} - (L^i_K - \ell^i_{fK})\sigma^i_K \qquad n = 2,3$$

$$(14)\quad \frac{d\ell^i_{fK}}{d_{W_h}} = -\frac{\phi^i_{23}}{\phi^i} - (L^i_n - \ell^i_{fK})\frac{\phi^i_{4n}}{\phi^i} = \sigma^i_{Kh} - (L^i_h - \ell^i_{fh})\sigma^i_K$$

$$(15)\quad \frac{dL^i_k}{dW_h} = \frac{F^i_{\ell_K\ell_h}}{\Delta^i} \quad \begin{matrix} < 0 \text{ for } k = h \\ > 0 \text{ for } k \neq h \end{matrix}$$

(16) $$\frac{d\ell^i_{fK}}{dA^i} = F^i_A \frac{\phi^i_{4n}}{\phi^i} = -F_A{}^i \sigma^i_K < 0$$

(17) $$\frac{dL^i_K}{dA^i} = \frac{F^i_{L_hA} F^i_{L_ML_W} - F^i_{L_KA} F^i_{L_hL_h}}{\Delta^i}$$

where $\Delta^i = F^i_{L_WL_W} F^i_{L_ML_M} - (F^i_{L_ML_W})^2 > 0.$

Equations (13) and (14), which give the own and cross wage effects on the total supply of work time for each household member in the land-owning households, indicate that the substitution and income effects in those households are qualitatively similar to those of the landless households and are identical if the labor market is non-dualistic and competitive ($\Pi^N_K = \Pi^S_K = W_K$) and if the utility function in (5) is homothetic. However, unlike for landless laborers and small landowners (labor exporters) the uncompensated own wage effect on total (family) labor supply in labor importing farms is unambigiously positive, since a wage rise must lower net income for these households.

An important implication of Equations (15) and (17), giving the (own and cross) effects of a rise in wage rates and land holdings on total labor usage on the landowning farms, is that the "production" and "consumption" sectors of the farms are independent, as (15) and (17) depend only on the properties of the production function. Thus if competitive conditions prevail, the partial equilibrium changes in the allocation of production resources will be identical whether or not (some) households maximize utility or profits. However as will be shown below, the assumption that large landowners maximize utility and utilize family labor has consequences for the allocation of market (non-family) labor and thus for the levels of the equilibrium wage rates and the stability of the rural labor markets, which are functions of market supply and demand curves only.

The relationship between the supply of off-farm labor of type K from small farms and changes in wage rates, from (13), (14), and (15), is expressed in (18).

$$(18) \quad \frac{d\lambda_K^S}{dW_h} = \left[\sigma_{Kh}^S - \frac{F_{Kh}^S}{\Delta^S} \right] - \lambda_h^S \sigma_K^S$$

While for K = h the terms in brackets, the own compensated substitution effect and the negative of the labor usage effect, must be greater than zero, (18) may be of either sign because of the positive income effect on leisure. We note, however, that a comparison of (18) with (10), giving own uncompensated wage effect on the labor supplied to the market by members of landless households, suggests that the market supply curve of (small) landowners need not be negatively sloped even if that of the landless households is because of the family labor effect. Moreover, in the corner solution case considered by Barzel and McDonald, where members of all households must work full-time (ℓ_{fK}^N, $\ell_{fK}^S = 1$) to earn a subsistence income, so that an increase in the wage necessarily lowers total labor time initially, the off-farm participation of members of landowning households could increase with a wage rise if the necessary reduction in the use of family labor exceeds the increase in desired leisure time. Thus market labor supply curves in subsistence agriculture need not be negatively sloped, although total labor supply curves must be.

For the labor-importing, utility-maximizing farms, the own and cross wage effects on the quantity of labor of sex K hired, λ_K^L, is given by:

(19) $$\frac{d\lambda_K^L}{dW_h} = \left[\frac{F_{Kh}{}^L}{\Delta^L} - \sigma_{Kh}^L\right] - \lambda_h^L\, \sigma_K^L$$

Since the demand for all labor of type K to be used in agricultural production falls and the quantity of labor supplied by family members of sex K increases when W_K rises, a priori, the demand for hired labor must decline in response to a wage rise. Because of the latter family labor supply effect, (19) implies that 1) utility-maximizing large farms will display more elastic demand curves for hired labor than profit-maximizing farms, and 2) that the demand for hired labor is a function of changes in non-earnings income or wealth.

The effects of an exogenous increase in household landholdings on off-farm labor supply (small farms) and on the demand for hired labor of type K (large farms) depends also on both production and income-leisure effects, but are of unambiguous signs. An increase in the size

(20) $$\frac{d\lambda_K^S}{dA} = - F_A^S \quad \sigma_K^S - \left(\frac{F^S_{L_h A}\; F^S_{L_K L_h} - F^S_{L_K A}\; F^S_{L_h L_h}}{\Delta^S}\right) < 0$$

(21) $$\frac{d\lambda_K^L}{dA} = F_A^L\, \sigma_K^L + \left(\frac{F^L_{L_h A}\; F^L_{L_K L_h}\; F^L_{L_K A}\; F^L_{L_h L_h}}{\Delta^L}\right) > 0$$

of labor-exporting farms will reduce their supply of labor to other farms; an increase in the holdings of labor-exporting households will increase the demand for hired labor because of reinforcing production and income-lesiure effects.

Labor market equilibrium is characterized by equations (1), (4), and (6) through (8) as well as equilibrium conditions (22):

(22) $$\ell^N_{fK} + \lambda^S_K = \lambda^L_K \qquad K = M,W$$

A necessary condition for (Hicksian) multi-market static stability in the market for hired agricultural labor, from equations (13), (18), and (19), is that

(23) $$\frac{d(\lambda^L_K - \lambda^S_K - \ell^N_{fK})}{dW_K} = \sum_{i=S,L} \frac{F^i_{KK}}{\Delta^i} - \sum_{i=S,L,N} \sigma^i_{KK} - \lambda^L_K \sigma^L_K + \ell^N_{fk}\sigma^N_K < 0$$

The assumptions imposed in the analysis so far do not insure that condition (23) be met; it is thus possible that with sufficiently negatively-sloped market supply curves of agricultural labor, the market equilibrium will not be stable. However, the likelihood that static instability is the major reason for the existence of institutional, i.e., non-market determined, wages is low: positive income leisure effects in small-landowner and landless households must be extremely large, not only exceeding income effects in labor-importing households, but greater than the sum of the production and consumption substitution effects in all households and the income-labor supply effect in the large households, each of which is negative for (23) to be violated. Indeed, the presence of labor-hiring institutions (large landowners) which maximize utility and employ family labor, as in India (Table 3), as well as the existence of labor-supplying households whose members both work their own land and offer labor services to the market, makes the fulfillment of the static stability conditions more likely in the context of Indian agriculture than in developed country (modern sector) labor markets. In the latter, where employers of hired labor are profit maximizers and household members who supply labor do not participate in household income production, three negative terms tending toward stability, F^S_{KK}/Δ^S, $-\sigma^S_{KK}$, and $-\lambda^L\ \sigma^L_K$, would not appear in (23). Moreover, because of the participation of family members in agricultural production on labor-importing farms, the stability condition must be satisfied if the utility function is homothetic (and $\rho = 0$) since the last three terms in (23) vanish ($\sigma^L_K = \sigma^N_K = \sigma^S_K$).

III. General Equilibrium Comparative Statics

Assuming a unique, stable equilibrium we can ascertain the effects of a change in landholdings A^i or any other exogenous variable hypothesized to influence supply behavior on the wage rates of the two types of labor by totally differentiating equations (1), (4), (6) through (8) and (22) and solving for dW_M and dW_W. First we briefly consider the effects of an increase in non-agricultural factors which might draw labor from all agricultural households. Let Z represent the stock of production inputs employed outside the farm sector such that $d\ell^i_{fK}/dZ < 0$, $i = N,S,L$ so that $d\lambda^L_K/dZ > 0$, $d\lambda^S_K/dZ < 0$. Then for a small change in Z around equilibrium the effect on male and female agricultural wage rates can be written in terms of the partial equilibrium comparative static results where $\varepsilon^i_{KX} = d\lambda^i_K/dX$:

$$(24)\qquad \frac{dW_K}{dZ} = \left[\frac{(d\ell^N_{fK}/dZ + \varepsilon^S_{KZ} - \varepsilon^L_{KZ})}{(\varepsilon^L_{KW_K} - \varepsilon^S_{KW_K} - \varepsilon^N_{KW_K})} - \frac{(\varepsilon^S_{hZ} + d\ell^N_{fh}/dZ - \varepsilon^L_{hZ})}{(\varepsilon^L_{hW_h} - \varepsilon^S_{hW_h} - \varepsilon^N_{hW_h})} \cdot \frac{(\varepsilon^L_{KW_h} - \varepsilon^S_{KW_h} - \varepsilon^N_{KW_h})}{(\varepsilon^L_{KW_K} - \varepsilon^S_{KW_K} - \varepsilon^N_{KW_K})} \right] \Omega^{-1}$$

where
$$\Omega = 1 - \frac{(\varepsilon^L_{KW_h} - \varepsilon^S_{KW_h} - \varepsilon^N_{KW_h})\,(\varepsilon^L_{hW_K} - \varepsilon^S_{hW_K} - \varepsilon^N_{hW_K})}{(\varepsilon^L_{KW_K} - \varepsilon^S_{KW_K} - \varepsilon^N_{KW_K})\,(\varepsilon^L_{hW_h} - \varepsilon^S_{hW_h} - \varepsilon^N_{hW_h})}$$

To sign (24) we note that the assumption of strict concavity in production and second-order conditions require that $\Omega > 0$ and that if the equilibrium is dynamically stable, from (23), $(\varepsilon^L_{KW_K} - \varepsilon^S_{KW_K} - \varepsilon^N_{KW_K}) < 0$ and $(\varepsilon^L_{KW_h} - \varepsilon^S_{KW_h} - \varepsilon^N_{KW_h}) > 0$.[10] The first term in brackets (the own effect) must therefore be positive and own and cross effects are reinforcing so that an increase in non-agricultural capital will increase both male and female wage rates, the magnitude of the effect being positively related to the sensitivity of labor supply to changes in Z and negatively to the sensitivity of market agricultural demand and supply curves to changes in agricultural wages. This "prediction" of the competitive wage model, that increases in non-agricultural labor demand will raise agricultural wage levels, is one of the few which directly contradict one of the implications drawn from the nutritional wage model by Rodgers, who suggests that the presence of slack-season non-agricultural employment may lower all agricultural wages.[11]

The competitive general equilibrium model can also be used to demonstrate that the attenuation of factors inhibiting only female participation in market work, such as religious or cultural attitudes, will not necessarily result in wider male-female wage differentials, as suggested by Boserup, but will most probably lower agricultural wage rates generally, consistent with Rodgers' observations. To see this let R be an environmental characteristic such that $d\ell^N_{fW}/dR$, $d\lambda^S_W/dR < 0$; $d\ell^N_{fM}/dR$, $d\lambda^S_M/dR$, $d\lambda^L_K/dR = 0$, then

$$(25) \qquad \frac{dW_W}{dR} = \left[\frac{d\ell^N_{fW}/dR + d\lambda^S_W/dR}{(\varepsilon^L_{WW_W} - \varepsilon^S_{WW_W} - \varepsilon^N_{WW_W})} \right] \Omega^{-1} > 0$$

$$\text{(26)}\qquad \frac{dW_M}{dR} = \left[\frac{d\ell^N_{fW}/dR + d\lambda^S_W/dR}{(\varepsilon^L_{WW_W} - \varepsilon^S_{WW_W} - \varepsilon^N_{WW_W})}\right]\left[\frac{(\varepsilon^L_{WW_M} - \varepsilon^S_{WW_M} - \varepsilon^N_{WW_M})}{(\varepsilon^L_{MW_M} - \varepsilon^S_{MW_M} - \varepsilon^N_{MW_M})}\right] \Omega^{-1} > 0$$

Expressions (25) and (26) must be greater than zero so that

an increase in female market participation must reduce female wage rates and male wage rates as well. However, the change in the wage rate differential, given by (27), cannot be predicted:

$$\text{(27)}\qquad \frac{d(W_M - W_W)}{dR} = \left[\frac{d\ell^N_{fW}/dR + d\lambda^S_W/dR}{(\varepsilon^L_{WW_W} - \varepsilon^S_{WW_W} - \varepsilon^N_{WW_W})}\right]\left[\frac{(\varepsilon^L_{WW_M} - \varepsilon^S_{WW_M} - \varepsilon^N_{WW_M})}{(\varepsilon^L_{MW_M} - \varepsilon^S_{MW_M} - \varepsilon^N_{MW_M})} - 1\right] \Omega^{-1}$$

Finally, we derive the effect of a redistribution of land (without compensation for the transfer of wealth) from large to small landowners on wage rates in the general equilibrium system by solving for the effects of an increase in A^S on W_W and W_M under the side condition that total landholdings, $A^T = A^S(1 + \theta)$ remain constant:[12]

$$\text{(28)}\qquad \frac{dW_K}{dA^S} = \left[\frac{\varepsilon^L_{KA} + \varepsilon^S_{KA}}{(\varepsilon^L_{KW_K} - \varepsilon^S_{KW_K} - \varepsilon^N_{KW_K})} - \frac{\varepsilon^L_{hA} + \varepsilon^S_{hA}}{(\varepsilon^L_{KW_K} - \varepsilon^S_{KW_K} - \varepsilon^N_{KW_K})} \frac{(\varepsilon^L_{KW_h} - \varepsilon^S_{KW_h} - \varepsilon^N_{KW_h})}{(\varepsilon^L_{hW_h} \quad \varepsilon^S_{hW_h} \quad \varepsilon^N_{hW_h})}\right] \Omega^{-1}$$

Assuming that the direct effect, the first bracketed term, dominates, the sign of (28) depends on the sign of $\varepsilon^L_{KA} + \varepsilon^S_{KA}$, so that from (20) and (21):

$$\text{(29)}\qquad \frac{dW_K}{dA^S} \gtreqless 0 \text{ as } \frac{F^S_{L_hA} F^S_{L_KA} - F^S_{L_KA} F^S_{L_hL_h}}{\Delta^S} - \frac{F^L_{L_hA} F^L_{L_KA} - F^L_{L_KA} F^L_{L_hL_h}}{\Delta^L}$$
$$+ F^L_A \sigma^S_K - F^L_A \sigma^L_K \gtreqless 0$$

Thus whether or not a land reform program, without compensation,[13] increases or decreases the wage rates for laborers of type (sex) K depends on the properties of the production function and the differences in income-leisure relationships for individuals of sex K and the marginal product of land on small and large farms. To parameterize these relationships assume that the production function is Cobb-Douglas,[14] such that $F = Q^i = L_M^{\beta_1} L_W^{\beta_2} (\theta^j A)^{\beta_3}$ and $\beta_1 + \beta_2 < 1$. Expression (29) can then be rewritten as:

$$(30) \quad \frac{dW_K}{dA^S} \gtreqless 0 \text{ as } \gamma \frac{L_K^S}{A^S}\left[1 - \theta^{(\gamma-1)}\left(\frac{W_K-\rho_K}{W_K}\right)^{\frac{1-\beta_h}{1-\beta_1-\beta_2}}\left(\frac{W_h-\rho_h}{W_h}\right)^{\frac{\beta_h}{1-\beta_1-\beta_2}}\right]$$

$$- \beta_3 \frac{Q^S}{A^S}\left[\sigma_K^L\, \theta^{(\gamma-1)}\left(\frac{W_K-\rho_K}{W_K}\right)^{\frac{1-\beta_h}{1-\beta_1-\beta_2}}\left(\frac{W_h-\rho_h}{W_h}\right)^{\frac{\beta_h}{1-\beta_1-\beta_2}} - \sigma_K^S\right] \gtreqless 0$$

where $\gamma = \beta_3/1-\beta_1-\beta_2$

The following conclusions emerge:

1) With no factor distortions ($\rho=0$) linear homogeniety ($\gamma=1$), increasing returns to scale ($\gamma > 1$), or decreasing returns to scale ($\gamma < 1$) are each neither sufficient nor necessary for land redistribution to be wage neutral ($dW_K/dA^S = 0$), wage augmenting, or wage decreasing because of income-leisure effects. With $\gamma=1$, moreover, the differences between income-leisure effects in small and large farm households will uniquely determine the direction of the wage effect, assuming compensation, if any, is not complete. Since that differential may be of opposite sign for males and females, it is possible that land reform could raise wage rates for one group while lowering them for another.

2) In the special case, considered by Gersovitz, Mabro and others, in which the production function is linear homogeneous and large farms are owned by profit maximizing absentee landlords (no employment of family labor so $\sigma_K^L = 0$), wage rates of men and women will rise unambiguously, the magnitude of the rise, from (28), being a negative function of the sensitivity of the demand and supply of hired labor to wage rate changes and a positive function of the magnitude of the income-leisure effects on small farm households. In this case, the wage group benefitting most from the land reform will be that which has the greatest income elasticity of leisure and the most inelastic market demand and supply curves.

3) Sufficient but not necessary conditions for land reform to be wage neutral under competitive conditions (with $\rho=0$) are that the production function be linear homogeneous <u>and</u> the utility function be homothetic; neither assumption by itself is necessary or sufficient.

4) "Dualism" in agriculture does not necessarily imply that land reform will increase rural wages. Moreover, rural wages can rise after a land reform without factor distortions. However, the greater the costs to workers of off-farm employment, the more likely will wages rise as a result of a land redistribution. To see this, differentiate (30) with respect to ρ_K, noting that $\beta_h < 1$.

$$(31) \qquad \left(\frac{1-\beta_h}{1-\beta_1-\beta_2}\right) \left(\frac{W_K-\rho_K}{W_K}\right)^{\frac{1-\beta_h}{1-\beta_1-\beta_2}-1} \left(\frac{W_h-\rho_h}{W_h}\right)^{\frac{\beta_h}{1-\beta_1-\beta_2}} \theta^{(\gamma-1)}\left[\gamma \frac{L_K^S}{A^S} + \sigma_K^L \beta_3 \frac{Q^S}{A^S}\right] > 0$$

5) Finally, by differentiating (30) with respect to the relative land size parameter θ, to obtain (32), it can be seen that if production is characterized by decreasing (increasing) returns to scale,

(32) $$-(\gamma-1)\ \theta^{(\gamma-L)} \left(\frac{W_X-\rho_K}{W_K}\right)^{\frac{1-\beta_h}{1-\beta_1-\beta_2}} \left(\frac{W_h-\rho_h}{W_h}\right)^{\frac{\beta_h}{1-\beta_1-\beta_2}} \left[\gamma \frac{L_K^S}{A^S} + \sigma_K^L\, \beta_3 \frac{Q^S}{A^S}\right] \gtreqless 0$$

as $\gamma \gtreqless 1$

the greater the differential between the original landholdings of farms from whom land has been taken and the size of the holdings of households receiving the land, the more positive (negative) the impact of such a land distribution on agricultural wages.

In general then, if the agricultural labor market is competitive or contains factor distortions which are invariant with respect to the allocation of resources the direction of the effect of a land redistribution program on agricultural wages cannot be known a priori without imposing prior restrictive assumptions or without evidence concerning scale economies[15] and differential income-leisure effects for large and small farm households. Moreover, knowledge of the quantitative impact of land reform on wage rate differentials requires information as well on market supply and demand elasticities characterizing different groups of agricultural labor. In the next section it is shown that these agnostic conclusions hold a fortiori in the case of a partial land reform program carried out under conditions of imperfect competition, even if agricultural labor is homogeneous.

IV. Land Reform and Monopsony

The major theoretical justification for implementing a land reform program may not lie in either the exploitation of scale economies (which may be non-existent or perverse) or in the improvement of the distribution of incomes (which may, as shown above, worsen) but in improving the bargaining power of landless laborers and small landowners vis-à-vis large, labor-importing landowners. Assume that the distribution of landholdings is such that the labor-importing household is a utility-maximizing, family labor-using monopsonist facing an upward sloping supply curve for hired labor, $L^M - \ell_f^M = \lambda^M$, supplied by landless and small landowner households. To reduce complexity assume further that all households contain only one individual and all agricultural labor is homogeneous.[16] The monopsonist maximizes the utility function.

(33) $U = U(X^M, \ell^M)$

subject to the income (consumption) constraint

(34) $X^M = F(L^M, \theta A^S) - \lambda^M W^*$

where $W^* = f(\lambda^M)$, $f^1 = dW/d\lambda^M > 0$, $f'' = d^2W/(d\lambda^M)^2$

First order conditions are:

(35) $U_X^M - \Psi^M = 0$

(36) $U_\ell^M - \Psi^M W^*(1+\eta_S^{-1}) = 0$

(37) $F_L^M - W^*(1+\eta_S^{-1}) = 0$

where $\eta_S^{-1} = (f^1)\, \lambda^M/W^*$

Since labor-importing and landless households behave as before (equations (6) - (8), with Π^S, $\Pi^N = W^*$) the exercise of monopsony power by the large landowners results in a dualistic agriculture (even with $\rho=0$) - the marginal value product of labor and the marginal value of leisure on large monopsonistic farms exceeds the observed market wage, W^*, which is equal to the marginal value product of labor and the marginal value of leisure on small farms. Total labor per acre on small farms will thus exceed that on large farms, as $F_L^M > W^*$, $F_L^S = W^*$.[17]

In the absence of significant scale economies a land redistribution scheme which eliminated the monopsonistic exploitation of hired workers would thus be likely to increase agricultural wages. However, a <u>partial</u> redistribution of land which placed more land in the hands of small landowners but did not significantly improve their bargaining power in the labor market could lower wage rates still further; moreover, the effects are ambiguous <u>a priori</u> even when scale and income-leisure effects are known. To show this we totally differentiate equations (1), (4), (6) through (8), $i = S,N$, equations (34) through (37) and the equilibrium condition (38)

$$(38) \qquad \ell_f^N + \lambda^S = \lambda^M$$

with respect to A^S, holding A^T constant, solving for dW^*/dA^S around equilibrium. Again for tractability we assume that production is described by a Cobb-Douglas production function $Q = L^{\beta_1} (\theta^j A^S)^{\beta_2}$, $0 < \beta_1 < 1$, $\beta_3 > 0$. After tedious manipulation, the sign of dW^*/dA^S can be shown to depend on the sign of (39).

$$(39) \quad \frac{dW^*}{dA^S} \gtreqless 0 \text{ as } \gamma \frac{L^S}{A^S}\left[1 - \theta^{(\gamma-1)}(1 + \eta_S^{-1})^{1/\beta_1-1} (1-\Gamma)^{-1}\right] - \beta_3 \frac{Q^S}{A^S}$$

$$\cdot \left[\sigma_K^M \theta^{(\gamma-1)} (1 + \eta_S^{-1})^{1/\beta_1-1} (1-\Gamma)^{-1} - \sigma^S\right] \gtreqless 0$$

where $\sigma^i = \dfrac{-\Pi^i U_{XX}^i + U_{\ell X}^i}{(-U_{\ell\ell} + 2U_{\ell X} \Pi^i - (\Pi^i)^2 U_{XX})}$, $\Pi^i = \begin{cases} W^*, & i = S \\ W^* (1+\eta_S^{-1}), & i = M \end{cases}$

$$\Gamma = (\lambda_M f'' + 2f') \left(\frac{-U_{\ell\ell} + 2U_{\ell X} \Pi^M - (\Pi^M)^2 U_{XX} - F_{LL}^M}{-F_{LL} (-U_{\ell\ell} + 2U_{\ell X} \Pi^M - (\Pi^M)^2 U_{XX})} \right)$$

$$\gamma = \frac{B_2}{1-B_1}$$

which is ambiguous. The direction of the agricultural wage change (if any) caused by a partial land redistribution implemented under a monopsonistic regime depends not only on scale economies and the differential in the income-leisure relationships in large and small farm households, as in the competitive case, but also on the curvature and elasticity of the supply curve faced by the monopsonistic farm. Thus, for instance, conditions of linear homogeniety in production and homotheticity of the utility function would not guarantee that such a land reform program would be wage-neutral because of the dualism inherent in the monopsony case: the suppliers of market labor and the monopsonist face different shadow prices of labor and leisure.

V. Empirical Analysis

A. Variables and Reduced-Form Estimates

The principal implication of the preceding theoretical analysis is that the direct impact of a land redistribution program on agricultural wage rates is indeterminate. As was demonstrated, however, data pertaining to scale economies and the labor supply elasticities of landless and landowning households would provide only indirect evidence on the consequences of land reform policy and would not, in any event, indicate the quantitative magnitude of its impact on rural wages. In this section we adopt a more direct approach, utilizing aggregate district-level data from India to estimate the direct ceteris paribus relationship, if any, between the size-distribution of landholdings and the wage rates of adult males, adult females, and children in the agricultural sector, thereby obtaining a quantitative estimate of the potential wage-impact of a land redistribution program. We also seek empirical answers to more fundamental questions concerning the agricultural labor market: first, whether the differential levels in annual agricultural wage rates across Indian districts, as presented in Table 1, are importantly influenced by the variation in factors contained within the agricultural sector, in contrast to the view expressed by Bardhan and Srinivasan, and second, more specifically, whether inter-district differences in rural aggregate market labor supply and demand influence wage levels, in contrast to the institutional wage hypothesis.

We first estimate a set of six reduced-form equations in which the levels of the agricultural wage rates of adult males and females and children (WAGEM, WAGEF, WAGEC) and the number of <u>wage</u> laborers per household in each sex-age group (LABM, LABF, LABC) are the dependent variables, using aggregate cross-sectional data pertaining to the rural populations in 159 Indian districts, 1960-61.[18] The maintained hypothesis motivating the empirical analysis, to be tested below, is that inter-district labor mobility in India is sufficiently low such that district-level characteristics, whether institutional, non-institutional, outside or inside the agricultural sector, are the important determinants of district wage rates and market labor supply.

Each of the six equations, described in (40) and (41), contains an identical vector

$$(40) \qquad W_j = a_D X_j^D + a_R X_j^R + a_Z X_j^Z + a_M X_j^M + a_P X_j^P + a_E X_j^E + e_{1j} \qquad j = 1...159$$

$$(41) \qquad L_j = b_D X_j^D + b_R X_j^R + b_Z X_j^Z + b_M X_j^M + b_P X_j^P + b_E X_j^E + e_{Lj}$$

where W = WAGEM, WAGEF, $WAGE_C$; L = LABM, LABF, LABC;
X^D = NOLAND, AVLAND, DIST; X^R = RAIN, IRR; X^Z = URB, FACTRY, FUEL, SCALE; X^M = MOSLEM; X^P = PLANTN; X^E = PRIMM, PRIMF, MATM, MATF, CASTE

of exogenous explanatory variables X which includes X^D, a 3x1 column vector of variables characterizing the size distribution of land - NOLAND, the proportion of households in rural areas without land, AVLAND, the mean holdings of landowners, and DIST, a measure of landholding inequality among landowners, the Kusnets ratio , given by (42).[19]

$$(42) \qquad DIST_j = \sum_{i=1}^{12} \left| \frac{P_{ij}}{P_j} - \frac{A_{ij}}{A_j} \right|$$

where P_j = total number of landowning households in district j

P_{ij} = number of landowning households in interval i in district j

A_j = total landholdings (acres) in district j

A_{ij} = landholdings in interval i in district j

Characterizing the distribution of land at the upper tail is a dummy variable PLANTN, which takes on the value of 1 if a district contains plantations. Other variables included in X standardize for differences in land-augmenting factors (X^R), and represent non-agricultural demand factors (X^Z) and other rural population characteristics and institutions (X^M, X^E); a_D and b_D are 3x3 matrices, a_R and b_R are 3x2 matrices, a_Z and b_Z are 3x4 matrices, a_P, b_P, a_M and b_M are 3x1 vectors, and a_E and b_E are 3x5 matrices of coefficients; e_1 and e_2 are 3x1 column vectors of error terms. All variables are listed and defined in Table 5, which also provides means and standard deviations.

The Bardhan - Srinivasan exogenous wage assumption, in its extreme form, is that at least some of the elements in a_Z are positive, while those of a_D, a_R, a_M, a_P, $a_E = 0$. The nutritional wage theory of Rodgers suggests, however, that the variables in X^Z and agricultural wages are negatively correlated, i.e. the elements in $a_Z < 0$. The market, endogenous wage model described in sections II and III predicts that $a_Z > 0$, from (24), and suggests, in addition, the following: (1) The coefficients of AVLAND, IRR and RAIN should display positive signs in all wage equations since an increase in average landholdings, or land-augmenting factors, per household, controlling for the distribution of land among landholders and the proportion of landless households, from (20) and (21), would increase the

Table 5 - Variable Definitions, Means, and Standard Deviations
159 Districts,[a] India 1960-61

VARIABLE	DEFINITION	MEAN	s.d.
WAGE	Daily wage in rupees for male field labor (sowers, reapers, weeders, ploughers)	1.52	0.43
WAGEF	Daily wage in rupees for female field labor (sowers, reapers, weeders, ploughers)	1.11	0.37
WAGEC	Daily wage in rupees for child field labor and herding	0.85	0.37
LABM	Percentage of males per household aged 15-59 working at least one hour per day as hired agricultural laborers	23.4	11.2
LABF	Percentage of females per household aged 15-59 working at least one hour per day as hired agricultural laborers	22.0	14.4
LABC	Percentage of children per household aged 5-14 working at least one hour per day as hired agricultural laborers	5.75	3.98
PRIMM	Percentage of males 15-59 with primary education	12.7	9.27
PRIMF	Percentage of females 15-59 with primary education	3.34	4.11
MATM	Percentage of males 15-59 with secondary education	2.44	2.50
MATF	Percentage of females 15-59 with secondary education	0.27	0.68
RAIN	Average normal rainfall per year in cm.	302.2	584.2
IRR	Percentage of cultivated acres irrigated	12.8	17.4
DIST	Kuznets ratio of land-holding inequality	81.7	16.3
AVLAND	Average land owned per land-owning household	12.4	10.3
NOLAND	Percentage of households without land	34.9	13.1
MSLM	Percentage of population Moslem	33.2	66.6
CASTE	Percentage of population in scheduled tribes	12.8	6.32
URB	Proportion of population living in urban areas	0.17	0.11
PLANTN	Dummy = 1 if at least one plantation in district	0.10	
FACTRY	Factories and workshops per household	0.17	0.18
FUEL	Percentage of factories and workshops using power	20.5	19.2
SCALE	Percentage of factories and workshops employing 5+ persons	3.9	4.0

[a]States covered: Andhra Pradesh, Assam, Bihar, Gujurat, Kerala, Madhya Pradesh, Madras (Tamil Nadu), Maharashtra, Mysore, Orissa, Punjab (and Haryana), Uttar Pradesh.

Source: See Appendix

demand for hired labor on labor-importing farms and decrease the supply of off-farm work from labor-exporting households. (2) The proportion of households without land, NOLAND, should be positively associated with the employment of wage laborers and negatively correlated with the wage levels of all sex-age groups, since landless household should supply more labor to the market than those households owning land. (3) The DIST coefficients in the wage equations should give estimates of the net impact of a small change in the distribution of land among landowners on wage levels, which, as was demonstrated in prior sections, cannot be predicted a priori. (4) PLANTN, however, should be positively correlated with all wage levels (and market employment) unless, as suggested, by Boserup's observations concerning women's wages, plantations exercise monopsony power in the labor market.[20]

The OLS reduced-form parameter estimates are presented in Table 6. The set of district-level variables X explains approximately 47 to 35 percent (adjusted for degrees of freedom) of the interdistrict variation in rural male, female and child wage rates, with the highest explanatory power being obtained for adult male wages. The same variables account for 53 to 60 percent of the variation across districts in wage laborers per household for the three sex-age groups.

The results clearly reject the hypothesis that agricultural wages are determined only by factors outside the agricultural sector, as the removal of the individual sets of agricultural variables, X^D, X^R, X^E, together and singly reduce significantly the explanatory power of each of

Table 6 - Unrestricted Reduced Form (OLS) Coefficient Estimates,

Indian Districts, 1960-61

Independent Variable	WAGEM	WAGEF	WAGEC	LABM	LABF	LABC
	Dependent Variable					
AVLAND	.0187 (4.66)	.0136 (3.81)	.0054 (1.40)	-.0594 (0.61)	-.124 (1.05)	-.0030 (0.09)
NOLAND	-.0018 (0.53)	-.0018 (0.59)	-.0004 (0.13)	.380 (4.57)	.405 (4.04)	.0906 (3.32)
DIST	-.0133 (6.39)	-.0101 (5.42)	-.0062 (3.12)	.355 (6.96)	.430 (6.99)	.120 (7.22)
IRR	.0059 (2.69)	.0033 (1.66)	.0006 (0.31)	.0413 (0.77)	-.0166 (0.25)	-.0052 (0.30)
RAIN	.0003 (3.20)	.0002 (2.69)	.0001 (1.18)	-.0006 (0.32)	.0024 (1.04)	.0004 (0.67)
URB	.501 (1.81)	.514 (2.09)	.318 (1.20)	-14.13 (2.09)	-10.78 (1.32)	-3.88 (1.75)
FACTRY	-.0027 (0.02)	.110 (0.72)	.0495 (0.30)	-4.42 (1.05)	-7.37 (1.45)	-2.88 (2.09)
SCALE	-.0039 (0.30)	-.0006 (0.07)	.0010 (0.10)	-.210 (0.85)	-.260 (0.87)	-.120 (1.49)
FUEL	.0050 (2.75)	.0067 (4.16)	.0064 (3.68)	-.0213 (0.48)	-.176 (3.32)	-.0192 (1.33)
CASTE	.0092 (1.74)	.0149 (3.18)	.0166 (3.29)	-.243 (1.88)	-.522 (3.36)	-.128 (3.04)
MOSLEM	-.0004 (0.59)	.0012 (1.94)	.0019 (2.72)	.0376 (2.14)	.0023 (0.11)	-.0094 (1.63)
PLANTN	-.196 (1.51)	-.185 (1.60)	-.148 (1.19)	-1.23 (0.39)	-4.36 (1.14)	-1.44 (1.39)
PRIMM	.0140 (2.44)	.0091 (1.79)	.0099 (1.81)	.219 (1.56)	.133 (0.78)	-.0483 (1.05)
PRIMF	-.0019 (0.14)	.0064 (0.51)	-.0040 (0.30)	-.152 (0.44)	-.282 (0.68)	-.0260 (0.23)
MATM	.0095 (0.64)	.0056 (0.43)	.0002 (0.13)	-.262 (0.72)	-.189 (0.43)	-.118 (1.00)
MATF	.0793 (1.06)	.0280 (0.42)	.0792 (1.10)	-1.83 (1.00)	-5.58 (2.53)	-1.58 (2.63)
Constant	2.31 (7.31)	1.64 (5.84)	0.99 (3.28)	-26.82 (3.47)	-21.11 (2.26)	-5.74 (2.27)
S.E.E.	.331	.295	.318	8.09	9.77	2.65
$\bar{R}^2$	.465	.424	.349	.534	.587	.603

t-values in parentheses

Number of districts = 159

the wage and employment equations (F-tests, 1 percent level). The set of non-agricultural variables do, however, significantly influence agricultural employment and wages, with nine of the twelve coefficients in a_Z displaying signs predicted by the market model, in contrast to the nutritional wage hypothesis, although only five are individually statistically significant. Of these variables,the presence of factories with power engines in rural areas and proximity to urban areas appear to have the most significant impact on agricultural wage levels and employment.

The coefficients of the landholding variables, AVLAND, RAIN and IRR also display the predicted signs in the wage equations, the coefficients being statistically significant in all but the child wage equation. NOLAND, as expected, is positively associated with the proportion of laborers in agricultural employment, and has a (small) negative affect on wages. Most importantly, the coefficients of the land distribution variable, strongly significant in all equations, suggest that wage rates of men, women and children are lower and market employment higher where the distribution of land is most unequal. Moreover, the presence of plantation agriculture appears also to reduce wage rates for all three groups, *ceteris paribus*, although the PLANTN coefficients only approach statistical significance for men and women and are insignificant in the child wage and employment equations. The unrestricted reduced-form coefficients thus suggest that a redistribution of land among landholders which reduced landholding inequality would raise agricultural wages in India. The differences in the DIST coefficients in the WAGEM, WAGEF, and WAGEC equations, statistically significant at the 1 percent level, however, suggests that reductions in land inequality would exacerbate arithmetic sex-age wage differentials in rural areas.

Of the remaining variable coefficients, the results suggest that the presence of Moslem households increases the wage rates received by women and children but does not appear to increase male wages, in contrast to Rodgers' notion that employers pay higher wages to Moslem men in order to compensate them for the lack of market participation by their wives. Boserups' wage-differential labor supply hypothesis is thus given some support, although the negative relationship between MOSLEM and LABF is not statistically significant. Indeed, CASTE appears to have a stronger impact on both agricultural wages and employment than does the religion variable.

B. Structural Estimates

To more fully explore the market wage hypothesis, we estimate structural demand and supply equations for hired labor, described by (43) and (44):

$$(43) \quad W_j = \alpha_L L_j + \alpha_D X_j^D + \alpha_R X_j^R + \alpha_P X_j^P + \alpha_E X_j^E + u_{1j} \qquad j = 1 \ldots 159$$

$$(44) \quad L_j = \beta_W W_j + \beta_D X_j^D + \beta_Z X_j^Z + \beta_M X_j^M + \beta_E X_j^E + u_{2j}$$

where α_L, B_W are 3x3 coefficient matrices; the dimensions of all other variables and parameter matrices are defined above.

Each of the six structural equations satisfies the rank and order conditions for identifiability. The assumptions underlying the coefficient restrictions imposed are: (1) Non-agricultural demand factors X^Z influence only the off-farm supply of landless and small landowning households, not significantly attracting members of large farm families away from family agricultural employment and thus not affecting the demand for hired agricultural labor. (2) The X^R variables influence only the demand for hired agricultural labor since land-augmenting factors do not directly affect the quantitiy of labor supplied by landless households. (3) Plantation agriculture, pertaining only to large farms, influences wages directly, and/or the demand for hired laborers, but not the supply of wage labor. (4) Moslem does not affect the demand for hired labor since it would only have a deterrent effect on female off-farm labor supply and thus should not influence the supply of family labor on labor-importing farms. In addition, because of multicollinearity, we set the off-diagonal elements of the B_W matrix equal to zero, thus abstracting from cross-wage effects on household labor supply to the market. We also include only the "own" education variables in the demand equations.[21]

We have chosen to specify the demand equations in (43) with the wage rate as the dependent variable so that the direct influence of labor supply changes on wage rates can be more easily tested. If wage rates are influenced by shifts in supply and demand, as assumed in the theoretical analysis, the diagonal elements in the α_L matrix should display negative signs since from (25), an increase in the quantity of labor of type K must have a negative "own" wage effect in equilibrium. The cross-effects are likely, from (26), to be negative as well.

The theoretical analysis also suggests that AVLAND, IRR, and RAIN should be positively associated with the demand for hired labor and that the demand for wage labor should be greatest in areas where the value of DIST is highest if the labor market is competitive, since where the distribution of landholdings is more unequal more land is likely to be held by labor-importing farm households. If, however, the inequality in landholdings in some districts is sufficiently high such that large landowners are monopsonistic, the relationship between DIST and wage rates paid (demand for wage labor) may be negative, reflecting monopsonistic exploitation. Similarly, the coefficients of PLANTN will exhibit negative signs in the demand equations if plantation agriculture is monopsonistic, as suggested by the reduced-form results. The schooling attainment variables, however, should be positively correlated with the demand for hired labor if more educated members of labor-importing households tend to be employed in non-agricultural jobs rather than as family laborers.

With respect to the supply equations, the own wage effects on labor supply are theoretically ambiguous as was shown; however, the model suggests that the proportion of landless households and the degree of landholding inequality should be positively associated with LABM, LABF, and LABC, from (20), since an increase in DIST or NOLAND is equivalent to a reduction in the landholdings of labor-exporting households. Similarly, an increase in AVLAND would decrease the supply of market workers per household. Both the non-agricultural demand and the schooling coefficients should display negative signs in the agricultural labor supply equations; the former because unskilled labor would be attracted to employment opportunities outside of the agricultural sector, the latter for at least three reasons: (1) An increase in schooling, given the agricultural wage level, may increase productivity on the small farmer's own land, thus increasing family relative to market labor time. (2) If schooling increases agricultural productivity, there would be a positive wealth effect on leisure time which would reduce total labor supply. (3) Schooling may augment non-agricultural skills and thus be positively associated with participation in non-agricultural employment.

Because of omitted or non-measurable variables the error terms in the six equations are likely to be correlated, especially those within the sets of demand and supply equations, as is confirmed by inspection of the residual correlation matrix in Table 7 obtained from the estimation of (43) and (44) by two-stage least squares. Accordingly, we estimate the system of market demand and supply equations using full information maximum likelihood (FIML) to capture the potential efficiency gains indicated by the residual correlations.[22] As a check on the robustness of the specification to estimation technique and as insurance against a likelihood function with undesirable properties, we also employ three-stage least squares (3SLS).[23] The parameter estimates obtained, which have the same asymptotic properties,[24] are indeed quite close and are displayed in Tables 8 and 9. We discuss the FIML estimates over those obtained using three-stage least squares because of the additional invariance property of FIML, which may be of importance because of our placement of wages on the left-hand side of the demand equations.

The structural coefficient signs are generally consistent with the expectations generated by the market model of rural agriculture. In particular the matrix of supply variable coefficient signs in the demand equations is supportive of the market hypothesis, as wages appear to be sensitive to

Table 7 - Residual Correlation Matrix, Structural Equations
India Districts 1960-61

	WAGEM	WAGEF	WAGEC	LABM	LABF
WAGEF	.645				
WAGEC	.348	.761			
LABM	.0182	-.104	-.249		
LABF	-.0928	.135	-.0186	.774	
LABC	-.296	.0461	-.372	.549	.756

Table 8 -FIML Coefficient Estimates,

Indian Districts, 1960-61

Independent Variable	Dependent Variable					
	WAGEM	WAGEF	WAGEC	LABM	LABF	LABC
LABM	-.0055 (0.39)	-.0342 (0.24)	-.0501 (0.31)			
LABF	-.0285 (2.49)	-.0321 (2.78)	-.0325 (2.30)			
LABC	-.0295 (0.79)	-.0440 (1.30)	-.0395 (0.98)			
WAGEM				6.82 (0.96)		
WAGEF					18.94 (1.37)	
WAGEC						8.68 (1.07)
AVLAND	.0170 (4.69)	.0131 (3.65)	.0058 (1.39)	-.173 (1.24)	-.328 (1.53)	-.0441 (0.70)
NOLAND	.0058 (1.20)	.0031 (0.62)	-.0013 (0.23)	.368 (4.66)	.390 (3.47)	.0765 (2.09)
DIST	-.0064 (1.32)	-.0028 (0.54)	-.0050 (0.89)	.430 (4.63)	.606 (4.38)	.173 (3.30)
IRR	.0060 (3.41)	.0022 (1.23)	.0002 (0.10)			
RAIN	.0003 (4.41)	.0002 (3.44)	.0001 (1.54)			
PRIMM	.0149 (4.51)			.153 (1.01)	.0092 (0.04)	-.136 (1.35)
PRIMF		.0122 (2.47)		-.217 (0.61)	-.474 (0.81)	-.0057 (0.03)
MATM	.0065 (0.65)			-.328 (0.89)	-.441 (0.80)	-.158 (1.02)
MATF		-.117 (0.26)		-3.54 (2.05)	-6.59 (2.78)	-2.58 (2.46)
FACTRY				-4.52 (1.09)	-8.52 (1.31)	-3.32 (1.80)
SCALE				-.211 (0.84)	-.248 (0.65)	-.102 (0.97)
FUEL				-.0382 (0.79)	-.284 (2.98)	-.0694 (1.39)
PLANTN	-.278 (2.21)	-.353 (2.88)	-.277 (1.95)			
URB				-12.49 (1.61)	-18.11 (1.65)	-4.74 (1.52)
CASTE	-.0015 (0.25)	-.0004 (0.07)	-.0057 (0.83)	-.296 (1.92)	-.838 (2.82)	-.281 (1.79)
MOSLEM				.0411 (2.32)	-.0092 (0.33)	-.0229 (1.38)
Constant	1.64 (7.37)	1.16 (5.13)	0.92 (3.55)	-37.30 (2.50)	-49.74 (2.51)	-12.59 (2.01)
S.E.E.	.302	.302	.377	8.60	12.43	4.04

Asymptotic t-values in parentheses

Number of districts = 159

Table 9-3SLS Coefficient Estimates, Indian Districts, 1960-61

Independent Variable	WAGEM	WAGEF	WAGEC	LABM	LABF	LABC
	Dependent Variable					
LABM	-.0013 (0.10)	-.0280 (0.22)	-.0426 (0.31)			
LABF	-.0257 (2.23)	-.0282 (2.47)	-.0290 (2.29)			
LABC	-.0332 (0.84)	-.0474 (1.36)	-.0430 (1.15)			
WAGEM				3.77 (0.71)		
WAGEF					12.67 (1.28)	
WAGEC						6.58 (1.08)
AVLAND	.0164 (4.21)	.0129 (3.33)	.0053 (1.28)	-.0115 (1.02)	-.242 (1.51)	-.0313 (0.65)
NOLAND	.0067 (1.43)	.0041 (0.82)	.0006 (0.11)	.376 (5.01)	.393 (3.75)	.0792 (2.35)
DIST	-.0057 (1.17)	-.0019 (0.37)	-.0033 (0.64)	.395 (5.26)	.552 (5.18)	.161 (4.02)
IRR	.0055 (3.19)	.0021 (1.18)	.0005 (0.28)			
RAIN	.0003 (4.07)	.0002 (2.98)	.0001 (1.37)			
PRIMM	.0160 (4.38)			.160 (1.14)	.0088 (0.05)	-.119 (1.50)
PRIMF		.0129 (2.13)		-.115 (0.35)	.281 (0.57)	-.019 (0.14)
MATM	.0085 (0.76)			-.275 (0.80)	-.392 (0.80)	-.161 (1.17)
MATF		-.114 (0.27)		-3.25 (2.04)	-6.37 (2.97)	-2.41 (2.92)
FACTRY				-4.167 (1.04)	-7.29 (1.31)	-3.26 (2.14)
SCALE				-.174 (0.76)	-.173 (0.53)	-.099 (1.16)
FUEL				-.034 (0.74)	-.257 (3.19)	-.0568 (1.39)
PLANTN	-.288 (2.36)	-.360 (2.97)	-.298 (2.42)			
URB				-14.87 (2.22)	-19.27 (1.97)	-5.04 (1.66)
CASTE	-.0006 (0.10)	-.0002 (0.04)	.0051 (0.80)	-.257 (1.84)	-.737 (3.07)	-.244 (2.04)
MOSLEM				.0397 (2.37)	-.0006 (0.03)	-.0180 (1.37)
Constant	1.61 (6.91)	1.13 (4.91)	0.86 (3.51)	-34.12 (2.58)	-43.84 (2.49)	-11.47 (1.82)
S.E.E.	.316	.302	.369	8.52	11.74	3.72

Asymptotic t-values in parentheses

Number of districts = 159

shifts in the supply of laborers for hire such that increases in the number of people participating in the agricultural labor market, from any age-sex group, reduces all agricultural wage rates. The negative supply effects of males and children on their respective wage rates are not statistically significant, however. The strongest supply impact on wages appears to come from shifts in female participation -- a ten percent increase in the number of women working as hired laborers reduces their own wage rate and those of males and children by four, six, and eight percent respectively. Contrary to Boserup's observation, however, we cannot reject the null hypothesis that an increase in female labor supply has equal negative effects on male and female wages -- differences in female market participation are therefore not a proximate cause of the variation in male-female wage differentials across Indian districts, although they do significantly affect wage levels.

The supply equation structural estimates suggest that the relationship between the quantity of laborers in each sex-age group supplying labor to the agricultural labor market and the level of wage rates is positive, although none of the wage coefficients are statistically significant by conventional standards. The coefficients of the land distribution variables suggest that the expected reduction in female market participation in response to decreases in landholding inequality would be significantly greater than for the other two sex-age groups, although reductions in the proportion of landless households would appear to decrease male and female participation equally. The market participation of children appears least sensitive of the three groups to alterations in the distribution of landholdings.

All of the coefficients of the X^Z variables also display the correct signs, although all but two do not achieve statistical significance at the 10 percent level (one-tailed test). Of the schooling variable coefficients, 10 of the 12 are of the "right" sign but the only statistically significant coefficients are displayed by MATF. Indeed, the schooling attainment of women above the primary level appears to be more strongly related to their market participation in agriculture than does being in a Moslem household. Males, however, appear to participate more in market employment where Moslem households are more prevalent. CASTE appears to inhibit the supply of laborers to the agricultural labor market, particularly women.

Land size and land-augmenting variables have the expected positive effects on the demand for hired labor; increases in rainfall and irrigation, however, would appear to raise the demand for male labor significantly more than for female or hired wage labor. The most interesting result in the demand equations, however, is the negative signs displayed by the DIST coefficients, which indicate that where landholding inequality is greater, the demand for hired labor (wages offered) is lower for all three groups. The distribution variable coefficients thus suggest that the negative relationships between landholding inequality and wage rates obtained in the reduced form may not be the fortuitous net result of favorable scale (dis-) economics, dualism and/or income-leisure differentials but rather may reflect the restriction of wages and employment by large landowners, consistent with the monopsony model. This result is supported by the negative and statistically significant PLANTN coefficients in the demand equations.

An equalization of the distribution of landholdings would thus appear to have a strong negative impact on the supply of agricultural market labor but negligible effects on hired labor demand, with the net result that landholding inequality and rural wage rates are negatively and significantly associated. To obtain a rough estimate of the quantitative impact of a land reform program on the level of agricultural wage rates and wage differentials we compute the derived reduced-form coefficients from the FIML structural parameters, reported in Table 10, which should give quantitative estimates of the relationships between DIST, wages and wage labor employment which are asymptotically more efficient than the unrestricted reduced-form parameters. Using the actual distribution of landholdings in India (1961-62), reported in Table 4, we consider as one example a policy of placing a limit of 51 acres on all farms and then redistributing the "excess" holdings so that no <u>landowning</u> farm household would own less than 1.5 acres of arable land. It can be easily be shown that this would reduce the Kusnets ratio , computed in column 5 of Table 4 for the displayed landholding distribution,from 97.7 to 77.1, a decline of approximately 21 percent.[25] The FIML reduced-form coefficients indicates that such a land reform policy, in the absence of other changes, would raise male wage rates by 16.5 percent, female wage rates by 17.0 percent and child wages by 14.1 percent.[26]

VI. Concluding Remarks

In this paper we have investigated the wage effects of redistribution of landholdings by formulating competitive and monopsonistic rural labor market models with particular attention to labor heterogeneity and the determinants of off-farm labor supply. Although the models were constructed to be

Table 10 - Derived (FIML) Reduced Farm Coefficient Estimates

Independent Variable	WAGEM	WAGEF	WAGEC	LABM	LABF	LABC
AVLAND	.0189	.0136	.0057	-.0445	-.0703	-.0052
NOLAND	-.0005	-.0005	-.0012	.3659	.3811	.0872
DIST	-.0130	-.0098	-.0062	.2414	.4201	.1191
IRR	.0051	.0020	.0003	.0351	.0385	.0022
RAIN($X10^{-2}$)	.0196	.0149	.0057	.1337	.2828	.0496
URB	.1975	.2419	.0502	11.147	13.524	4.307
FACTRY	.0595	.1545	.0792	-4.116	-5.606	-2.629
SCALE	.0010	.0034	-.0002	-.2041	-.1827	-.1035
FUEL	.0043	.0060	.0058	-.0091	-.1708	-.0187
MOSLEM	-.0004	.0012	.0018	.0383	.0136	-.0075
CASTE	.0090	.0151	.0171	-.2340	-.5516	-.1326
PLANTN	-.2143	.2115	-.1642	-1.462	-4.004	-1.426
PRIMM	.0110	.0061	.0095	.2288	.1255	-.0530
PRIMF	.0050	.0134	-.0017	-.1826	-.2205	-.0087
MATM	.0098	.0070	.0024	-.2605	-.3083	-.1373
MATF	.1011	.0430	.1094	-2.846	-5.780	-1.633
Constant	2.01	1.38	0.75	-23.61	-23.64	-6.12

consistent with the important features of the agricultural labor market in India, they are sufficiently general and can be easily altered to suit structural conditions in the rural labor markets of other developing countries. The wage impact of a partial land reform was found to be theoretically indeterminate, due mainly to the assumption, consistent with household-level Indian data, that land-owning labor exporting and importing households employ family labor so that market labor supply shifts are affected by opposing wealth-leisure effects. However, the empirical results suggest that a redistribution of land from large to small farm households in India would raise agricultural wage levels significantly and thus benefit landless households, although sex-differentials in rural wages would appear to widen.

The econometric results also tend to support the hypothesis that the Indian rural labor market is competitive, suggesting that inter-district wage differences can be attributed to geographical differences in the relative positions of market labor supply and demand curves. The results also suggest, however, the existence of monopsonistic wage and employment attenuation in areas characterized by a high degree of land-holding inequality. The question remains, however, why disparities in agricultural wages across districts persist in India despite the apparent mobility of members of small-farm households between their own land and that of other land-owners: The high proportion of the <u>wage</u> labor force accounted for by members of land-owning households, however, suggests that with <u>land</u> (capital) market imperfections geographical mobility of hired laborers as a whole would be relatively low. Thus although the empirical results do not explicitly take into account migration, the quantitative estimates of the wage-land distribution relationships probably do not merely represent short-run effects. Moreover, the analysis would suggest that the transfer of land to landless laborers, while increasing wage levels, would reduce the geographical mobility of agricultural labor and thus increase the spatial dispersion of rural wages.

APPENDIX

Sources of Data:

Agricultural Wages in India, 1960-61, Directorate of Economics and Statistics, Delhi, 1964- WAGEM, WAGEF, WAGEC.

Census of India, 1961, Office of the Registrar General, New Delhi, 1965

Part IIB - LABM, LABF, LABC, RAIN, PRLMM, PRIMF, MATM, MATF, MOSLEM

Part IIC - AVLAND, NOLAND, DIST, URB,

Part IVB - FACTRY, FUEL, SCALE

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FOOTNOTES

1. Notable exceptions are Berry, Gersovitz, and Rahman. All of these authors, however, employ geometric analyses, with differing assumptions leading to wholly different "predictions" regarding wage effects. None consider the heterogeneity of agricultural labor, pay attention to questions of stability, or attempt to apply their models to data.

2. Information on the differential impact of alternative agricultural policies, including land reform, on sex or age specific wage rates is not only important in settling income distribution and equity issues but, as suggested in Rosenzweig and Evenson, may have significant implications for population growth and schooling as well.

3. In addition to these assumptions, Berry, who emphasizes the possibility of a wage decrease following a land redistribution, abstracts from labor-leisure choices in all households. Gersovitz, in his non-dualistic example assumes production is characterized by constant returns-to-scale and rules out negatively-sloped labor supply curves. Rahman assumes constant-returns-to-scale production and neglects labor-leisure choice.

4. From a tabulation of monthly wage rates for males, females and children by task from Agricultural Wages in India, 1960-61, Directorate of Economics and Statistics, Delhi, 1964, we find that over 95 percent of total months show male wages for ploughers while less than 10 percent report wages for women or children. Child and adult male wage rates are reported for over 90 percent of total months in the category 'herding', while less than half show female wages. Tasks such as weeding, sowing and reaping, however, appear to employ men, women, and children equally, although at different wage levels.

5. The wage levels for each group were computed for all districts in the 13 states listed in Table 5 which reported wage rates for that group for field labor or animal herding at least one month of the year. The 159 districts are those which reported wages for all three sex-age groups.
6. For a more detailed discussion of this data set, see Sarma.
7. The average numbers of potential earners in households cultivating less than 1.5 hectares is 2.4, increasing significantly with average land size. Farms with 30 hectares or more reported an average of 5.6 household members of working age.
8. These costs are assumed to embody search and direct transportation costs and reflect the value of the disutility of off-farm work and the difficulties of distributing family income among members when some individuals are employed away from home. Considerable complexity is introduced into the analysis if these costs vary with the extent of market work.
9. We also assume that the land market is imperfect, such that the distribution of land is fixed, ignore other agricultural inputs, and abstract from uncertainty, seasonality, and land tenure considerations.
10. The second inequality embodies the condition that wage laborers of each type are gross substitutes, which guarantees dynamic local stability for all speedsof adjustment. See Arrow, Block and Hurwicz.
11. With alternative sources of incomes (and nutrition) for agricultural laborers, farm owners are able to lower agricultural wages withou reducing work efficiency.
12. It may be argued that comparative statics based on differential equations is an inappropriate tool of analysis for examining large-scale land redistributions. However, most actual or contemplated land redistributions are likely to be only marginal. It is also likely that any radical land

reform programs which were to be enacted would be accompanied by structural changes as well, thereby violating ceteris paribus assumptions.

13. The degree of compensation can be easily introduced into the analysis as a parameter. As long as compensation is not complete, so that both the recipients and the donors of land experience opposite changes in real wealth (apart from indirect wage effects), income-leisure effects will be relevant.

14. Bardhan, fitting a number of alternative functional forms to Indian production data, could not reject the Cobb-Douglas function.

15. The evidence is mixed. Wellisz, using aggregate pooled time-series data from Andhra Pradesh, concluded that agricultural production was characterized by increasing returns to scale. Bardhan, however, found evidence of decreasing returns to scale in paddy agriculture and constant returns to scale in wheat-growing areas based on individual farm data from seven Indian districts.

16. We also abstract from the possibility that the monopsonist may "discriminate," paying different wages to laborers in different sex/age groups based on their market labor supply elasticities. In that case the group with the most inelastic market supply curve would receive the lowest wage.

17. However, unlike in the competitive dualistic case, the consumption and production "sectors" in the monopsonist household are not independent. Thus changes in the demand for leisure by members of the monopsonist household, due to changes in non-earnings income, for instance, will alter <u>total</u> labor usage on the monopsonist's land.

18. These are the same districts from which the wage distributions of Table 2 were taken, the criterion being that wage rates be reported for at least one month of the year for all three groups. The districts selected are thus not necessarily representative of India as a whole although they cover a wide geographic area.

19. This measure was chosen for computational ease and because of its well-known property of being sensitive to changes occurring at the tails of the distribution, where a land reform program is likely to operate. Experimentation with alternative distributional parameters, such as the log-variance and the Gini coefficient, on a subset of districts produced insignificant changes in results.

20. Alternatively, lower wages in plantation agriculture may reflect greater employment security.

21. Inclusion of the complete set of schooling variables in all demand equations resulted in slightly higher (asymptotic) coefficient standard errors for all variables.

22. See Rothenberg and Leenders.

23. There is a possibility that the FIML estimates will converge where the likelihood function is at a local rather than a global maximum. Moreover, the FIML estimates may not be "good" if the likelihood function is characterized by a flat top (plateau).

24. See Sargan.

25. A finer division of landholdings would enable the computation of the wage effects of a less radical, but perhaps more realistic, land redistribution program.

26. Thus <u>relative</u> sex/age wage differentials are diminished but arithmetic differentials are increased as a result of an equalization of landholdings.