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Efficiency Wages in Agriculture:
Analysis of Monopsony Wage and Employment with Effort-Augmented Production Functions for LDCs*

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This paper models agricultural labour markets in LDCs under the monopsonistic and quasi-monopolistic setting that characterise it. It applies the effort-augmented production function of the efficiency-wage model, within which the sector is shown to exhibit standard features under relevant assumptions about effort responses.

The results indicate that the effectiveness of agricultural employment policies such as technological infusion or labour rehabilitation in LDCs, require: (1) the necessary condition that agricultural labour supply be elastic, and (2) the sufficiency condition that there be "labour surplus" in the sector.

I. Introduction

This study applies the efficiency wage model to the analysis of agricultural labour markets against the background of the characteristic conditions and observed production practices surrounding agricultural activity in LDCs. We utilize Bardhan's (1979b), and Ahmed's (1983) findings that market production in LDCs' agriculture is dominated by monopsony power; and also apply the wage-productivity nexus of the efficiency wage paradigm as advanced by Yellen (1984), Akerlof and Yellen (1986, 1990), Stiglitz (1976), and Malcolmson (1981).

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The efficiency wage theory employs the fundamental postulate that worker productivity is a positive function of the real wage paid, such that employers tend not to reduce wage payments even in the presence of excess labour supply, since such an action is considered to be productivity-diminishing. Current research which have further illuminated and extended the model's theoretical advances include, Drago (1990), Carmichael (1990), and Danthine and Donaldson (1990) among others.[1]

However, apart from Harvey Leibenstein's (1957) pioneering study and the empirical studies that followed in the wake of it, particularly Bliss and Stern (1978) and Rodgers (1975), the application made by Stiglitz (1976) to the analysis of surplus labour is one of the only few that have utilized the efficiency wage theory for explaining agricultural employment and productivity in LDCs. This work addresses itself toward filling this apparent deficiency.

The standard neoclassical short-run production function: $Q = Q(L)$ expressing output (Q) as a function of labor input (L), does not adequately reflect worker-effort utilized as against labour time. Labor time does not automatically translate to productive effort applied, as has been shown in the Shirking models of Shapiro and Stiglitz (1984), and Akerlof and Yellen (1990).

The effort-augmented short-run function:

$$Q = Q[Le(\omega)],\ Q' > 0,\ Q'' < 0, \tag{1}$$

where

e = work effort per hour applied by the workers,
L = labour employed,
ω = the real wage rate per hour

gives output as a function of actual work effort derived from labour time employed. Work effort is a function of real wage paid:

$$e = e(\omega), \tag{1a}$$

with effort response functions: $e'(\omega) \geqslant 0$, $e''(\omega) < 0$.

Thus, given that effort responses are varied, the effort function $e(\omega)$

[1] Others such as Krueger and Summers (1988), Raff and Summers (1987), and Katz (1986), have applied the model in analysing different aspects of the labour market. For an excellent profile of these, see Weiss (1990) for labour markets in developed countries, and Ezeala-Harrison (1991, 1988) for applications to LDCs.

can assume various forms depending on the distribution of the e(.) function, the distribution of which is conditioned by the degree of capital intensity in the production sector (see Ezeala-Harrison, 1988). For instance, where $e(\cdot) = 1$, the function reduces to $Q = Q(L)$ which is the standard neoclassical case, and may be relevant for analysis of some sectors of production in which work effort is constant and unresponsive to wage levels.[2] However, for some other sectors of production the effort function is not constant but responds positively to wage levels.

The augmented function thus provides for a generalized framework for analysis of employment and wages in a world of non-uniform production technologies and sectoral differences, in contrast to the standard neoclassical function which implicitly presumes constant effort applied to work at all times. With stress on adaptation of effort-responses to apply to various industrial situations as the case may be, the augmented function is an improvement over the conventional one. Therefore its use in the analysis of employment and earnings would yield more realistic outcomes.

The basic approach is motivated in Section II in which we set out the analysis of employment and wages within the framework of the effort-augmented function. Section III focuses the model to the study of agricultural wage rates and the determining influences which the elasticity of agricultural labour supply has on it. Employment/unemployment analysis is given in Section IV, and in Section V we offer some policy conclusions of the study.

II. Employment and Wages in the Effort-Augmented Model

Agricultural wage-employment in LDCs is characterized by monopsonistic power that the employer wields due to the extremely unequal land distribution, low labour mobility, and lack of alternative opportunities that exist (Bardhan, 1979b). Bardhan and Rudra (1981) had suggested the seasonal characteristic of agricultural operations, and Eswaran and Kotwal (1985) argued that in order to save on his hiring costs during the peak cropping and harvesting seasons, the employer tends to enter into explicit and/or implicit contracts with a group of labourers on a permanent basis to ensure steady supply of workers whenever needed.

In agricultural production setting, effort response functions are such that:

[2] Under this constant effort (or null- effort-response) situation, the magnitude of e ranges from a fraction to infinity depending on the nature of the particular industry and skill of the work force. In small scale agriculture, say, $e \leqslant 1$.

$$e'(\omega) \begin{cases} = 0 & \text{for commercial agriculture} \\ > 0 & \text{for subsistence agriculture.}^{3} \end{cases}$$

The null effort response situation ($e'(\omega) = 0$) particularly applies in agricultural production because of its non-capital intensive, casual labour dependent, and seasonal character. This is because under such a setting, work-effort is insensitive to wage rate due to the very nature of casual labour contractual arrangements, and as there are no disincentives to shirking (see Carmichael (1989)).

The typical profit-maximizing monopsonist employer, by definition, faces the linear market labour supply curve:

$$\omega = \omega(L),\ \omega'(L) > 0,\ \omega''(L) = 0;$$

with the objective function:

$$(2) \qquad \text{Max } \Pi_{\{L,\omega\}} = p\Omega Q\{[Le(\omega)\} - (\omega L + \phi(u,v)[\alpha L])$$

where

Π = profit,
p = (fixed) output price,
Ω = an exogenously determined shift (technological) parameter for agricultural output,
ϕ = average incidental labour costs that is a negative function of local unemployement level u, and a positive function of quasi-fixed labour costs v; thus[4]:
(a) $\phi(u,v) \geqslant 0$,
(b) $\partial\phi/\partial u = \phi_1 < 0$; $\partial\phi/\partial v = \phi_2 > 0$,
α = a positive fraction: $0 < \alpha < 1$.

The employer chooses (L^*, ω^*) to achieve (2) under the first-order conditions:

[3] For an analytical model of subsistence agriculture using the efficiency wage framework, see Ezeala-Harrison (1992).

[4] Incidental labour costs are lesser under higher unemployment rates and higher under lower unemployment rates, as suggested by Stiglitz's (1974) "Labour Turnover Model"; — higher unemployment rate reduces turnover as employees face lesser alternative job openings. Costs, however, increase as additional workers are contracted for replacement and/or expansion. These costs (e.g. transportation and feeding costs) represented by ϕ, are said to be *incidental* because they are incurred only if the employer needs to augment his employment levels.

(3a) $p\Omega Q'e-(\omega+\omega' L+\alpha\phi)=0$

(3b) $(p\Omega Q'e'-1)L=0.$

(3b) yields expression for the value of marginal product

$$p\Omega Q'=1/e'.$$

(3a) yields the optimal wage rate

(4) $\omega^{*}=p\Omega Q'e-(\omega' L+\alpha\phi)$

which expresses value of marginal product as greater than the optimal wage according to monopsony power, with implications that equilibrium employment level would be lower than it would be under regular competitive market conditions.

The question now is, does the optimal wage get influenced by market supply and demand forces? And would there be involuntary unemployment whose existence is explained within the framework of the employer's wage policy and employment behaviour? The answer to these are explored in the following comparative static exercises.

Totally differentiating (4) and rearranging:[5]

$$d\omega^{*}\{1-p\Omega e'(Q'+e/Q''L)\}=(pe^{2}\Omega Q''-\omega')dL$$
$$+peQ'd\Omega-\alpha(\phi_{1}du+\phi_{2}dv)$$

so that:

(5) $$\frac{\partial\omega^{*}}{\partial L}=\frac{pe^{2}\Omega Q''-\omega'}{1-p\Omega e'\,(Q'+eQ''L)}$$

whose sign is indeterminate, but which could now be applied to determine the labour market employment conditions under the null effort response and positive effort response settings.

Under null effort responses (5) reduces to:

(5a) $\partial\omega/\partial L=pe^{2}\Omega Q''-\omega'<0,$

[5] See Appendix A for derivation.

confirming the standard negative relationship between employment demand and wage rate.

Under positive effort responses, (5) is ambiguous. This is the efficiency wage rule practised by the employer under labour-tying conditions. Under this rule, the wage level ω^* is optimal and inflexible downwards (but the employer's response to upward movements in ω^* would be to reduce employment, thus we presume that ω^* is quasi-flexible (sticky?) upwards). At ω^* any excess labour supply will result in unemployment, for even though unemployed workers would be prepared to work at the real wage ω^* rather than be unemployed, profit maximizing employers would not be prepared to hire them at that or lower wage since any reduction in wage paid would lower productivity of all employees already on the job. This indicates that a disequilibrium outcome could characterise the agricultural labour market, depending on the employer's disposition toward either an efficiency wage or non-efficiency wage practice. Thus, a two-tier labour market of the type identified by Eswaran and Kotwal (1985) is in view.

Where an efficiency-wage policy of employment is in place, the efficiency wage and employment levels for a representative firm i, with its state of technology (a proxy for Sattinger's capital intensity parameter) Ω_i, are

$$\text{(5b)} \qquad \omega^*_i = \omega^*(p, \Omega^*_i, Q', e^*_i(\omega^*), \phi_i(u,v))$$

$$\text{(5c)} \qquad L^*_i = L^*(p, \Omega^*_i, Q', e^*_i(\omega^*), \phi_i(u,v)).$$

Thus, efficiency wages and employment in agriculture are functions of the output price, production technology, productivity, and quasi-fixed labour costs, and each producer's efficiency wage and employment levels will differ according as these parameters differ across the agricultural sector. Therefore, within any given agricultural labour market, employees may receive different levels of wages even if they possess similar skills and similar productive potentials. This is the notion advanced in the segmented labour market literature, and it is important that we have established that it applies equally to the agricultural labour markets in LDCs.

The fundamental results of the foregoing are stated in the following Lemmas:[6]

6 See proofs of the Lemmas in Appendix B.

LEMMA 1:

Under positive effort responses, monopsony employment demand in agriculture $D(e'>0)$ is technologically-determined at the efficiency wage ω^* greater than a market-clearing alternative wage ω^a, with consequent efficiency employment level L^* lower than the equilibrium counterpart L^a.

LEMMA 2:

With null effort responses, monopsony employment in agriculture $D(e'=0)$ reflect the standard conditions of marginal factor cost and value of marginal product equality, yielding a wage payment (ω^0) that is flexible, and lower than both the value of the marginal product (MP) and the efficiency wage level (ω^*).

The proofs of these Lemmas are given in Appendix B, and illustrated in the diagrammatic analysis of Figure 1.

L^* is the employment offered at efficiency wage ω^* under positive effort response policy. In this setting it is possible that:

Case 1: $0<e'(\omega)<1$
as in moderate local technology applied to cash-crop farming, depicted by the demand curve $D(0<e'<1)$, or that:

Case 2: $e'(\omega)>1$
such as high technology export-oriented plantation agriculture depicted by the curve $D(e'>1)$.

Case 1 yields optimal employment level L^*, with worker marginal productivity MP^*_1 which ought to be paid, but the employer pays a wage $\omega^*_1<MP^*_1$, and keeps $\alpha\phi+\omega'L>0$ (as monopsony rent).[7]

Case 2 yields a similar optimal employment L^* as Case 1 (as both are optimally determined at the efficiency wage), but with the efficiency wage $\omega^*_2>\omega^*_1$ (actually, $MP^*_2>\omega^*_2>\omega^*_1$, reflecting both monopsony power on the one hand, and the higher productivity conditions on the other).

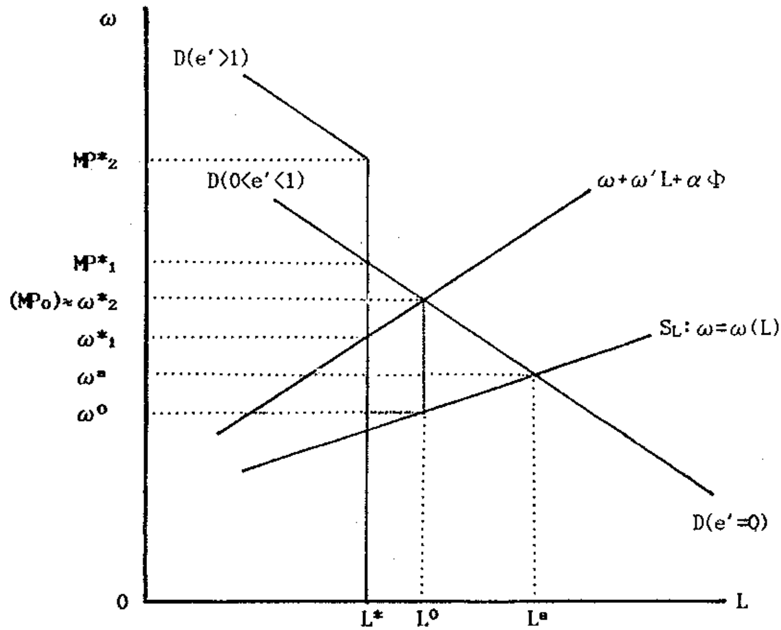
Under null effort responses, an efficiency wage rate would be unnecessary for ongoing employment contract as a shirking deterrent which it is in the positive effort response conditions. The wage that would obtain is the flexible one ω^0 with employee marginal productivity MP_0.

7 This measures the amount of monopsony exploitation. It is seen here to be a function of the quasi-fixed labour costs and elasticity of labour supply. The exact nature of these relationships are explored in greater detail below.

This model offers an alternative explanation as to why agricultural wages have been observed to vary widely within the same geographical areas (Osmani, 1991) and across the agricultural sector economy as a whole (Ahmed, 1983). We now extend the analysis to focus on the wage rate determination.

Figure 1

Efficiency-Wage Employment and Productivity in Agriculture



III. Elasticity and Wages

To stress the foregoing, we explore the nature of labour supply elasticity on the wage rates of workers. Monopsony wage tends to be predicated on the nature of elasticity of labour supply under the monopsony setting, with the standard discriminating monopsony notion that labourers with lower supply elasticities receive lower wages. In this setting workers have low contractual bargaining power that varies with strength of the monopsony employer (Bardhan, 1979a).

The wage function may be written as

$$\omega = p\Omega Q'e-(\omega'L/\omega)\omega-\alpha\phi$$

or

$$\omega = \frac{\xi}{1+\xi}(p\Omega Q'e-\alpha\phi) \tag{6}$$

where

$\xi>0$ is the labour supply elasticity.

Totally differentiating (6) and rearranging[8]:

$$d\omega[1-\frac{\xi}{1+\xi}p\Omega e'Q'(eL+1)] = \frac{\xi}{1+\xi}p\Omega Q''e^2dL$$

$$+\frac{d\xi\ (1-\xi)}{(1+\xi)}(p\Omega Q'e-\alpha\phi)-\frac{\xi}{1+\xi}\alpha(\phi_1 du+\phi_2 dv)$$

The elasticity effect on wage is:

$$\frac{\partial\omega}{\partial\xi} = (p\Omega Q'e-\alpha\phi)\frac{1-\xi}{1+\xi} \tag{7}$$

Under positive value of marginal product,

$$p\Omega Q'e >> \alpha\phi,$$

so that (7) would be positive or negative according as

$$1-\xi>0 \text{ or } 1-\xi<0,$$

i.e. according to labour supply is inelastic or elastic. This verifies the wage effects of elasticity of labour supply under monopsony. For labourers with inelastic labour supply, for instance, $1-\xi>0$, then $\partial\omega/\partial\xi>0$, suggesting that such workers will receive higher wages only if their labour supply elasticity increases (becomes more elastic). Continuing supply inelasticity would confer lower wages.

To clearly understand this phenomenon, clear distinction should be made between the relative impacts of v and ξ, on the wage. Large values for v (caused by, say, irregularity in labour availability) need not imply

8 See Appendix C for the complete derivation.

that such a group of farm labourers are inelastic in supply, for a casual labourer may have wage-inelastic supply but need not necessarily be irregular in supply and hence more difficult and expensive to hire. A farm worker with large number of dependants may have low supply elasticity of his labour effort (which tends to lower his wage rate), but he may be easily available to the employer for hiring, who then would be able to economize on his hiring costs and to offer a higher wage to such a labourer. But since such a worker at the same time has inelastic supply of labour hours, the net effect on wage will depend on which of the aspects of v and elasticity is stronger. A female labourer may have higher elasticity of labour supply than some male counterparts (for she is more likely to withdraw her labour supply more readily in response to a wage decline, because she readily substitutes domestic work for "market" work), but because of the constraints that make her more difficult to hire (high v), she may not receive a higher wage rate than her male counterpart. The notion here differs from, though analogous to, Nelson's (1973) model for the developed economies, in which real wage variation is determined by the distance workers must travel to work. In our model, the "distance" factor is implied by the factors that affect the worker's availability: those that reduce v. These factors are rather inversely related to the magnitude of the wage rate.

In this model we see that those workers employed under positive effort response conditions receive higher wages according to the efficiency-wage rule; casual workers employed under null effort response settings receive wages also in accord with their productivities under the monopsony arrangement. However, wages in both cases vary positively with the magnitude of elasticity of labour supply. This again goes to stress the results established earlier: that agricultural wages are not so uniformly determined, even under competitive market conditions, as some recent contributors in the literature have asserted. We now proceed to explore how far these conclusions are strengthened through alternative expository analysis within the model.

IV. Employment Determination

For analytical simplicity, we model the employment problem under assumption of a general case of null effort responses (where $e = 1$). (Since $e' = 0$ in such a case, it makes no significant difference as to what the constant magnitude of the level of effort (e) is; and while this assumption enables us to suppress the effort function without losing its input, it helps in simplifying the exposition immensely).

Depict the agricultural labour supply function N in the general form:

(8a) $$N = N(\omega/\omega^{**}),\ N' > 0,$$

where

ω^{**} = an exogenously determined alternative non-agricultural earnings[9].

Substituting the optimal wage rate into (8a) gives

(8b) $$N = N\left[(p\Omega Q'e - \omega'L - \alpha\phi/\omega^{**})\right]$$

which is total labour availability in equilibrium. Using equation (8b), we obtain

$$\frac{N'p\Omega Q'' - \omega'}{\omega}\, dL = dN - \frac{N(pQ'd\Omega - \alpha\phi_1 du - du - \alpha\phi_2 dv)}{\omega^{**}}$$

$$-d\omega^{**}(p\Omega Q' - \alpha\phi)$$

from which

$$dL = \frac{\omega^{**}dN}{N'p\Omega Q'' - \omega'} - \frac{d\omega^{**}(p\Omega Q' - \alpha\phi)}{\omega^{**}p\Omega Q'' - \omega'}$$

$$-\frac{pQ'd\Omega - \alpha\phi_1 du - \alpha\phi_2 dv)}{p\Omega Q'' - \omega'}$$

and this gives the level of employment growth per time period, from which the roles of technology and quasi fixed-cost are respectively given:

(9a) $$\partial L/\partial\Omega = -pQ'/(p\Omega Q'' - \omega') > 0,$$

(9b) $$\partial L/\partial v = \alpha\phi_2/(p\Omega Q'' - \omega') < 0,$$

(9a) $$\partial L/\partial\Omega = -pQ'/(p\Omega Q'' - \omega') > 0,$$

(9b) $$\partial L/\partial v = \alpha\phi_2/(p\Omega Q'' - \omega') < 0,$$

9 ω^{**} is the opportunity cost of labour supplied in agriculture. Although the employer dominates the labour market by his quasi-monopsony power, a worker still has options for alternative use of his/her labour time: hunting, fishing, and/or self-employment in subsistence family units. ω^{**} therefore represents a subjective index of what the worker envisages that he/she could earn elsewhere.

(9a) is a result that is consistent with the findings in the preceding section (verified in Lemma 1).

(9b) goes to indicate that lower fixed labour costs would lead to higher employment.

Before we attempt to deduce the policy importance of these results, it would be illuminating to approaching the problem from an unemployment standpoint[10].

In Section II, we established that disequilibrium unemployment characterises the sector at a going efficiency wage ω^*. We denote this unemployment as:

(10) $$U^* = N(\omega^*) - L^* = N(p\Omega Q' - \omega' L - \alpha\phi) - L^*$$

where

L^* = employment at the efficiency wage for a typical employer.

From this,

$$dU^* = N'[(p\Omega Q'' - \omega')dL + pQ'd\Omega - \alpha\phi_1 dU^* - \alpha\phi_2 dv] - dL$$

or

$$dU^*[1 + \alpha\phi_1 N'] = N'[(p\Omega Q'' - \omega')dL + pQ'd\Omega - \alpha\phi_2 dv] - dL.$$

Hence:

(11a) $$\partial U^*/\partial\Omega = N'pQ'/(1 + \alpha\phi_1 N')$$

(11b) $$\partial U^*/\partial v = -\alpha\phi_2 N'/(1 + \alpha\phi_1 N')$$

The signs of these results are predicated on the signs of the common denominator, $1 + \alpha\phi_1 N'$, which is indeterminate. However,

10 The question of the definition of unemployment in an agrarian setting is confronted. The conventional yardstick of whether a person is seeking employment in agriculture cannot apply. The agricultural sector has "idle" periods (when there is practically no labour demand), and there is no reason why the individual should look for work when he knows that there is none available. The concept of "seasonal" or "hidden" unemployment is then referred to; or a worker is classified as inactive because he is not seeking employment. But one wonders whether this is really a relevant classification, since conventionally such a work is not regarded as underemployed either.

(11c) $1 + \alpha \phi_1 N' < 0$ if $N' > 1$.

If inequality (11c) is satisfied, then (11a) and (11b) would be negative and positive respectively. These imply that unemployment would be reduced by varied technology, and lowering labour recruitment costs, provided agricultural labour supply is elastic. Thus, approaching the problem from this angle reveals an interesting fact which did not surface from analysing the problem from the viewpoint of employment demand: namely, that the elasticity of labour supply is a factor in employment determination.

This finding complements the earlier result concerning the wage effects of supply elasticity. An important policy implication of this finding is that any agricultural development policy by way of technological improvement and/or labour cost abatement, would only be effective if commensurate with an action that accords regularity in the supply of agricultural labour.

To buttress this finding, we verify from (10):

$$dL = dU^*\{(1 + \alpha\phi_1 N')/\{N'(p\Omega Q''-\omega')-1\} - [(N'pQ'd\Omega)/\{N'(p\Omega Q''-\omega')-1\}] + \alpha\phi_2 N'dv/ N'(p\Omega Q''-\omega')-1\}$$

from which

(12) $\partial L^*/\partial \Omega = -N'pQ'/\{N'(p\Omega Q''-\omega')-1\} > 0$

(13) $\partial L^*/\partial v = \alpha\phi_2 N'dv/\{N'(p\Omega Q''-\omega')-1\} < 0$.

These do not only confirm the results we have in (11a) and (11b) but also reveals that at any going efficiency wage and employment levels ω^* and L^* respectively, it is possible to actually increase employment through the appropriate policies of varied technology and lowering labour recruitment costs, provided agricultural labour supply is elastic.

The elastic condition is thus a fundamental labour market *necessary condition* for policy effectiveness. But is this elastic condition also a *sufficient condition* for agricultural policy effectiveness? To assess this question, we apply our definition of labour supply of equation (8b), which, substituting into (10):

(14) $U^* = N[(p\Omega Q'-\omega' L-\alpha\phi/\omega^{**}] - L$;

from which

$$dU^{**} = N'[\omega\{(p\Omega Q''-\omega)dL + pQ'd\Omega - \alpha\phi_1 dU^{**} - \alpha\phi_2 dv\}$$
$$-(p\Omega Q'-\alpha\phi)d\omega]/\omega^{*2} - dL$$

and simplifying further

$$dU^{*} = N'[(p\Omega Q''-\omega')dL + pQ'd\Omega - \alpha\phi_2 dv) - (p\Omega Q'-\alpha\phi)d\omega^{**}]/$$
$$(\omega^{**} + \alpha\phi_1 N') - \omega^{**}dL/(\omega^{**} + \alpha\phi_1 N')$$

giving

$$(15a) \quad \partial L^{*}/\partial\Omega = pQ'N'/(\omega^{**} + \alpha\phi_1 N')$$

$$(15b) \quad \partial L^{*}/\partial v = -\alpha\phi_2 N'/(\omega^{**} + \alpha\phi_1 N')$$

again with ambiguous signs.

These become determinate under:

$$(16a) \quad \lim_{N'\to\infty} \frac{pQ'N'}{(\omega^{*} + \alpha\phi_1 N')} = \frac{pQ'}{\alpha\phi_1} < 0$$

and

$$(16b) \quad \lim_{N'\to\infty} \frac{pQ'N'}{(\omega^{*} + \alpha\phi_1 N')} = -\frac{\phi_2}{\phi_1}$$

These are limiting cases where N′ approaches infinity. They indicate in this case that to obtain the desired results the supply of labour should be perfectly elastic; the implication being that if agricultural labour supply is not perfectly elastic while labourers base their decision as to whether or not to offer labour time on the relative levels of the agricultural wage and an alternative earning possibility, unemployment can only be reduced under "labour surplus." This establishes the sufficiency condition for policy effectiveness.

A further implication of this result is that several agricultural development policies have not succeeded in significant employment creation in some LDCs because a large proportion of the agricultural labour force tend to desert the agricultural sector and move to other sectors, thereby rendering labour supply in the sector less than perfectly elastic. Therefore, any policy that encourages labour to remain in the sector coupled with application of varied technology and/or reducing hiring costs would reduce unemployment in the sector.

V. Summary and Policy Conclusions

This study has applied the framework of efficiency wages and monopsony theory to analysis of employment and wages in the agricultural labour markets of LDCs. The model has used the effort-augmented production function within a generalized framework that allows for varying effort-sensitivity functions according to the particular employment circumstances in place.

Generally, the results have demonstrated that the efficiency wage postulate is a relevant analytical model for studying the agricultural labour markets in LDCs. In particular, the implications of monopsony conditions for the agricultural labour market in LDCs have been articulated in a general model that simulates varied circumstances of labour supply functions and relative earnings.

It has been found here that rigid wages formed according to efficiency wage behaviour characterise a (primary) sector of the labour market in which wages are higher and factors such as technology and productivity tend to influence the wage rate. In this sector, market supply and demand forces do not seem to play significant role in wage determination. The study has also shown that involuntary unemloyment is consistent with equilibirum (or disequilibrium) in the labour market as employers stick to their optimal employment levels at the efficiency wage and only hire from the casual labour pool during the peak seasons under competitive conditions. There is, also, a casual labour market with lower and flexible wage conditions. This exercise provides an alternative approach for explaining why rural wage rates are known to vary widely across localities as well as between seasons.

An all pervasive policy implication of this study is that, for agricultural employment policies (such as technological infusion or labour rehabilitation) to be more effective, a necessary condition is that labour supply be abundant and forthcoming (elastic), and the sufficient condition is that there should be labour surplus in sense of Lewis (1954). This was important lessons for rural income enhancement measures and general development programs in LDCs.

Appendix

Appendix A:

We verify the derivation of equation (4a) through (5): Assuming constant technology, the efficiency wage expressed as

$$\omega^* = p\Omega Q'e - \alpha\phi$$

yields upon total differentiation:

$$\text{(A.1)} \quad d\omega^* - p\Omega eQ''Le'd\omega^* - p\Omega Q'e'd\omega^* = p\Omega eQ'' + edL$$
$$-\omega''LdL - \omega'dL - \alpha(\phi_1 du + \phi_2 dv)$$

Collecting terms, and substituting (3b):

$$\text{(A.2)} \quad d\omega^* [1 - pQ'\Omega L\{(Q''e/Q') + (1/L)\} = dL\{p\Omega e^2 Q'' + p'e^2\Omega Q'^2$$
$$-\omega''(L)\cdot L - \omega'(L)\} + du - \alpha\phi_1] - \alpha\phi_2 dv$$

and further simplifying:

$$\text{(A.3)} \quad d\omega^*(1 - p\Omega Q'e'L\{pLQ''e + pQ' + p'Q'^3Le\}/pQ'L)$$
$$= dL[p\Omega e^2 Q'' - \omega''L + \omega' - \alpha\phi_1 du - \alpha\phi_2 dv]$$

Then substituting $\omega'' = 0$, and collecting terms yields

$$d\omega''\{1 - p\Omega e'(Q' + e/Q''L)\} = (pe^2\Omega Q'' - \omega')dL + peQ'd\Omega$$
$$-\alpha(\phi_1 du + \phi_2 dv)$$

This is equation (4a) in the text.

Further, under ceteris paribus, $d\omega/dL \rightarrow \partial\omega^*/\partial L$ (i.e. as $du = dv = 0$), and substituting these into (A.3) gives equation (5) in the text.

Appendix B:

Verifying Lemmas (1) and (2):

LEMMA 1:

We now relax the constant technology assumption, and then differentiate the wage function totally and rearrange, and then substitute the optimality condition (3b), to obtain:

$$\text{(B.1)}\quad dL\{p\Omega e^2Q''-(\omega'+\omega''L)\}=d\omega^*_i[1-pQ'\Omega^*_i e'L\{(Q''e/Q')+(1/L)\}]-d\Omega^*_i pQ'e_i+\alpha\phi_1 du+\alpha\phi_2 dv.$$

Employment is technologically determined under the efficiency wage rule if:

$$(\partial L^*/\partial\omega)_{e'>0}>0.$$

Under ceteris paribus, $dL/d\Omega\rightarrow\partial L^*/\partial\Omega$ (i.e. as $d\omega=du=dv=0$). Substituting these into the above we obtain the employment distribution effect of technology for any given employer i:

$$\text{(B.2)}\quad \partial L^*_i/\partial\Omega^*_i=-pQ'e_i/\{p\Omega e^2Q''-(\omega'+\omega''L)\}$$

which, on invoking the linear labour supply assumption ($\omega''=0$), simplifies to

$$\partial L^*_i/\partial\Omega^*_i=-pQ'e_i/p\Omega e^2Q''-\omega'>0.$$

This verifies Lemma 1. (Figure 1 verifies the corresponding L^* and ω^*).

LEMMA 2:

Under null effort responses ($e''=0$), equation (5) reduces to

$$\partial\omega/\partial L=pe^2\Omega Q''-\omega<0,$$

and this indicates wage flexibility proposed in the Lemma.

Then, we show that in equilibrium any static change in ω^*_i exceeds a similar change in ω^0_i, and to that extent ω^*_i must exceed ω^0_i in absolute terms, i.e.

$$(d\omega^*_i)_{e'>0}>>(d\omega^0_i)_{e'=0}$$

or

$$(d\omega^*_i)_{e'>0}-(d\omega^0_i)_{e'=0}>0.$$

Under 'ceteris paribus' ($du=dv=d\Omega=0$), this gives:

$$\frac{dL(p\Omega^*_i e^2 Q''-\omega')}{1-pQ'\Omega^*_i eL[(Q''e'/Q')+(1/L)]}-\frac{dL(p\Omega^*_i e^2 Q''-\omega')}{1-pQ'\Omega^*_i e}>0$$

which yields upon dividing through by the common numerator (which is a negative value) and inverting

$$1-pQ'\Omega^*_i eL\{(Q''e'/Q')+(1/L)\}-(1-pQ'\Omega^*_i e)>0,$$

i.e.

$$-pQ'\Omega^*_i eL\{(Q''e'/Q')+(1/L)\}+pQ'\Omega^*_i e>0$$

or

$$pQ'\Omega^*_i e_i[-L(\frac{Q''e'}{Q'}+\frac{1}{L})+1]>0$$

which reduces to

$$pQ'\Omega^*_i e(-LQ''e/Q')>>0.$$

This verifies the above LEMMA.

Appendix C:

Verifying the wage and elasticity of supply relationship:
Equation (6):

$$\omega=\frac{\xi}{1+\xi}(p\Omega Q'e-\alpha\phi)\rightarrow\frac{1}{1+\xi}(p\Omega Q'e-\alpha\phi)$$

Differentiating equation (6) in the text:

$$d\omega=[\xi/(1+\xi)\cdot p\Omega e'Q'(eL+1)]d\omega+\xi/(1+\xi)\cdot p\Omega Q''e^2dL$$
$$+d\xi(1-\xi)/(1+\xi)\cdot p\Omega Q'e-\alpha\phi)-\xi/(1+\xi)\alpha(\phi_1du+\phi_2dv)$$

and collecting terms

(C.1) $$d\omega[1-\frac{\xi}{1+\xi}p\Omega e'Q'(eL+1)]=\frac{\xi}{1+\xi}p\Omega Q''e^2dL$$

$$+\frac{d\xi(1-\xi)}{(1+\xi)}(p\Omega Q'e-\alpha\phi)-\frac{\xi}{1+\xi}\alpha(\phi_1 du+\phi_2 dv)$$

Solving for the elasticity effect on wage $\partial\omega/\partial\xi$, under the 'ceteris paribus' assumption that $d\omega/d\xi \rightarrow \partial\omega/\partial\xi$ as $dL = du = dv = 0$, from (C.1), yields equation (7) in the text.

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