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EDUCATION IN A "JOB LADDER" MODEL AND THE
FAIRNESS-IN-HIRING RULE

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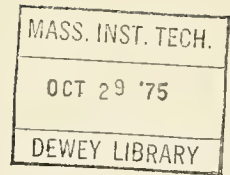
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The views expressed herein are the authors' responsibility and do not reflect those of the Department of Economics, the Massachusetts Institute of Technology, or the National Science Foundation.

Abstract

Education in a "Job Ladder" Model and the "Fairness-in-Hiring" Rule

Jagdish N. Bhagwati and T. N. Srinivasan

Education turns a person into a different kind of labor. Any economic analysis of education therefore must be based on a theory as to what this difference consists in; it must also presuppose a theory as to how the market for this kind of labor functions. This paper proposes and analyzes, in general equilibrium, a theory of education that is novel on both dimensions. As to what education does to an individual, two alternatives are considered: (i) it provides the needed skills to become employed in better-paying occupations; and (ii) education has no social productivity but is only an instrument for job competition in a world where employers feel that it is "fair" to hire an educated worker in preference to an uneducated one even though they are equally productive. As for the market for educated labor, we consider a "Job Ladder" model in which wages are sticky and postulate that, if the educated labor force exceeds the jobs for which it is qualified, then the excess supply filters down to the "next-best" job in the "Job Ladder". The job ladder model is analyzed, therefore, with and without the "fairness-in-hiring" rule. Each, in turn, is investigated for its equilibrium, efficiency, and distributional properties vis-a-vis flexible wage models, and the differences for both the job ladder and the flexible wage models from socially-optimal solutions are also analyzed.



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I. Introduction

Education turns a person into a different "kind" of labor. Any economic analysis of education therefore must be based on a theory as to what this difference consists in; it must also presuppose a theory as to how the market for this kind of labor functions. In consequence, any theory of education may be distinguished from others on either of these two dimensions.

In this paper, we propose, and analyze in general equilibrium, a theory of education that in fact is novel on both dimensions. To appreciate this, it is useful to distinguish among the different hypotheses about what education does and about how the market for educated labor functions, including in our taxonomy the ideas that we formalize in this paper.

1. What Education Does

(1) The most familiar, and indeed the most obvious as also traditional, theory of what education does is that education confers skills which are tantamount to "human capital" formation. This approach has naturally been developed most extensively by the Chicago school.

(2) The radical economists of present U.S. vintage, on the other hand, have advanced the interesting view that the role of education is to "socialize" the educated, breaking them into productive workers in the capitalist economy. This view, which may be described as the "toilet-training" theory as against the "training" theory of the human capital variety, leads to no special wrinkles as far as the divergence between social and private returns to education is concerned and, on that dimension, is indistinguishable from the human capital theory.

(3) An alternative view of education has been advanced by Spence (1973) and Arrow (1973). In this view, education imparts neither training nor toilet training. Rather, it acts as a filter, screening and grading the educated. Education, in itself, is therefore not productive in the sense of imparting skills or socialization to the educated but it does manage to convey the information about ability to prospective employers. By acquiring it, therefore, the ones with ability are able to secure better wages; and hence education offers a private return. But clearly a divergence between private and social returns can now arise.

(4) An altogether different view of education however can be that it is an instrument for job competition. Imagine a job specification with a certain number of jobs at a wage. If the wage is sticky, an excess supply of labor at that wage cannot be cleared by lowering the wage. Then, the access to these jobs, in a competitive system, could imply resort to either a randomized choice from among the available labor force or another method of choice from that labor force which otherwise preserves a sense of fairness. Education can then be perceived as an attribute which, when acquired, gives a member of this labor force precisely the attribute which the employer can utilize to prefer him to other (uneducated or lesser-educated) members of the labor force seeking the jobs.¹ The sociological principle of job selection then is to prefer those who are

¹ An apt example of our fairness-in-hiring rule is provided by the recent hiring of an Accounts Assistant at the Indian Statistical Institute. Although the required educational qualification was stated as high school diploma, the fact of a large number of applicants led the selection committee to consider only those applicants who had a Bachelor's or Master's Degree.

more educated to those who are less: that seems "fair" as the educated have "put in more" to get the job, even though the job does not "require" any education at all for satisfactory performance.¹ The "fairness" principle of preferring the educated in hiring thus turns education into an instrument of competition for jobs, yielding therefore a divergence between private and social returns to education.²

¹ (i) The obverse of "fairness", of course, is prejudice. Thus, when jobs are rationed or scarce in relation to applicants, one may not hire those whom one is prejudiced against: e.g., blacks may be ruled out from the jobs by white employers. This is discrimination in hiring rather than discrimination in wages.

(ii) The fairness-in-hiring notion, developed in this paper, extends also to other phenomena. Thus, men may be hired in preference to women because "men have to support families" and therefore it is "fair" to prefer them. This theme has been developed and its similarity to our fairness-in-hiring rule is noted by Padma Desai (1975).

² (i) It may be argued that, in some cases, the "fairness-in-hiring" rule may only be an indirect proxy for screening for better ability. This is however not necessarily so; and the non-equivalence in reality of the two alternative hypotheses is evident to us from the fact that employers typically advertise for jobs, specifying lower educational requirements than they "settle for", as also from the fact that most educational qualifications have been "objectively speaking" reduced in terms of their intellectual input anyway, degenerating often into sheer lapse of time, energy and financial resources by the candidate (as with law degrees in India, which are acquired typically via diets of capsuled questions and answers).

(ii) Next, we may note that labor market imperfection could also account, in some cases, for the preference for a once-and-for-all upgrading of educational requirements. Thus, if jobs 1 to n objectively require increasing qualification but the access to the more-skilled jobs is partly or wholly biased in favor of those who already hold the less-skilled jobs (because of unionized rules giving preference to those already within the organization), then it could well pay the employer to "overbuild" the skills at the lower end of the job ladder. This argument however explains why the employer may advertise for candidates with greater qualifications than (currently) necessary for a job; it does not really explain why he would advertise for the job with specification of lesser qualifications and then hire those who have more.

2. How the Market for Educated Labor Functions

(1) The functioning of the market for educated labor, in the traditional neoclassical writings, takes the form of a flexible wage: excess supply of educated labor leads to a reduction in the wage until the market is cleared.

(2) Alternatively, one can postulate that the wage is sticky and that the educated laborer, when in excess supply, spills over into open unemployment (as in standard Keynesian, short-run analysis). The counterpart to this in trade-theoretic literature is the analysis of a generalized sticky wage in general equilibrium, as in Brecher (1974) and Lefebvre (1971). Such a clearance of the labor market for educated labor, however, is unsatisfactory, in general equilibrium analysis, as the educated labor force could always seek employment in the uneducated labor market: an idea which we turn to later.

(3) Yet another version of the spillover under the sticky wage is that introduced by Harris and Todaro (1970) where they equate the employment-rate-weighted, "expected" wage in the sector with unemployment to the "actual" wage in the sector with full employment in a homogeneous-labor market model for analyzing intersectoral migration. This approach would imply that the excess supply of educated labor would spill over into unemployment, with the "expected" wage in educated employment then becoming the sticky wage weighted by the jobs as a proportion of the educated labor force. This is a sensible assumption if we think of every member of the educated labor force as having equal, randomized access to the available jobs: i.e. that, in the steady state, everyone is earning the expected wage and is therefore "underemployed" rather than "unemployed". Note that this assumption implies that the average wage to educated labor has indeed been cut but that, unlike with the flexible wage assumption, the cost of hiring to the employer is not.

We therefore have here a source of inefficiency in the economic system: the method of cutting the wage is inefficient.

(4) Finally, we can stick to the sticky wage assumption and instead assume that if the educated labor force exceeds the jobs for which it is qualified, then the excess supply filters down to the "next-best" job in the "job-ladder". Thus the average wage of educated labor is again cut in effect: for, it is a weighted average of the "best" and the "next-best" wages.

In the model of education that we analyze in this paper, we take the last assumption on how the labor market works (i.e., we take a job ladder model) and we analyze its implications for issues such as: Is the system sub-optimal vis-a-vis a flexible-wage model, would education be overexpanded in such a regime, and would the private and social marginal product to education diverge?

The job ladder model is reduced to its essential barebones, by assuming only two non-educational sectors: sector 1 which employs only educated labor and sector 3 which employs, at identical wage, both educated and uneducated labor. Sector 2 employs educated labor as teachers at an exogenously specified student-teacher ratio. The "job ladder" phenomenon is then introduced by assuming that wage in sectors 1 and 2 is fixed/sticky and that the supply of educated labor in excess of its employment in sectors 1 and 2 then "spills over" into sector 3.

Now, in Section II, we compare this model with the flexible wage model and with the socially optimum solution, in order to examine its economic implications. This analysis is thus predicated on the assumption that the top rung in the job ladder, sector 1, uses only educated labor because it "needs" educated labor. Thus, the job ladder model in this section presupposes the use of educated labor, in "its" sector 1, as "productive"

along the lines of the training models: and our theory of education therefore departs from them essentially in regard to the "job ladder" assumption: an assumption which leads us to characterize the model equivalently as the "minimum wage" model.

In Section III, however, we proceed to interpret the job ladder model rather as one where sector 1 employs only educated labor because employers "prefer" educated to non-educated labor in hiring on the fairness principle: the fourth assumption delineated above under the sub-section on What Education Does. Thus both educated and uneducated labor could, in principle, be employed with equal productivity in sector 1 but the educated enjoy preference in hiring. Hence, as long as the educated labor force available for employment in sector 1 exceeds the jobs in sector 1 at the fixed wage, sector 1 will hire only educated labor. Thus, the "job ladder"/minimum-wage model in Section II applies equally to the case where the "fairness" principle in hiring is in force. What does change however is the comparison with the flexible wage model and the social optimum. For, in the flexible wage model with the "fairness" principle, we would now have to allow for the hiring of uneducated labor in sector 1 as well: and, with both kinds of labor equally productive within each of sectors 1 and 3, educated labor supply will fall to zero even if there is no direct or opportunity cost to getting educated.

Note finally that we will compare the "job ladder" (or "minimum wage") model with the flexible wage model and with the social optimum solution, in each of Sections II and III as already explained, using two alternative devices for handling the education sector: (i) that there is a domestic education sector which uses educated labor to produce educated labor; and alternatively, in the Appendix, (ii) that education is undertaken with foreign teachers.

II. The "Pure" Job Ladder Model and Analysis

We now set out the job ladder model in its different dimensions, describing the production functions, the education sector, the determination of the wage structure, etc. We also describe, in the process, how the model modifies if we instead assume a flexible wage. Recall that we will be interpreting the job ladder model in its "pure" version in Section II (where sector 1 employs only educated labor because it "needs" educated labor) and in its "augmented" version in Section III (where sector 1 can employ both educated and uneducated labor equally at identical wage but the "fairness" principle in hiring leads to hiring of only educated labor in sector 1 as long as the supply of educated labor for such employment is not below the jobs available in sector 1).

1. The Production Functions and Relative Output Prices

We set up the following simple two-sector model which enables us to capture the essence of the "job ladder" phenomenon without bringing in any inessential complications. In sector 1 output is a function $f(L_1^E)$ only of L_1^E the number of educated laborers employed, the production function being strictly concave with marginal product $f'(L_1^E)$ being positive for all $L_1^E > 0$ and infinite (zero) for $L_1^E = 0$ (∞). (One could, if one wishes, postulate a two-factor production function with the factor other than labor being kept constant.) In sector 3, output is a linear function wL of labor

employed.¹ (Again, one could, if one wishes, postulate that sector 3 relates to agriculture in a land-abundant economy.) Let us assume that our economy is "small" and open in the sense that the relative price of output of sector 1 to that of sector 3 is exogenous to it. Without loss of generality we can assume this relative price to be unity.

2. The Education Sector

It is assumed that the only direct costs of education are teaching costs per unit of time per person in school. We consider two alternative ways in which the education sector is organized. In the first version, the education sector is domestic and the teachers are drawn from the pool of the educated labor force, with the teacher-student ratio exogenously specified. The direct cost per student year will then equal the teacher-student ratio times the teacher's wage. In the second version (in the Appendix), the direct cost of education is assumed to be payment for foreign teachers and hence a charge on national income.

3. The Determination of the Wage Structure

The wage of an uneducated laborer is set equal to his marginal value product w (in terms of the numeraire, the output of sector 1, given the exogenously-specified relative output price of unity) in the only sector

¹ The assumption that educated and uneducated labor in sector 3 have the same productivity is, of course, the essence of our model. Remember that, as with all theory, we are building a "stylized" model that focuses on one central idea. In reality, it may well be that, in certain sectors, the employment of educated labor, in the long run, may wind up causing unanticipated productivity gains or that the employment of such labor in upgraded jobs may even cause loss of productivity due to inaptitude--could a Nobel Laureate in Economics sweep the streets well?--or discontent at the desk.

employing him, namely sector 3. In the minimum wage version of the model, the wage of an educated laborer employed in sector 1 is set at $\lambda_1 w$ ($\lambda_1 > 1$) and that of a teacher in the domestic education sector at $\lambda_2 w$ ($\lambda_1 > \lambda_2 > 1$). In the flexible wage version of the model, however, the wage of an educated laborer as a worker in sector 1 or as a teacher in the domestic education sector equals his marginal value product in sector 1.

4. The Determination of the Size of the Educated Labor Force

The size of the educated labor force is determined such that, for an educated worker, the present value of his income stream net of any educational costs charged to him during his period of education equals the present value of his income stream had he not educated himself but was employed in sector 3 throughout his working life. More precisely, let the working life of a worker be T periods, of which the first t periods are spent in school if he chooses to educate himself. Let the non-negative rate of discount be r . Let c be the educational costs charged to the worker per each period in school. Let \bar{w} be the wage per period of an educated worker. Then,

$$-c \int_0^t e^{-r\tau} d\tau + \bar{w} \int_t^T e^{-r\tau} d\tau = w \int_0^T e^{-r\tau} d\tau \quad (1)$$

Denoting by γ the ratio of $\int_t^T e^{-r\tau} d\tau$ to $\int_0^T e^{-r\tau} d\tau$, we get then:

$$\gamma \bar{w} = w + (1 - \gamma)c \quad (1')$$

In the flexible wage model, entrepreneurs in sector 1 will then equate the marginal product of labor in that sector to \bar{w} . In the minimum wage model, \bar{w} will further equal the weighted average of the wages in sectors 1, 2 and 3, with the weights equalling the proportion of the educated labor force employed

in each of these sectors respectively. However, in determining c , we will allow for situations in which c differs from the direct costs of education as, for instance, in the case where the state subsidizes in full or partially the costs of education.

5. The Steady State

Except for some brief remarks later, we shall be concerned mainly with comparison of steady states and not with the dynamic approach to the steady state. In the steady state it will be assumed that the total labor force is set at unity by choice of units and a portion L^E of the labor force is educated. Given that the working life of a person is T periods, of which t periods are spent in school in the case of an educated worker, it is clear that the number of persons in school in a steady state is $(\frac{t}{T-t}) L^E$. Let us denote the fraction $(\frac{t}{T-t})$ by δ . Hence the number of students in a steady state is δL^E . Denoting by ϵ the teacher-student ratio in the domestic education sector, it follows that the number of teachers in a steady state is $\epsilon \delta L^E$. Since the employment of educated workers in sector 1 is L_1^E , the number of workers employed in sector 3 will therefore equal $[1 - L_1^E - (1 + \epsilon)\delta L^E]$ in the case of the domestic education sector (and $[1 - L_1^E - \delta L^E]$ in the case where teachers are foreign).

6. Equilibrium

We discuss at length only the case in which there is a domestic education sector. As noted already, the case in which the teachers are foreign is briefly discussed in the Appendix.

Note that the size of the total labor force is given and normalized at unity and that the employment in the domestic education sector is

determined once the size of the educated labor force is determined because of our assumptions of a fixed student-teacher ratio and a steady state. Hence, the equilibrium values of only two variables, namely the size L^E of the educated labor force and the part of it L_1^E that is employed in sector 1, are to be determined. We have also two equations: one that equates the marginal value product of labor in sector 1 to the relevant wage rate thus determining the level of employment in that sector and equation (1') determining the size of the educated labor force.

Finally, the Job Ladder or equivalently the Minimum Wage Model (with superscript M) will be distinguished from the Flexible Wage Model (with superscript F) in the determination of wage rate in sector 1. We therefore proceed now to discuss these two alternative models in detail.

(1) The Job Ladder or Minimum Wage Model

Here the employment L_1^{EM} in sector 1 is determined, given the wage $\lambda_1 w$ and the production function f , through the following marginal productivity equation:

$$f'(L_1^{EM}) = \lambda_1 w \quad \text{or} \quad L_1^{EM} = g(\lambda_1 w) \quad (2)$$

where $g(\cdot)$ is the inverse function f' . Given our assumptions on f , $g(\cdot)$ is a decreasing function of its argument with $g(0) = \infty$ and $g(\infty) = 0$.

A part of the educated labor force, $\varepsilon \delta L^{EM}$, is employed as teachers at a wage rate $\lambda_2 w$ in sector 2 in the steady state. This means that the expected wage rate \bar{w} of an educated worker is a weighted average of the wage rates $\lambda_1 w$, $\lambda_2 w$ and w in the sectors 1, 2 and 3 respectively, with weights $\frac{L_1^{EM}}{L^{EM}}$, $\varepsilon \delta$ and $[1 - \varepsilon \delta - (\frac{L_1^{EM}}{L^{EM}})]$. Hence, in this case, (1') becomes:

$$\gamma w \left(\frac{\lambda_1 L_1^{EM} + \lambda_2 \varepsilon \delta L^{EM} + (1 - \varepsilon \delta) L^{EM} - L_1^{EM}}{L^{EM}} \right) = w + (1 - \gamma) c \quad (3)$$

This yields:

$$L^{EM} = \frac{\gamma (\lambda_1 - 1) w - L_1^{EM}}{(1 - \gamma)(w + c) - \gamma w (\lambda_2 - 1) \varepsilon \delta} \quad (3')$$

This equilibrium solution is meaningful provided $(1 - \varepsilon \delta) L^{EM} \geq L_1^{EM}$, i.e., the size of the educated labor force net of teachers is at least as large as the employment in sector 1, and $(1 + \delta) L^{EM} \leq 1$, i.e., the educated labor force and the student body does not exhaust the total labor force.

The first condition will be satisfied provided:

$$(1 - \gamma) (w + c) - \gamma w (\lambda_2 - 1) \varepsilon \delta \geq 0 \quad (4)$$

or

$$w + (1 - \gamma) c \geq \gamma w [\lambda_2 \varepsilon \delta + (1 - \varepsilon \delta)] \quad (4')$$

and

$$\gamma w (\lambda_1 - 1) (1 - \varepsilon \delta) \geq (1 - \gamma) (w + c) - \gamma w (\lambda_2 - 1) \varepsilon \delta \quad (5)$$

or

$$\gamma w [\lambda_1 (1 - \varepsilon \delta) + \lambda_2 \varepsilon \delta] \geq w + (1 - \gamma) c \quad (5')$$

Now, the RHS of (5'), $[w + (1 - \gamma) c]$, is the opportunity cost (but for a multiplicative factor of $\int_0^T e^{-r\tau} d\tau$) of education including the discounted sum of income foregone and tuition charges. The RHS of (4') is discounted sum (but for the same factor) of the expected income of an educated worker when no educated worker is employed in the highest-paying sector 1. Inequality (4') thus ensures that it is not worthwhile to educate oneself if the only job opportunity outside sector 3 consists of a teaching job! On the other hand, the LHS of (5') is the discounted sum of the expected income of an educated worker when no educated worker is employed in the lowest-paying sector 3. Thus (5') ensures that this sum

is not below the opportunity cost of education. Thus (4') and (5') together ensure that the opportunity cost of education lies between the minimum expected income of an educated worker (when none of them is employed in sector 1) and the maximum expected income (when none of them is employed in sector 3).

Finally, the welfare measure W for comparing the outcomes of different models will be the value of output of sectors 1 and 3 (except in the Appendix when teachers are foreign, in which case the payments to them have to be subtracted). Essentially, therefore, we are placing no value on education as a consumption good. Thus:

$$W^M = f(L_1^{EM}) + w [1 - L_1^{EM} - (1 + \epsilon) \delta L^{EM}] \quad (6)$$

(2) The Flexible Wage Model

Turning now to the flexible wage model, we note that there can no longer be any difference in the wages of an educated worker by sector of employment. Nor can there be any spill-over of educated workers into employment in sector 3. Thus, in this model,

$$L_1^{EF} = (1 - \epsilon\delta) L^{EF} \quad (7)$$

$$L_2^{EF} = \epsilon\delta L^{EF} \quad (8)$$

$$L_3^{EF} = 0 \quad (9)$$

The size of the educated labor force L^{EF} is determined by (1') with \bar{w} satisfying:

$$f'(L_1^{EF}) = \bar{w} \quad (10)$$

Substituting (10) in (1'), we get:

$$f'(L_1^{EF}) = w + (1 - \gamma) c \quad (11)$$

or

$$L_1^{EF} = g\left(\frac{w + (1 - \gamma) c}{\gamma}\right) \quad (11')$$

This solution is clearly meaningful provided $1 \geq \left(\frac{1 + \delta}{1 - \epsilon\delta}\right) L_1^{EF} \geq 0$, i.e., the educated labor force together with the student body does not exceed the total labor force.

The welfare level attained in this model is given by:

$$W^F = f(L_1^{EF}) + w [1 - (1 + \delta) L_1^{EF}] \quad (12)$$

(3) The Social Optimum Model

In this model, the size of the educated force L^{ES} is so chosen as to maximize welfare, i.e., such that L^{ES} maximizes $f\{(1 - \epsilon\delta)L\} + w\{1 - (1 + \delta)L\}$ with respect to L .

In defining this maximand, we have implicitly taken into account the fact that all educated workers are used either as teachers or as production workers in sector 1 and that, given L educated workers, $\epsilon\delta L$ have to be employed as teachers (since there will be δL students in school). Thus the employment in sector 1 is $(1 - \epsilon\delta)L$ and, in sector 3, it is $\{1 - (1 + \delta)L\}$.

Maximization of the above function leads to the first-order condition:

$$f'(1 - \epsilon\delta) L^{ES} = \frac{w(1 + \delta)}{1 - \epsilon\delta} \quad (13)$$

or

$$L^{ES} = \frac{g\left(\frac{w(1 + \delta)}{1 - \epsilon\delta}\right)}{1 - \epsilon\delta} \quad (13')$$

It is easy to interpret (13). The LHS represents the marginal social product of an educated worker. The RHS represents the marginal social cost (in terms

of output foregone in sector 3) of adding one more person to employment in sector 1: this is so because maintaining one more educated person employed in sector 1 involves, in the steady state, withdrawing this person from sector 3 and in addition $[\delta + \delta(\epsilon\delta) + \delta(\epsilon\delta)^2 + \dots] = \frac{\delta}{1 - \epsilon\delta}$ students as well as $[\epsilon\delta + (\epsilon\delta)^2 + \dots] = \frac{\epsilon\delta}{1 - \epsilon\delta}$ teachers. These persons, $1 + \frac{\delta}{1 - \epsilon\delta} + \frac{\epsilon\delta}{1 - \epsilon\delta} = \frac{1 + \delta}{1 - \epsilon\delta}$, would have produced $\frac{w(1 + \delta)}{1 - \epsilon\delta}$ in sector 3.

Finally, it is clear that the welfare level attained in this model is:

$$W^S = f\{(1 - \epsilon\delta) L^{ES}\} + w\{1 - (1 + \delta) L^{ES}\} \quad (14)$$

7. The Comparison of Steady States

We will now compare the steady state outcomes of the job ladder model with those of the flexible wage model on the one hand, and the latter with those of the social optimum model on the other. The variables whose values will be compared are: employment in sector 1, the size of the educated labor force, private and social marginal products of education, welfare levels, and the share of the educated labor force in total wage income.

(1) The Employment in Sector 1

(A) Minimum vs. Flexible Wages. Comparing the minimum wage and flexible wage models, it is easy to see from (2) and (11') that $L_1^{EM} \leq L_1^{EF}$. This is because $g(\cdot)$ is a decreasing function and $\lambda_1 w \geq w [\lambda_1(1 - \epsilon\delta) + \lambda_2 \epsilon\delta] \geq \frac{w + (1 - \gamma)c}{\gamma}$ in view of $\lambda_1 \geq \lambda_2$ and (5'). Thus the flexible wage model leads to equal or higher employment level in sector 1 than the minimum wage model.

(B) Flexible Wage vs. Social Optimum. Furthermore, comparing the flexible wage with the social optimum models, we see from (11') and (13) that:

$$L_1^{EF} \begin{matrix} \geq \\ < \end{matrix} L_1^{ES} = (1 - \epsilon\delta) L^{ES} \quad \text{according as} \quad \frac{w + (1 - \gamma)c}{\gamma} \begin{matrix} \leq \\ > \end{matrix} \frac{w(1 + \delta)}{1 - \epsilon\delta} \quad (15)$$

Rewriting (15) slightly differently, we get:

$$L_1^{EF} \begin{matrix} > \\ \equiv \\ < \end{matrix} L_1^{ES} \quad \text{according as} \quad \frac{w}{\gamma} + c \left(\frac{1-\gamma}{\gamma} \right) \begin{matrix} \leq \\ \equiv \\ > \end{matrix} w(1+\delta) + \varepsilon \left(\frac{w(1+\delta)}{1-\varepsilon\delta} \right) \delta \quad (15')$$

Now, it can be easily shown that for nonnegative discount rates r , $\frac{1}{\gamma} \geq (1+\delta)$ and $\frac{1-\gamma}{\gamma} \geq \delta$ with equality holding only for a zero discount rate. Note also that $\varepsilon \frac{w(1+\delta)}{1-\varepsilon\delta}$ is the social cost of schooling per student year, being the product of the teacher-student ratio ε and the social wage of the teacher, $\frac{w(1+\delta)}{1-\varepsilon\delta}$.

It is evident, therefore, that as long as a student is charged at least as much as it costs socially to educate him, employment in sector 1 under a flexible wage model will not exceed the socially optimal level. This conclusion will hold even if the charge is below social cost, provided the private discount rate is sufficiently high. Of course, the two employment levels will be the same if either (i) the students are charged the social cost of education and the private discount rate is zero (as is the implicit social discount rate) or (ii) students are charged less than the social cost of education but the private discount rate is suitably high. The flexible wage model will lead to overemployment in sector 1 (i.e., to greater employment than is socially desirable) only if students are charged less than the social cost of education and the private discount rate is sufficiently low.

A perhaps more illuminating way of illustrating the effect of private discount rate and the fee charged to students is to note that if the education sector itself is privately organized with no subsidies or taxes from the state, the students will have to pay the direct cost of their education, namely, the product of the teacher-student ratio ε and the wage of a teacher. In the flexible wage model the latter equals the wage of an

educated worker in sector 1, which in turn equals the marginal value product of labor in that sector. Hence we have:

$$\gamma f'(L_1^{EF}) = w + (1 - \gamma) \epsilon f'(L_1^{EF})$$

or

$$L_1^{EF} = g\left(\frac{w}{\gamma - (1 - \gamma)\epsilon}\right)$$

Comparing this value of L_1^{EF} with L_1^{ES} we note the two will equal when $\gamma = \frac{1}{1 + \delta}$.

And γ will equal $\frac{1}{1 + \delta}$ when the private discount rate is zero, and will be less than $\frac{1}{1 + \delta}$ when the private discount rate is positive resulting in L_1^{EF} being less than L_1^{ES} . Thus, the fact that individuals have a positive time preference, while our implicit social rate of time preference is zero, leads to an under-expansion of the education sector in the flexible wage model even if the students pay the full market cost of education. A subsidy towards educational costs will be needed to reach the social optimum in such a situation.

(C) Minimum Wage vs. Social Optimum. Our third and final comparison of the minimum wage and the social optimum models in respect to employment in sector 1, on the other hand, is straightforward. As long as the minimum wage in sector 1, namely $\lambda_1 w$, is greater (less) than the social product of labor $\frac{w(1 + \delta)}{1 - \epsilon\delta}$, then L_1^{EM} will be less (greater) than L_1^{ES} .

(2) The Size of the Total Educated Labor Force

(A) Minimum vs. Flexible Wages. Again, we begin by comparing the minimum wage and flexible wage models. We first note that, from (3') and (7):

$$L^{EM} = \theta L_1^{EM} \quad \text{where} \quad \theta = \frac{\gamma(\lambda_1 - 1)w}{(1 - \gamma)(w + c) - \gamma w(\lambda_2 - 1)\epsilon\delta};$$

and

$$L^{EF} = \frac{1}{1 - \epsilon\delta} L_1^{EF}$$

Now, it will be apparent from our earlier analysis that if we set

$\lambda_1 w = \frac{w + (1 - \gamma)c}{\gamma}$, then $L_1^{EM} = L_1^{EF}$; i.e., if the minimum wage in sector 1

is set just equal to what it would have been under a flexible wage model, the employment in sector 1 would have been the same in the two cases.

However, as is to be expected, for this to be feasible in the minimum wage model, the teachers also have to be paid the same wage, i.e., $\lambda_2 = \lambda_1$.

(For, if $\lambda_2 < \lambda_1$, then (5') will be violated.) Then, given

$\lambda_1 w = \lambda_2 w = \frac{w + (1 - \gamma) c}{\gamma}$, it follows that $\theta = \frac{1}{1 - \epsilon \delta}$ as well. Hence $L^{EM} = L^{EF}$.

Suppose next that λ_2 is now left unchanged while λ_1 is increased.

It is clear then that, as λ_1 is increased, employment L_1^{EM} in sector 1 decreases. However, θ increases with λ_1 . Hence, θ will exceed $\frac{1}{1 - \epsilon \delta}$ and it is therefore possible that L^{EM} could exceed L^{EF} because of this factor.

We can, however, say more than this. Thus, writing $L^{EM} = \theta g(\lambda_1 w)$, we get:

$$\frac{dL^{EM}}{d\lambda_1} = \frac{L^{EM}}{\lambda_1 - 1} \left(1 + \frac{\lambda_1 - 1}{\lambda_1} (\lambda_1 w) \frac{g'}{g} \right) = \frac{L^{EM}}{\lambda_1 - 1} \left(1 + \frac{\lambda_1 - 1}{\lambda_1} \eta \right)$$

where η is the elasticity of employment with respect to the wage rate in sector 1. If this (negative) elasticity is less (greater) in absolute value than $\frac{\lambda_1}{\lambda_1 - 1}$, then L^{EM} will increase (decrease) as λ_1 increases. Thus we conclude that, if the demand for labor in sector 1 is not very elastic with respect to the wage rate, the minimum wage model will lead to a larger educated labor force than the flexible wage model in the case where the specified minimum wage in sector 1 exceeds that under the flexible wage.

So far, in our comparison of the two models, we have kept the wages of teachers fixed at the value they take in the flexible wage model. Now, continue keeping $\lambda_1 w$ (the minimum wage in sector 1) fixed at some value higher than its level in the flexible wage model; but increase λ_2 . Since λ_2 does not affect L_1^{EM} and an increase of λ_2 increases θ , L^{EM} will increase. Thus, in the case where the demand for labor in sector 1 is not

very elastic with respect to the wage rate, increasing λ_1 and λ_2 work in the same direction and result in increasing L^{EM} above L^{EF} . However, if the demand for labor in sector 1 is sufficiently elastic, we will have two opposing effects: while the increase in λ_1 will push L^{EM} below L^{EF} , a simultaneous increase in λ_2 will raise L^{EM} . The net result could then clearly go either way.

(B) Flexible Wage vs. Social Optimum. Next, since $L_1^{EF} = (1 - \epsilon\delta) L^{EF}$ and $L_1^{ES} = (1 - \epsilon\delta) L^{ES}$, our earlier comparison of L_1^{EF} and L_1^{ES} is equivalent to comparing L^{EF} and L^{ES} and therefore we do not repeat our analysis.

(C) Minimum Wage vs. Social Optimum. The comparison of L^{ES} with L^{EM} ($= \theta L_1^{EM}$) is similar to the comparison of L^{EF} and L^{EM} , as we proceed to show.

Suppose that the social wage $\frac{w(1+\delta)}{1-\epsilon\delta}$ is less than $\frac{w+(1-\gamma)c}{\gamma}$.

In this case, clearly (3) cannot be satisfied if $\lambda_2 w \leq \lambda_1 w \leq \frac{w(1+\delta)}{1-\epsilon\delta}$: as such,

a minimum wage equilibrium cannot exist. If we now raise λ_1 , so that $\lambda_1 w$ exceeds $\frac{w(1+\delta)}{1-\epsilon\delta}$, such that a minimum wage equilibrium does exist, L_1^{EM}

will fall below L_1^{ES} while θ will exceed $\frac{1}{1-\epsilon\delta}$. Again, the elasticity

of demand for labor in sector 1 will then determine what happens to L^{EM} .

Suppose instead that the social wage $\frac{w(1+\delta)}{1-\epsilon\delta}$ equals $\frac{w+(1-\gamma)c}{\gamma}$.

If we now set $\lambda_1 w = \lambda_2 w = \frac{w(1+\delta)}{1-\epsilon\delta}$, the minimum wage equilibrium is

naturally identical to the social optimum one. Again, elasticity considerations

will determine whether L^{EM} will exceed or fall short of L^{ES} as λ_1 , and λ_2 ,

are increased from this common value.

The interested readers can readily work out the results for the third

case where $\frac{w(1+\delta)}{1-\epsilon\delta}$ exceeds $\frac{w+(1-\gamma)c}{\gamma}$.

(3) The Marginal Product of Education

The private marginal product of education is the difference between the wage \bar{w} that an educated laborer expects to earn and the wage of an uneducated laborer. In both the minimum wage and the flexible wage models, this is the same and equals $\frac{w + (1 - \gamma) c}{\gamma} - w = \left(\frac{1 - \gamma}{\gamma}\right) (w + c)$.

The social marginal product of education, on the other hand, is the difference between the wage of an educated laborer and an uneducated one in the social optimum. This equals $\frac{w(1 + \delta)}{1 - \epsilon\delta} - w$.

The difference between the private and social marginal product of education thus equals $\left(\frac{w + (1 - \gamma) c}{\gamma} - \frac{w(1 + \delta)}{1 - \epsilon\delta}\right)$. The factors influencing this difference have already been discussed in Section 7(1).

It is also possible to compute a "second-best" social marginal product to education in the following way. Suppose one more person is educated: what would be his net addition to output? In the minimum wage model, this will be zero as long as there are educated workers employed in sector 3, whereas in the flexible wage model it will equal the private marginal product to education.

(4) The Welfare Levels

It is obvious that the welfare level W^S attained in the case of the social optimum model is the maximum attainable, and as such exceeds W^F and W^M , the welfare levels attained in the case of flexible and minimum wage models.¹

¹ The difference between W^S and W^F arises only because of the difference in private and social cost of education. This difference is due to two factors as we have seen earlier: (i) the difference between c , the cost borne by the student, and the direct cost of teaching him; and (ii) the fact that private discount rate is positive while the implicit social discount rate is zero. Hence if the student pays his cost of education and the private discount rate is also zero, W^S and W^F will be equal. However, if the private discount

It remains only to compare W^F and W^M .

Now:

$$\left(W^F - W^M \right) = f(L_1^{EF}) + w \left(1 - \frac{1 + \delta}{1 - \epsilon \delta} L_1^{EF} \right) - f(L_1^{EM}) - w \left(1 - \delta(1 + \epsilon) \theta L_1^{EM} - L_1^{EM} \right)$$

where θ (as defined earlier) equals $\frac{\gamma (\lambda_1 - 1) w}{(1 - \gamma) (w + c) - \gamma (\lambda_2 - 1) w}$.

And, using the concavity of f , we then get:

$$\begin{aligned} \left(W^F - W^M \right) &\geq f'(L_1^{EF}) (L_1^{EF} - L_1^{EM}) - w \left(\frac{1 + \delta}{1 - \epsilon \delta} L_1^{EF} - \delta(1 + \epsilon) \theta L_1^{EM} - L_1^{EM} \right) \\ &\geq \left(f'(L_1^{EF}) - \frac{w(1 + \delta)}{(1 - \epsilon \delta)} \right) (L_1^{EF} - L_1^{EM}) + \left(\theta - \frac{1}{1 - \epsilon \delta} \right) \delta(1 + \epsilon) L_1^{EM} \end{aligned} \quad (16)$$

Now, we have already shown that $L_1^{EF} \geq L_1^{EM}$ and $\theta > \frac{1}{1 - \epsilon \delta}$.

Now $f'(L_1^{EF}) = \frac{w + (1 - \gamma) c}{\gamma}$ and, as discussed earlier, will exceed the social wage rate $\frac{w(1 + \delta)}{1 - \epsilon \delta}$ as long as the students are charged at least what it costs society to educate them and the private discount rates are positive.¹ Hence, in these cases, $W^F > W^M$: the flexible wage model leads to higher welfare than the minimum wage model.

rate is positive, then c has to be sufficiently less than the cost of education to bring about an equality between W^S and W^F .

Incidentally, it may be worth noting that if we treat c the tuition fee per student as a policy parameter, increasing it will improve welfare in the minimum wage model by reducing the incentive to get educated even though some educated workers are employed in sector 3. In the flexible wage model, increasing c will improve welfare only if the education sector is over-expanded relative to the social optimum.

¹ In fact, as we argued, even if the students are charged less, this result holds provided discount rates are sufficiently high.

(5) The Share of Educated Labor in Wage Income¹

We finally turn to the income distributional implications of our educational model. The share α^i of educated labor in total wage income can be written as:

$$\alpha^i = \frac{\bar{w}^i L^{Ei}}{\bar{w}^i L^{Ei} + w[1 - (1 + \delta) L^{Ei}]} \quad i = M, F, S$$

where \bar{w}^i is the expected wage of an educated worker. In the flexible wage and social optimum models \bar{w}^i equals the actual wage of an educated worker (in sector 1 or sector 2) while in the minimum wage model it equals the weighted average of the wage rate $\lambda_1 w$ in sector 1, $\lambda_2 w$ in sector 2 and w in sector 3. However, the private optimization decision regarding education ensures that this expected wage is the same in the minimum and flexible wage models.

(A) Minimum vs. Flexible Wages. Hence, we can conclude that

$\alpha^F \underset{<}{\overset{>}{=}} \alpha^M$ according as $L^{EF} \underset{>}{\underset{<}{=}} L^{EM}$, i.e., according to whether the size of the educated labor force under a flexible wage model exceeds, equals, or falls short of that under the minimum wage model: conditions determining the latter having been already discussed earlier under Section 7(2).

¹ Income distributional questions have not been formally investigated in all theories of education, although the different views regarding education have led to fragmentary remarks and empirical work, as in Bhagwati (1973b). However, for a systematic treatment, using the human-capital approach, see Dasgupta (1975) and an analysis in the screening framework, see Stiglitz (1975).

(B) Flexible Wage vs. Social Optimum. As for the comparison of α^F and α^S , however, it is clear that $\alpha^F \gtrless \alpha^S$ according as $\bar{w}^F L^{EF} \gtrless \bar{w}^S L^{ES}$. Since $L^{EF} = \frac{1}{1 - \epsilon\delta} L_1^{EF}$ and $L^{ES} = \frac{1}{1 - \epsilon\delta} L_1^{ES}$, it follows that $\alpha^F \gtrless \alpha^S$ according to whether the labor income in sector 1 under a flexible wage model exceeds, equals, or falls short of that under the social optimum model. Clearly the answer depends in an obvious way on the elasticity of demand for labor with respect to the wage rate in sector 1.

(C) Minimum Wage vs. Social Optimum. Finally, the comparison of α^M and α^S leads to the similar conclusion that $\alpha^M \gtrless \alpha^S$ according as $\bar{w}^M L^{EM} \gtrless \bar{w}^S L^{ES}$. In this case, however, we have $L^{EM} = \theta L_1^{EM}$, $L^{ES} = \frac{1}{1 - \epsilon\delta} L_1^{ES}$ and $\theta \geq \frac{1}{1 - \epsilon\delta}$. Thus, in addition to the elasticity discussed above (for the $\alpha^F - \alpha^S$ comparison), the factor θ has to be taken into account in determining the behavior of the shares. For instance, if the expected wage \bar{w}^M exceeds \bar{w}^S and the demand for labor in sector 1 is inelastic with respect to wage rate, then we will find that $\alpha^M > \alpha^S$, i.e., the share of educated labor in the minimum wage model will exceed that in the social optimum model.

8. The Approach to Steady States

We now briefly discuss the approach to steady states. If one postulates the simple and natural adjustment mechanism that the rate of change of the size of the educated labor force is proportional to the difference between the expected life-time discounted income (net of costs of education) of an educated worker and that of an uneducated worker, then it is easy to see that the steady states postulated in the earlier sections are reached asymptotically if the economy is not initially in the steady state provided

a steady state exists. The crucial equations to examine in this connection are (3) under the minimum wage situation and (11) under the flexible wage situation.

It is then immediately obvious that, with our assumptions on the production functions, a unique solution for L^{EF} exists in the flexible wage model. Provided this unique solution does not exceed the available total labor force net of teachers and students it is also the unique steady state solution that is approached asymptotically. However, under the minimum wage situation, if $\gamma = 1$ (i.e., education requires no time) and $c = 0$ (i.e., students are charged nothing for their education), the LHS of (3) will always exceed the corresponding RHS as long as there is at least one educated worker.¹ Thus the process of education goes on until all workers are educated. Thus either $\gamma < 1$ (i.e., education requires time or equivalently the opportunity cost in terms of income foregone is positive) or $c > 0$ (i.e., some of the direct cost of education is passed on to the students) is a necessary condition for the existence of a steady state. Of course, these (γ or c or combination thereof) have to be sufficiently high to preclude the situation in which the education process ends up with everyone educated.

¹ To be exact, we assume that, if initially the size of the total educated labor force is less than L_1^{EM} (this latter being the level of employment in sector 1 when the marginal product equals the minimum wage) then each educated worker receives a wage which exceeds $\lambda_1 w$.

III: Education as a Competitive Instrument:
"Fairness-in-Hiring" in the Job Ladder Model

If we now interpret the sole employment of educated labor in sector 1 as attributable to the "fairness-in-hiring" principle, the analysis of the job ladder (i.e., minimum wage) equilibrium is not altered. However, we can no longer analyze the equilibrium in the flexible wage and social optimum models as in Section II.

Now that educated and uneducated labor are perfect substitutes for each other in sector 1 as well as sector 3, but education has resource costs, the size of the educated labor force will fall to zero in both the flexible wage and social optimum models and together with it therefore also the employment opportunities for teachers! This means that in both these situations, the allocation of the labor force between sectors 1 and 2 will be such as to equate the marginal value productivity of labor in the two sectors. Thus $L_1^S = L_1^F$ and $f'(L_1^S) = w$. The rest of the labor force, namely $(1-L^S)$, will be employed in sector 3.

The welfare level in this case is $W^S = f(L_1^S) + w[1-L_1^S]$. It is trivially obvious that this exceeds W^M , the welfare under the minimum wage model. For

$$W^S - W^M = f(L_1^S) + w[1 - L_1^S] - f(L_1^M) - w[1 - L_1^M - (1 + \epsilon) \delta \theta L_1^M] \quad (17)$$

$$\geq f'(L_1^S) [L_1^S - L_1^M] - w[L_1^S - L_1^M (1 + \epsilon) \delta \theta L_1^M] \quad (17')$$

$$\geq w (1 + \epsilon) \delta \theta L_1^M \geq 0 \quad [\text{since } f'(L_1^S) = w] \quad (17'')$$

Thus, as is to be expected, when education has no productivity, the minimum wage model with the fairness-in-hiring rule necessarily leads to a wasteful creation of an educated labor force.

IV: Concluding Remarks

In the foregoing analysis, we have provided a general-equilibrium analysis of a model of education in a job ladder model, with and without the fairness-in-hiring rule.¹ The analysis has embraced positive aspects as also efficiency and income-distributional implications.

The job ladder model with the fairness-in-hiring rule, as depicted in Section III, represents the "pure" version of our theory, emasculating education of all productivity connotation of the human-capital or socialization variety. Hence it is the "ideal" version to be compared with the alternative theories of education in their idealized versions. In particular, the contrast with the Arrow-Spence screening theory, which also departs from the productivity principle, should be noted.

Next, note that the analysis can be readily extended to cover the effects of alternative policy interventions in our job ladder model of the economy. In particular, we should remark in conclusion that the policy instrument to counter the fairness-in-hiring rule (whose inefficiency has been precisely modelled in Section III) is to ensure selection processes which eliminate the use of (excess) educational attainment as a hiring criterion. One way in which this can be done is to ensure randomized access by all qualified and overqualified applicants through the use of a lottery system.² Note however that this would be a second-best policy, since it

¹ Note that the presence of the fairness-in-hiring rule requires a job ladder but the reverse is not true.

² This has been proposed in Bhagwati (1973a).

would nullify the fairness-in-hiring rule while continuing the job ladder economy;¹ the first-best policy would clearly be to eliminate the job ladder (and hence also the fairness-in-hiring practice) and to restore full flexibility of wages.

Finally, we should note that no simple theory of education -- ours (job ladder and fairness-in-hiring) or the Schultz-Becker (human-capital) or the radical (socialization) or the Arrow-Spence (screening) -- is likely to fit all of the educational system in any country. If we had to generalize at the peril of oversimplification, we would guess that the fairness-in-hiring theory is likely to apply most to liberal arts education in the less developed countries with developed educational systems inherited from progressive colonial governments (e.g. in Asia)²; the screening theory most to liberal arts education in the developed countries, and the human-capital doctrine to technical and scientific education in both LDC's and DC's.

¹ The counterpart of this, in the Arrow-Spence screening theory, would be the question: Is there a cheaper way of screening than using the educational system? This question has been discussed in Taubman and Wales (1973).

² For an application of our theory of education to the welfare analysis of the brain drain problem of less developed countries (LDC's), see Hamada and Bhagwati (1975).

Appendix: The Foreign Teachers Model

We discuss briefly the implications of assuming that the education sector is operated exclusively by hiring foreign teachers. Let us assume that the payment to foreigners per student is k in terms of the numeraire. Naturally the payment to foreigners, $k\delta L^{Ei}$ [$i = M, F$ or S], has to be subtracted now from the sum of the values of output of sectors 1 and 3 to arrive at welfare levels.

Now, since only c , the fees charged per student, enters the private cost calculations of the flexible and minimum wage models, the parameter k is irrelevant for this purpose. However, recall that the teacher-student ratio δ plays a role in the determination of equilibrium when domestic teachers are assumed. So, now we must set $\epsilon = 0$ to obtain the equilibrium values of the size of the educated labor force in the minimum and flexible wage models from equations (3') and (7). However the welfare levels will now be:

$$W^M = f(L_1^M) + w [1 - L_1^M - \delta L_1^M] - k\delta L_1^M$$

$$W^F = f(L_1^F) + w [1 - (1 + \delta)L_1^F] - k\delta L_1^F$$

The fact that payment to foreign teachers has to be subtracted also affects the maximand in the social optimum model. Thus we maximize $f(L) + w [1 - (1 + \delta)L] - k\delta L$ with respect to L . This leads to

$$f'(L^S) = w(1 + \delta) + k\delta$$

This is the analogue of (13) and has a similar interpretation. The LHS is the social product of an educated laborer while the RHS is the social cost in terms of output foregone in sector 3 (from the withdrawal of $(1 + \delta)$ persons,

one person being added to the educated labor force and δ persons to the student body) plus the direct cost of education equalling k per person in the educated labor force.

Comparisons of the sort made in Sections 7(1) to 7(5), in the context of the present models with foreign teachers, lead to similar results as in those sections provided it is understood that the direct social cost of education is k per student.

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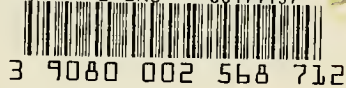
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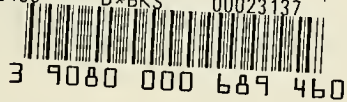
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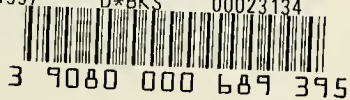
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