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POLICY INSTRUMENTS FOR RURAL INCOME REDISTRIBUTION

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POLICY INSTRUMENTS FOR RURAL INCOME REDISTRIBUTION

William R. Cline

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1. Introduction

This study surveys the recent literature regarding redistributive effects of principal policy instruments affecting the agricultural sector in developing countries, updating a similar evaluation prepared in an earlier study on the relationship between agricultural strategy and income distribution, [18]. In addition, specific attention is given to a model of land reform with compensation to owners, in view of the special importance of land redistribution as an instrument for improving rural income distribution.

2. Land Reform

2.1 Recent Literature. The single most powerful policy instrument for the combined objectives of rural equity and output growth is land reform. The theoretical reasons why land redistribution should increase output as well as improve rural equity are considered at length in an earlier study by the author [17]. The central thrust of the arguments is that large estates underutilize their available land resources while at the same time the latifundio-minifundio lanholding structure compresses excess labor into the very small properties (minifundia) and into an underemployed landless labor force. Poor utilization of land on large farms results from various factors: "labor market dualism" in which the effective price of hired labor is higher on large farms than that of family labor on small farms; land monopoly and monopsony over labor in large estates; the holding of land as a portfolio asset rather than

for production; and the fact that in part production for own consumption provides small farms with greater market certainty than large estates. The resulting misallocation of resources within agriculture means that output could rise from the combination of underutilized labor in small farms and the landless labor force with underutilized land on large farms. Production function analysis using Brazilian farm survey data indicate the creation of family farms would incur no loss in potential efficiency since returns to scale are constant, and simulations of the production impact of redistribution of land into family farms of equal size suggest production gains for Brazil of 25% overall (see [17]). Numerous other studies, particularly those concerning Latin America, reach similar conclusions, and they need not be recounted here.

Recent literature on land reform includes caveats about its distributional effects (Berry [11], Sinha [35], Minhas [29]) and useful reports on recent land reform in Chile (Barraclough and Fernandez [8] and Peru (Horton [23]). Berry makes the point that if in actual execution a land reform distributes land of large estates to a relatively limited class of former small farmers, (or, the logic of the analysis would require, a favored subset of landless workers) then there may be a perverse distributional effect concerning income distribution among landless workers and small farmers. While the latter may gain at the expense of former landlords (equalizing distribution at the upper end of the income scale), they may begin to employ family labor for tasks that fomerly were performed on the large estates by landless workers, thereby reducing the total demand for labor from the landless work force (and, possibly, the rural wage).

The warning raised by Berry is particularly important. Any land reform which excludes the majority of rural labor from direct benefits will as a minimum fail to achieve its full potential for increasing equity, and may also reduce the demand for hired labor. Nevertheless, Berry's analysis does not appear to give sufficient weight to the output effect of land reform on labor demand. The increase of land cultivation and production which should follow from redistribution of land should increase labor demand, and by an amount more than proportionate to the output increase since it will be accompanied by a shift towards labor intensity in the overall factor combinations within agriculture, given the relatively low utilization of labor relative to land and capital on pre-reform large farms. In short, while it is quite possible that land redistribution to an elite class of former small farms may lead to the substitution of their formerly underemployed family labor for hired labor services previously provided by the landless labor force, it seems unlikely that this negative effect on demand for labor for the non-beneficiary population would swamp the positive effect of increased output and increased labor intensity in factor combinations on total demand for that labor.

Another current of thought on the limitations of land reform for rural redistribution is represented in an essay by Sinha [35]. Referring to the Asian context of dense population (rather than to the Latin American case), the author argues that there is so much rural labor and so little land that equal division of land would create a structure of hopelessly small inefficient farms. In particular, Sinha assumes an "optimal" farm size which maximizes farm output given available agricultural land; a farm structure with smaller farms would

generate less total output despite its absorption of more labor, according to the author. Aware that this proposition is inconsistent with past evidence showing systematically higher output per farm area on smaller farms, Sinha maintains that this old pattern no longer holds thanks to the Green Revolution and its relative increase in land productivity of larger farms, and he cites fragmentary evidence for support.[1] Based on the underlying assumption of an optimal farm size exceeding that which would absorb all rural families in an equalizing reform, the author then maintains that the best strategy for rural equity would be to limit land redistribution to a subset of the rural population (i.e. a number consistent with optimal farm size) while absorbing the remainder in rural public works. This scenario would take advantage of the greater marketable surplus the author believes would be forthcoming from the somewhat larger land reform parcels operated on a "commercial" rather than "subsistence" basis to finance the public works, and similarly would permit the bureaucracy to focus its limited administrative resources on such programs rather than have these resources bogged down in assisting the countless subsistence farms which would result from fully equalizing land redistribution.

The difficulty with this analysis is its presumption of an optimal farm size and the notion that smaller size with more labor retained in agriculture would actually reduce potential output. While the idea of an optimal farm size is extremely popular, it is simply inconsistent with the vast bulk of empirical analysis, which shows constant

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1. The author also attempts to disarm the argument that Japan's land reform succeeded on a very small farm, equal distribution basis, maintaining that Japan had irrigation while India's is limited, and that moreover Japan had a long experience with technological adoption by small tenants prior to the post-World War II land reform whereas India's labor force has a large proportion of landless laborers not similarly trained.

returns to scale considering inputs actually used as well as greater utilization of available land as farm size diminishes. The author's argument of change in this pattern due to new technology is unconvincing, especially when the potential for small scale labor intensive use of new varieties and ferilizer is considered; temporary advantage on larger farms no doubt may be observed but it reflects the S-curve sequence of adoption in which the larger farms adopt new techniques first but may be soon followed by the smaller. The most serious difficulty with the approach is its assumption that ongoing employment can be generated in non-agricultural pursuits for the excess labor left out of a land reform. Yet public works by their nature create current employment but not necessarily the capital requirements for permanent jobs. Moreover, from the standpoint of income distribution it should be noted that the public works carried out by the excess labor would enhance the profitability of agriculture for those fortunate enough to remain in a reformed agricultural structure, conferring additional benefits on them.

In sum, the appropriate farm size for an equalizing land redistribution into family farms is merely the available land divided by the number of agricultural families net of those which can realistically be expected to be abosrbed into non-agricultural activities. Given growing population as well as very limited industrial employment growth, it seems reasonable that this formulation will normally involve absorption of the total agricultural population into the reformed structure. Whether a substantial portion instead can be siphoned off into rural public works with permanent employment prospects in socially efficient work is a matter for careful empirical analysis which should neither be ruled out as a possibility nor counted upon as an article of faith.

Minhas [29] presents a viewpoint similar to that of Sinha, arguing that land redistribution to the full rural population in Indian conditions would leave a structure of rural population mostly below the "poverty line", so that instead fewer rural families should be included in reform, much more attention should be given to the integration of currently splintered (i.e. physically separated) parcels under operation by single farm units, and unabsorbed rural labor should be attended to through public works. The same difficulties cited above apply to this approach, in addition to the point that any arbitrary "poverty line" constitutes a precarious basis for policy making as it is more likely to reflect aspiration than realistic potential.

The cases of Chile and Peru represent important recent experiences in the area of land reform in developing countries. Barraclough and Fernandez [8] have compiled a description and analysis of the Chilean reform through mid-1972. Under the Frei government land reform had reached a total of approximately 14% of productive land; the Allende regime by mid-1972 had extended the total area expropriated to 35% of the country's total land (where it apparently remained at the time of the coup against Allende). The reform sector included practically all land formerly in estates larger than 80 irrigated hectares equivalent ("HRB") as well as land from poorly utilized farms from 40 to 80 HRB. The reform units remained undivided in "Assentamientos", Centers of Agrarian Reform (CERAs), or Centers of Production (CPs), all essentially cooperative farms. These units were dualistic: they contained areas of collective operation (on the basis of wages to members and outside workers) as well plots cultivated by individual members for their own account ("goces" and "talajes"). Barraclough and Fernandez emphasize

that this structure led to poor utilization of the collective resources within the reform units: members tended to concentrate their working time, as well as some of the inputs belonging to the cooperative, on their own individual plots, leaving larger collective areas inadequately worked.

Despite its impressive speed and extent, the Chilean land reform has benefitted directly only approximately one-tenth of the rural labor force. Thus, while 75,000 workers became members of reform units on the large farms where they previously worked, another 700,000 rural poor remained outside the reform sector.

The reform units did increase their employment of labor by 25% above pre-reform levels. Nevertheless, the low labor intensity on former large estates continued to dominate the agrarian structure, and the reform sector absorbed only 18% of total agricultural labor despite its possession of 35% of the land (adjusted for quality). Output on the reform sector did rise, despite the decapitalization accompanying reform as expropriated owners withdrew capital onto the "reserve" farm area they were permitted to retain. However, the bulk of the output increase appears to have been in the individual plots (goces) of the reform unit members rather than on the more extensiv e collective areas (with approximately 13% of reform unit area but 33% of its output represented by the individual plots). The marked difference in labor/land ratios among sectors persisted after the reform: on minifundios (under 5 HRB) labor per area remained ten times as high as on the new reform units, and even the medium farm sector retained a slightly higher labor/land density than the reform units.

At the time of the study, Barraclough and Fernandez emphasized the importance of the medium-size farm sector to the supply of marketed

surplus and therefore to the future of the Allende regime. A mushrooming of monetary income of lower classes had provoked an enormous increase in demand for food, only partially met by increased imports. Despite the fact that aggregate agricultural production rose 6% by 1972 compared with 1970, demand grew much faster and in the face of official food price controls, queues and black markets developed. The medium farm sector (20 to 80 HRB) supplied 45% of output but perhaps as much as 60% of marketed output, and its continued production growth was crucial to food supply. The authors noted the very strong performance of the sector but cautioned that much clearer government plans would have to be announced before sufficient certainty would exist to encourage continued investment and output growth in the sector, in view of the threat of reduction of the permissible private farm size ceiling below the 80 HRB limit.

The Barraclough-Fernandez report implies several important points. (a) The difficulties of agricultural supply resulted not from production declines attending land reform but from price controls on food in the face of rapid expansion of money incomes of the urban poor; actual quantities supplied rose but inconsistent policies led to apparent shortages. (b) Despite its substantial territorial penetration the land reform reached only a minority of the rural poor. This pattern appears to have resulted from the turning over of land to pre-existing workers on large estates. Although some partial increase in labor use followed, the increase was inadequate to redress the dramatic under-utilization of labor on this land previously characterizing the private estates. As a result the pre-existing workers received a windfall gain and became an elite rural "middle" class. (c) The failure to divide reform units into individual family parcels created a clash of ideals

with reality: the ideal of collective production collided with the reality of past tradition of access to individual plots; and the reality of much more direct reward to the worker for effort expended on his individual plot conflicted with appropriate allocation of resources within the reform sector.[1]

To the present author, there are important lessons from this experience. First, land expropriated should not be considered the preserve of its former workers alone but should incorporate an appropriate additional portion of the landless labor force. Second, the ideological pursuit of large collective farms may lead to an inefficient reform unit; division into family farms would generally appear preferable from the efficiency standpoint unless vigorous planning efforts are successful in duplicating the resource allocation patterns which would be generated spontaneously under a small family farm structure. (The role of ideology is evident in the prologue to the study by Fermandez, who asserts that "the small family farm is a stagnant production form," a viewpoint perhaps echoing that of some Chilean land reform planners). Fernandez and Barraclough frequently cite the existence of economies of scale in support of non-division of the estates; however, the large body of empirical production function estimates available shows constant returns to scale. Third, as the authors of the report suggest, certainty for the non-reform sector is crucial to continued aggregate agricultural supply.

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1. This pattern of resource misallocation due to private versus collective incentives is not new: in the U.S.S.R. the very small portion of total land allocated to private plots accounts for a disproportionately large share of agricultural output.

Horton [23] has conducted a field investigation of 27 new reform enterprises as the basis for an evaluation of recent land reform experience in Peru. After a long history of pressure for land reform, including especially a land reform law in 1964 which went unenforced and, according to the author, discouraged investment and increased peasant pressure for land redistribution, the military government in 1969 decreed a new land reform law and began energetic implementation. Expropriating land primarily with compensation in long term agrarian bonds, the government first took over 12 large coastal sugar plantations and a limited number of extremely large livestock ranches in the highland. Subsequently regional units of the national Land Reform Agency expropriated additional units. Reform units became "Agrarian Production Cooperatives," (CAPs) with collective ownership of resources in large scale units, or "Agrarian Social Interest Societies," (SAIS), primarily cooperatives maintaining the physical unity of large scale livestock units while distributing their profits to neighboring peasant communities. In addition expropriated land went to peasant communities or individuals.

Horton reports that the government intends by 1976 to redistribute 9 million hectares of farmland among 340,000 beneficiaries, with 80% of the land in production cooperatives and SAIS, 16% for peasant communities, and 4% for individuals. These changes in agrarian structure would then leave 43% of Peru's land in private farms, 32% in the possession of peasant communities, 13% in CAPs, and 12% in SAIS. In terms of resources this target profile for agrarian structure would leave only a small portion of the country's livestock in the CAPs and SAIS, for somewhat less than half of foodstuff production. Only one-third of the rural population would benefit directly from the land redistribution after the complete plans for 1976 were fulfilled.

Production characteristics have changed very little as a result of reform, according to Horton. The principal difference is worker ownership of former private estates. Where profits were previously ample, there is thus scope for increased wages; Horton found that real wages had remained constant on the coast, risen one-fourth on interior livestock enterprises, and more than tripled on interior crop enterprises. An important structural difference between the Peruvian reform units and those of Chile is that the CAP in Peru prohibits the use of resources for individual production. Production is collective, with worker management, and profits are distributed among members in proportion to the number of days worked by each. This sytem appears to avoid the serious problem of diversion of effort to individual plots to the detriment of coleective area encountered in the Chilean cooperatives.

The economic impact of the land reform to date is unclear. Horton reports that although production data are generally unreliable, land reform has not caused major disruptions in agricultural production. At the same time, the study relates that the reform has induced substantial slaughter of cattle, leading to a subsequent meat shortage. Employment effects have been a major area of disappointment, according to the author. Land reform has neither increased nor decreased employment. Officials seeking to increase the employment impact have forced cooperatives to grant membership to "a few previously part-time workers;" otherwise, reform enterprise members are apparently not hiring additional labor or expanding membership, in order to protect their profits.

Finally, the study describes the strong ideological commitment of the government to collective, large scale production. This orientation succeeded in the coastal sugar estates, but elsewhere (particularly in the highlands) authorities met strong opposition in the attempt to

collectivize individual production by tenants and sharecroppers on former private estates. In these areas cooperative members were subsequently allowed to keep their individual livestock and small plots of land. The determination of the government to establish large collective units derives in part from the notion that reform units will as a result be self-contained and constitute less of an administrative burden than would a complex of numerous small farms.

In summary, the Chilean and Peruvian experiences appear to represent redistribution of rural income away from the former landholding class to the former workers on expropriated estates. As such, they constitute improvements in rural distribution, but they fail to take the opportunity to make the income equalization as throughgoing as it could be through more equal distribution of land among the entire rural work force.[1]

2.2 A Model of Land Reform with Compensation to Landowners

While properly executed land reform constitutes a powerful instrument for rural income equalization and output growth, it is frequently ruled out as politically infeasible. Yet sweeping land redistribution with little real compensation to owners may be out of the question politically in circumstances where more limited land redistribution with full payment to owners is a realistic policy option. Landowner opposition is certain to be mitigated when the prospects for compensation are good. Moreover, if the reform process is gradual rather than complete in a single sweeping stroke, ground rules of full

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1. Note however that there is no evidence that the two reforms worsened the absolute circumstances of rural workers excluded from direct benefits due to replacement of hired labor with family labor in the reform sector.

compensation will contribute to the maintenance of investment incentives in agriculture outside the reform sector, since remaining producers will not fear total loss of the value of their investments from subsequent reform. The maintenance of incentives in the non-reform sector in turn is essential if short run disruption of production is to be minimized in a land reform.

The potential for raising output through land redistribution provides the opportunity for a "capitalist land reform" which would improve worker income while fully compensating former owners. Such a reform would constitute a classical "Pareto Optimal" redistribution: one in which some individuals are made better off while the rest are made no worse off than before. The purpose of the following model is to examine the order of magnitude of improvement in income of the rural workers to be expected from land reform with compensation. The principal policy question is whether, in the attempt to facilitate reform by compensation, the potential for increased income for the rural poor would be sacrificed.

Consider an agricultural region dominated by large farms with aggregate area "A". There are N total workers in the region, of whom Np are permanent workers on these large farms, and No are other workers: the landless labor force plus the labor on very small farms

(the aggregate area of which is assumed for convenience to be zero).

As discussed above, in Peru and Chile there has been a tendency to distribute large farm area "A" to existing permanent labor Np, thereby making them a privileged rural labor class while perhaps reducing the opportunities of the remaining workers No. It is assumed here that land reform planners will avoid this mistaken or intended inequity, and will distribute the area among the full rural labor force.

Consider a land redistribution into family farms, each family having "F" workers. There will then be "m" number of post reform farms, where

1) $m = \frac{N}{F} = \frac{N_p + N_o}{F}$

The size of each reform parcel (average, with larger size for poorer soil and smaller for better soil) will be:

2) $a = A/m$

Suppose that prior to reform the relationship of land use to farm size generated a characteristic declining relationship of output per farm area to total farm size,

3) $q = h(x) \quad ; \quad h'(x) < 0$

Where q = output per hectare of total farm area
x = total farm area (heactares)
h = a function (e.g. $q = e^{\alpha} x^{-\beta}$).

Suppose that prior to reform there were n large farms, each of size s :

4) $s = A/n$

Then pre-reform output for the region will have been:

5) $Q_o = n\, s\, q(s)$

If post-reform land use follows the patterns found on pre-reform

modest-sized farms (but not the smallest, since they will be expanded by reform due to extra land availability), post-reform total output will be:

6) $Q^* = m\ a\ q(a)$

Since the number of farms times average size must equal the total regional farm area,

7) $n\ s = m\ a$

Therefore the ratio of post-reform output to pre-reform output will be determined solely by the per-hectare (of farm area) production characteristic of pre-reform and post-reform average farm sizes,

8) $Q^*/Q_o = \frac{m\ a\ q(a)}{n\ s\ q(s)} = q(a)/q(s)$

This conclusion assumes that labor, capital, and intermediate inputs will be sufficient to reproduce at the full regional level the production features characterizing the reform-parcel sized farms prior to reform.

Note that in the convenient case of the form $q(x)=e^{\alpha}x^{-\beta}$, equation 8) becomes:

8a) $Q^*/Q_o = (s/a)^{\beta}$

For example, suppose $\beta = .1$. Then as farm size rises 10%, per-hectare (of total farm) output falls by 1%. From 8a), a reform which reduced average farm sizes to 1/100 the original level (e.g. distributing 2000 hectare farms into 20 hectare parcels) would raise output by approximately 60% (that is, $[100]^{.1} = 1.59$).

More generally, let the ratio of post-reform output to pre-reform output be :

9) $\Theta = Q^*/Q_o$

Note that a prior study for the Brazilian case [17] indicates that 25% increase in output might be a reasonable level to anticipate.

To examine the effect of reform on worker income, consider first the pre-reform average worker income:

10) $\bar{y}_o = \dfrac{w N_p + w(1-u)N_o}{N}$

where $\bar{y}_o$ = average worker annual income, w= wage (annual), and u= unemployment rate among the non-permanent laborers. After reform, gross income per worker (not deducting for payments for land) will be:

11) $y^*_G = Q^* / N = \dfrac{\theta Q_o}{N}$

The ratio of post-reform gross income per worker to pre-reform average worker income will therefore be:

12) $y^*_G / \bar{y}_o = \left[\dfrac{\Theta Q_o}{N}\right] / \left[\dfrac{w\{N_p + (1-u)N_o\}}{N}\right]$

If we denominate Wo as aggregate wage payments before reform and Π_o as aggregate profits before reform, and abstract from capital and intermediate input costs (or, the equivalent, define Q_o and Q^* net of them , then

13) $Q_o = \Pi_o + W_o$

and, from 12),

14) $y^*_G / \bar{y}_o = \dfrac{\Theta[\Pi_o + W_o]}{W_o} = \Theta(\Psi_o + 1)$

where Ψ_o = the original ratio of profits to wage bill.

Equation 14) tells the proportional rise in average worker income resulting from a land reform with no land payment compensation. The rise can be quite high with reasonable values. For example, if wage and profits

shares are equal prior to reform, $\psi_o = 1$; with $\theta = 1.25$ (as suggested above), $y_G^*/\bar{y}_o = 2.5$ and average labor income hence rises by 150% as the result of reform, in the absence of land repayment. Note that the income rise is greater proportionately for the former landless workers, and smaller proportionately for the former permanent workers, since $y_o^{LL} < \bar{y}_o < w$ where y_o^{LL} is the original average wage for landless workers (equal to $[1-u]w$). Now consider the effect of payment for land by parcel recipients. A crucial question is the value of land attributed for compensation. By capital theory, this value should have been the present discounted value of the future stream of expected profits, or:

15) $V = \Pi_o/\rho$

where V= aggregate land value and ρ = landowners' discount rate. Because of the standard cleavage between capitalist rate of return and the rate of return paid to savers (due to capital market imperfection), ρ should be relatively high, say 15% to 20%.

Let r = the financial interest rate which parcel recipients are charged on the unpaid balance of their land purchase. Note that since a pure transfer from former to new owners is involved, it is not clear that "r" should equal the opportunity cost of capital. More particularly, if the compensation is paid to owners in bonds bearing <u>real</u> interest rate "r" typical in the financial markets, there is no reason to charge more than "r" to parcel recipients despite the fact that the social opportunity cost of capital may exceed "r" - - since, again, it is a transfer and not an acquisition of incremental capital beyond that originally held by the landlords that is involved.

Defining y_{NI}^* as post-reform income per worker <u>net</u> of <u>interest</u> on the land-loan, we have in the first year when the full debt on purchased

land remains outstanding:

16) $y^*_{NI} = y^*_G - \frac{rV}{N} = y^*_G - \frac{r\Pi_o}{\rho N}$

That is, total interest payments are rV; there are N workers, so per worker interest payments are $\frac{rV}{N}$. Given 15) the equation yields the final expression on the right. But since

17) $\frac{\Pi_o}{N} = \frac{Q_o}{N} - \frac{W_o}{N} = \frac{Q_o}{N} - \bar{y}_o$

we may write:

18) $y^*_{NI} = y^*_G - \frac{r}{\rho}\left[\frac{Q_o}{N} - \bar{y}_o\right]$

$= \theta(\psi_o + 1)\bar{y}_o - \frac{r}{\rho}\left[\frac{Q_o}{N} - \bar{y}_o\right]$

so that:

19) $y^*_{NI}/\bar{y}_o = \theta(\psi_o + 1) - \frac{r}{\rho}\left[\frac{Q_o}{N\bar{y}_o} - 1\right] = \theta(\psi_o + 1) - \frac{r}{\rho}\left[\frac{Q_o - W_o}{W_o}\right]$

$= \theta(\psi_o + 1) - \frac{r}{\rho}(\psi_o) \qquad = \psi_o(\theta - \frac{r}{\rho}) + \theta$

The final form of equation 19) indicates the proportional rise of average worker income net of interest payments. As the interest rate r falls to zero, the rise approaches that of gross worker income; as r approaches the discount rate used in evaluating land value, the proportional rise in worker income falls by ψ_o.

Thus, in the limiting case of $r = \rho$, average worker income would rise by 50% rather than 150% in the example above.

Note that worker income net of interest would rise over time as outstanding land debt declines. Furthermore, net worker income would rise as a result of any technical progress above pre-reform production characteristics on family farms. Such technological change would have a "leveraged" effect on net income: a given percentage rise in output relative to inputswould allow a larger percentage increase in net income

(since net income is a residual between output value, land interest payments, and intermediate costs).

Finally, it is important to consider the fact that net income includes "forced saving" as the land loan is amortized. Thus, the income expressed in equation 18) exceeds the net income available for consumption by the amount of amortization paid during the year. That amortization constitutes income because it represents accumulation of equity, but it is income which must be saved.

If interest and amortization were phased in equal annual instalments over z years, as in a home mortgage with declining interest and rising amortization components of a flat annual payment, then "liquid" net income per worker would be:

20) $$y^*_{LIQ} = y^*_G - \mathcal{E}_{r,z} \frac{r}{\rho} \left[\frac{Q_o}{N} - \bar{y}_o \right]$$

where $\mathcal{E}_{r,z}$ is the ratio of the flat interest-cum-amortization payment to the interest alone on full debt outstanding. (For example, with a 20 year loan with 6% interest, the equal annual installment paid is 8.72% of original principal or $\mathcal{E}_{6\%,\ 20\ \text{years}}$= 8.72% / 6% = 1.45).

Following equation 19), the ratio of y_{LIQ} to original worker average income would then be:

21) $$y^*_{LIQ} / \bar{y}_o = (\Psi_o)(\theta - \mathcal{E}_{r,z} \frac{r}{\rho}) + \theta$$

To assess the range of improvement in worker income under capitalistic land reform, the above equations may be examined under reasonable assumptions of parameter values. The results are shown in table 1. It is clear from the table that over the reasonable parameter ranges quite substantial real income increments can be expected for workers even though they must pay for the land. Even liquid income --excluding forced saving

through amortization of land debt -- shows substantial increase except in the two least favorable cases (E and G) in which a low discount rate is used to evaluate land or, what is the same thing, a high price is paid to landlords.

Table I

Effects of "Capitalistic" Land Redistribution on Average Income of Workers

	A	B	C	D	E	F	G	H
ψ_0	1.0	1.0	1.33	1.33	1.0	1.0	1.33	1.33
θ	1.25	1.50	1.25	1.50	1.25	1.50	1.25	1.50
r	.06	.06	.06	.06	.06	.06	.06	.06
ρ	.15	.15	.15	.15	.10	.10	.10	.10
$\mathcal{E}_{r,z}$	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
$y_G^*/\bar{y}_o$	2.5	3.0	2.91	3.50	2.5	3.0	2.91	3.5
$y_{NI}^*/\bar{y}_o$	2.1	2.6	2.38	2.96	1.30	1.8	1.51	2.1
$y_{LIQ}^*/\bar{y}_o$	1.92	2.42	2.14	2.72	.76	1.26	.89	1.47

In sum, "capitalistic" land reform may hold promise for substantially increasing income of the rural poor while at the same time being more feasible politically than land redistribution without compensation. Two additional notes on land payments are important: (a) in evaluating land, a justification for using a high discount rate (e.g. 15%) despite the

fact that landlords will receive a lower rate (e.g. 6%) on bonds is that the bonds -- indexed to correct for inflation -- are riskless assets and therfore should carry lower return than productive risk capital; (b) to enhance receptivity of landlords to the program, the bonds might be more favorable (e.g. redeemable at earlier date) if the proceeds are put into selected development programs by the landlord recipients. Such a mechanism has been employed in the Peruvian land reform, in which long term bonds given for compensation to expropriated landlords were made eligible for immediate use if invested in industrial projects (with the degree of discount applied for such purposes related to the priority assigned by the government to the project).

Finally, it is important to consider whether land reform based on full compeansation is feasible from the standpoint of financial requirements. Actual experience is one guide to answering this question. In the case of Peru, reliable sources indicate the government anticipated a total cost of approximately $850 million for acquisition of land, capital, and livestock assets on the full target reform area of 9 million hectares. This cost amounted to approximately 10% of GNP and was considered fully manageable given payment over time (terminating in 20years). In the case of Brazil, there is also evidence that financing for "capitalist land reform" is available. The government earmarked more than $1 billion for a "Program of Land Redistribution" in the Northeast over five years beginning in 1971. At market land prices as of 1973, this funding would have been adequate to purchase 8 million hectares of land, practically one-fifth of the entire land area of the region. Instead, the funds have been used almost completely for credit to the existing agricultural structure.

In more general terms, it seems likely that the total value of land and capital in the agricultural sector of the developing country is approximately equal to one year's GNP.[1] Full compensation for an instantaneous complete expropriation would be out of the question. On the other hand, a program expropriating one-tenth of agricultural land annually over five years (for example) would involve government borrowing or extra tax revenue equal to 1/10 of GNP in the first year and less thereafter as peasant repayments accrued. Such a magnitude would amount to perhaps a one-third increase in the government spending in many countries, a very large effort indeed but one not impossible and a reasonable one in view of the radical transformation of agricultural production and equity and which could be obtained.

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1. Suppose agriculture provides 30% of GNP. With a capital (including land) output ratio of 3.3 agricultural capital value equals GNP. Alternatively, suppose non-labor share in agriculture is 40%, or 12% of total GNP. If the capitalist discount rate is 15%, then the stock value of non-labor income is 80.4% of GNP (that is, 12% .15).

3. Land Taxation

An instrument sometimes considered an alternative to land reform is land taxation. Berry [12] has considered the effects of a "presumptive income tax on land" for the case of Colombia. In his formulation, imputed income based on a standard rate applied to land value would be added on to the income reported for income tax purposes. The author first examines the effects of such a tax in the context of perfect markets. Berry concludes that in this case the tax would reduce land prices (by lowering net return to land), and could have positive, neutral, or negative investment and agricultural output effects "depending on relative present and future wealth elasticities of consumption."[1] In a context of unequal farm sizes, still with perfect markets, there would also be an effect of land sales by richer farmers to poorer, smaller farmers --because the standard presumptive income inputed would be taxed at a higher rate for the higher income farmers given a progressive income tax.

Turning to the Colombian case, Berry modifies the analysis to take into account the serious market imperfections which generate a pronounced pattern of higher value added and higher labor input per unit of constant quality land on smaller farms than on large. In this

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1. The argument is that decline in land price inflicts a wealth loss. If the time preference for consumption is neutral with respect to wealth there will be no change in the savings rate (and hence, investment).

context, the presumptive tax would almost certainly have a positive effect on output (so long as the tax were levied on raw land, not improvements) because it would induce the sale or rental of land from large farms to smaller units where it would be more fully exploited. The income distributional effect would be positive, although if the fragmentation of large farms led to creation of very small family farms, the hired labor force might suffer a loss of employment (whereas they would gain jobs if the transition were to a structure of medium sized farms using hired rather than family labor).[1] Finally, Berry judges that the political prospects of a presumptive income tax on land have improved in Colombia, and notes that farm groups considering themselves progressive have advocated such a tax, feeling they would escape the burden due to their high productivity.

One difficulty with the analysis appears to be that it specifies an imputed income per land value which is added onto actual income regardless of the level of the latter. One would have thought that a presumptive tax would instead specify a minimum income per hectare (or per land value); farmers actually producing more than this minimum would be unaffected by the tax.[2] With this "tax on minimum imputed income" approach, most of the analysis would require revision; most importantly, the effects would be even more equalizing than those

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1. Behind Berry's concern in this dimension lies an assumption that the structural transformation to small farms would be incomplete: a sector of the rural population would remain landless. Otherwise the concern is irrelevant, as all workers would have employment on their family farms in a "complete" transformation of the ownership structure.

2. The enthusiastic farmers' organization reported by Berry seems to have been thinking of this type of tax.

assessed by Berry -- since small farmers with high income per land value would pay no additional tax while large owners with very low income per land value would have to pay much more in taxes than before. Another aspect requiring additional attention is the market for land purchase credit. In the absence of efforts to provide long term credit for land purchase, a presumptive income tax on land would probably fall far short of its potential for fragmenting large estates into small family properties; instead, rental of formerly unused land would be the likely result.

Lewis [28] similarly argues that a progressive land tax (by farm size) or a tax on potential rather than actual farm income can help reform the agrarian structure. He notes (as have others) the influence of portfolio asset decision making in land use: land may be held for capital gains purposes without productive utilization, and more progressive capital gains or land taxation will make such holding more costly, pressuring owners to use the land more fully themselves or to rent or sell it. He adds that the land tax may have been a major factor in bringing about the important contribution of agriculture to development in Japan.

An opposing line of argumentation is presented by Sazama and Davis [33], who examine the influence of land tax on land use in Colombia, Chile, and Brazil. The authors maintain that land tax has erroneously been seen as a substitute for land reform; in actuality, they argue, land tax is inadequate for this purpose, and the tax should be viewed as a potential instrument for revenue which in turn can be used to good purpose, rather than as an instrument for structural reform. The authors begin with the postulate that since a tax on

unimproved land value falls on economic rent, it will have no influence on production or land redistribution. They then soften the stand to allow for possible increases in production as owners attempt to recover the wealth loss from a new land tax.

The authors' argument that land is a fixed asset and taxation of its rent will influence nothing appears quite shaky. In the Latin American context (and in underdeveloped areas generally) output and labor inputs per unit of land available are systematically higher on smaller than on larger farms. The effect of a tax on land must therefore be more onerous on large landowners than on small. In effect, a tax on unimproved land should raise its relative price as a productive input, causing those farms (the large estates) using it heavily in combination with little labor and capital[1] to shift factor combinations, to employ more capital and labor per hectare, and raise "land utilization." Moreover, the cost of holding the land idle for portfolio purposes rises, as mentioned above. In short, it appears theoretically inadequate to assert that a tax on land does not effect output decisions and factor combinations, on the grounds that land is a fixed asset.[2]

The authors seem on more solid ground in their empirical analysis. Data for two counties in Colombia indicate no difference in land utilization between the two, although in one the land tax burden was double that of the other due to a recent reassessment. In Chile, a variety of "performance" indicators fail to show strong relationships to

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1. i.e. Intensively in the neoclassical idiom, extensively in the Ricardian.

2. The issue is related to the dispute over land's "marginal product" in "alternative uses," in neoclassical factor payment analysis, as opposed to land's "rent" as a fixed factor, in Ricardian analysis.

the land tax burden over time,[1] despite a substantial rise in tax rates after 1962 and despite interview material suggesting farmers do take land tax into account in their decisions. Finally, one county in Brazil resembled its neighbor in land utilization although its land tax rate was seven times as high.

The evidence presented by Sazama and Davis support the contention that, as practiced in Latin America, land taxation has been a poor instrument for structural reform and has had little influence on land use. However, in all cases they considered, the basic tax rate was minimal, and it was usually applied to a nominal value radically eroded by inflation. There is therefore no basis in the evidence for concluding that a higher tax rate applied to realistically updated land values would be ineffectual in terms of structural reform. There is, however, the political difficulty of instituting such rates, and Sazama and Davis maintain that if the political context is ripe for meaningful land taxation it is also ripe for land reform. Berry's view is the opposite.

On balance, land taxation as an instrument for rural equalization deserves continued attention. If land tax rates can be raised to levels sufficiently high to influence land use (by means of "presumptive income" measures or otherwise, and with the necessary corrections for inflation) then the instrument may have a sharper cutting edge than is usually admitted. However, it is certainly true that policy makers will be practicing deception (possibly including self deception) if they

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1. Unfortunately, the authors consider R^2 of .2 to .5 to indicate poor relationships. Robust "t" statistics would be of greater interest, but they are not reported.

eschew land reform under the justification that taxation can accomplish the same structural reform, and then proceed to institute trivial tax levels.[1]

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1. Recent evidence available to the author for Brazil indicate that the land tax averages only 1/2 of 1% of market value of land in the Northeast, and is still lower in the rest of the country. A "high" tax rate of 1.6% of land is reported by Sazama and Davis for Chile in 1965. Such rates are marginal compared with a probable opportunity cost of assets of 15% per annum. They become even less important if the real value of land is rising over time at a substantial rate, and they turn totally inconsequential if the base year valuation is not updated for inflation. In contrast, Berry suggests approximately 6% of real land value as presumed income; combined with a progressive income tax, the effective rate might reach 3% of land value for large owners. Such a level might begin to influence land use: supposing net income per hectare could double by more intensive land use, the burden of such a tax would fall from one-fifth to one-tenth of land's earnings.

4. Tenancy Conditions

Revision of sharecropping and rental conditions is a policy measure frequently recommended as a partial substitute for redistribution of land ownership. Indeed, it is often argued that transfer of land ownership to current tenant workers is a "safe" form of land reform because worker incentive will increase while all else -- physical production units and patterns -- will remain undisturbed, circumventing output declines in a transitional phase of reorganization.[1]

In a highly unequal land ownership structure, agrarian reform based on conversion of tenants to owners is likely to suffer from the same inefficiencies as conversion of wage earners to owners on large estates without absorption of additional workers onto the properties: labor density per farm area will be suboptimal from the standpoint of agriculture as a whole. In other words, large owners placing their land in share cropping or renting it out are not likely to have higher labor density per area (and higher land utilization) than large owners utilizing wage labor. Therefore, conversion of tenants to owners without absorption of additional labor onto tenant-farmed area should be viewed with suspicion.

But what about reform of "tenancy conditions"? One tenancy form in particular has been a popular candidate for reform among economists: sharecropping. The traditional argument has been that sharecropping causes inefficient factor allocation: the tenant will apply inputs, including his own labor, only to the point where his share of their marginal product equals their full marginal cost, violating

1. The land reforms of Taiwan and Japan are often cited as owing their success partly to the fact that they involved conversion of pre-existing tenants to owners.

marginal cost equal to marginal product conditions for efficiency and leading to underutilization of land.

Cheung /15/ has challenged this view. He argues that its proponents have erroneously assumed that the landlord's share is "mysteriously" fixed exogenously. According to Cheung, once it is recognized that both (a) the share, and (b) the amount of land allocated to each sharecropper are endogenous variables resulting from landowner wealth maximization, the normal efficient, neoclassical allocation of resources can be seen to result even from sharecropping. The author employs Lagrangian multiplier analysis to demonstrate the point, but his argument condenses to the following (1) The landlord will maximize output subject to the constraint that what he pays to labor has to equal what it can earn elsewhere, equal to the wage rate. (2) As a result, sharecropping is nothing more than a masquerade leading to the same results as profit maximization with wage labor; the landlord is smart enough to juggle his "share" and the amount of land he places at the disposal of each tenant to ensure this result. In the process, it turns out that landlord share is nothing other than the familiar elasticity of output with respect to land; and marginal products of land and labor equal the rental rate per land area and the going wage --all neoclassically reassuring.

The weak spot in Cheung's analysis is that he replaces rigid landlord share cum tenant maximization with rigid (or "passive") tenant labor behavior cum landlord maximization. By assuming the landlord can set a fixed amount of land to which the tenant will then apply his full labor availability, Cheung robs the tenant of his decision making;- yet the tenant's decision making process is precisely where inefficiency enters according to the traditional analysis, since the tenant will always, at

the margin, ask why he should devote Δ Nw worth of extra work to the plot (as opposed to outside work) when the result for him will be $(1-r)\Delta Nw$ extra income.[1] In short, it appears unsatisfactory to conclude with Cheung that all's for the best in the best of all sharecropping worlds under the notion that landlord share and land allocation per worker will settle down to an equilibrium imitating the standard entrepreneurial wage labor equilibrium.

Bardhan and Srinivasan [5] were quick to notice the problem in Cheung's analysis, and proposed an alternative model introducing maximization on the land demand side from the tenant's standpoint to complement maximization on the supply side by the landlord. Despite adroit mathematical features, the Bardhan-Srinivasan model has its serious shortcomings: early in the model [p. 49 equation 2] the unacceptable assumption is made that the marginal product of land is zero. This feature results from the assumption that sharecroppers will "demand" land until it no longer produces anything extra for them (i.e. their share times marginal product of land falls to zero; hence, marginal product of land equals zero since tenant share doesn't). Yet this requirement of the model invalidates it for meaningful application to land scarce, surplus labor countries where the marginal product of land is anything but zero.[2]

In pragmatic terms the problems of share cropping become evident when considering adoption of new technological packages. If the sharecropper receives only half (say) of the benefits of extra output, and if furthermore even this half should exceed the cost of the sharecropper of

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1. Where N is labor, w is outside wage, and r is landlord's share.

2. In addition to the logical point that land's marginal product must be above zero in a context of population density, there exist numerous empirical production function estimates indicating positive marginal product of land.

the package to allow margin for risk of failure, then the package must be highly productive indeed to warrant adoption by the sharecropper. Moreover, even if the landowner agrees to pay a share of the cost of the package equal to his share in output, the "real" cost share of the tenant will still exceed the tenant's output share if application of the package requires the devotion of extra days of labor at the peak season when the tenant could out-hire his labor. Hence, the landowner's share of new technology package costs may have to exceed his share in output in order to keep the tenant's "real" share of costs including foregone extra earnings equals to the tenants' share in output, if such technology is to be adopted.

5. New Technology: Improved Seeds and Fertilizer

A representative assessment of distributional effects of the new high-yielding varieties (HYV) is reported by Ahmad [4]. After documenting the rapid growth of HYV wheat (from 4% of crop area to 40% in India and from 2% to 46% in Pakistan between 1967 and 1970) and rice (2.8% of crop area to 12%, India; 0 to 6.7%, Pakistan; 6% to 40%, Philipines, for the same period), Ahmad's review finds that the potential for distributional equity inherent in the scale neturality of new seeds and fertilizer has not been realized in practice. Instead, greater capacity of larger farmers for installing complementary tube-well irrigation, easier meeting of high credit requirements by the larger farmers, discouragement of adoption of HYV among share croppers due to sharing distortions to incentives, have all concentrated HYV gains in the larger farm sector. Moreover, pressures for land reform have abated as the result of the new belief that income gains through technical improvements offer the land-poor an alternative to increased access to land through land redistribution, and because a new class of "progressive farmers from non-agricultural sectors" (Ricardo's capitalists) has emerged which is welcome to output-conscious governments and which possesses political clout.

Ahmad's survey points out the conflicting evidence on whether labor has gained or lost from the HYV. In India, the demand for hired labor may have risen by as much as one million man years for rice and wheat converted to HYV in India.[1] This gain would constitute less than 1% of the rural labor force. At the same time, there is evidence of substantial labor displacement through mechanization (discussed below) and eviction of

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1. According to data for 1968-69 from Lahiri, cited in [4].

tenants or raising of rental charges. Ahmad also emphasizes the difference between irrigated and rain-fed areas, noting that the greatest potential for increased labor demand is in the irrigated areas suited to double cropping. These, according to an Asian Development Bank survey cited by the author, amount to less than 10% of the rice and wheat area for Asia as a whole. Finally, Ahmad presents data showing a mixed pattern of real rural wages in India; of ten states, real wages rose in 6 but fell in 4 in the 1960's.

Bartsch [9] has assembled from a variety of sources data concerning the impact of new varieties and mechanization on the demand for labor in Asia. Distinguishing among three levels of "technology" ("traditional"; "improved," with one or more of the following -- improved seeds, irrigation, chemical fertilizers; and "modern" -- with a complete package of HYV seeds, fertilizers, and assured irrigation), and three "techniques" (traditional, intermediate, and mechanized), the author defines nine possible production modes for each crop. Based on selected data for rice and wheat in regions of India, Pakistan, the Philippines, Sri Lanka, and Thailand, Bartsch reaches the following conclusions. (1) Holding technology constant, a shift towards mechanized technique unequivocally reduces labor demand. (2) Holding technique constant, a shift towards HYV technology unequivocally raises demand for labor per unit of cropped area (as more labor is required to prepare the seed bed, apply cultural treatments and, especially, harvest). (3) A combined shift towards mechanization and HYV technology is ambiguous

in its effects on labor: the result is usually a decline in labor requirements per unit of cropped area, which may or may not be fully offset by a rise in the incidence of multiple cropping.(4). Modernization - either of technique or technology reduces labor requirement per unit of output, raising ominous implications for labor demand unless the product has highly elastic demand due to potential for import substitution (or, the reader infers, in a small country export context). Indirect demand for industrial labor is quite limited for agro-chemicals, and is much higher for "partial mechanization" involving modest improvements in implements, than for a high degree of mechanization requiring large sophisticated equipment produced on a capital intensive basis.

While these conclusions are not new, and while the study pleads insufficient evidence on the crucial question of the net impact on labor from mechanization and HYVs with increased double-cropping, the study is particularly useful in placing quantitative estimates on the various labor demand effects by synthesizing a number of isolated empirical studies.

Bell /10/ has examined the distributional impact of the new technology. Following a semantical bout differentiating "technique" from "technology," the study raises familiar observations: the HYV is intrinsically scale neutral, but better access to credit due to better collateral and privileged social status (in addition to official agencies' desire to maximize impact by focusing on "the stronger farms), as well as greater margin for risk-taking, permit the larger farmer to exploit the new technology more fully than the small farmer. This tendency is reinforced by tractor and tube-well indivisibilities.

The empirical evidence presented in the study indicate the surprising result that, for wheat in the Bihar region of India, shifting to HYVs raises wage labor participation in value added. The data appear to represent the "constant technique, improved technology" category in Bartsch's taxonomy, so that increased labor requirements for cultural practices are not swamped by mechanization. Even so, it is suprising that yield-multiplying innovation would increase labor costs by a greater proportion than value added;[1] and Bell warns that the conclusion

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1. For wheat, Bell's "typical" or stylized data indicate per-acre increases of 400% for output, 436% for wage bill, and 720% for intermediate input costs. These data are surprising: in general, one would expect the percentage change in labor necessarily to fall short of the percentage change in labor necessarily to fall short of the percentage change in output, since part of labor should be proportional to unchanged land area while only the remaining part should be proportional to output. Moreover, Bell's data imply a declining labor productivity, contrary to all of the technological or technique improvement results reported by Bartsch /9/.

must be treated with caution (adding that his data on labor are merely "notional").

A particularly interesting phenomenon which Bell mentions in passing is that the fertilizer dose applied to HYV wheat has fallen progressively since the first year of widespread utilization of the seeds (1967/1968). High yields with the recommended dose were followed by lower yields the second year despite application of the same fertilization, the third year farmers reduced fertilizer application, prompting a further decline in yields, and so forth until low level equilibrium seemed to have been reached. Bell interprets the development as evidence of peasant cunning in the face of extension agents' horror. More recently, a renewed decline in the use of fertilizers must certainly have been stimulated by energy-crisis fertilizer price increases. Since a crucial attribute of the HYVs is their ability to respond to increased fertilization, the likely decline in fertilizer use would seem to bode ill indeed for the production gains of the Green Revolution.

Bieri, de Janvrey and Schmitz [13] emphasize the sociological relationship between income distributional impact of technological change and the generation of that change. The authors first characterize labor and machinery as close substitutes, land and chemicals as close substitutes, and postulate little substitutability between these two subsets of factors. They then conclude that mechanization confers gains on landowners, whose land values rise from the resulting reduction in cost at constant output. In contrast, innovations using chemicals raise total output (by extending the constant quality equivalent land endowment), confering benefits on consumers in the closed economy (as price declines), upon both producers and consumers in the open economy (as export and import increases spur welfare gains through trade specialization), or upon producers alone in a support-price context. The authors maintain that once market imperfections, input producers, and consumers are considered, the income distributional effects of technological change cannot be foreseen simply (e.g. in a dichotomy naming mechanization unequalizing and seeds-fertilizers equalizing), but that one can be certain the inventions' nature will be swayed by the landlords who lobby for mechanical innovations and the "agribusinesses" which push innovations in order to sell inputs.

One of the more rigorous examinations of distributional effects of the Green Revolution is provided by Srivasta and Heady [36]. The authors use farm level data for two states in India referring to pre- and post-technological change periods to estimate CES production functions. The results indicate that technical change was labor saving, since the parameter determining labor's marginal productivity relative to that of capital declined.[1] Moreover, the production functions indicate the elasticity of substitution between capital and labor increased. The effect of the increase was unfavorable to labor share, because during the period the price of labor rose relative to that of capital.

Actual labor share declined in the two states, consistent with the production function estimates. Srivasta and Heady note that despite the decline, both absolute number of wage workers and the agricultural wage rose. The authors attribute the rise in wage to a sharp increase in the demand for peak season labor, unaccompanied by a similar increase in demand for off-season labor.

The study may be misleading in that it employs only capital and labor as inputs in the production function. The land input is subsumed into capital value, thereby forcing land to be a perfect substitute for machinery (precisely the opposite of the approach taken by Biere, de Janvrey, and Schmitz in [13]); and intermediate inputs of seeds and fertilizers are absent from the production function altogether. Moreover,

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1. That is, $(1-\delta)/\delta$ in the production function $Q=\gamma\left[\delta K^{-\rho}+(1-\delta)L^{-\rho}\right]^{-1/\rho}$ where Q, K, and L are output, capital, and labor.

the analysis does not clothe the particular empirical results in substantive detail indicating why one would have expected the technical change to have been labor saving (and, in particular, differentiating the potential factor "bias" of HYV -- which is probably neutral --from the ex post realized bias in view of simultaneous mechanization).

Gotsch [20] has explored the influence of rural institutions on the distributional impact of new technology. First he issues a caveat that evaluation of the distributional effect of a particular technology requires detailed micro analysis. As examples, he notes that despite the frequent classification of biological-chemical innovations as labor-using and mechanical innovations as labor-saving, herbicides are highly labor-saving and tubewells can be labor-using in their impact (as can tractors, where essential for multiple cropping). The author then discusses the relationship of the organization of input markets to the social structure, emphasizing the difficulty of creating institutions that deliver services to the small farmer.

The case of tubewell innovation in Pakistan is contrasted with that in Bangladesh to illustrate the crucial role of rural institutions as opposed to the technology itself. Comilla District in Bangladesh has a small farm structure with relatively equal land distribution; the Sahiwal District in Pakistan has a much larger median size of holdings and more unequal distribution. Since one tubewell irrigates from 50 to 80 acres, the small (1 to 2.5 acre) Comilla farms perforce banded together in cooperative organization to install tubewells, while in Pakistan the larger 50% of owners installed tubewells individually. Subsidized official credit assisted the large farmers in this effort. The distributional result (at least as mapped by programming models) will be that tubewell adoption aggravates inequality in Pakistan while spreading benefits relatively equally in Comilla District. Gotsch does note, however, that the extent of tubewell adoption has been much greater in the Pakistan District than in Comilla.

There also has been feedback reinforcing the divergence between distributional effects in the two cases. According to Gotsch, tubewells strengthened the hand of large landlords heading political factions, making it more difficult for sharecroppers and other workers dependent on them to form horizontal groups to break the power of the vertical political factions. (Indeed, the main new political lobby was that of large commercial farmers opposing land reform and taxes and advocating support prices.) In contrast, the tubewell strengthened community organization among middle and small peasant classes in Comilla.

Concerning receptiveness to technical change, Gotsch reports that several studies indicate smaller farmers in the Asian context adopt new varieties practically as completely as larger farmers, although perhaps with a one or two year lag and utilizing less than optimal fertilizer inputs.

Dalrymple and Jones [19] have drawn interesting parallels between the Mexican experience with high yielding varieties and current experience in Asia. Noting the "S" curve relating the fraction of area in new varieties to time, they emphasize that the HYV cycle is still in its early phase in Asia. They find it not surprising that the initial wave of adoption was concentrated on larger farms, given their greater access to credit and greater ability to take risks; yet it would be misleading to conclude from this pattern that the HYV will have unequitable distributional effects over the long run, because eventually adoption is likely to spread to all farm sizes. In Mexico, where the "cycle" began with the first family of new varieties in 1948, improved wheat varieties are now used on virtually all farm sizes, and more than 40% of wheatland is in ejido farms (according to the 1960 census).

The authors also note the trade implications of the variety adoption cycle. In the case of Mexican wheat, an early phase of rapid import substitution was followed, after complete replacement of imports, by a temporary effort at export subsidization, then reversion to supply for domestic demand alone. The import substitution phase has particularly important implications for labor demands: by providing infinitely elastic product demand over an initial range of output, import substitution circumvents the negative impact on demand for labor which is inherent in an inelastic product demand situation -- given the decrease in labor input per unit of output (as opposed to labor demand per cultivated area) associated with introduction of HYV (as noted in [18]).

Considering the implications of the Green Revolution for Latin America, Thiesenhusen [38] has argued that in the absence of land reform the result of the new technology will be a deterioration in the already unequal income distribution. Influences causing unequal benefits from the supposedly scale neutral HYV are the same as in Asia only worse (given Latin America's more extreme inequality of land distribution). The credit and technical assistance institutions are "usually designed to help the large-scale farmer." Compounding the distributional problem is labor's displacement from rapid mechanization in the hemisphere, stimulated by favorable exchange rates and cheap credit. Not only will small owners fall behind, Thiesenhusen notes, but renters and sharecroppers will be displaced as landowners become more determined to avoid all claims against their appreciating land.

Thiesenhusen then cites the success of yield-raising varietal adoption in small farm areas of southern Brazil. He reports the favorable experience of credit agencies in Venezuela (CIARA) and Mexico (Puebla Project) in improving technology on small farm, post-reform sectors (noting that in the Venezuelan case credit has been refused to farmers unwilling to follow the proposed crop scheme with new varieties). The author concludes that it is quite possible to achieve production gains from small farmers if an appropriate technological package and credit are available, and that while similar gains may occur on large estates in the absence of land reform the resulting distributional effect will be seriously detrimental.

The above references represent recent views in the literature on the Green Revolution's income distributional effects. In summary, three basic questions are involved: (a) the distribution of HYV technology across farm sizes; (b) the effect of the new technology on labor demand and functional income shares; (c) the price elasticity of demand for domestically produced agricultural goods. With regard to distribution across farm size, the evidence indicates that the small farms are receptive to adopting new varieties, and that where in practice the large farmers have been the principal adopters the reason is usually better access to credit and inputs, due in large part to institutional structure in which the sources of these prerequisites cater to the large farmers. This assessment has optimistic policy implications, since it indicates that where policy workers vigorously attempt to channel improved inputs to small farmers, they should meet with a receptive response. Channeled credit and inputs should be an effective instrument for rural equalization (as discussed further below). This optimism receives additional support if past experience with the S-curve for the varietal cycle is an indication of the pattern of future adoption by small farms.

The issue of functional distribution hinges on the final balance between the positive influence of increased demand for labor for new cultural practices and extra harvesting, and the negative influence of mechanization and decreased labor requirements per unit of output. Even without mechanization there is a strong likelihood that the HYV will reduce labor share. The more productive technology raises labor productivity, so the percentage rise in labor demand falls

short of the percentage rise in gross output. Intermediate costs rise greatly (from a very low base), so that value added also rises less than proportionately with gross output. The behaviour of labor's share in value added thus depends on whether the proportionate rise in labor demand exceeds or falls short of the proportionate increase in value added (so long as wage is constant, reasonable in a surplus labor context).

To demonstrate the point, it is useful to consider some definitional relationships along with some "stylized" data.

Defining V= Value added, Q= gross output; λ = initial ratio of value added to gross output;
N= Labor; I= intermediate input cost;
ℓ = proportional rise in output per worker; and using a dot to indicate proportional changes, we have:

a) $\dot{N} = \dfrac{\dot{Q} - \ell}{1 + \ell}$

b) $\dot{V} = \dfrac{\dot{Q} - \dot{I} + \lambda_0 \dot{I}}{\lambda_0}$

Equations a) and b) follow from the definitions, as may be shown easily. Consider the following "stylized" parameters: (i) ℓ =.33 (from Bartsch [9] for HYV rice and wheat, India and Pakistan); (ii) $\dot{Q}$ = .75 (Bartsch); (iii) λ_0=.9 (from Bell [10]; (iv) $\dot{I}$=2 (that is, expenditure on seeds and fertilizer triples). Then from a) and b), $\dot{N}$ =.32 and $\dot{V}$=.61. The shift to HYV even without mechanization raises output 75% and value added by 61% but raises labor demand by only 32%. So long as wage remains constant, labor's share must fall in this "typical" case, as labor demand increases less than proportionately with value added. Increased labor productivity swamps increased intermediate input cost.

In view of these relationships, planners should not be surprised if the new seed-fertilizer technology shifts the income distribution away from labor, and the likelihood of the result is reinforced if the new inputs are coupled with mechanization and if the country's demand for the grains in question is inelastic. Limited prospects for labor's share make land reform all the more important, since in a small family farm structure the worker receives land and capital shares as well as labor share.

The third major issue concerns demand elasticity. If agricultural demand is inelastic, then rising labor productivity due to the new technology can reduce the absolute demand for labor as well as labor's relative share. In this crucial dimension the recent literature is probably already outdated. The literature does not deal with what may be a new medium or long term agricultural scarcity, associated with the entry of Socialist countries into the world grain market, prolonged drought (especially in Africa's Sahel), decreased real volumes of food aid, and increased costs for petroleum derivative agricultural inputs. The "new scarcity" would appear to guarantee "brighter" prospects for elastic demand for agricultural goods produced within the developing countries, ameliorating the potential income distributional problem involved in rapidly rising agricultural labor productivity.

6. Mechanization

Another instrument affecting rural income distribution is policy towards farm mechanization. National governments and foreign aid agencies in the past have stimulated farm mechanization, in the general belief that "modern" agriculture was necessary for development, or in the more specific desire to achieve impressive production gains through combining mechanization with varietal and chemical innovations of the Green Revolution. The reaction of many economists has been dismay, under the presumption that agricultural mechanization would displace abundant labor and use scarce capital in the one sector where there appeared to be ample scope for substitution between the two factors. A debate has ensued which to date has failed to reach definite conclusions on the merits of farm mechanization, but which on balance leaves to its advocates the burden of proof in establishing the special circumstances justifying mechanization on a case by case basis.

Singh and Billings /34/ conducted early work on the implications of agricultural mechanization in India. They acknowledged the caveat that mechanization could be inappropriate due to excess labor, but maintained that by speeding up operations at peak seasons mechanization could increase double-cropping and thus increase total labor demand although reducing it for a single operation or crop. Their projections for the states of Punjab and Maharashtra concluded that within two decades extensive mechanization (tractors, u psets, threshers) would decrease demand for labor substantially (by 17% for Punjab) but extension of the use of high yielding varieties and increased crop area would more than offset this labor displacement (although the resulting net growth of employment in Maharashtra would be insufficient to absorb the expected increase in the labor force). The overall approach of the authors was that output gains justified mechanization.

Inukai [24] presented a similarly favorable view for the case of Thailand. Challenging the conventional opinion that mechanization was inappropriate due to labor abundance, the author maintained that plowing with tractors rather than bullocks permitted earlier preparation of the soil (which otherwise was too hard to work prior to monsoon rains), thereby spreading out labor requirements from their previous peak period when labor was a constraint. The result was to permit expansion of cultivated rice area, which, added to a switching from "broadcasting" to transplanting in the planting process, increased total labor demand despite the tractor mechanization. In addition the author estimated regressions of yield on an index of mechanization, and concluded that mechanization raised yields per acre (although these tests were undoubtedly biased due to the omission of variables for fertilizer use and seed variety).

Lawrence [27] reached similar conclusions for irrigated areas in West Pakistan. Based on the assumption that tractor mechanization permitted more timely plowing and therefore increased double cropping as well as improved yields , Lawrence calculated that tractors were socially profitable, although similar analysis revealed them to be socially unprofitable in East Pakistan where there was a lower sensitivity of rice yield to planting time.

In contrast, other studies appearing at approximately the same time roundly condemned farm mechanization policies. Kaneda [25] disputed the notion that mechanization raised yields per acre, and attributed rapid mechanization in Pakistan to overvalued exchange rates and tariff exemptions which, together with high wheat price supports, stimulated farm machinery imports. Bose and Clark [14] rejected the "timing" argument on grounds that improved implements could speed up bullock plowing. They maintained that the case for tractors hinged on

whether their opportunity cost exceeded that of the irrigated area which could be released from production of fodder for bullocks replaced by machines. Making such an evaluation, Bose and Clark concluded that tractor mechanization was socially unprofitable though privately profitable (due primarily to high crop price supports).

Yudelman, Butler, and Banerji [41] concluded, from evidence on several developing countries, that large scale farm mechanization was often profitable in private terms but unprofitable at social costs. The authors identified the "managerial and technical difficulty of employing a large labor force" as one important factor stimulating mechanization on large farms. Noting that a wide variety of evidence indicated large scale mechanization reduced demand for labor (ceteris paribus) by 16% to 27% [41, p. 163] the authors called for "pre-emptive" institutional change such as land reform or formation of cooperatives to stave off the likely transition of developing country agriculture towards Western agricultural patterns but with a much larger proportion of rural households "disenfranchised." The study did advocate "selective" mechanization, which the authors believed capable of increasing output without reducing labor demand (for example, through reducing seasonal labor shortages). Turning to case studies, the authors identified Taiwan and Japan as instances of technique choice appropriate to factor endowment, and cited Mexico as a case of inappropriate mechanization in light of labor abundance.

More recent literature has produced certain recurrent themes: (a) farm mechanization has been excessively stimulated by subsidized credit, (often from international aid entities) and favorable access

to foreign exchange at overvalued exchange rates; (b) there can be certain types of machinery and certain production conditions, for which mechanization is appropriate; (c) in practice radical reductions of labor demand have not been observed along with mechanization due to concomitant innovations in varieties and chemical inputs; (d) nevertheless, at the most general level farm mechanization tends to be socially unprofitable; (e) farm size and institutional structure are crucial determinants of the course of mechanization.

Concerning mechanization's influence on yields, I have estimated regressions relating rice yields to tractor and fertilizer use for a southern state in Brazil, and have found the net influence of tractor mechanization on yields to be negligible [18]. Gotsch [21] has argued that there probably are such yield effects due to the possibility of planting at the optimal time with mechanization, but apparently he assigns little weight to the effect since he explicitly omits it in subsequent empirical estimates of rates of return to mechanization. The same study by Gotsch makes an overall assessment of mechanization for the case of Pakistan. He notes that the divergent earlier conclusions of Bose and Clark on the one hand and Lawrence on the other stemmed from their different assumptions about yield and double-cropping effects of mechanization. Judging that the availability of irrigation water in Pakistan is insufficient to permit the radical increase in double-cropping assumed by Lawrence, and noting that price declines should be incorporated into such analysis presuming output growth, Gostch concludes that net social benefits are negative for current patterns of farm mechanization in Pakistan(because irrigation is inadequate to provide sufficient output gains on land liberated from fodder production as

bullock requirements decline).

Gotsch then present results of linear programming exercises evaluating the profitability of farm mechanization (with and without tube-wells). He differentiates between the "capitalist" and "landlord" cases, with the latter including effects from the eviction of tenants as well as substitution of mechanical for animal power. The results indicate high rates of return for mechanization (especially when combined with the tube-well) at private costs. Even after adjusting foreign exchange and interest rates to "scarcity" costs, the author finds high rates of return to mechanization. The "social" rate of return adjusting for opportunity cost of labor is not calculated, yet the author considers social return to be negative (based, apparently, on the bullock fodder opportunity cost argument). Accordingly, he recommends not only the termination of official subsidization of mechanization through low exchange rates, cheap credit, and artificially high crop prices[1], but also imposition of taxes on tractors (although the author admits limited political feasibility of this measure).

As noted above, a recent study by Bartsch [9] synthesizes data from several Asian countries to identify the separate influences of mechanization (technique) and varietal and chemical inputs (technology) on labor requirements. With traditional "technology," shifting from traditional to mechanized techniques reduces labor demand per cropped area by 24% for Punjab wheat and by 50% for rice (India, transplant method). With improved varieties and fertilizer, the corresponding

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1. It does not seem, however, that crop prices should influence the choice of technique, except insofar as capital intensive crops receive relatively more favorable price treatment than labor intensive crops (or vice versa).

labor reductions due to mechanization are 78% and 59%. Once double-cropping is accounted for, changes in labor requirements per cultivated area are more ambiguous. Bartsch appears to attribute increased scope for double-cropping to varietal changes (shorter growing seasons) rather than mechanization, so that one could argue the negative partial impact of mechanization is even greater after considering double-cropping. What tends to occur in practice is the simultaneous shift towards modern varietal and fertilizer inputs, greater mechanization and greater double-cropping. The study's summary evaluation of this joint movement is that its effects on labor requirements per cultivated area are unclear (although the effect on labor per unit of output is clearly a reduction).

In a study of mechanization in the Philippines, Barker, Meyers, Crisostomo and Duff [6] reach a similarly ambiguous conclusion. They find that government-stimulated mechanization in the rice sector has not resulted in major labor displacement, and that reduced labor requirements for land preparation have been offset by increased labor requirements for weeding, harvesting and threshing. It appears that the latter increases are attributable to the concurrent introduction of high yielding varieties, however, suggesting that labor requirements would have risen in the absence of mechanization. The study contains a useful demonstration of the response of mechanization to factor prices, showing that the variation in mechanical horsepower per agricultural worker among Thailand, Taiwan, the Phillipines, and Japan is related to the ratio of the price of horsepower to farm wages. The authors also emphasize the institutional influences on mechanization: they indicate that credit at favorable interest rates stimulated tractor imports during 1966-69,

while the floating of the exchange rate in 1970 discouraged them. The influence of fluctuating official policies was much stronger than inherent technological characteristics in determining the pace of mechanization, according to the authors. Despite the absence of a clear trend in demand for labor per cultivated area, the study notes the unfavorable long run implications for income distribution, of the decline in labor requirement per unit of output.

A study of farm mechanization in India and Sri Lanka by Raj /32/ is even more cautious in its conclusion that available information on mechanization is "not adequate to determine precisely how and to what extent it has been responsible for suboptimal use of the available resources." Raj points out that tubewell "mechanization" almost certainly increased employment. Even tractor mechanization may have done so in selected cases, as in certain districts of Sri Lanka where tractors substitute for irrigation by permitting the tillage of soil while it is dry and hard. In other cases, according to Raj, there is strong evidence that large landowners mechanized merely to reduce dependence on tenants or hired labor.

Raj presents interesting data showing the concentration of tractors in the Indian states of Punjab and Uttar Pradesh, in contrast to the low share of these two states in other types of machinery (diesel engines, electric pumps). He suggests that advanced tractor mechanization in the Punjab is explained by the large size of farms characterizing the region. This evidence lends support to his proposition that agrarian structure may be more important than the underpricing of capital and foreign exchange in leading to inappropriate mechanization.

Clayton [16] has examined the course of farm mechanization in East Africa. His study is particularly informative from the standpoint of illuminating the partial influence of institutional bias towards equity versus inequity. In contrast to most Latin American and Asian countries, Kenya, Uganda, and Tanzania appear to represent cases where government agencies have biased their assistance towards the small farmers. Clayton reports that the government of Uganda attempted to provide tractor hire services to small farmers, but the system required heavy subsidies and eventually failed. In Kenya, private mechanization proceded rapidly on the large units replacing former European plantations, but subsidized government sales of tractors to small holders proved to be a failure (due to the farmers' lack of experience with the equipment and its maintenance requirements, according to Clayton). Subsequently the Kenyan government instituted a limited tractor hire service at commercial rates, which met with more success. In Tanzania, while mechanization has been profitable in the plantation sector, various government attempts to supply tractor services to the small farm sector experienced poor results, and the five year plan beginning 1969 specifically downgraded mechanization plans.

The repeating patterns of failure of government tractor schemes for small farms in the face of strong private mechanization trends in the plantation sector in East Africa suggests that the pattern of large farm mechanization in other areas is not attributable alone to institutional favoritism to the large farm sector. The implication is that economic forces play a crucial role in large farm mechanization. Specifically, the need to simplify supervision of a large labor force, and a higher relative price of labor to capital (even in the absence of subsidized

official credit) lead to mechanization on large farms, while a low effective price of family labor plus the frictions involved in using machinery commanding an area in excess of the property unit (through hiring tractor services, cooperative ownership etc.) discourage machinery use on small farms. If the shadow price of capital is high and that of labor low, then these structural forces point to greater social efficiency of the small farm sector and the existence of socially inefficient technique choice on the large farm sector even in the absence of access to subsidized capital from the government.

Abercrombie [2] has recently examined farm mechanization and employment in Latin America. Although mechanization has penetrated only large farms in the region, it has been quite rapid (11% annual growth in the 1950s and 7% in the 1960s) and has extended much further than in other developing regions (reaching by 1968 a regional average of 220 hectares cultivated land per tractor compared with 440 hectares in the Near East, 560 in Africa, 1,540 in the Far East, 40 in the U.S., and 25 in Europe). Abercrombie catalogues the government measures typically stimulating large farm mechanization in the region: tariff and tax concessions for machinery, cheap credit (often with negative real interest rates), overvalued exchange rates, minimum wage and social security costs which raise the relative price of labor. Social unrest in the labor force has been an additional impetus to mechanization.

Very rapid mechanization of sugar cane in Cuba constitutes one phenomenon of particular interest in view of the interaction of institutions and technology. It would be highly interesting to analyze whether this development represented socially inefficient use of capital intensive means due to ideological commitment to mechanized

state farming, an efficient strategy due to a truly increased opportunity cost of labor resulting from provision of productive employment alternatives, a technological necessity to overcome harvest bottlenecks, or some other dominant influence. Another specific feature of the region's mechanization is its geographical concentration. The author reports that 70 percent of Brazil's tractors are in the State of Sao Paulo; 70 percent of Argentina's farm machinery is in the pampas; machinery has similar geographical concentration in Mexico and Uruguay. The spatial concentration is similar to that in India's Punjab. It undoubtedly reflects physical phenomena (e.g. flat land suitable for mechanization) as well as farm size structure and the relative scarcity of labor.

Abercrombie presents estimates of labor requirements per hectare with and without mechanization, on the basis of which he estimates that one tractor replaces from 4 workers in Chile to 7 in Guatemala; the author adds an approximate estimate of 2.5 million jobs as the magnitude of direct labor displacement throughout Latin America by the more than 500,000 tractors existing in the region. The indirect employment gains from industrial manufacture of farm machinery are very limited,[1] according to the author, although the indirect gains due to increased area cultivated may be as great as one-third of the direct labor displacement effect, in the author's judgement.

The study concludes with recommendations for "selective mechanization" where required for output increases(e.g. mechanized soil preparation where necessary to expand cultivated area, or mechanization to overcome seasonal labor bottlenecks where multiple cropping is possible) but

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1. Note that Kilby and Johnston /26/ have estimated the industrial labor requirements for production of simple farm implement for bullock traction to be much higher than similar indirect labor requirements for tractors.

the exclusion of mechanization which merely saves labor. The Author notes that such proposals have been elaborated within the Colombian Ministry of Agriculture (which favored mechanization of soil preparation and rice harvesting, the latter to permit double cropping on irrigated areas , but opposed other mechanization such as post-planting operations and harvesting). He cites government credit as the most powerful instrument for selective mechanization, while admitting the difficulty of limiting credit for mechanization to specific operations (as opposed to crops or regions).. As a minimum, governments should remove the windfall gain to machinery purchasers due to low interest rates in the face of inflation .

Finally, it is useful to note the results of a simulation study by Thirsk [40] examining the effects of farm machinery subsidization in Colombia. The approach taken by Thirsk is completely different from that of the other studies reported here. The author does not examine the issue so central to many of the other studies -- whether machinery merely replaces labor or instead makes possible increased output. Rather, Thirsk assumes mechanization essentially replaces labor, but he explores the various general equilibrium effects accompanying mechanization. According to the analysis, subsidized mechanization on large farms in Colombia (a) increased employment on large farms (as they expanded output); (b) decreased effective employment by an even greater amount in the small farm sector (in response to the decreasing agricultural price resulting from increased output in the large farm sector); (c) increased industrial employment but by limited amounts (as the industrial wage cost declined due to shifting terms of trade against agriculture); (d) increased employment and output to some extent as extensively used cattle lands were converted to large farm crop production; (e) in the aggregate, reduced economic growth below what

could have been achieved by allocating excessive capital to agriculture and thereby taking it away from industry where its return was higher; (f) redistributed income away from labor and small farmers towards capital owners. The analysis is particularly thorough, although specific results hinge on a myriad of parameters (such as elasticities of substitution among factors in supply and among products in demand), the empirical estimation of which (on the basis of numerous other studies) can yield widely differing results. Furthermore, a crucial thrust of the analysis concerns terms of trade between agriculture and non-agriculture; yet it is not clear that "optimal" terms of trade and sectoral allocation would have obtained in the absence of farm machinery subsidization, given the likely bias favoring industry in other policies (e.g. tariff protection).

In summary, the studies surveyed here repeatedly emphasize the need to remove artificial incentives to the replacement of labor by farm machinery (cheap credit, tariff exemption, overvalued exchange rate); they suggest that, other things equal, a large farm size structure, abetted by government institutions biased in favor of large farms, stimulates excessive mechanization; they admit the existence of cases in which mechanization increases output rather than merely replacing labor; they indicate that while the partial influence of mechanization is almost always to displace labor, the joint effects of mechanization, new varieites and fertilizer, and increased double cropping tend to leave little net increase or decrease in labor use (although reducing it per unit of output), and they point to policies of "selective" mechanization although the operational characteristics of such policies remain vague.

7. Channeled Credit

Farm credit is a particularly important policy instrument in terms of distributional impact. In the past it has usually benefitted the large farm sector disproportionately (as in the pattern of subsidized credit for mechanization discussed above). However, it should be possible to employ credit in an equity oriented manner. Two principal modes for this objective should be considered: (a) the supplying of credit specifically to small farms; (b) the linkage of credit access to number of workers employed.

The availability of official credit constitutes a "subsidy" insofar as it increases credit supply above the free-market quantity forthcoming at a given interest rate; in practice credit programs are usually much more highly subsidized than this, with interest rates frequently negative in real terms after accounting for inflation. There is no reason why this subsidy must go to the upper end of the rural income distribution rather than the lower. Some programs of favorable credit for small farms have in the past failed due to particular structure. For example, programs in Brazil imposing lower interest rates on loans to smaller farms tended to dry up the quantity banks lent to the sector since lenders could obtain higher rates from larger farms. However, it should be perfectly possible to designate specific quantities of rationed credit and limit their availability to the small farm sector, channeling the funds through special credit windows with access limited to the sector.

A major question which deserves attention is whether such restricted credit will not be inefficient. If the small farm sector has little land at its dispoal, does it not follow that credit focused

on the sector will have much lower production impact than what could be obtained through its unrestricted flow to agriculture at large? In order to examine this question, it is useful to draw upon production function estimates in a prior study by the author [17]. With a single production function characterizing farms of all sizes in a given product (as was found appropriate statistically), the marginal product of a factor is strictly proportional to its average product.[1] Therefore the issue of credit profitability for small farms may be directly examined by considering the average ratio of output to credit-financed inputs on small farms versus large. Wherever this ratio (average product) is higher for small farms, the marginal productivity of such inputs (and hence the incremental output to be expected from credit supplied for such inputs) is also higher for the small farms than for large.

For the case of Northeastern Brazil, the study referred to showed that for five out of six product sectors the marginal product of "seeds, fertilizer, and insecticides" was higher on small farms than on large. This result indicates that the small farms compensated for their lack of land by the heavy application of other factors, in particular labor, and, combined with somewhat lower utilization of these intermediate inputs, the net result was a higher ratio of output to the "seed, fertilizer, insecticide" inputs. In sum, this evidence suggests that if anythning the production impact of credit channeled to small farms would be higher instead of lower than that obtained from supplying the credit to large farms.

A second basis for investigating the question is examination of

1. This relationship must follow if the output elasticity of a factor is constant.

the resources at the command of the small farm sector. Data from the 1970 agricultural census indicate that in Northeastern Brazil farms under 50 hectares accounted for 80% of total labor, 50% of cropped area, and 38% of cattle, despite possession of only 25% of total land area. These data strongly suggest the sector of farms below 50 hectares produces as much as half or more of total output, meaning that credit channeled to the sector would have a very substantial output base on which to work. Once again the implication is that policy makers need not fear loss of potential production impact in channeling credit to small farms rather than large.

An alternative means of channeling credit for equity purposes would be to limit credit availability to a fixed quantity per worker employed. Since the small farm sector is much more labor intensive than the large farm sector, this measure would indirectly focus credit on the small farms. Moreover, it would guarantee that the credit going to large estates would be associated with a large labor force rather than stimulating mechanization for the replacement of labor. More fundamentally in the developing country context labor is the factor with a social "shadow price" below its market price. To the extent that farm credit were subsidized, linking credit to the number of workers would essentially transfer the subsidy price signal to the labor factor, increasing the tendency to use labor intensive methods (and produce labor intensive products) and increasing the overall efficiency of agricultural production.

In the absence of land reform, channeling official credit to small farms or linking credit availability to employment would appear to be a crucial second best strategy for improving rural equity, especially if the credit so channeled were concentrated in output-raising packages of new seeds and chemical inputs.

8. Other Measures

Several other policy instruments are available for affecting the rural income distribution. One instrument is agricultural price support. Thirsk [39] has analyzed the distributional impact of farm support prices in Colombia. Disaggregating producers and consumers of agricultural goods by income class, and taking account of foreign exchange scarcity in assessing probable changes in food imports, Thirsk examines the equity and efficiency impact of changes in support prices. The study finds that increasing support prices leads to both more inequitable income distribution and a decline in social efficiency. Essentially, low income consumers must pay higher prices for foodstuffs, while high income food producers benefit from increased farm income due to higher prices.

While specific programs may be analyzed as in the study by Thirsk, generalization about price support policy seems dangerous. One factor which deserves new attention is the apparent increase in instability of world grain markets in recent years, due in part to the entry of socialist countries in purchases at times of poor harvest. This development suggests that price support schemes should have some additional "risk-minimization" benefit attached to them when their costs and benefits are analyzed. Moreover, variations in implementation can change distributional implications. For example, if farm products receive price support for farmers while being subsidized for consumers the distributional impact will be more favorable than in programs not subsidizing consumption.

A more general aspect of agricultural pricing concerns the terms of trade between agriculture and industry. Many authors have pointed

out that the typical pattern of import substitution industrialization may deteriorate the income distribution within the country at large, by depressing the terms of trade of agriculture (as industrial prices soar behind tariff walls) and in view of the fact that the agricultural mean income is below that in the rest of the economy. Even this general chracterization becomes less clearly valid once the battery of subsidies to agriculture (especially subsidized credit) commonly encountered is taken into account. (Pakistan is a case in point. Some authors have emphasized the discrimination against agriculture inherent in its program of industrialization; other authors primarily examining its agricultural sector have criticized excessively high agricultural support prices.)

Other instruments include minimum wage policy, rent and sharecrop control legislation, colonization, irrigation, farm extension, rural education. A recent study on colonization projects in Latin America by Nelson /31/ adds a useful compilation of evidence supporting the view that this painless alternative to land reform is, in most cases, very costly and incapable of making a major impact in the absorption of rural labor in the near term.[1] Increasing minimum wages seems likely to encourage the replacement of agricultural labor by machinery (and various econometric estimates find high elasticities of subsitution between the two for agriculture); rent or sharecrop control seems likely to encourage owners to dispel tenants and replace

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1. The recent Brazilian strategy of meeting rural employment needs through colonization of the Amazon basin already appears to have met serious setbacks. Stretches of the new Trans-Amazonic highway reportedly have washed away; small farm colonists are a small fraction of the number anticipated.

them with temporary hired labor having even less security (a trend already in progress as a result of the Green Revolution); but more reliable assessment of these policies as well as those of irrigation, farm extension, and rural education require more detailed analysis and more specific cases for evaluation than those at the author's disposal.

9. Conclusion

Land redistribution is the most powerful instrument for equalizing rural income distribution, and should permit output gains as well. Land reforms which benefit only a minority of the rural population, however, fail to exploit their full potential for improving equity (as a may be the case in the Chilean and Peruvian reforms) and under certain conditions may even worsen the position of the remaining landless labor force. To increase the political feasibility of land reform, full compensation for expropriated land deserves consideration as a policy strategy. Despite full repayment for land, the increase in output following reform leaves ample room for very significant income gains for beneficiaries. Their gains will be still larger to the extent that the financial interest rate at which they repay loans falls short of the capitalist discount rate, since in this case their annual payments on land value will not exhaust the pre-reform profits of landlords, leaving over a portion of pre-reform profit share in addition to labor share for beneficiaries' net income. Experience in Peru, actual appropriations (but not application) in Brazil, and reasonable macro-economic parameters suggest that land reform with full compensation is financially feasible if implemented over time.

In the basence of land reform, a second-best strategy is to channel credit to small farms, or to link credit access to farm employment (thereby subsidizing the use of labor where credit is on subsidized terms). Evidence on marginal productivity of seeds, faertilizer, and

insecticide inputs suggests that credit to small farms would have at least as large a production impact as that obtainable on large farms, and other data suggest the same conclusion since they indicate the "small farm sector" accounts for a substantial production base despite its small share of land (due to its higher share of labor).

While the Green Revolution may appear to have concentrated rural income, the historical pattern of eventual adoption of technology by small producers after initial adoption by larger suggests that the concentration may be transitory. The policy implication is clearly that the new varieties and complementary input packages should be disseminated rapidly to smaller farms, rather than curtailed for fear of distributional impact. Most evidence indicates that the new varietal and fertilization technology increases demand for labor per unit of area but reduces labor requirements per unit of output. So long as demand is elastic (as in the replacement of food imports) the new technology should not worsen, and may improve, the absolute position of labor (although reasonable parameters suggest labor share may decline). Cases where demand is limited pose more serious problems for labor demand .

Farm mechanization has been exaggerated in many developing countries due to distortions favoring premature use of machinery (subsidized credit, access to foreign exchange at overvalued exchange rates, tariff exemption, low cost finance from foreign aid agencies). Nevertheless, a blanket proscription against further mechanization is inappropriate since there appear to exist circumstances in which it increases output rather than merely replacing labor -- although the empirical analysis in support of this proposition remains

at a dissapointingly undeveloped state. As a minimum, policy should be revised to remove artificial incentives favoring mechanization.

Land taxation is another policy instrument warranting consideration by policy makers concerned about rural equity. Past insensitivity of land use to land tax stems primarily from the very low tax rates usually applied, in conjunction with the initial undervaluation of land for tax purposes and its rapid outdating in the presence of inflation. Especially in Latin American conditions, higher land taxes should stimulate the utilization of underused land on large estates. For this purpose, the variant of applying income tax to "presumed income" which should be generated by available land may be helpful.

Recent literature attempting to demonstrate the efficiency of sharecropping is unconvincing. For practical policy purposes, perhaps the major difficulty with sharecropping is its impediment to the adoption of technological packages requiring higher cost to obtain their much higher benefits. Special attention to adjustment of cost and output share thus appears necessary in credit programs in such circumstances.

Finally, the entire subject of policy instruments for rural equity will require further examination considering the likely impact of higher petroleum prices as well as changes in world grain markets. The fertilizer requirements of high-yielding varieties throw them into jeopardy in view of the impact of petroleum prices on fertilizer prices. Tractor methods would seem even less efficient than before in view of higher fuel prices. The first consideration raises the possibility that the income equalizing adoption of new technology by smaller farms

may be delayed; the second constitutes an additional argument for terminating subsidies to mechanization. Greater scarcity in world grain markets may affect rural equity in opposing directions. By enhancing demand, scarcity would stave off a decline in labor's share which might arise from rising labor productivity (due to new technology) in the face of inelastic demand. At the same time, upward pressure in food prices can hardly have favorable equity implications in macroeconomic terms. Moreover, the "new scarcity" may seriously change the balance against those seeking to weigh equity along with production in policy-making, in favor of those proclaiming output maximization alone as the policy objective.

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