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EDUCATION, JOB SIGNALING, AND DUAL LABOR MARKETS IN DEVELOPING COUNTRIES

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Education, Job Signaling, and Dual Labor Markets in Developing Countries*

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ABSTRACT

An overlapping generational model of educational investment in a dual labor markets is presented in which education serves both as a screening device and as investment in human capital. Labor market dualism arises not only via the conventional technology (productivity) differential between a primary and a secondary sector, but also by a higher than a labor market clearing wage in the primary sector, to insure no shirking by the workers (an element shared with the efficiency wage theories). The important determinants of the workers' educational investment decision are the degree of discipline in the labor market and the cost of education. Among the three most commonly discussed educational policies of maximizing the number of the educated, maximizing the primary sector employment and maximizing social welfare, the last one, i.e., the most efficient one, leads to a lower level of education subsidy by the government.

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I. *Introduction*

There has been a long standing debate on the role of formal education (i.e., schooling) in society. The prevailing human capital school argues that education enhances one's potential ability and productivity. Educational expenses are viewed as investment in human capital, whose return shows up as higher wages. Since the 1960's, many development economists have accepted this view and argued that investment in education should be thought of and treated in the same way as investment in physical capital. To the advocates of the human capital school (e.g., Schultz [1961], Becker [1975]), efficient allocation of resources requires that returns on education be equalized with returns on any other investment. Thus, the high returns on education typically found in developing countries implies that more resources have to be devoted into the educational sector (see Psacharopoulos and Woodhall [1985]).

An alternative perspective criticizes the idea that formal education raises productivity, as fundamentally erroneous. Rather, the major function of education is to serve as a screening device (Dore [1976]). This perspective was rooted in the earlier critical views of formal schooling (e.g., Illich's [1970]). Spence [1974] presented a formal model in which education serves as a signaling device. While Spence's analysis does not negate a link between education and productivity, its real focus is on the signal that is conveyed by education. As the worker's real productivity is not fully known, educational performance serves as a proxy that conveys information about workers productivity related attributes (e.g., motivation, diligence, punctuality, discipline, and so on). In this model, it is optimal for more able workers (whose cost of education is low) to seek more education, expecting a higher wage, while less able workers (whose cost of education is high) would choose less education and face a lower wage. Further, such wage expectation will be realized as long as the employers recognize that workers with high education are more productive than the workers with low education. This idea of signaling equilibrium has been elaborated in game theory literature as a sequential equilibrium (see Cho and Kreps [1987], Banks and Sobel [1987], and Noldeke and Van Damme [1990].) In an extreme version of the model in which education does not increase the productivity at all, investment in education is obviously wasteful.

The above debate has a direct bearing on the question asked by this paper which is to explain the presence of under-employment and unemployment among the educated workers in the LDCs, *co-existent* with high returns on education, and to draw appropriate policy guidelines. The presence of the educated under-employed and unemployed in many of the LDCs has been a longstanding and widespread phenomenon as observed, for example, over a decade and half ago by Gary Fields (1974). Fields' explanation for this phenomenon was primary based on the oversupply of public education driven by political pressures that stem from demand by parents, unions, and the employers. Fields' paper asked an important question. But the reasons why demand for education should exceed its supply remain unclear. If the reasons for this lie in the higher returns to education associated with a limited number of jobs that require education, then a Harris-Todaro (1970) framework, based on a primary-secondary sector duality may be an appropriate starting point, since in a perfectly competitive labor market it is inconceivable to have high return on education with persisting high unemployment rate. Within this framework education acts a the *lottery* in that it is a necessary but *not a sufficient* condition for entry from the low paying secondary sector to the high paying primary sector. As a result, more people seek education than find primary sector jobs. But why do primary sector jobs pay higher? The Harris-Todaro answer has the usual limitation that it fixes the primary sector wage *exogenously*, via institutional rigidities. Instead we *endogenize* the primary-secondary sector wage duality in this paper. We do this in the general spirit of Stiglitz and Shapiro's (1984) view of unemployment as a labor discipline device, in which higher wages along with higher unemployment rates reduce the worker propensity to shirk.[1] Then because of the inability of the employers to monitor workers costlessly, higher primary sector wages are offered to discourage shirking, while the workers caught shirking are fired. In our model, as in Stiglitz and Shapiro (1984), unemployment in the primary sector[2] is a labor discipline device to ensure more intensive work among primary sector employees. In a relatively undisciplined labor market, in which hiring and firing is done through personal networks and promotions are mainly done through seniority, it is not optimal for employers to hire all qualified workers even though the marginal worker's value product is greater than the reservation wages of the unemployed. Thus a serious problem

[1] Earlier, Stiglitz (1974) and Salop (1979) developed labor turnover models, in which employers pay a higher wage to reduce labor turnover by reducing the number of quits rather than the extent of shirking. For a critical review of the first article, see Basu (1984).

[2] Later we will use the term underemployment for this purpose.

of moral hazard exists since without any threat of dismissal and real cost of unemployment, workers in the primary sector may not work hard.

As mentioned above, we assume that high paying and high productivity primary sector firms limit their search *only* to the *educated* workers, as was also assumed by Fields (1974, 1975).[3] This is because education can convey information about the degree of motivation, discipline and other characteristics of workers, as discussed earlier, and thus the productivity of the firms indirectly. Education in our model thus plays double roles. First, it is a human capital investment which enables workers to function in a high productivity primary sector. At the same time, it is a screening device, because primary sector employers will not consider uneducated workers. Although for the purposes of emphasizing the signaling aspects we do not take explicit account of the human capital aspect of education, once educated workers are placed in the high productivity primary sector, the fact that educational attainment qualifies a worker for the higher productivity primary sector (over the low productivity secondary sector), reflects both a social and a private gain in educational investment. However, since entry into the primary sector involves a queue, even among the educated workers, the investment will be wasted on those educated workers who fail to enter the primary sector.

The educated workers who fail to enter the primary sector are

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[3]The difference between this model and Fields' 1974 model is already discussed above. The difference between this model and his 1975 model is that in the latter *all* educated workers find jobs in the primary sector (so there is no educated unemployed) as his emphasis in that paper is on a rural-urban migration and not on the educated underemployed.

absorbed, along with those not educated, into the low productivity-low wage secondary sector in which employment is always guaranteed, following the tradition of the dual economy model (Lewis, 1954). We will call the educated subgroup, the *underemployed*, since they are not strictly unemployed. We use this term only for the educated segment because its members are absorbed into a sector whose productivity is *below* their own potential productivity. Evidence suggests that education does not enhance the earnings of those in the secondary sector (e.g. Dickens and Lang 1985).

Finally we use an overlapping generations model to capture the long term and cross-generational nature of educational investments. Thus, we integrate strands of the dual labor market literature, the efficiency wage theories, the signaling theory, and the human capital literature, in an overlapping generations model in which the rate of underemployment, the primary sector employment, and the primary sector wage are all endogenously determined. Following the formulation of the model, our primary goal will then be to examine the effect of government educational subsidy on social welfare. There is an important equity versus efficiency dimension related to the governments educational subsidies in the LDCs which stirs substantial debate among scholars and policy makers. As formal education is expensive, only a small fraction of population can afford high level of education in developing countries. Thus an increase in public subsidy encourages more people from less privileged groups to be educated and qualified for jobs with high wages, improving equity in the society. But, such increase of educated workers may create high underemployment and waste of resources, if high productivity jobs are limited. This would clearly increase inefficiency.

The next section describes the model and characterizes the equilibrium solutions. Section III will examine comparative static results of the model. Section IV examines the implications of an optimal policy of subsidizing education under different policy goals including one of maximizing social welfare. Conclusions are offered in section V.

II. The model and equilibrium solution

Consider an overlapping generations model of the following type. At each period, there are two groups of people without gender difference: old and young. The old people are engaged in working, whereas the young are engaged in education or leisure. The size of each group is fixed at L for each period. Each generation lives two periods. In the first period, the individual decides whether or not to be educated. In order to get an education (s)he has to incur a private cost c. The cost c includes opportunity costs as well as direct out-of-pocket costs, such as expenses on books and supplies. In the second period, the individual is in the labor market. The labor market is composed of four types of agents: educated workers, uneducated workers, primary sector employers, and secondary sector employers. An educated worker is an "old" worker who received education in the previous period when young; an uneducated worker is one who received no education in the previous period.

The description of the two types of employers follows the conventional dualistic economy of a developing country. In addition to the well known characterization of the dualistic economic structure, the two types of employers differ in terms of production technology and labor requirement. The secondary sector has a constant returns to scale technology with marginal productivity of workers equaling w_s, independent of whether or not a worker is educated. We assume that this sector is competitive, and denote its wage by w_s.[4]

The primary sector employers hire only educated workers. Each firm has a production function $Q_i = F_i(J_i)$, where J_i is firm i's effective level of employment (i = 1,2, ,M). As long as a worker does not shirk, he contributes one unit of effective labor; otherwise, he contributes nothing (see below). With M identical primary sector firms, aggregating the production function yields Q = F(J), where J is the aggregate effective employment. We shall assume the following regarding the aggregate production function:

$$F' > 0,\ F'' < 0,\ F(0) = 0,\ F'(0) = \infty. \tag{1}$$

The last assumption is necessary to ensure that there is always some positive employment in the primary sector. Further, the primary sector is assumed to be competitive such that it yields zero profits.

A worker in the primary sector has a choice of shirking or not-shirking. In order to make the worker's incentive problem as simple as possible, we shall assume that the worker's disutility of not shirking (compared to shirking) is exogenously given as e. More specifically, we shall assume that the worker's has a von

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[4]Alternatively, we can assume a downward sloping demand curve for the secondary sector, making the secondary sector wage *endogenous*. This will inevitably complicate the model without changing its essential nature, since the young take w_p and w_s for the next period as *given*. Moreover, it is the difference between the two wages, not the levels, that influence the decision on education.

Neumann-Morgernstern utility function with the form:

$$v = w_p - e, \tag{2}$$

where w_p is the wage paid in the primary sector. As the primary sector employers' goal is to maintain a highly motivated work force, with no shirkers, they are willing to offer higher wages than a competitive wage that would have resulted if all educated workers work in the primary sector.

A worker who shirks faces a probability of dismissal, q. Given the wage offer and the probability of dismissal, the worker chooses to shirk or not by comparing the level of utility of the two alternatives.[5] Thus, the worker will not shirk if,

$$w_p - e \geq (1-q)\, w_p + q\, w_s, \tag{3}$$

which can be rewritten as,

$$w_p - w_s \geq e/q \tag{3'}$$

Notice that the first form of the inequality assumes that a dismissed worker from the primary sector, can always obtain a secondary sector job. Thus, at any given period, secondary sector workers include educated workers who fail to obtain primary sector jobs and other educated workers who shirk and are thus fired (although

[5]One can envision a model in which the worker is allowed to choose a level of shirking and a dismissal probability depends on the level of shirking as well as the unemployment rate. We decided to adopt the simpler form, as we felt that such generalization would complicate the model substantially without giving additional insights.

in equilibrium, there will be no such workers as long as the primary sector wage is high enough to compensate the utility of shirking), and the old uneducated workers. Thus, strictly speaking, there is no true unemployment in our model. Instead, we observe underemployment of the educated workers. This is defined by the ratio of educated workers who fail to get the primary sector jobs to the total number of educated workers. Also we assume that there is no disutility of work in the secondary sector.

The dismissal probability is assumed to be an increasing function of the underemployment rate u:

$$q = q(u) \quad \text{with } q'(u) > 0 \text{ and } q(0) = 0. \tag{4}$$

As the marginal productivity of a shirking worker in the primary sector is assumed to be zero, primary sector firms would be willing to pay a wage high enough to ensure that workers do not shirk. This is found from inequality (3') which is the nonshirking constraint (NSC) on the primary sector employers. Substituting from (4) into (3') permits the NSC to be expressed in terms of the variables w_p and u:

$$w_p - w_s \geq e/q(u) \tag{3"}$$

The profit maximization condition for the primary sector firms ensures that:

$$w_p = F'(J). \tag{5}$$

If we denote the total number of educated workers by N, the underemployment rate u becomes:

$$u = (N - J)/N. \tag{6}$$

Substituting from (6) into (3"), the *minimum* primary sector wage employers are willing to offer to discourage shirking, consistent with the marginal productivity condition (5), becomes:

$$w_p = w_s + e/q(1-J/N) = F'(J) \quad (7)$$

The two equalities in (7) completely describe the equilibrium of the labor market of the second period, *given the number of educated workers (N) from the first period*. This is depicted in Figure 1. The NSC for the primary sector employers is upward sloping, i.e., higher w_p is associated with higher J and vice versa (given N). Intuitively a larger J, i.e., a lower underemployment rate, *reduces* the penalty of shirking by reducing the probability of dismissal. Thus employers must raise w_p to discourage shirking. In the limit, as J approaches N (underemployment rate approaches zero), w_p approaches infinity. Hence, full employment is *not* possible in our model. The second curve is the downward marginal productivity curve. Given the number of educated workers (N), the equilibrium values of J and w_p are determined by the intersection of the two curves.

Fig. 1 About Here

The next question is how to determine N in the first period. In the first period, the young (or their parents) decide whether or not to pursue education, based on their expectation of wage rates and the probability of getting a primary sector job. If education is *not* chosen, primary sector employment is precluded permanently. Thus, lifetime wealth becomes βw_s, where β is the discount factor ($0<\beta<1$).

However, if education *is* chosen, then a primary sector job with the wage w_p may be found in the next period, with probability of (1-u). Alternatively no primary sector jobs may be found with the probability (u), in which case the secondary sector employment with the wage w_s is the only option. In order to get education, the worker must bear the cost of education, c. In the absence of income or endowments, the young will borrow to finance the private portion of educational cost, with the interest rate assumed equal to the discount rate.[6] Thus the young maximize the discounted lifetime utility by comparing secondary sector earning with the expected primary sector earnings. With risk neutrality assumed and with no shirking in equilibrium, this implies:

$$\text{Max} \left(\beta w_s \quad ; \quad \beta[(1-u)\ w_p + u\ w_s] - c \right)$$

In equilibrium the two earning streams are equal,

$$\beta w_s = \beta[(1-u)\ w_p + u\ w_s] - c \tag{8}$$

yielding the equilibrium unemployment rate of:

$$w_p - w_s = c/\beta(1-u). \tag{8'}$$

Since J and w_p are found, conditional upon N, the value of u, in (8') is also a function of N. However, u is also given by u = 1-J/N (eq. (6)). Thus, the size of the education sector, N, is determined in equilibrium when workers have rational expectation regarding the primary sector wage and underemployment rate that they will face in the next period.

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[6] In a later section education will be allowed to be partly subsidized by the tax paid by the old workers.

III. *Comparative statics*

To perform comparative static exercises one would differentiate totally, the three equilibrium conditions, equations (7) and (8′), in the three endogenous variables, w_p, J and N. However, it is easier to work with the equilibrium underemployment rate (u) instead of the number of educated workers (N). Moreover, as J is solely determined by the firms' profit maximization condition (5), we can solve the equilibrium w_p and u by considering only (3") and (8′).

Fig. 2 About Here

Figure 2 depicts these two equations graphically in (w_p, u) space, with equation (3") having a downward slope and equation (8′) having an upward slope. The star ('*') denotes an equilibrium quantity. Changes in any of the parameters are represented by shifting one of the two curves in the figure. For example, a rise in the utility of shirking, e, shifts the curve representing (3") to the right, resulting in a new equilibrium with higher w_p and higher u. Intuitively, with a larger e, the primary sector firms must raise w_p to discourage shirking. At the same time, the underemployment rate (the penalty for shirking) would rise because workers are willing to trade higher underemployment rate for higher wages. Also, from equation (5) higher w_p implies lower J. However, the effect on the number of educated (N) is ambiguous, because a higher w_p encourages education among the young, while the higher underemployment rate reduces the chances of entering the primary sector. To summarize:

$$dJ^*/de < 0,\ du^*/de > 0,\ dw_p^*/de > 0,\ dN^*/de \lessgtr 0. \qquad (9.a)$$

If the cost of education (c) rises, the curve representing equation (8′) shifts to the left, resulting in a higher new equilibrium for w_p and a lower new equilibrium underemployment, u. Here, higher cost of education causes workers to demand higher primary sector wage and/or lower underemployment rate in order to recover their educational investment. At the same time firms would like to increase w_p by a only *minimum* amount so that the NSC is just satisfied. For a given utility of shirking, e, this would be achieved by combining some wage increase with a *decrease* in the probability of lay-off, in the case of shirking, which is consistent with a drop in the underemployment rate. The lower underemployment rate necessitates that the number of educated workers (N) should decrease by more than the number of jobs in the primary sector (J) in proportion. To elaborate, note that although the higher primary sector wage and the lower underemployment rate should induce a rise in the number of educated workers, this will be dominated by the *reduction* of educated workers due to the higher cost of education. To summarize:

$$dJ^*/dc < 0,\ du^*/dc < 0,\ dw_p^*/dc > 0,\ dN^*/dc < 0 \qquad (9.b)$$

The effect of the discount factor is just the opposite to the cost of education (eq. (8′)). For example, a rise in β increases workers valuation of the future relative to the present and thus their incentive to choose education for future primary sector employment. Thus, firms can effort to offer smaller w_p (accompanying a rising J) and also the underemployment rate can be higher in this case:

$$dJ^*/d\beta > 0,\ du^*/d\beta > 0,\ dw_p^*/d\beta < 0,\ dN^*/d\beta > 0 \qquad (9.c)$$

Higher wage in the secondary sector decreases the cost of shirking (eq. (3")), and also decreases the incentive to enter into the primary sector (eq. (8′)). Thus, primary sector firms would respond by raising the wage w_p (which causes a reduction in the number of jobs). However, the underemployment rate will not change due to the restrictive assumption of risk neutrality and additivity in our utility function. In this case, both curves in Figure 2 shift up by an equal amount, leaving u^* unchanged. If the underemployment rate stays the same, the reduction in the number of primary sector jobs is proportional reduction in the number of educated workers. Thus:

$$dJ^*/dw_s < 0,\ du^*/dw_s = 0,\ dw_p^*/dw_s > 0,\ dN^*/dw_s < 0 \qquad (9.d)$$

In order to solve for the equilibrium level of variables explicitly, we parameterize the q(u) function as:

$$q(u) = \gamma u, \qquad (\gamma > 0) \qquad (10)$$

where γ represent the *degree of discipline* in the primary sector labor market. A high γ implies a highly disciplined labor market in the sense that given any underemployment rate, workers are more likely to be punished (dismissed) when they shirk. Then, it can be shown that:

$$u^* = \beta e \ / \ (\beta e + \gamma c), \qquad (11.a)$$

$$w_p^* = w_s + e/\gamma + c/\beta \qquad (11.b)$$

$$w_p^* = F'(J^*) \qquad (11.c)$$

$$N^* = (1 + \beta e/\gamma c)\ J^*. \qquad (11.d)$$

Equation (11.b) shows that w_p falls a γ rises: The more disciplined the primary sector labor market, the less likely workers are to shirk in which case firms need not pay as high a wage. The lower wage increases the number of primary sector jobs (eq. (11.c)). The NSC implies that a smaller w_p can be accompanied by a reduced probability of firing and thus a lower underemployment rate (eq. (11.a)). Again, the number of educated workers may change in either direction, as the lower w_p reduces N but a lower u increase it (eq. (11.d)). To sum:

$$dJ^*/d\gamma > 0,\ du^*/d\gamma < 0,\ dw_p^*/d\gamma < 0,\ dN^*/d\gamma \lessgtr 0 \qquad (12)$$

IV. *Effects of educational subsidy on social welfare*

In this section, we shall examine the effects of government subsidy on education. Some have argued that education is a basic need and that it has to be subsidized by the government. However, subsidy in education is a little different from the subsidy on other items in the basic need basket. There is a spill-over effect on the labor market, when government subsidizes the education.

In order to make the story simple, let us assume that the total per capita educational expense, s, is exogenously given, and the production of education has a constant returns to scale technology. Out of the total per capita expense, workers are only required to pay c. Let us denote θ as the fraction of the workers' share. Thus $1-\theta$ is the public sector's share of educational expenses. Obviously a large θ implies little educational subsidy. With g as the per capita cost of education borne by the government, we have:

$$s = g + c \qquad (13)$$

and,

$$\theta = c/s,\ 0 \le \theta \le 1. \qquad (14)$$

The availability of subsidy reduces private expenditures on education, and hence affects the workers' decision on education. At the same time, financing the subsidy requires taxes, which reduce disposable income. Depending on the tax scheme, the latter issue may or may not affect the relative attractiveness of money income *vis-a-vis* leisure. Thus, it is useful to distinguish between the two effects of taxes. For this reason, we consider two cases; a lump-sum tax that does not distort the wage versus leisure trade-off, and only reflects the first effect (income-versus-educational cost trade-offs), and a proportional income tax system of constant tax rate with fixed deduction of w_s[7], that reflects both the first and the second effect. We shall assume that the government always balances the budget.

We will focus on three policy objectives commonly discussed in the context of educational investment: 1) maximizing the size of the education sector (N); 2) maximizing the size of primary sector employment (J); and 3) maximizing social welfare (W). Clearly the third policy objective favors efficiency criterion.

A. *Lump-sum taxes*

We will consider the implication of the first two policies (maximizing J and N), followed by a policy of maximizing social welfare. Since the lump-sum tax system does not alter the marginal rate of substitution between money income and leisure, the equilibrium solutions in eq. (11) will be directly applicable to this case.[8] We shall drop the star ('*') notation for simplicity. Substituting w_p

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[7]In addition to its prevalence in many countries, such a tax system is used here because it is analytically more tractable.

[8]Notice that we are keeping the assumption of eq. (10) for analytical convenience.

from (11.c) into (11.b) we get:

$$F'(J) = e/\gamma + s\theta/\beta + w_s \ , \tag{15}$$

whose implicitly differentiation with respect to θ yields:

$$dJ/d\theta = s/\beta F''(J) < 0 \ . \tag{16}$$

Also from (11.d),

$$dN/d\theta = (1 + \beta e/\gamma c)dJ/d\theta - \beta eJ/\gamma s\theta^2 < dJ/d\theta < 0 \tag{17}$$

Hence it is clear that the policy either to maximize the number of educated workers or to maximize primary sector employment is that government should fully subsidize education ($\theta = 0$).

We now analyze the socially optimal policy. The social welfare is defined as the sum of individual utilities. (Firms get zero profits and the government balances the budget.) In equilibrium, when shirking is absent, the utility of the older generation (consisting of primary and secondary sectors workers) is income net of tax, and that of the younger generation is income, for those in the secondary sector, minus cost of education, for those choosing education. This becomes gross national product minus depreciation on human capital, or net national product. (Note that human capital depreciates entirely in one period). In the lump-sum tax case this is:

$$\begin{aligned} W &= w_p J + w_s(N-J) + w_s(L-N) - T - cN \\ &= (w_p - w_s)J + w_s L - sN \\ &= (1 - \beta/\theta)\ (e/\gamma + \theta s/\beta)J + w_s L, \end{aligned} \tag{18}$$

where T is the total tax paid by workers. The second equality follows from $T = gN$, the government's balanced budget constraint. By differentiating W with respect to θ, we get:

$$dW/d\theta = (s/\beta + e\beta/\gamma\theta^2)J + (e/\gamma + \theta s/\beta)(1-\beta/\theta)\ dJ/d\theta, \qquad (19)$$

which implies that $dW/d\theta > 0$ if $\theta \le \beta$. In other words, if the subsidy rate is too large (i.e, if $1-\theta \ge 1-\beta$), then a reduction in its level increases social welfare monotonically, and conversely, an increase in its level decreases social welfare.[9] This occurs because a very high subsidy rate means that a large number of the young will choose education. This will increase the underemployment rate, and thus social waste because of *society's inability to utilize the skills of the educated workers in more productive primary sector.* Instead, these educated workers will be put into the secondary sector, where education does not increase their productivities nor wages.[10] On the other hand, when $\theta > \beta$, an optimal θ can be obtained by equating the above equation to zero.[11]

The three policy objectives are depicted in Figure 3, in which the case of a monotonically increasing $W(\theta)$ function is denoted as case 1 and the case of an interior optimum θ is denoted as case 2. (Note that since $\theta > \beta$ is only a necessary condition for the existence of an interior optimum, it is possible that such an interior optimum

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[9] Note that Since the time period under consideration is of the order of one generation, β will be substantially smaller than one.

[10] There may be some potential social externalities from a society of highly educated people even if they stay in the secondary sector. This issue is not analyzed in the present paper.

[11] The second order condition in this case,

$$d^2W/d\theta^2 = -2e\beta J/\gamma\theta^3 + 2(e\beta/\gamma\theta^2 + s/\beta)\ dJ/d\theta$$
$$+ (e/\gamma + \theta s/\beta)(1 - \beta/\theta)\ d^2J/d\theta^2 < 0,$$

is globally satisfied when $F''' \le 0$ (which ensures $d^2J/d\theta^2 \le 0$).

does not exist even if the condition is satisfied). From either case, the trade-off between efficiency and equity is apparent. A government policy of maximizing either the size of the education sector, or the primary sector employment, requires full educational subsidy but does not maximize welfare. On the other hand, a welfare maximizing educational policy requires either no subsidy (case 1) or some (but less than full) subsidy (case 2).

Fig. 3 About Here

B. *Proportional income tax with the deduction of* w_s

The government budget constraint in this case is:

$$\tau(w_p - w_s)J = gN. \tag{20}$$

The left hand side of this equation is the tax revenue and its right hand side is the educational expenditures of the government. The workers' NSC and the educational investment decision rule respectively become:

$$(1 - \tau)(w_p - w_s) = e/\gamma u. \tag{21}$$

$$(1 - \tau)(w_p - w_s) = c/\beta(1-u). \tag{22}$$

Solving these equations together, we get the same equilibrium underemployment rate as in (11.a), and therefore also the same J/N ratio as in (11.d):

$$u = \beta e/(\beta e + \gamma c), \tag{23.a}$$

$$N = (1 + \beta e/\gamma c)\ J. \tag{23.b}$$

Substituting u from (23.a) back into the NSC (21), we get:

$$(1 - \tau)(w_p - w_s) = (e/\gamma + c/\beta). \qquad (24)$$

The social welfare is given by:

$$W = (1-\tau)(w_p-w_s)\ J + w_sL - cN = (1/\beta - 1)cN + w_sL\ , \qquad (25)$$

where the second equality follows from (24) and then (23.b). From this we see that for given β and w_s maximizing social welfare is equivalent to maximizing private investment in education (cN). This is because, workers have a guaranteed rate of return $(1/\beta - 1)$ on educational investment. Workers' rationality ensures that social welfare, which is equivalent to their total net wealth, is maximized when the workers maximize their investment.

To find the link between the tax rate and the educational subsidy rate, we substitute for $w_p - w_s$ (from eq. (24)) and N (from eq. (23.b)) into the government's budget constraint and rearrange to get:

$$\tau = \frac{(1/\theta - 1)\beta}{1 + (1/\theta - 1)\beta} \qquad (27)$$

From this expression, we see that $d\tau/d\theta < 0$. Thus, the higher the subsidy rate, the higher is the tax rate.[12] Further, no subsidy (θ=1) implies $\tau = 0$, while full subsidy ($\theta = 0$) implies that $\tau = 1$.

First we analyze the primary sector by studying how it changes as the subsidy rate varies. Substituting τ into (24), and realizing that $F'(J) = w_p$, we get:

[12]This plausible result may not obtain for some other income tax system, as higher subsidy rate may increase the tax base (J) so that it could actually reduce the tax rate.

$$F'(J) = [1 + (1/\theta - 1)\beta]\ [e/\gamma + \theta s/\beta] + w_s, \tag{27}$$

which involves only one endogenous variable J, given the policy parameter of θ. Comparing the above equation with the lump-sum tax case (eq. (15)), one would recognize an extra term $(1/\theta - 1)\beta$ which represents the decrease of marginal utility of money income because of the introduction of income tax. Hence, it is clear that at a given rate of education subsidy primary sector employment would be smaller in the case of the proportional tax, that is,

$$J^{\ell}(\theta) > J^{p}(\theta),\ 0 < \theta \leq 0, \tag{28}$$

where the superscripts ℓ and p represent lump sum tax and proportional tax respectively.

The value of θ which maximizes J, i.e. $\hat{\theta}^{p}_{J}$, is either 1 or less than 1.[13] If $s < e\beta^2/\gamma(1-\beta)$ then J is maximized at $\theta = 1$.[14] This suggests that the no subsidy policy maximizes J if educational cost is sufficiently high, or labor market is not very disciplined, or

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[13] We shall use the hat ('^') notation to denote an optimal quantity of θ, that maximizes the quantity in the subscript (in this case, J).

[14] Differentiating (27) with respect to θ, we obtain:

$$dJ/d\theta = [s/\beta - s - e\beta/\gamma\theta^2]/F''(J),$$

$$\text{and } d^2J/d\theta^2 = [2e\beta/\gamma\theta^3 - F'''(J)(dJ/d\theta)^2]/F''(J),$$

where the second equation has been derived by first differentiating the first equation in θ, and then using it again in the resulting expression. Setting the first equation to zero, we find an optimum θ. The local concavity of J in the neighborhood of θ^{p}_{J} is guaranteed, i.e., from eq. (31):

$$d^2J/d\theta^2|_{\hat{\theta}^{p}_{J}} = 2e\beta/\gamma\theta^3F''(J) < 0.$$

The second order condition will be globally concave if $F''' \leq 0$ as in the lump sum tax.

disutility of work is very high, or discount rate is very low. Otherwise, J will have the interior maximum:

$$\hat{\theta}^{\rho}_{J} = \left(\frac{e\beta}{\gamma s(1/\beta - 1)}\right)^{1/2}. \tag{29}$$

In this case, the following hold:

$$d\hat{\theta}^{\rho}_{J}/d\gamma < 0, \quad d\hat{\theta}^{\rho}_{J}/de > 0. \tag{30.a}$$

Several interesting points emerge from these results. First, a more disciplined labor market (γ), permits a *higher* optimal subsidy rate $(1-\hat{\theta}^{\rho}_{J})$. This is because in a disciplined labor market, primary sector wage need not be as high to prevent shirking, and thus number of primary sector jobs is larger. Thus optimum subsidy rate is higher as fewer educated workers end up in the secondary sector (less waste). On the other hand, If the labor market is not very disciplined, the government should not subsidize the education too much, since the social waste (educated workers in the secondary sector) increases, via higher w_p and lower J, as the subsidy rate increases.

Secondly, larger e implies a greater disutility of work, thus inducing a higher primary sector wage and with that a reduction in the number of primary sector jobs. Social waste is therefore higher if more educated workers, via a higher subsidy rate, end up in the secondary sector. Thus larger e implies reduced optimal subsidy rate.

Two additional parametric responses are:

$$d\hat{\theta}^{\rho}_{J}/ds < 0, \; d\hat{\theta}^{\rho}_{J}/d\beta > 0. \tag{30.b}$$

A high cost of education raises the optimal subsidy rate aimed at maximizing primary sector jobs, at such a rate as to permit the proportion borne workers and the government to be shared (since $c=\theta s$, equation (29) shows that c rises with $s^{1/2}$). An increase in the discount factor reduces the degree of optimal subsidy because it causes workers to overinvest in the future. This reduces primary sector wages and increase J (see the discussion preceding equation (9.c)), reducing the need for subsidy.

To study social welfare we first express W in terms of J (by substitution from (23.b) into (25)), to obtain:

$$W = (1 - \beta)\ (e/\gamma + \theta s/\beta)\ J + w_s L. \tag{31}$$

It can then be shown that:[15]

$$\hat{\theta}_W > \hat{\theta}^{\rho}_J > \hat{\theta}^{\rho}_N\ . \tag{32}$$

These are shown in Figure 4, where W reaches its peak *after* J has reached its peak, which in turn occurs *after* N has reached its peak. Thus, a smaller subsidy $(1-\theta)$ is needed to maximize welfare than to maximize either N or J. As between the education maximization policy and the employment maximization policy, maximizing the former incurs a greater efficiency loss as greater number of educated workers are shut

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[15]Differentiating this with respect to θ, we obtain:

$$dW/d\theta = (1-\beta)\ (e/\gamma + \theta s/\beta)\ dJ/d\theta + (1-\beta)(s/\beta)J,$$

$$\text{and } d^2W/d\theta^2 = (1-\beta)(e/\gamma + \theta s/\beta)\ d^2J/d\theta^2 + 2(1-\beta)(s/\beta)\ dJ/d\theta.$$

Setting $dW/d\theta = 0$ yields optimum $\hat{\theta}^{\rho}_W$, which maximizes W if $d^2W/d\theta^2$ is assumed to be negative. Now from the $dW/d\theta$ expression it follows that at the point where θ maximizes J, W is still rising in θ [i.e. $dW/d\theta(\hat{\theta}^{\rho}_J) = (1-\beta)(s/\beta)J > 0$], and at the point where θ maximizes W, J is already falling in θ [i.e., $dJ/d\theta(\hat{\theta}^{\rho}_W) = -(s/\beta)J/[e/\gamma + \theta s/\beta] < 0$]. It follows that $\hat{\theta}^{\rho}_J > \hat{\theta}^{\rho}_N$. Assuming N is single peaked and using a similar argument as above, we can also show that, $\hat{\theta}^{\rho}_J > \hat{\theta}^{\rho}_N$.

out from gainful employment in the primary sector and are thus absorbed into the less productive secondary sector.

Fig. 4 About Here

V. *Summary and Conclusion*

We have examined the role of education in a dual labor market. Education serves both as a screening device to screen workers for primary sector jobs and as human capital device to enhance productivity. Underemployment is viewed as the inability to obtain a primary sector job among those qualified educationally, and thus settle for the available secondary sector employment. Underemployment also serves as a worker discipline device to discourage shirking. The paper incorporates these concepts in a simple overlapping generations model, where the young must decide on education and the old are employed either in the primary sector or in the secondary sector.

Socially optimal educational policies are investigated where the policy instrument is the extent of subsidizing education. The analysis is conducted under two tax schemes to finance the subsidy; a nondistortionary lump sum tax scheme and a distortionary income tax in which income up to the secondary sector wage is deducted. Many conclusions emerge, the most of which are that the size of optimal subsidy is smaller in the case of a welfare maximizing educational policy than in the case of alternative policies. In turn, a goal of maximizing the number of primary sector jobs requires less subsidy than one maximizing the size of the education sector (the number of the pupils). Also, an income tax regime which penalizes work *vis-a-vis* leisure yields lower primary sector employment at any given rate of subsidy. Further, when maximizing the size of primary sector is the goal, it is found (in one of the tax schemes) that a more disciplined labor market or one with a lower discount rate permit for a *larger* optimal educational subsidy, while a labor market prone to shirking, or one with a high discount rate implies a *smaller* optimal subsidy rate. In this case, the optimal subsidy rate also rises with an increase in the total cost of education.

An important corollary to our analysis is the equity aspects of our results. For example, over-subsidizing the professionals for the purpose of primary sector employment is not only socially suboptimal but may also be unegalitarian since such resources (wasted on those who fail to enter the primary sector) may have been more appropriately used to improve the welfare of secondary sector employees.

The analysis does abstract from possible externalities of education. First, some output from the education (such as inventions) may be a public good. Second, even if the educated are only partially in employed in primary sector, some of them may set up own entrepreneurial activities. Such externalities may be too intangible and ambiguous to model precisely but may be nonetheless important.

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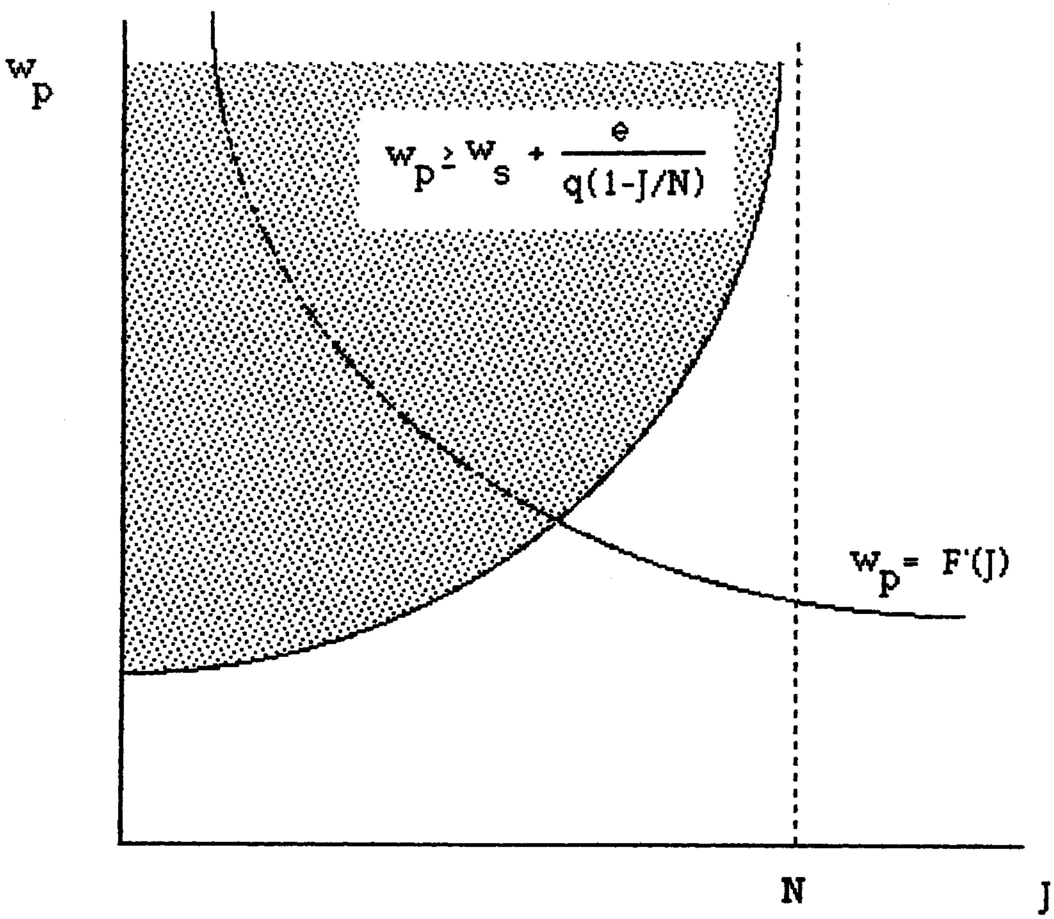

Figure 1 Equilibrium in the Second Period

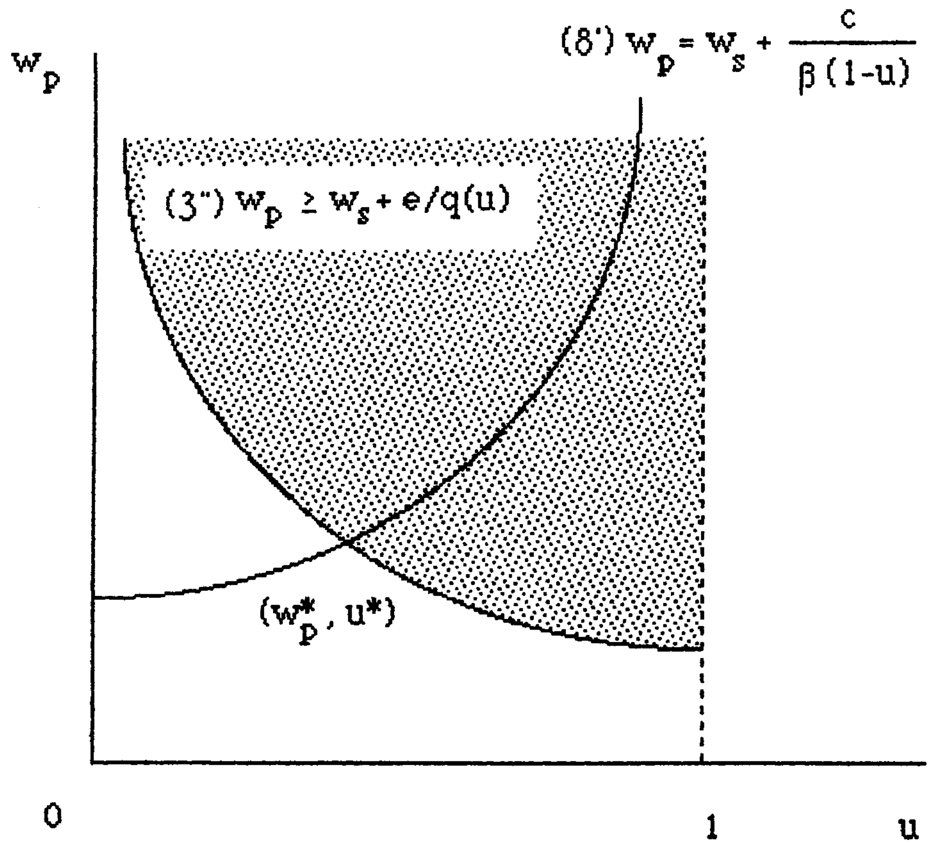

Figure 2 Equilibrium in the First Period

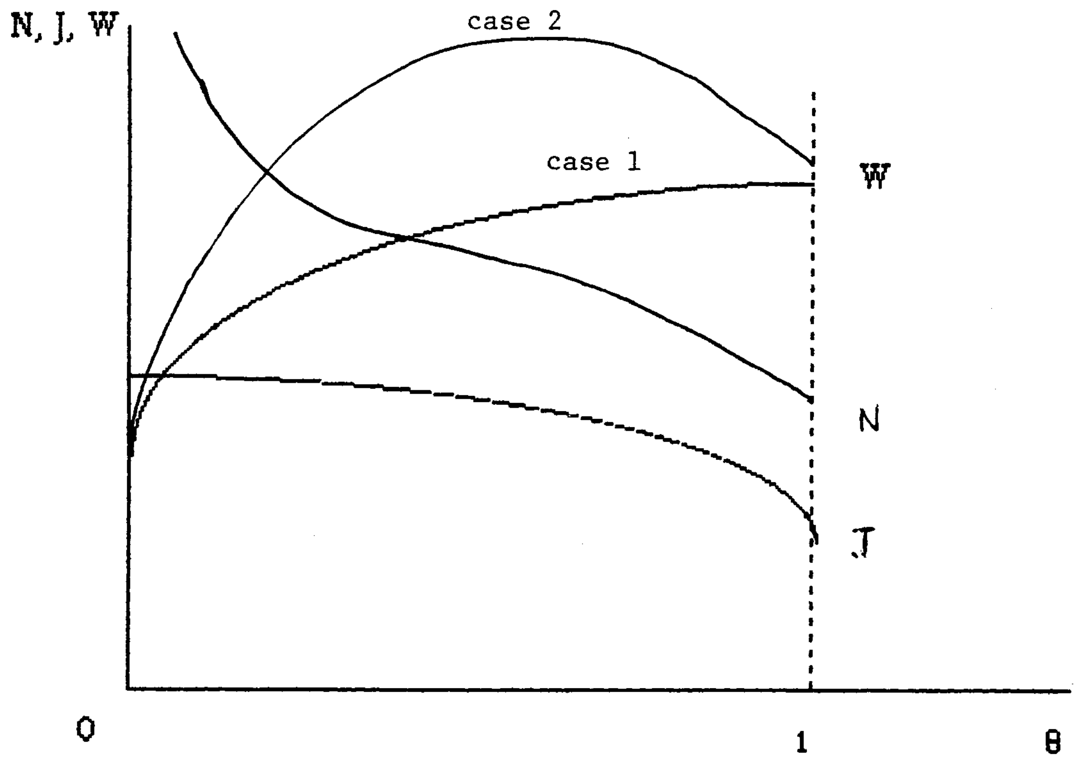

Figure 3 Lump-sum tax system

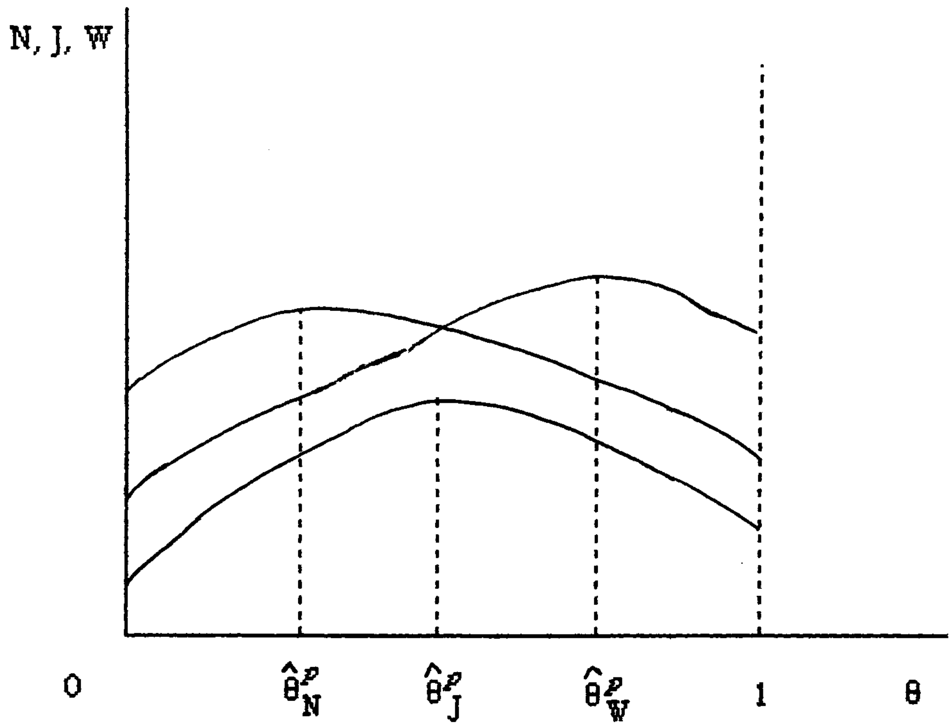

Figure 4 Proportional Income Tax System

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