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THE WAGE-PRODUCTIVITY HYPOTHESIS: IT'S ECONOMIC CONSEQUENCES AND POLICY IMPLICATIONS FOR L.D.C.s

Joseph E. Stiglitz

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ABSTRACT

This paper explores the implications for less developed countries of the hypothesis that workers' productivity depends on the wages they receive. In particular, we show that this hypothesis may explain the high urban wages and unemployment found in many such countries.

The market equilibrium is shown not to be pareto efficient. If the government could not control urban-rural migration, but could control wages and urban employment, it would, in general, set wages and employment levels differently. The sources of inefficiency are identified. The (constrained) pareto optimal policy can be implemented via taxes and subsidies; but two instruments (both specific and ad valorem wage tax/subsidies) are required.

More generally, policy changes will affect both the urban wage and the level of unemployment, and these consequences need to be taken into accounce, both in the determination of shadow wages to be used in cost benefit analysis and in the analysisis of the incidence of any set of taxes and subsidies. The shadow price of labor may differ markedly from what it would be if wages were arbitrarily fixed and there were no migration. In particular, in the special case of the Harris-Todaro migration model, with fixed rural wages and productivity depending only on the absolute wage received, the shadow wage is the market wage, regardless of the relative evaluation of current and future consumption. Shadow prices under other specifications of the wage-productivity relationship are analyzed.

Joseph E. Stiglitz
Department of Economics
Dickinson Hall
Princeton University
Princeton, NJ 08544

The Wage-Productivity Hypothesis: Its Economic Consequences and Policy Implications for L.D.C.'s

by

Joseph E. Stiglitz[1]

Under a variety of circumstances, the wage which a firm pays has an important effect on the productivity of its labor force. This simple observation has profound implications on the nature of market equilibrium. It implies, for instance, that there may be competitive equilibria in which demand does not equal supply: wages may not be cut, even in the face of an excess supply of labor, for to do so might lower the productivity of the labor force more than proportionately to the reduction in the wage, and hence labor costs would rise. The law of supply and demand is repealed! It also implies that, since the wage productivity relationship may differ for different jobs, equilibrium may be characterized by (ex ante) identical workers receiving different

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wages. Indeed, even with identical firms, equilibrium may be characterized by a wage distribution with the higher wages paid by some firms being exactly offset by the higher productivity. If the wage productivity curves characterizing different groups differ, there may be high rates of unemployment in some groups while other groups are fully employed. Moreover, reductions in the demand for labor (associated, say, with business cycles) may have their impact concentrated on particular groups, those for whom the (maximal) ratio of productivity to wage is lowest. Cyclical reductions in demand may be accompanied by lay-offs rather than work sharing (as predicted by most of the standard implied contract theory).

This paper is particularly concerned with exploring some of the policy implications in the context of L.D.C.'s, e.g. for wage subsidies and shadow pricing. The fact that the wage is endogenously determined, rather than arbitrarily given, has, we believe, some important consequences which may be fundamentally different from those in which, say, the urban wage is arbitrarily set at a level above that which would clear the market. Such models provide no insight into what will happen when the government changes some policy. In particular, they provide no insight into the circumstances in which such changes will lead to changes in the urban wage. A central thesis of this research is that policy changes will affect the urban wage, and thus affect the level of unemployment; and that these consequences need to be taken into account, for instance, both in the determination of shadow wages to be used in cost benefit analysis and in the analysis of the full incidence of any set of taxes and subsidies.

We show that the presence of unemployment of wages in excess of the

market clearing level does not, in itself, indicate that the economy is inefficient. In a planned economy, wages too might well be in excess of the market clearing level. On the other hand, in the class of models with which we are concerned here, there is no presumption that the competitive equilibrium is efficient; and in particular, that the level of unemployment which emerges in the market equilibrium -- what macroeconomists might be tempted to refer to as the natural level of unemployment -- has any optimality properties.

This paper is divided into five sections. In section I, we review the basic arguments for why wages affect productivity; section II discusses the implications of the dependence of productivity on wages for market equilibrium. Section III assesses the efficiency of the market equilibrium. The presence of unemployment, of wages in excess of the market clearing level, does not, in itself, indicate that the economy is inefficient. In a planned economy, wages too might well be in excess of the market clearing level. We show, however, that there is no presumption that the competitive equilibrium is efficient; and in particular, that the level of unemployment which emerges in the market equilibrium, what macroeconomists might be tempted to refer to as the natural level of unemployment, has any optimality properties. Section IV then explores the policy implications, focusing in particular on the implications for tax policy and cost benefit analysis. Section V presents some concluding remarks.

I. Why do Wages Affect Productivity.

There are a large number of reasons that a firm may expect that an increase in the wage it pays may have a positive effect on the

productivity of its labor force.

(a) The efficiency wage hypothesis. This is the oldest explanation provided within the development literature (see e.g. Leibenstein).[2] When workers are close to the subsistance level, then increases in their nutritional level and health care will lead to an increase in their productivity.[3] An increase in wages is generally believed to result in an increase in nutrition and hence in productivity. The relationship between the paid by the ith firm, wage, w_i, and the productivity of its labor force, λ_i, is conventionally depicted as in figure 1, with an initial region in which increases in wages lead to more than proportionate increases in productivity. We write

$$\lambda_i=\lambda_i(w_i),\ \lambda'>0,\ \lambda_i''(w_i)\lessgtr 0 \text{ as } w_i \lessgtr \hat{w}_i \qquad (1)$$

The curve shows that for low wages, increases in wages have a marked (and an increasing) effect on productivity; at high wages, however, diminishing returns sets in: though increases in wages continue to increase productivity somewhat, the increment in productivity from each successive increase in wage becomes smaller and smaller. The shape of the curve is important for many of the results obtained below.

If the urban worker is sharing his wage with family members in the rural sector who receive a wage of w_r, then the productivity of an urban worker will depend not only on the firm's wage, w_i; but also on the rural wage w_r:

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[2]Some of the analytic implications have been explored by Mirrlees (1975), Stiglitz (1976), and Dasgupta and [1984a, 1984b].

[3]Recently Bliss and Stern have examined the empirical validity of this hypothesis.

$$\lambda_i = \lambda(w_i, w_r), \quad \partial\lambda/\partial w_r < 0 \qquad (2)$$

Moreover, the magnitude of the increase in productivity from a given change in wages will be smaller than it would be if they did not share. As a consequence, firms may attempt to provide meals and health care to their workers, to ensure that a larger proportion of the wage is spent on productivity enhancing expenditures. They may also subsidize other productivity enhancing expenditures, e.g. through a company store. Thus, (2) can be generalized to $\lambda_i = \lambda_i(w_i, w_r, p)$ where p is the price vector. Firms may also hire members of the same family, to reduce the dissipation of the benefits of high wages from sharing. If the worker is sharing his income with family members who are unemployed or who are employed elsewhere in the urban sector, then productivity may be positively related to the amount of wages paid by other firms, $\bar{w}$,[4] negatively related to the unemployment rate.

$$\lambda_i = \lambda_i(w_i, \bar{w}, w_r, U), \quad \partial\lambda_i/\partial w_i > 0, \partial\lambda_i/\partial\bar{w} < 0, \quad \partial\lambda_i/\partial w_r < 0, \quad \partial\lambda_i/\partial U > 0 \qquad (3)$$

An alternative explanation of the dependence of λ on the unemployment rate is that individuals go into debt during job search; they must repay these debts after obtaining employment, thus reducing the funds available for consumption.

In the limiting case where the interest rate is zero and where individuals engage in rent seeking activity to the point where the lifetime consumption of the individual who obtain the high wage jobs is

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[4] $\bar{w}$ is the vector of wages paid by other firms. Since we focus on symmetric equilibria, all components of $\bar{w}$ are identical.

the same as those who remain in low wage jobs (and do not search), then an increase in the wage increases expenditures on job search, but does not increase labor productivity.[5] But this is an extreme case. If there is a positive interest rate, then even if lifetime expected utilities are equalized by rent seeking expenditures, consumption during periods of employment will be higher in high wage firms. Moreover, to the extent that this is an important problem, firms will be induced to recruit workers in ways which ameliorate these effects.

(b) Labor turnover. A second important way that workers' behavior affects the productivity of firms is through labor turnover.[6] In most jobs, there are costs of hiring and training which are specific to the firm. So long as individuals do not pay these full costs at the moment they are hired (recouping them later in the form of higher wages), then the greater the quit rate, the greater the firm's expenditures on training and hiring costs. Increasing the wage rate will, in general, lead to a reduction in the quit rate, and hence to an increase in the profits of the firm.

The retention rate r (which equals one minus the quit rate) and hence the turnover costs, depend on the relationship between the given firm's wage and all other wages in the economy. Lower wage individuals have a higher probability of finding a job at a higher wage, and thus of

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[5]Assuming, that is, that productivity depends on lifetime consumption, or, if it depends on current consumption, at a zero interest rate individual smooth their consumption evenly throughout their life.

[6]In the context of developed countries, this hypothesis has been explored by Salop (1973), Stiglitz (1972, 1985), and Hall (1975) among others. In the context of less developed countries, see Stiglitz (1974).

quitting. This is true whether there is costly search, or whether all individuals apply to all firms offering a higher wage than their present firm, and the firm simply randomly picks among the applicants. Moreover, the greater the unemployment rate, the less likely it is that the worker will find a better job. Thus, in this hypothesis

$$r=r(w_i, \bar{w}, w_r, U), \quad r_1>0, r_2<0, r_3<0, r_4,>0 \qquad (4)$$

The effect of higher quite rates is to decrease the "net" productivity (net of turnover cost). Firms would not have to pay higher wages to reduce turnover costs if either (a) they could force workers to sign binding contracts; or (b) workers paid for all of the training costs. Indentured servitude is, in most countries, illegal.

As an empirical matter, it appears that workers seldom pay the full turnover costs at the moment they are hired; and so long as workers are risk averse and there is some chance that they will leave the firm (either because they are badly "matched" with the firm or because of some exogenous reasons which induces them to leave) the optimal contract between the firm and the worker will entail the firm bearing some of the risks associated with the costs of labor turnover (so turnover will be costly to the firm). (See Arnott and Stiglitz [1985]). There are further reasons for workers not bearing the entire costs of training and hiring. Workers may have insufficient capital; and the costs of training and hiring may not be verifiable. Were the worker to have to pay the full training and hiring costs, there might be an incentive for firms to overstate these costs, and then to fire workers, making a profit out of the difference between the payments and the true training

costs.

(c) Incentive Effects.[7] It is, in general, costly to monitor workers. If there were no unemployment and if all firms paid the market clearing wage, then the threat of being fired would not lead individuals to reduce their shirking: they would know that they could quickly obtain another job. But if firms pay wage in excess of that of other firms, or if there is unemployment (so that a fired worker must spend a period in the unemployment pool before he again obtains a job) then workers have an incentive not to shirk; there is a real cost to being fired.[8]

This again gives rise to a productivity wage relationship of the form (3), with

$$\frac{\partial \lambda}{\partial w_i} > 0, \quad \frac{\partial \lambda}{\partial w_j} < 0, \quad \frac{\partial \lambda}{\partial w_r} < 0, \quad \frac{\partial \lambda}{\partial U} > 0:$$

An increase in other's wages reduces productivity, an increase in unemployment increases productivity.

(d) Morale Effects. It is sometimes postulated that an individual's behavior is affected by his views of how fairly he is being treated, or more generally, how he sees himself being treated in relationship to

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[7]The incentive effect of paying high wages, within the context of developed countries, has been analyzed by Shapiro and Stiglitz (1984), Calvo (1979), and Calvo and Phelps (1977).

[8]A full analysis of this motive for paying higher wages again requires an investigation into alternative methods of providing incentives. One such method is to provide a bond, which the individual forfeits if he shirks. The difficulties with this are similar to those discussed above. Alternatively, the firm could threaten to lower the wage of any individual caught shirking. But lowering the wage simply increases the likelihood that the individual will shirk in subsequent periods, and hence is not an effective incentive device. (See Shapiro and Stiglitz).

others. Thus, the wage relative to others' wages enters into the utility function, and consequently also enters into the effort supply function.[9]

(e) Quality effects.[10] Changes in the wage affect the mix of applicants for a job. If reservation wages are correlated with productivities on the job, by offering a higher wage, a firm obtains, on average, a higher quality labor force.[11] Again, in this hypothesis the productivity of the worker is a function of the wage paid by the given firm relative to the wages paid by all other firms.[12]

(f) Recruitment effects. It is costly for firms to recruit workers, particularly to find workers who are "well-matched" with the firm. Even if search were costless, a firm paying a higher wage would have a larger applicant pool among which to choose workers, and this would enable him to recruit a more productive labor force.[13]

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[9] Like the previous explanation, this requires that it be costly to monitor the actual level of effort put out by the individual. For a discussion of evidence for this effect in the psychological literature, see Akerlof, 1984. For an earlier discussion of these morale effects, see Stiglitz, 1973, 1974a.

[10] In the context of developed countries, this model has been explored by Stiglitz (1976a), Weiss (1980), and Nalebuff and Stiglitz. For L.D.C.'s see Stiglitz (1982a).

[11] The assumptions that firms can imperfectly observe the inputs of individuals (as in the previous two explanations), and that they can imperfectly screen individuals prior to hiring them are critical. Moreover, we also require that individuals not be able to guarantee their peformance (either for one of the reasons presented above, or because individuals are risk averse, and imperfectly informed concerning their skills relative to the job.)

[12] When workers are heterogeneous, there is not, in general, a single rural wage; what turns out to be relevant for most of the analysis is the wage of the marginal migrant. When labor is heterogeneous, this is

(Footnote continued)

II. Implications of the Dependence of productivity on wages for market equilibrium.

Regardless of the explanation, the dependence of productivity on wages has one critical consequence: firms may not lower wages in the presence of an excess supply of labor. For to lower the wage will lower the productivity of the labor force, and if its productivity is lowered enough, the profits of the firm will be reduced.

2.1 Introduction: The basic efficiency - wage model. This is seen most simply in the basic efficiency wage model (equation 1). We assume that output of the firm is a function of the effective labor supply[14]

$$Q = F(\lambda L) \tag{5}$$

where L is the number of workers. We call this technology the multiplicative technology. Then profits of the firm, π, are

$$\pi = Q - w L \tag{6}$$

(taking output as our numeraire so w is the real wage); the firm maximizes this with respect to w and L to obtain

$$F'\lambda'L = L, \tag{7a}$$

$$F'\lambda = w \tag{7b}$$

or, dividing (7a) by (7b),

$$\lambda'=\lambda/w \tag{8}$$

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[12](continued)
what w_r will denote.

[13]In models with costly search, it may take some time before a firm is successful in filling a vacancy. The expected length of time is dependent on the wages the firm pays. The effect of this is analagous to that of a direct increase in productivity resulting from a wage increase.

[14]Where there is no confusion, we drop the subscript i denoting the ith firm.

(8) simply says that the firm chooses a wage to minimize its wage per efficiency unit

$$\min w/\lambda \ , \tag{9}$$

depicted as the point of tangency of the line through the origin with the productivity curve. The solution to (8) is referred to as the efficiency wage, w^*. At the efficiency wage, the demand for labor, given by

$$L^d = \frac{F'^{-1}(w/\lambda)}{\lambda} \ , \tag{10}$$

may be less than the supply; nonetheless firms will not be induced to lower their wages. A firm knows that an unemployed worker who offers to work for a wage less than w^* will have a lower productivity, a sufficiently lower productivity that its labor costs will be higher, and its profits lower.

This argument holds, with equal force, for any of the other explanations we have proferred for the dependence of productivity on wages. Thus, for instance, in the labor turnover model firms will not lower their wages, even in the face of an excess supply of labor, knowing that if they do so, they will face higher turnover costs, which may more than offset the direct savings from the lower wages.

Though all of the models can yield equilibrium unemployment, the different models do, however, differ in their welfare consequences and policy implications. Some of these differences we shall note below.

2.2 **A General Model.** In this section, we analyze the equilibrium of a

more general version of the wage-productivity model. We focus our attention on symmetric equilibria, in which all firms in the urban sector pay the same wage. Then the productivity curve facing the ith firm can be written as

$$\lambda = \lambda_i (w_i, \hat{w}, w_r, U). \tag{11}$$

when $\hat{w}$ is the wage paid by other firms in the urban sector. (In the symmetric equilibrium, $w_i = \hat{w}$).

We employ a general production function of the form (where Q_i is the value of net output and L_i is the number of workers).

$$Q_i = Q_i (\lambda_i, L_i) \tag{12}$$

One special case of this is the labor turnover model, in which

$$Q_i = F_i(L_i) - T_i (\lambda_i) L_i \tag{13}$$

where λ_i now has the interpretation of the retention ratio, $T_i (\lambda)$ is the expected turnover costs; $T_i'(\lambda) < 0$, so $\partial Q_i / \partial \lambda > 0$.

Another special case is that discussed earlier, where the production function takes on the simple form

$$Q=F (\lambda L). \tag{5'}$$

In this version, a more productive work is just a "multiple" of a less productive worker. (In the more general case, a more productive worker may be capital saving.)[15]

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[15]To use the vocabulary of traditional growth theory, in the formulation (5'), increases in labor productivity are "Harrod neutral" or "labor augmenting". A more general formulation would have

(Footnote continued)

Profits are still represented by (6). Profit maximization entails the real wage equaling the value of the marginal product,

$$\partial Q/\partial L_i = w_i \tag{14a}$$

and w_i being chosen so

$$(\partial Q_i/\partial \lambda)(\partial \lambda_i/\partial w_i) = L_i. \tag{14b}$$

Note that for the labor turnover model, (14b) has a familiar interpretation. The total labor costs per unit time of a worker is

$$w_i + T^*_i (q+\rho) \tag{15}$$

where T^*_i is the training costs (not paid by the worker), q the quit rate (= 1-r, the retention rate) and ρ the interest rate. (ρT^*_i is the interest cost associated with the training expenditure, and qT^*_i is analogous to the depreciation costs on physical capital.) Thus, turnover costs $T_i(\lambda)$ can be written as

$$T_i(\lambda) = T^*_i (q + \rho), \tag{15a}$$

so (15b) takes on the familiar form

$$-T^*_i (\partial q/\partial w_i) = 1 \tag{15b}$$

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[15](continued)

$$Q=F(\alpha(\lambda)K,\beta(\lambda)L).$$

Thus, if $\beta' = 0$, increases in productivity are purely capital augmenting.

The quit rate function facing any firm, taking the wages of other firms, the wage in the rural sector, and the unemployment rate a given, is usually depicted as in figure 2; the solution to (14b') is represented by the tangency between the quit rate function, and the iso-cost curve (15a). Thus, there exists an optimal wage for the firm, in excess of w_{min}, the minimum wage at which the firm can recruit workers.

2.2.1 The Generalized Efficiency Wage Condition

Dividing (14b) by (14a) we obtain the generalized efficiency - wage condition:

$$\frac{\partial \lambda}{\partial w_i} \frac{w_i}{\lambda_i} = \frac{\partial \ln Q_i / \partial \ln L_i}{\partial \ln Q / \partial \ln \lambda} \qquad (16)$$

The elasticity of productivity with respect to wages should equal the ratio of the elasticity of output with respect to employment to the elasticity of output with respect to wages.

2.2.2 Urban Sector Equilibrium

We assume a fix number of identical competitive firms. It is easy to establish that the aggregative behavior of the sector is determined by functions of the form (14a) and (14b) (or 16), where we substitute the aggregate production function for the firm's production function. From now on, L_u will denote the aggregate urban employment, $\bar{w}$ average urban wages, w_i, the wage of a representative firm. Thus (14a) and (14b) can be thought of as determining the demand for labor and the wage rate as a function of N_u, the supply of labor to the urban sector. To see how this is done, we note that the rural wage is simply a function

of the number of rural workers N_r; but workers are either in the urban sector or the rural sector:

$$N_u + N_r = \bar{N},$$

where $\bar{N}$ is the total labor supply. Thus

$$N_r = \bar{N} - N_u$$

and

$$w_r = w_r(\bar{N} - N_u) \tag{17}$$

Moreover, from the definition of U:

$$1 - U = L_u/N_u \quad . \tag{18}$$

Substituting (17-18) into the productivity equation, we obtain

$$\lambda = \hat{\lambda}(w_1, \bar{w}, L_u, N_u) = \lambda(w_1, \bar{w}, w_r(\bar{N} - N_u), (1 - L_u/Nu)) \tag{3'}$$

Substituting this into (16) we can solve for the equilibrium urban wage as a function of N_u and L_u

$$\bar{w} = \phi(N_u, L_u) \tag{19}$$

We can solve (14a) for the demand for labor by the ith firm as a function of $\bar{w}$, U, and w_r; and again using (17) and (18) we write L_u as a function of $\bar{w}$ and N_u

$$L_u = L_u(\bar{w}, N_u) \tag{20}$$

We can solve (19) and (20) simultaneously to obtain the demand for labor and the wage as functions of N_u:

$$L_u = L_u(N_u) \tag{21a}$$

$$\bar{w} = \bar{w}(N_u) \tag{21b}$$

Note that, in general **the demand (L_u) for labor depends on the supply (N_u).**

An increase in supply of labor increases unemployment, which increases productivity at any given wage, and hence increases demand if the elasticity of demand for labor is large, but may decrease demand if the elasticity is small.[16]

The effect of a change of N_u on $\bar{w}$ is more complicated, and is discussed below.

2.2.3 Migration

When the wage in the urban sector exceeds that in the rural sector, we need to have a theory to determine how labor allocates itself between the two sectors. We assume that the supply of laborers to the urban sector, N_u, is a function of the urban wage, $\bar{w}$, the unemployment rate, the number of urban jobs, L_u, and the rural wage.

$$N_u = H(\bar{w}, U, L_u, w_r) \tag{22}$$

We can simplify (20) using (19) and (18):

$$N_u = N_u(\bar{w}, L_u), \tag{23}$$

giving the supply of workers to the urban sector as a function of urban wages and employment.

The Harris Todaro Model. A special case of our migration model (22) is the so-called Harris-Todaro migration hypothesis, in which migration continues until the expected urban wage equals the rural wage

$$\bar{w}(1-U)=w_r.$$

Then (23) takes on the form

$$N_u=L_u w_r/\bar{w}, \tag{23'}$$

and, using (17), (23) becomes

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[16] It is apparent with elastic demands that there will be a unique equilibrium. With elastic demands, it is difficult to rule out multiple equilibrium.

$$N_u = L_u w_r (\bar{N} - N_u)/\bar{w}. \qquad (23'')$$

2.2.4 Market Equilbrium

Notice that in this model, the supply of labor in the urban sector is a function of the demand: just as we noted earlier thatthe demand for labor is a function of the unemployment rate, and hence indirectly of supply. There is not the simple dichotomy between supply and demand that characterized simple equilibrium models. Moreover, while in traditional competitive supply and demand analysis, firms and workers treat the wage parametrically, now firms determine the wage. Thus, while traditional analysis depicts demand and supply as a function of the wage, here, the wage is endogenous, and the demand can, accordingly, be thought of as simply a function of the supply (eq. 21a) and the supply simply as a function of demand. The derivation of the pseudo-supply curve is straightforward. Substituting (21b) into (23) we obtain:

$$N_u = N_u(\bar{w}(N_u), L_u) \qquad (24)$$

At a fixed wage, an increase in the demand for labor reduces unemployment, so leads to an increase in the supply of labor. The same holds even if wages adjust, so long as the wage does not fall too much as a result of an increase in N_u.

The equilibrium, the intersection of the pseudo-supply curve (24) and the pseudo demand curve (21a), is depicted in figure 3.

2.3 Some Special Cases

To gain insight into the nature of the equilibrium, it is useful to investigate three special cases of our general model (22).[17]

2.3.1 The absolute wage hypothesis.

In the first, we postulate that the production function takes on the multiplicative form. Then, as we noted earlier, (16), giving the optimal wage, takes on the simple form:

$$\lambda_1 / w_1 = \partial\lambda_1/\partial w_1 \qquad (16')$$

If we now postulate further that productivity depends simply on the wage paid by the firm, the simple nutritional model (1), then the efficiency wage (the solution to (16')) is independent of both the number of workers in the urban sector, the unemployment rate, and the employment level. Thus, (21b) takes on the simple form

$$\bar{w} = w^* \qquad (21b')$$

The derivation of the pseudo-demand curve is now straight-forward:

$$L_u = F'^{-1} (w^*/\lambda (w^*))/\lambda (w^*). \qquad (21a')$$

Notice that the demand for labor is independent of the supply: the pseudo-demand curve is a vertical straight line. (See Figure 4a).

We focus on the special supply equation (22') corresponding to the Harris-Todaro Model. We simplify further by assuming a land surplus economy, where the rural wage is independent of the number of individuals in the rural sector,

$$w_r = \bar{w}_r;$$

then (22') takes on the particularly simple form

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[17] We emphasize that this is still not the most general model. We have, in particular, ignored the dependence of productivity on relative prices. The omission of this would be particularly serious in the analysis of a closed economy model, where the relative price of agricultural and industrial goods affects industrial productivity. See Sah and Stiglitz (1985).

$$N_u = L_u \bar{w}_r / \bar{\bar{w}}. \qquad (19'')$$

(See Figure 4a). There is a unique intersection of the pseudo-demand and pseudo-supply schedules. The level of unemployment is also easy to see diagramatically: it is simply the vertical distance between the equilibrium value of L_u and the 45 degree line.

2.3.2 The Relative Wage Hypothesis, Multiplicative Technology. The second special case we investigate is that where we retain all of the assumptions employed in the previous one, except that productivity is postulated to be homogeneous of degree zero in $w_i, \bar{\bar{w}}$, and w_r.

The productivity equation can be written as

$$\bar{\lambda}_i = \bar{\lambda}_i(w_i/\bar{\bar{w}}, w_r/\bar{\bar{w}}, U).$$

The migration equilibrium condition is generalized so that the equilibrium unemployment rate is assumed to be a (monotonically decreasing) function solely of the ratio of rural-urban wage ratio:

$$U = M(w_r/\bar{\bar{w}}), \quad M' < 0 \qquad (25)$$

or inverting

$$w_r/\bar{\bar{w}} = m(U). \qquad (25a)$$

In equilibrium, $w_i = \bar{\bar{w}}$, so λ is simply a function of the unemployment rate, or using (18), of L_u/N_u:

$$\lambda_i = \bar{\lambda}_i(1, m(U), U) \qquad (16'')$$

Thus, (21b) takes on the special form of

$$\tilde{w} = \phi(L_u/N_u). \qquad (19')$$

We would normally expect that an increase in the unemployment rate would lower the optimal wage paid by the firm; hence $\phi' > 0$.[18] Substituting (16") into (10), it is immediate that the demand for labor is simply a function of L_u/N_u:

$$L_u = F'^{-1}[\phi(L_u/N_u)/\lambda(1,m(1-(L_u/N_u)),\ 1-(L_u/N_u))]/\lambda \qquad (21a")$$
$$= z(U)$$

We would normally expect that an increase in the unemployment rate reduced the cost of an efficiency unit of labor; the effect of this on the demand for laborers would depend on the elasticity of the demand for labor. If, for instance, the elasticity of demand for labor is low, then the demand for workers actually decreases.

The supply of labor equation from (25a) is now

$$N_u = L_u/1-M[w_r/\tilde{w}]$$

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[18] This is, however, not necessarily the case. Under the assumption that productivity is homogeneous of degree zero in w_i, $\tilde{w}$, and w_r, the first orer condition for the optimal wage can be written as

$$\frac{\partial\tilde{\lambda}}{\partial(w_i/\tilde{w})}\ \frac{w_i}{\tilde{w}} = \lambda_i$$

The effect of a change in U on the equilibrium level of w thus depends on the sign of

$$\frac{\partial\tilde{\lambda}_i}{\partial m}\ m' \quad \frac{+\partial\tilde{\lambda}_i}{\partial U} - \frac{\partial^2\tilde{\lambda}_i}{\partial(w_i/\tilde{w})\partial m}\ m' \quad \frac{\partial^2\tilde{\lambda}_i}{\partial(w_i/\tilde{w})\partial U}$$

In the case of a fixed rural wage, we can write

$$N_u = L_u/1-M[\bar{w}_r/\phi(L_u/N_u)] \qquad (24'')$$

Though (21a") and (24") thus describe the equilibrium for this model, it is easier to see the effects of various policies if we express both the "supply wage" (the wage at which a given unemployment is generated by the market) and the demand wage (the wage set by firms) as functions of the unemployment rate. For simplicity, we focus on the case where w_r is fixed. Then

$$\bar{w} = \bar{w}_r/(1-U) \quad \text{(migration equilibrium)}$$

and

$$\bar{w} = \tilde{\lambda}(1,m(U),U)/\tilde{\lambda}_1(1,m(U),U). \quad \text{(wage determination)}$$

See figure 3c. Notice that in this case, the unemployment rate and the wage are determined independently of the demand for labor. Rural employment is determined essentially as a residual:[19]

$$N_r = \bar{N}-N_u = N - L_u(U^*)/1-U^*.$$

2.3.2 The Relative Wage Hypothesis: The Labor Turnover Model.

The labor turnover model yields similar results. Labor turnover

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[19] In the more general case, where w_r is a function of N_r, the pseudo-supply function takes on the form

$$\bar{w}(1-U) = w_r(N_r) = w_r(N-N_u) = w_r(N - L_u(U)/1-U).$$

depends only on relative wages and the unemployment rate. But the efficiency wage condition takes on the form (15b), again yielding

$$\dot{w} = h(U).$$

The demand for labor equation is slightly different from (10). It takes on the form:

$$F'(L) = w + T.$$

where, it will be recalled, T is the turnover costs per worker (given by (15")).

Both T and w are functions of U, so, inverting, we obtain

$$L_u = F'^{-1}(h(U) + T(U)).$$

The demand for labor is again simply a function of the unemployment rate. The equilibrium is again depicted by a diagram, such as figure 4.

III. Efficiency of the Market Equilibrium

The fact that some workers are unemployed suggests that resources are not being used efficiently. However, assessing the efficiency of the market in the presence of the wage-productivity nexis is not an easy matter. We need to specify what the government's objectives are, as well as the set of available instruments. If, for instance, the government could control migration directly, then it could eliminate unemployment. It might, for instance, randomly assign some individuals to the high paying urban jobs, but require all other individuals to remain in the rural sector. Such control of migration requires a level of repression that many L.D.C.'s find objectionable. Accordingly, the more relevant question may be, if the government could control directly the urban wage rate and the level of urban **employment** would it set these variables at levels different from those of competitive markets?

Alternatively, the government may not be able to control wages and employment directly; it may have to resort to wage subsidies or taxes. Again, we need to ask, if these are the only instruments available, would the government wish to impose such subsidies taxes, and if so, at what rates?

In this section, we assume the government has direct control of $\bar{w}$ and L_u. We first assume that the government wishes to maximize national output, and then consider the more general objective of (constrained) pareto efficiency.

3.1 Assume that the government is simply concerned with maximizing net national output. Let Q_u and Q_r be output in the urban and rural sectors respectively; then the government[20]

$$\max_{\{L_u,\bar{w}\}} Q_u(\hat{\lambda}(w,\bar{w},L_u,N_u(\bar{w},L_u)),L_u)+Q_r(N-N_u(\bar{w},L_u))$$

yielding the first order conditions

$$L_u \frac{\partial Q_u}{\partial L_u} - L_u Q'_r \frac{dN_u}{dL_u} + \frac{\partial Q_u}{\partial \lambda}[\hat{\lambda}_3 L_u+\hat{\lambda}_4 N_u \frac{d\ln N_u}{d\ln L_u}] = 0 \qquad (27a)$$

$$\frac{\partial Q_u}{\partial \lambda}[\hat{\lambda}_1+\hat{\lambda}_2+\hat{\lambda}_4 \frac{dN_u}{dw}] - Q_r' \frac{dN_u}{dw} = 0 \qquad (27b)$$

Rewriting

$$\frac{\partial Q_u/\partial L_u - \bar{w}}{w} = (\frac{Q_r' N_u}{w L_u} \frac{d\ln N_u}{d\ln L_u} - 1) - a \frac{d\ln Q_u}{d\ln L_u} \qquad (28a)$$

$$\frac{\hat{\lambda}_1 w}{} \quad d\ln N_u/d\ln w \quad (1+a) \quad \partial \ln Q_u/\partial \ln L_u \qquad (28b)$$

[20] We ignore efficiency wage considerations in the rural sector.

$$\frac{\quad}{\lambda} = \left(\frac{\quad\quad}{d\ln N_u/d\ln L_u}\right) \frac{\quad\quad}{(1+b)} \quad \frac{\quad\quad\quad\quad}{\partial \ln Q_u / \partial \ln \lambda_u}$$

where

$$a = \frac{d\ln Q_u/\partial \ln \hat{\lambda}}{d\ln Q_u/\partial \ln L_u} \left(\frac{Q_u}{wL_u}\right) \left(\frac{\partial \ln \hat{\lambda}}{\partial \ln L_u} + \frac{\partial \ln \hat{\lambda}}{\partial \ln N_u} \frac{\partial \ln N_u}{\partial \ln L_u}\right), \quad b = \frac{\hat{\lambda}_2 \bar{w}}{\lambda} + \frac{\partial \ln \hat{\lambda}}{\partial \ln N_u} \frac{\partial \ln N_u}{\partial \ln w} \qquad (29)$$

Thus, the market is efficient only if (comparing (28a) and (28b) with (14) and (15)).

$$Q_r' \frac{dN_u}{dL_u} = \bar{w}\left(1+a \frac{d\ln Q_u}{d\ln L_u}\right) \qquad (30a)$$

and

$$\frac{1+a}{1+b} = \frac{d\ln N_u/d\ln L_u}{d\ln N_u/d\ln w} \qquad (30b)$$

To see what is entailed, we consider some special cases:

Labor Supply With Harris-Todaro Model.

Assume $w_r = Q_r'$, the rural wage equals the value of the marginal product of labor in the rural sector. If migration equilibrium entails equating the rural wage to the expected urban wage,

$$w_r = \bar{w} L_u / N_u$$

then the elasticity of urban labor supply with respect to the urban wage and employment are identical:

$$d\ln N_u/d\ln w_u = d\ln N_u/d\ln N_u \qquad (31)$$

and

$$\frac{d\ln N_u}{d\ln L_u} = \frac{1}{1+\xi} \qquad (32)$$

where

$$\xi = \frac{*(Q_r'' N_r)\ (N_u)}{Q_r \qquad N_r}$$

$\xi = 0$ when the rural wage is independent of the number of workers in the rural sector.

Labor Supply With Risk Aversion

If individuals are risk averse, and set their expected utility in the urban sector equal to that in the rural, then, letting $v(0)=0$, (where $v(w)$ is the utility associated with wage w, with $v'' < 0$, as a result of risk aversion and,

$$Ev = v(w)(1-U) + U\,v(0) = v(w)(1-U) = v(w_r)),$$

$$\frac{d\ln N_u/d\ln \bar{w}}{d\ln N_u/dn\, L_u} = \frac{u'(\bar{w})\bar{w}}{u(w)} < 1, \quad \frac{d\ln N_u}{d\ln L_u} = \frac{1}{1+\xi}$$

3.1.1 Absolute Wage-efficiency Model: Harris-Todaro Migration

In the absolute wage-efficiency model described above, $a = b = 0$. Thus, for that model, with expected wages in the two sectors equalized, the market wage is set at its efficient level ((28b) is satisfied) even though there is unemployment. Moreover if $a = 0$ and $\xi = 0$ (the wage in the rural sector does not change as workers migrate to the urban sector) urban employment in the market economy is set at its efficient level; for then (30a) becomes

$$w_r N_u = \bar{w} L_u,$$

which is clearly satisfied. If $a = 0$ but $\xi > 0$, it is set too low.

3.1.2 Relative Wage Efficiency Model.

Under the relative wage efficiency hypothesis, with a fixed rural wage, and the Harris-Todaro migration equilibrium condition, a is again zero, employment is at the right level, contingent on the wage being offered, but the wage may be either too large or too small. Which

depends on whether a proportionate increase in the employment rate has a greater or less effect on productivity than a proportionate increase in the average urban wage.

Under the relative wage efficiency hypothesis, and the Harris-Todaro migration equilibrium condition, but with a variable rural wage, $a < 0$. On the other hand, under those circumstances

$$\frac{Q'_r}{\bar{w}} \frac{dN_u}{dL_u} < 1$$

Hence, from (28a), it is clear that employment, conditional on the wage, may be either too large or too small (since the above expression does not depend on the properties of the productivity function but clearly a does, the right hand side of (28a) may be either positive or negative.)

Similarly, from (28b), it is clear that the wage may be either too high or too low. While

$$\frac{d\ln L_u / d\ln \bar{w}}{d\ln N_u / d\ln L_u}$$

will be less than unity if individuals are risk averse, the sign of b depends on the sensitivity of productivity to changes in the average urban wage relative to its sensitivity to the rural wage rate and the level of unemployment.

3.2 Pareto efficiency. The fact that the competitive allocation does not maximize net national output does not imply that the market economy is not pareto efficient. Pareto efficiency may be most easily examined in the context of the case where the rural wage is fixed and hence (under the Harris-Todaro hypothesis), so is the welfare of workers, is fixed. Pareto efficiency then requires the maximization of profits in the urban sector, i.e.

$$\max \quad Q_u - wL_u \tag{33}$$

so $$\partial Q_u/\partial L_u - w = (\partial Q_u/\partial \lambda)(\partial \hat{\lambda}/\partial L_u + (\partial \hat{\lambda}/N_u)(\partial N_u/\partial L_u)) \tag{34}$$

$$(\partial Q/\partial \lambda)\hat{\lambda}_1 - L_u = -(\partial Q_u/\partial \lambda)(\hat{\lambda}_2 + (\partial \hat{\lambda}/\partial N_u)(\partial N_u/\partial w) \tag{35}$$

Contrasting (34) and (35) with (15) and (16), it is clear that the market will essentially never be pareto efficient unless $\hat{\lambda}_2 = \hat{\lambda}_3 = \hat{\lambda}_4 = 0$. Further distortions obtain in the case of variable w_r

3.3 Sources of Market Failure. There are several sources of market failure in this economy. First, firms fail to take into account the effect of their wage and employment policy on the productivity of workers at other firms, both directly and indirectly through their effect on the unemployment rate and rural wages. (These productivity externalities[21] would arise regardless of the explanation of the

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[21] Some of the externalities appear to be pecuniary externalities, which in traditional economic theory do not interfere with the productive efficiency of the economy. But the result that pecuniary externalities

(Footnote continued)

wage-productivity relationship.) Some of these externalities are positive, some are negative. Policies which lead to a reduced unemployment rate are likely to reduce productivity (e.g. as a result of incentive effects). Increases in productivity as a conseqence of a higher quality applicant pool are at the expense of the quality of those working at other firms, except to the extent that the wage/employment policy has resulted in a better matching of workers with firms (on the basis of comparative advantage.)

As a result, in this class of models the wage does not measure the correct opportunity cost of labor. For instance, if the reason that productivity increases with the wage is that reservation wages are correlated with productivity, then the applicant pool consists of all of those whose productivity in the rural sector is less than the wage offered by the firm; in that case, the wage clearly exceeds the opportunity cost of a randomly selected applicant.

If by hiring an additional worker, more than one worker migrates from the rural sector (to seek employment in the urban sector) the loss in output exceeds the rural wage. Later, we present an example where the loss in output equals the urban wage.

Throughout this section we have assumed that the government cannot effect migration indirectly through subsidies to the rural sector. As we show later, such subsidies are, in general, desirable (though it will not be in the interest of any firm to provide such a subsidy).

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[21](continued)
do not matter is special, and does not hold in the class of models with which we are concerned here, and more generally, as Greenwald and Stiglitz show (1985), in any economy in which there is imperfect information and/or an incomplete set of markets.

IV. Policy

Indirect Intervention. The government can attempt to use taxes and subsidies to effect the constrained optimum. Since there were two variables that the government controlled, it requires at least two instruments to attain the constrained optimum. In particular, if we impose ad valorem and specific wage subsidies at the rates τ and t, the firm

$$\max \quad \pi_u = [w(1-\tau) + t]L_u \tag{36}$$

and so sets

$$\partial Q_u/\partial L_u = w(1-\tau)+t \tag{37}$$

$$(\partial Q_u/\partial \lambda)(\partial \lambda/\partial w_1) = (1-\tau)L_u \tag{38}$$

If t and τ are set appropriately, so

$$\frac{t - \tau w}{w} = \frac{Q_r' N_u}{w L_u} \frac{d\ln N_u}{d\ln L_u} - 1 + a \frac{d\ln Q_u}{d\ln L_u} \tag{39}$$

$$(1-\tau)L_u = \frac{\partial Qu}{\partial \lambda}\left(\hat{\lambda}_2 + \hat{\lambda}_4 \frac{dN_u}{dw}\right) + Q_r' \frac{dN_u}{dw} \tag{40}$$

then the market solution will be a constrained optimum.

Note that a pure ad valorem subsidy leaves unchanged the equation for the optimal wage (dividing (38) by (37)) but does increase the level of employment. Thus, in the pure wage efficiency model, where the market wage was optimal, the government will only employ an ad valorem wage subsidy. A specific wage subsidy will increase the wage paid: it will be partly shifted backwards towards workers (see Figure 5).

If the wage subsidy is shifted backwards towards workers, it will

result in an increase in the unemployment rate, as depicted in figure 6. In contrast, in the pure efficiency wage model, where an ad valorem wage subsidy leaves the market wage unaffected, the unemployment rate is unchanged, if the rural wage is fixed (under the Harris-Todaro migration hypothesis) but because the number of employed workers increases, the number of unemployed increases. On the other hand, if the rural wage is not fixed, the out-migration from the rural sector raises the rural wage, and this reduces the level of unemployment. The consequences of this are described more fully below.

Additional Taxes. Although by assumption, the government cannot directly control migration, it may be able to affect the level of migration (and the associated unemployment) by providing subsidies to the rural sector, financed, for instance, by a tax on profits in the urban sector. In the pure efficiency wage model, such subsidies unambiguously increase national output and lower unemployment. In models where productivity in the urban sector is affected by the rural wage, such a policy has a positive effect on rural output and a negative effect on urban output. The optimal rural subsidy entails a balancing of these two effects.

Shadow Prices. The models formulated in this paper have very different implications for shadow pricing from those of the standard model. First the opportunity cost of having an additional worker in the urban sector depends critically on the effect this has on the unemployment rate. If the government's hiring of an additional worker left unemployment unchanged, it would imply an induced migration of $1/1+U$ workers, and hence a loss in output in the rural sector of $w_r/1+U$, if w_r is the

marginal product of labor. Under the hypothesis that expected income in the urban sector equals the rural wage

$$w_r = \bar{w} \frac{L_u}{N_u} = \bar{w} \quad (1-U)$$

so that the opportunity cost of hiring an additional worker is just the urban wage. It is easy to ascertain, within the context of the models formulated here, the effects of a change in urban employment on U. For instance if the rural wage is constant and equal to the value of the marginal product and if the urban wage remains unchanged (as it will be in the pure efficiency wage model or in any other model in which the urban wage depends simply on the rural wage and the unemployment rate, as in the labor turnover model or the incentive models)[22] then U will remain unchanged. If the rural wage increases as workers leave the rural sector, it implies that as the government hire more workers, the supply wage (the urban wage where generates the indicted level of umemployment) will be higher.[23]

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[22]But in the efficiency - quality model, the mix of applicants applying to jobs in the urban sector changes as urban employment changes, and this may lead to a change in the urban wage.

[23]Equilibrium requires

$$\bar{w} = w_r[N-N_u]/1-U-w_r[N - \frac{L_u}{1-U}]/1-U$$

where, letting L_g denote government employment

$$L_u = F'^{-1}[\bar{w}/\tilde{\lambda}(1,m(U),U)] + L_g$$

in the relative wage model, and

(Footnote continued)

As figure 7 illustrates, the new equilibrium level of unemployment will be lower, provided the efficiency wage decreases with the unemployment rate. (But just the opposite occurs if the efficiency wage increases with U).

Note too, in the case where the rural wage is fixed, that changing the level of urban employment has no effect on aggregate workers' consumption; hence if all profits are invested, investment is maximized by maximizing net national output. Regardless of the relative weight associated with investment, the shadow price on labor is the urban wage. (These results are in marked contrast to the earlier studies of Sen, Marglin, etc., which ignored the endogenity of migration and of urban wage determination.)

If the rural wage increases as individuals leave the rural sector, then at a fixed urban wage, the unemployment rate wil be reduced, and hence the opportunity cost of labor is less than the urban wage (but still greater than the rural wage). The reduction in the unemployment rate may lead to an increase in urban wage, but presumably by an amount which is less than proportionate to the rise in the rural wage.

V. Disequilibrium versus equilibrium models and wage dispersion.

In all of the models presented here, we have assumed that the wage is determined endogenously. There is another important class of models in which wages are set arbitrarily (say by custom, unions, or government fiat). Such models do not provide a basis for inferring what will

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[23](continued)
$L_u = F'^{-1}[\bar{w}/\lambda(\bar{w})] + L_g$
in the absolute wage model.

happen as a result of a change in, say, taxes, and thus provide an inadequate basis for the analysis of policy. Since the pure efficiency wage model is one in which the wage does not depend either on the level of hiring in the sector, on unemployment, public employment, wages paid by other firms, or ad valorem subsidies, the analysis of the rigid wage model corresponds (for these policy variables) to that special case of our general model. On the other hand, our model predicts that even in the pure efficiency wage model, a specific wage subsidy will have an effect on wages paid in the urban sector.

In the disequilibrium models, the observed productivity differences between different sectors (or different firms within a given sector) may be viewed as caused by differences in the exogeneously given wages. In our more general equilibrium formulation, there may exist differences in the wages paid by different firms; labor turnover may be more important to some firms than to others; physical health may be more important in some occupations than in others; in such cases, wages may be higher. Even more interesting, however, is the possibility that identical firms (identical jobs) may pay different wages; the differences in wages being perfectly offset by differences in productivity. Equilibrium may be characterized by wage disperion, even among otherwise identical firms. In these models, there is no single direction of causation: productivity is higher because wages are higher, and wages are higher because productivity is higher.

This paper has considered only some of the important facets of the wage productivity nexus and its implications for development policy. It has, not considered, for instance, important consequences for education policy (whether education is for screening or human capital formation)

and investment policy (including the allocation of capital between the urban and rural sector). These are questions which we hope to explore elsewhere.

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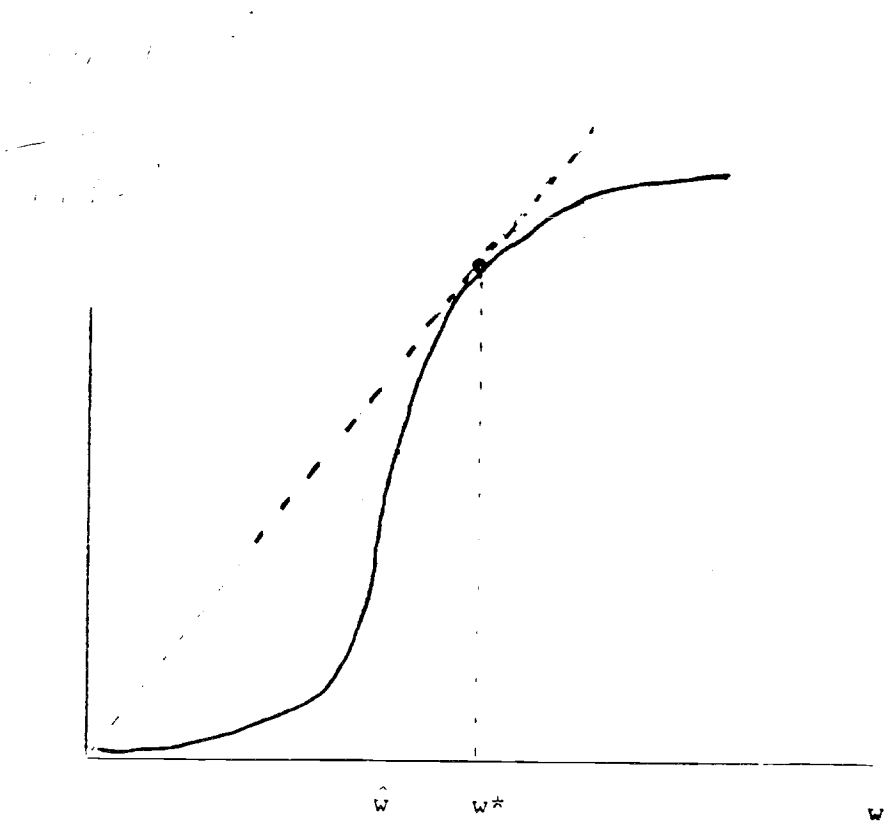
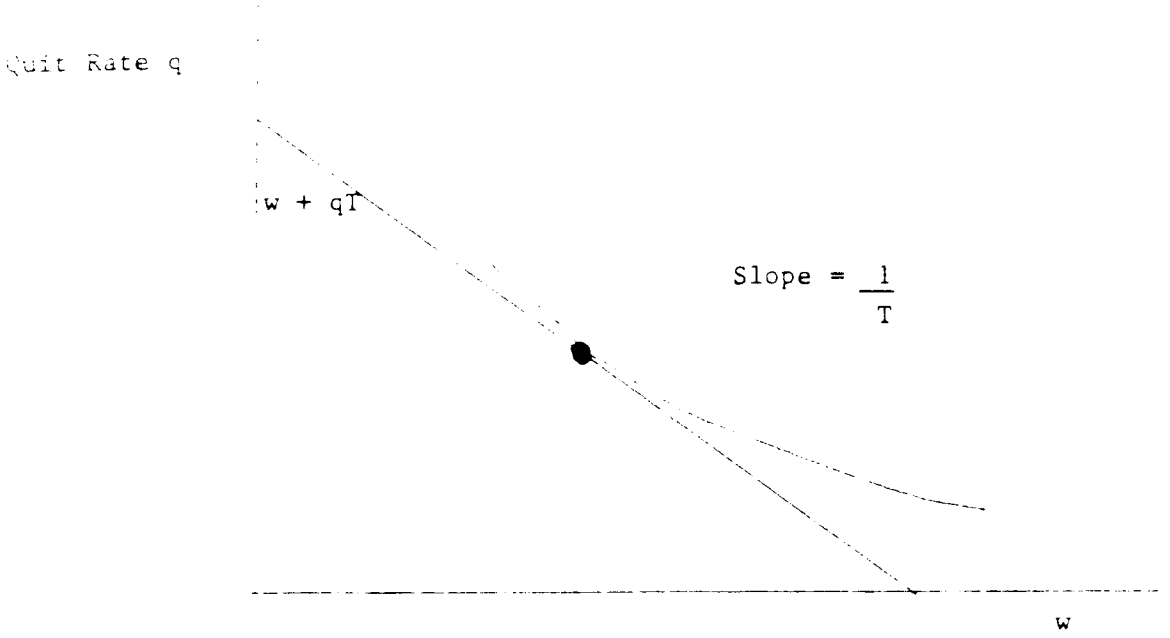


Wage-productivity relationship

Figure I



Labor costs are minimized with

$$-T_i^* \quad \frac{\partial q}{\partial w_i} = 1$$

Figure 2

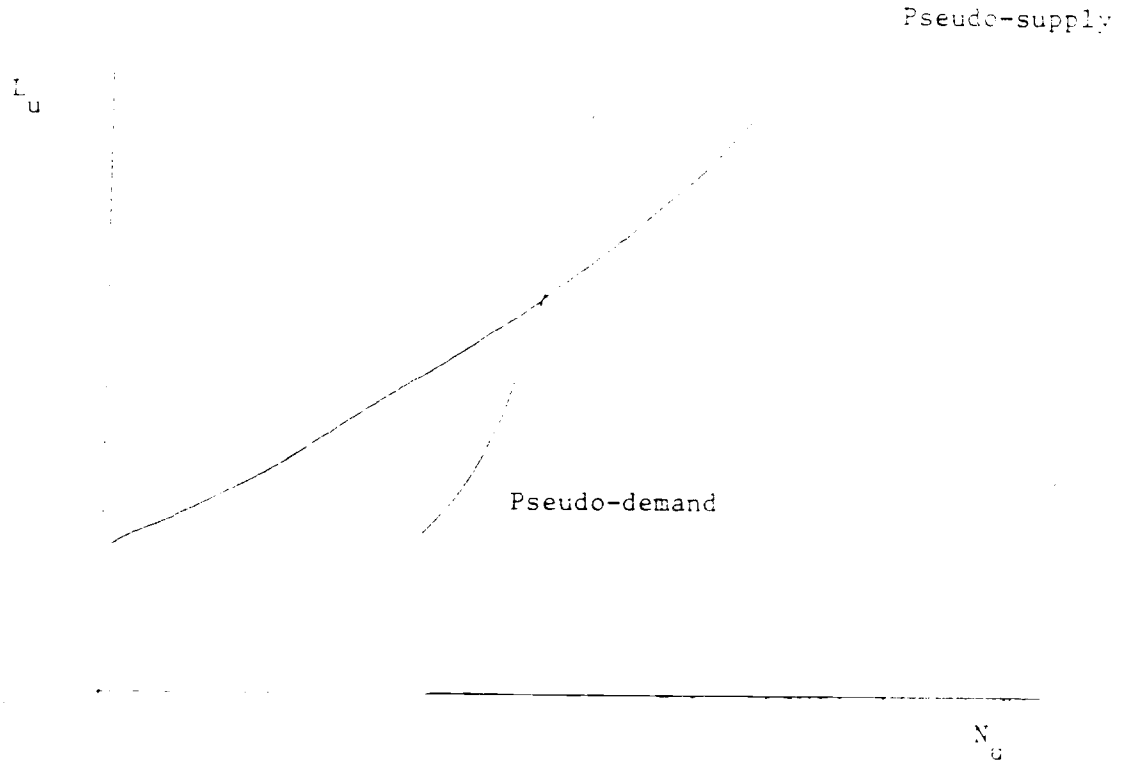
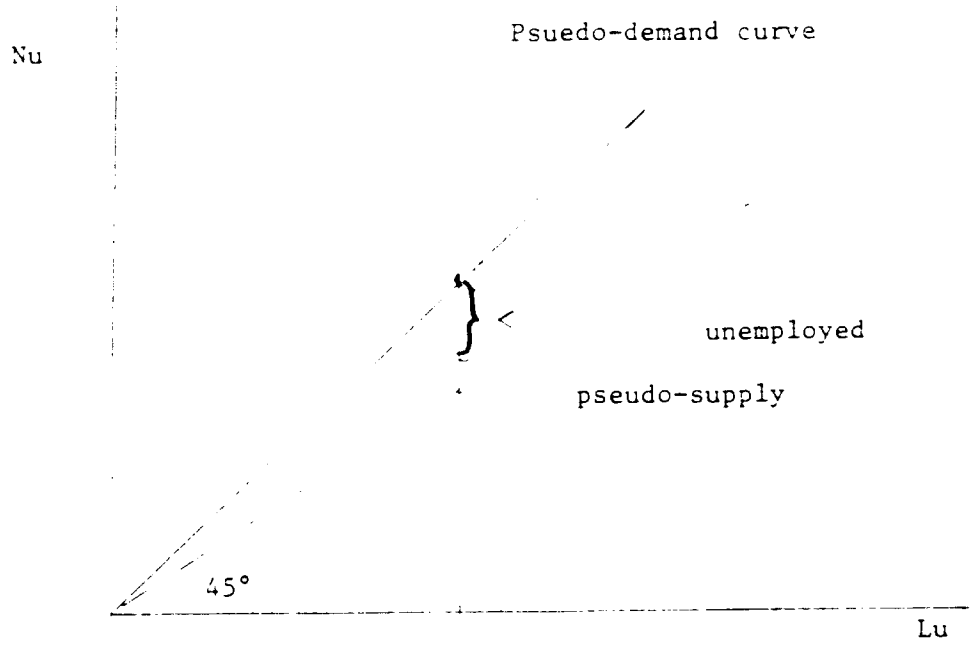


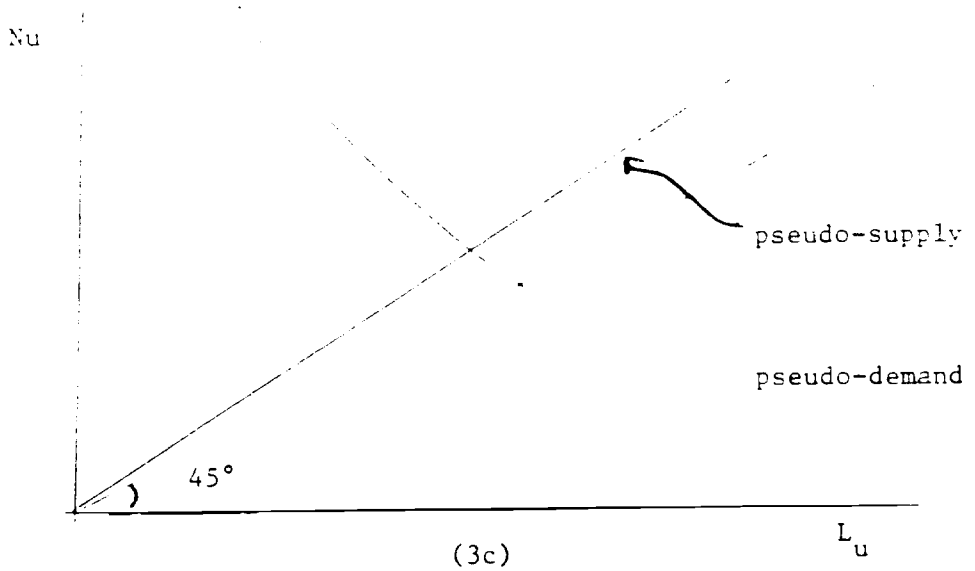
Figure 3a

The demand for labor is a function of the supply, and the supply a function of demand. While supply normally increases with demand, demand may increase or decrease with supply. Here we depict the former case.



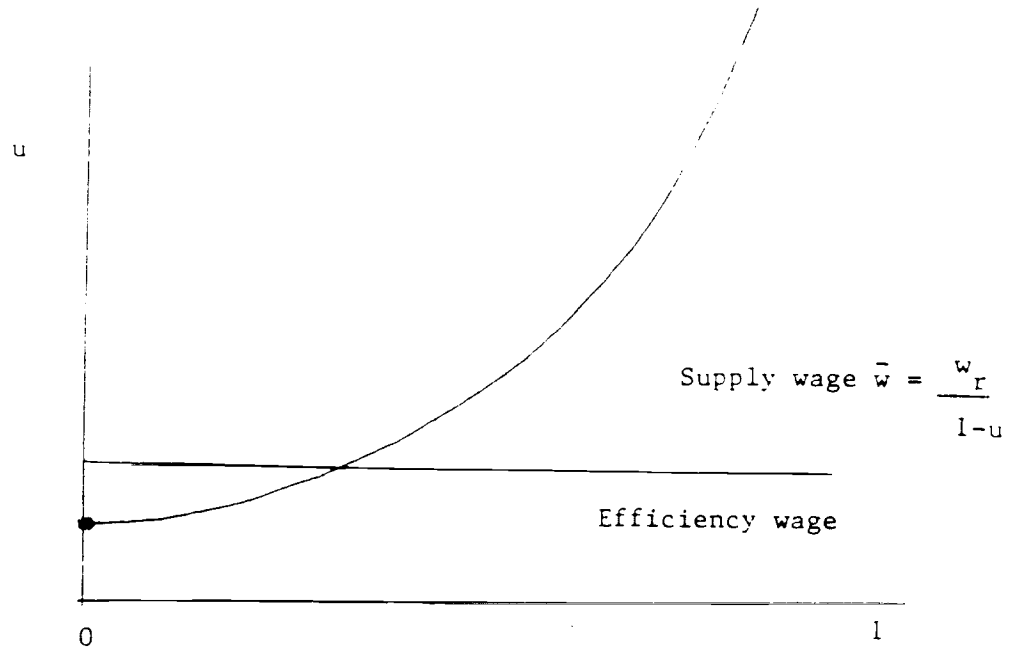
(3b)

Harris-Todaro Migration Model with Absolute wage efficiency model and fixed rural wage.

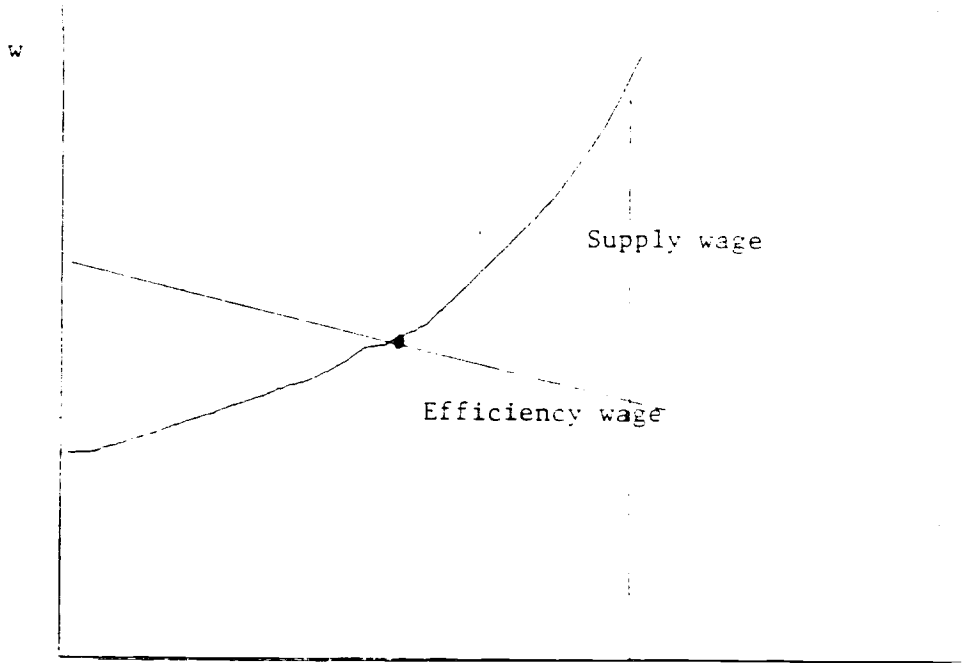


(3c)

Harris-Todaro Migration model with relative wage efficiency model, fixed rural wage, and low urban demand elasticity for labor.



Absolute wage efficiency wage hypothesis



Relative wage efficiency wage hypothesis

Figure 4

Supply wage gives that urban wage which generates the indicated level of unemployment (in these diagrams w_r is fixed, so $\bar{w}^s = w_r/1-u$.)

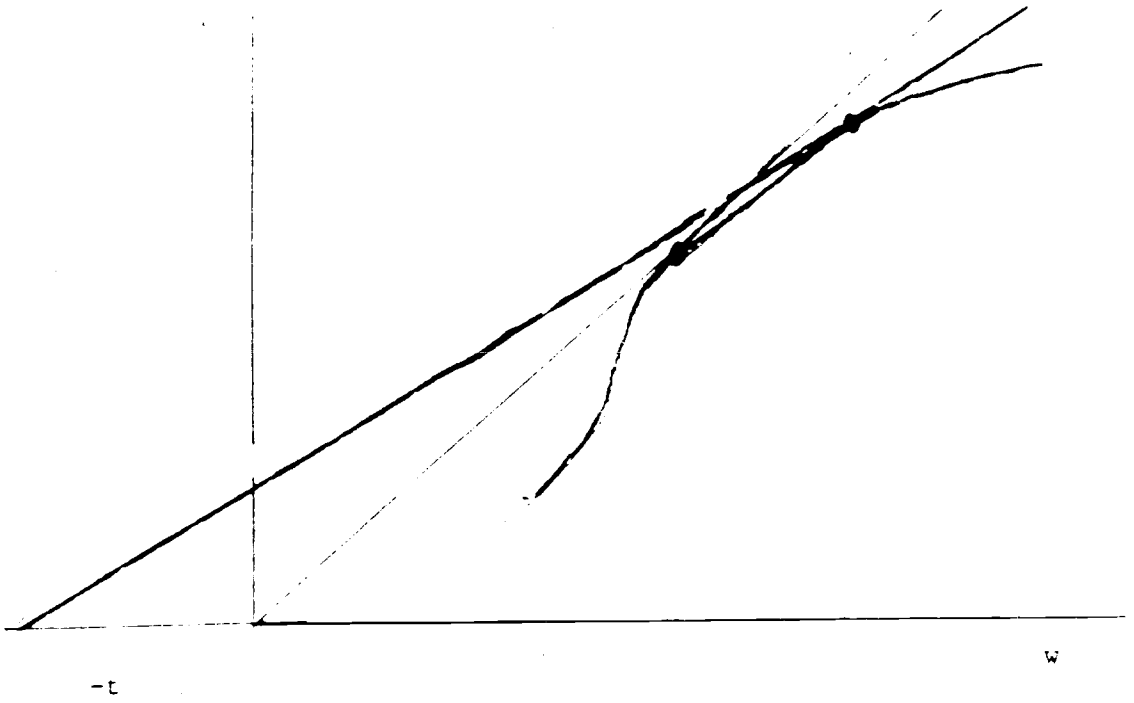
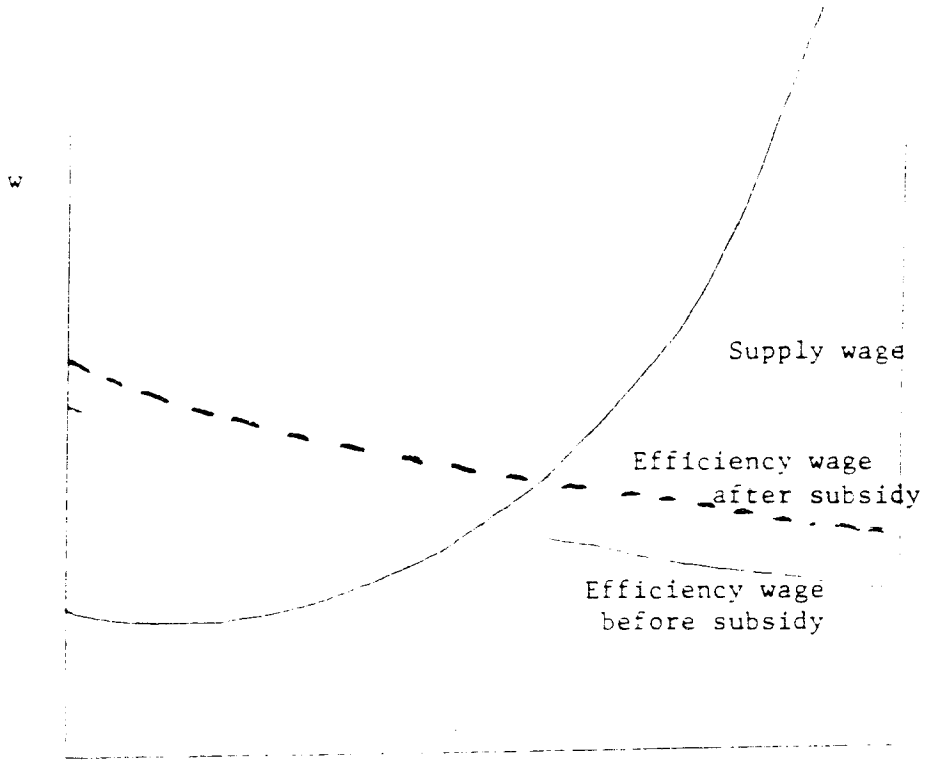


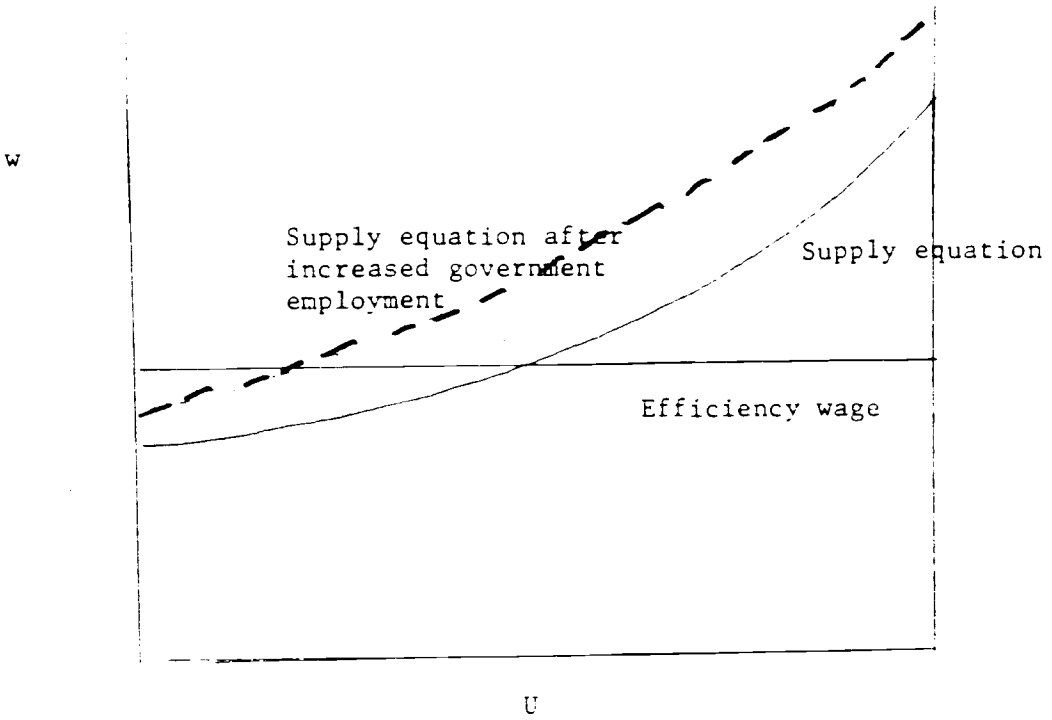
Figure 5

An advalorem wage subsidy leaves wage unchanged, but increases employment. A specific wage subsidy increases wage paid.



A specific wage subsidy increases unemployment rates

Figure 6



Government employment reduces unemployment rates, and hence shadow wage is less than urban wage.

Figure 7