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Factor Mobility, Regional Development, and the Distribution of Income

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A three-factor model of a small country or region is used to analyze the general equilibrium consequences of three frequently advocated regional development policies—investment subsidies, migration incentives, and educational expenditures. The analysis focuses on policy-induced changes in absolute and relative factor earnings. The results link changes in the distribution of income to the degree of complementarity and substitutability among factors of production and to the pricing scheme adopted by educational institutions. Programs intended to aid lagging regions may produce perverse results, particularly if the cost of education is the same to all individuals regardless of ability.

The existence of mobile factors has important consequences for the effectiveness of regional development policies. Increased mobility of capital and skilled labor has substantially altered the possibilities of achieving social and economic objectives through allocational incentives. Moreover, policies designed to promote these objectives may generate unintended distributional shifts as a result of induced factor flows.¹

In this paper, a one-sector model of a small country or region is used to analyze the general equilibrium consequences of three frequently advocated regional development policies—investment subsidies, migration incentives, and educational expenditures. The analysis focuses on policy-induced changes in absolute and relative factor earnings.² Capital is

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¹ See, esp., Cooper 1968 and 1974.

² Most other writers have emphasized changes in total or per capita income rather than its distribution among factors; see, e.g., Johnson 1967; one exception is Mishan and Needleman 1968. However, possibilities for redistribution of income are generally limited, so that changes in factor earnings are an important policy concern.

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treated as perfectly mobile, an assumption suggested by the growing importance of interregional and international investment flows. Skilled labor is assumed to be mobile within limits imposed by the costs of migration; unskilled labor is assumed to be immobile. The decision to treat only skilled labor as mobile is motivated by current immigration regulations in the United States and some other developed countries, which effectively limit immigration to those with needed skills. Even within developed economies, skilled labor appears to have higher interregional mobility than unskilled labor.

The proportion of skilled workers in the labor force is determined endogenously, with individuals investing in education whenever its private cost is less than the differential between the skilled and unskilled wage rates. While for simplicity skilled and unskilled labor are treated as homogeneous in their productive roles,³ an underlying distribution of innate ability is reflected in opportunity costs of education which differ across individuals.

The analysis underscores the distributional consequences of policies designed to aid less developed countries or depressed regions of modern economies. The results link changes in the distribution of income to the degree of complementarity and substitutability among factors of production and to the pricing scheme adopted by educational institutions. We show that programs intended to aid lagging regions may produce perverse results, particularly if the private cost of education is the same for all individuals regardless of ability. Investment incentives, for example, may hurt both skilled and unskilled labor. Similarly, while relocation subsidies for skilled workers will increase their earnings at the expense of unskilled workers when the private cost of education varies inversely with ability, all labor may lose if the private cost of education is independent of ability. Both outcomes reflect increased overinvestment in education under an inefficient pricing mechanism.

I. The Model

The model assumes a single output,⁴ produced by three factors—capital, skilled labor, and unskilled labor: $Y = F(K, U, S)$, where the neo-classical production function F is concave and characterized by constant returns to scale. The production function can also be written in intensive form: $y = f(u, s)$, where y , u , and s are the ratios of output, unskilled labor, and skilled labor to capital and f is strictly concave. We assume

³ This extreme assumption can be relaxed without altering fundamentally the results obtained as long as the rate of return to education increases with ability; see Section II.

⁴ The use of a one-sector model excludes the possibility that changed factor proportions are accommodated at unchanged factor prices.

that factor markets are competitive, so that each factor is fully employed⁵ and paid its marginal product:

$$\frac{dY}{dK} = F_K = f(u, s) - uf_1(u, s) - sf_2(u, s) = r_K \quad (1)$$

$$\frac{dY}{dU} = F_U = f_1(u, s) = w_u \quad (2)$$

$$\frac{dY}{dS} = F_S = f_2(u, s) = w_s. \quad (3)$$

Under the assumption that capital is perfectly mobile,⁶ risk-adjusted rates of return are equated across regions. This implies that r_K in equation (1) is exogenously determined.⁷ Capital market imperfections can be interpreted in this context as a large differential between r_K and similar rates elsewhere.

Skilled labor is internationally mobile, with a one-time cost c_M associated with migration. For simplicity, wages are assumed to be independent of age or years of experience. Thus, in equilibrium, the cost of migration will always be incurred at the start of the individual's working life, while the benefits, in the form of higher wages, accrue over time. To make costs and benefits comparable, we define $M(c_M, r_M)$ as the cost of emigration, amortized at the interest rate r_M over the working life of the individual.⁸ Within the limits imposed by costs of migration, mobility of

⁵ McCulloch and Yellen (1975) relax the full employment assumption by postulating institutionally determined wage rates which prevent labor markets from clearing. Also see Bhagwati and Hamada (1974).

⁶ Our assumption of perfect capital mobility is an important departure from the approach chosen by most previous authors—see, e.g., Berry and Soligo (1969), Johnson (1967), and Epstein (1974). Berry and Soligo, in dealing with the regional effects of labor mobility, attach crucial significance to the behavior of emigrants with respect to the capital they own. Yet with mobile capital this will be almost irrelevant, since any appreciable change in the rate of return on capital triggers new flows of capital owned by foreign investors. Thus, the predilection of emigrants to carry their capital with them affects the ownership, rather than the size, of the capital stock in the region of emigration. Long-run changes in the size of the capital stock induced by emigration result from changes in the supplies of other factors, rather than from investment choices made by the emigrants. For a criticism of the Berry-Soligo analysis within a model which emphasizes saving behavior of residents, see Rodriguez (1975).

⁷ The analysis could be generalized by assuming that the region faces an upward-sloping supply of capital schedule.

⁸ If migration requires a one-time expenditure c_M at the start of the working life of T periods, $M(c_M, r_M)$ is defined by the equation

$$\begin{aligned} c_M &= \int_0^T M(c_M, r_M) e^{-r_M t} dt = M(c_M, r_M) \int_0^T e^{-r_M t} dt \\ &= M(c_M, r_M) [1 - e^{-r_M T}] / r \end{aligned}$$

and

$$\frac{\partial M}{\partial c_M} = M_1 = \frac{M}{c_M}$$

$$\frac{\partial M}{\partial r_M} = M_2 = M [1/r_M - T e^{-r_M T} / (1 - e^{-r_M T})] > 0.$$

skilled labor ensures worldwide equality of net returns to skilled labor. Letting w_s^* represent the foreign wage rate, $M(c_M, r_M)$ the amortized cost of emigration as perceived by domestic skilled labor, and $M^*(c_M^*, r_M^*)$ the cost of immigration as perceived by foreign skilled labor, the wage rate for skilled labor in the home country, w_s , will be free to fluctuate between $w_s^* - M$ and $w_s^* + M^*$ without inducing either immigration or emigration of labor.⁹ Whenever the equilibrium wage rate w_s would lie outside of these bounds in the absence of migration, it is assumed that enough migration will occur to maintain a wage differential between the home and foreign countries just equal to the cost of emigration (immigration).¹⁰ These relationships are expressed by equations (4a), (4b), and (4c):

$$w_s^* - M(c_M, r_M) < w_s < w_s^* + M^*(c_M^*, r_M^*) \quad (m = 0) \quad (4a)$$

$$w_s = w_s^* + M^*(c_M^*, r_M^*) \quad (m \geq 0) \quad (4b)$$

$$w_s = w_s^* - M(c_M, r_M) \quad (m \leq 0) \quad (4c)$$

where m is the rate of migration as a fraction of total population.

Education, like migration, is treated as an all-or-nothing decision undertaken in equilibrium prior to the working life of the individual. A worker is assumed to acquire education whenever this increases his net earnings. The cost of education is also treated by the device of amortization (at the interest rate r_E). In equilibrium, the fraction of the native-born population acquiring education is determined by the condition that $E(e, c_E, r_E)$, the amortized private cost of education¹¹ to the marginal skilled worker, must be equal to the differential between the skilled and unskilled wage rates:

$$w_s - w_u = E(e, c_E, r_E). \quad (5)$$

The social cost of educating the marginal skilled worker is assumed to be an increasing function of e , the fraction of the native population (including descendants of previous immigrants) who acquire education. The rationale for this assumption lies in the belief that in every generation there is some natural distribution of abilities which tends to remain constant over time.¹² The ablest members of a cohort will be relatively

⁹ This well-defined interval reflects the assumption that M and M^* are the same for all individuals.

¹⁰ In studies such as Grubel and Scott (1966a, 1966b) and Berry and Soligo (1969), emigration flows are treated as autonomous. In contrast, we view factor movements as endogenous responses to changes in the values of economic parameters in the system.

¹¹ We assume that the educational production function is the same as that for the one final output in the model; or, equivalently, that the process of education consumes final output.

¹² This assumption would be violated if the children of skilled migrants differ in average ability from the local population.

inexpensive to educate, while successively less talented individuals will require larger and larger resource inputs to transform them into skilled labor.¹³

The private cost of education, $E(e, c_E, r_E)$, depends on the pricing scheme used by educational institutions. Equation (5) is consistent with a number of alternative assumptions concerning the pricing of education. If each individual is charged the marginal social cost of his own education, private cost will vary inversely with ability. Alternatively, if each is charged the average social cost of education, then private cost to an individual will be independent of his own ability but will rise with e . The latter case is especially interesting in light of recent egalitarian trends in the public provision of education, both in developed and less developed countries. Although the formal model is consistent with either assumption, the consequences of policy changes for the distribution of income hinge crucially on the chosen assumption.

The function E also depends on a shift parameter, c_E , which takes account of subsidies or taxes imposed on education or technological changes in the educational production function. A policy which affects the cost of education to each individual by the same *percentage* is exactly equivalent in its effects to a change in the interest rate r_E used in the amortization. However, a shift in c_E could also be used to analyze other types of changes in the private cost of education. Such shifts have consequences for income distribution and will be discussed further in Section III.

The relative proportions of skilled and unskilled workers in the labor force depend both on migration of skilled labor and on the fraction of the native-born population which is educated. The rate of change in the unskilled labor force at any time t is given by

$$\frac{\dot{U}(t)}{U(t)} = \frac{[(1 - e)\beta P(t) - \delta U(t)]}{U(t)},$$

where $P(t)$ is total labor force (resident population); β and δ are the constant birth and death rates. It is assumed that the same rates apply for all groups. Similarly, the rate of change in the skilled labor force is given by $\dot{S}(t)/S(t) = [(e\beta + m)P(t) - \delta S(t)]/S(t)$. In long-run equilibrium, $\dot{S}/S = \dot{U}/U$ so that

$$\frac{S}{U} = \frac{s}{u} = \frac{m + e\beta}{(1 - e)\beta}. \quad (6)$$

¹³ An essential feature of the model, embodied in equation (5), is that the incentive to acquire education (i.e., the rate of return on investment in human capital) is positively related to individual ability. However, the human capital literature has emphasized the role of foregone earnings as a principal cost of education. If—contrary to the assumption made here—wages depend on individual ability, the rate of return on education could

Although the main focus of our analysis is policy-induced changes in factor rewards, it is also useful to consider measures of aggregate welfare. The choice of an appropriate measure of aggregate income is complicated by two features of the model. First, some fraction of the capital stock in the region may be foreign owned, and this fraction need not remain constant. Hence, we treat separately income from labor and income from capital. Also, when migration is possible, per capita income for the region includes the income of nonnatives when immigration occurs and excludes that of some natives when there is emigration from the region.¹⁴ We therefore define two alternative measures of labor income:¹⁵

$$y_1 \equiv (1 - e)w_u + e(w_s - \bar{E}) \quad (7)$$

$$y_2 \equiv \frac{(1 - e)\beta}{\beta + m} w_u + \frac{e\beta + m}{\beta + m} (w_s - \bar{E}), \quad (8)$$

where \bar{E} is the average private cost of education.¹⁶ The first measure, y_1 , is per capita labor income for all natives of the region, regardless of present residence; y_2 is per capita labor income of residents of the region, regardless of origin. Using (5) we can express y_1 and y_2 as

$$y_1 \equiv w_u + e(E - \bar{E}) \quad (7')$$

$$y_2 \equiv w_u + e'(E - \bar{E}), \quad e' \equiv \frac{e\beta + m}{\beta + m}, \quad (8')$$

where e' is the fraction of skilled workers in the resident population. Then $y_1 \geq y_2$ as $m \leq 0$. In the case of outward migration (e.g., the brain drain), $y_1 > y_2$ because the latter measure excludes the incomes of some relatively high wage natives working abroad.

Since population (labor force) is endogenous in the model, to capture effects on the capital stock we consider

$$k \equiv \frac{K(t)}{P(t)} = \frac{K(t)}{[S(t) + U(t)]} = \frac{1}{(s + u)},$$

which is capital per resident worker. Although an endogenous fraction of

vary inversely with ability, at least over some range. In this case, those acquiring education need not be the most able members of the cohort. Thus, policy changes which reduce the gross skilled-unskilled wage differential may increase income inequality, because net earnings of the ablest (who remain unskilled) exceed those of less skilled workers.

¹⁴ The question of whose welfare is relevant in assessing the consequences of factor movements is discussed for the brain drain case in Bhagwati and Rodriguez (1975).

¹⁵ In calculating the effects of policy changes on labor income, we assume that domestic tax rates are unaltered. This implies that resources required to implement the programs discussed are provided externally, or by reducing government spending for other purposes. The former assumption seems realistic for most regional and international development programs.

¹⁶ In terms of the cost of education function,

$$\bar{E} = (1/e) \int_0^e E(z, c_E, r_E) dz.$$

the capital stock is foreign owned, movements in k and $r_K k$ may be of interest as a base for taxation of profits.

Equations (1)–(6) can be solved for the steady state values of the endogenous variables, u , s , e , w_s , w_u , and m . If r_K , r_E , r_M , c_E , c_M , and w_s^* remain constant over time, the endogenous variables also remain constant over time. Our analysis abstracts from dynamics of adjustment. Constancy of the ratios u , s , e , and m is consistent with overall growth or decline in the scale of the economy over time. The rate of growth of population is equal to $(\beta - \delta) + m$, the rate of natural increase in population due to births and deaths plus the rate of immigration (emigration). Even if the rate of natural increase is equal to zero, the rate of overall population growth will be zero only if no migration occurs.

The solution of the model is contingent upon the parameter values r_K , r_E , r_M , c_E , c_M , and w_s^* . Given arbitrary values of these parameters, the model can be solved by first setting $m = 0$ and then determining the values of u , s , w_u , w_s , and e from (1), (2), (3), (5), and (6). That is, it is assumed initially that the parameter values are consistent with a solution for w_s which satisfies (4a) and hence involves no migration. If the resulting w_s lies within the interval $w_s^* - M \leq w_s \leq w_s^* + M^*$, the values of the endogenous variables calculated from (1), (2), (3), (5), and (6) subject to $m = 0$ constitute the appropriate solution of the model. If instead the calculated value of w_s is less than $w_s^* - M$, (4c) holds and emigration will occur, so that $m < 0$ and $w_s = w_s^* - M$. In this case the relevant endogenous variables are u , s , e , m , and w_u , and their values can be obtained by solving (1), (2), (3), (4c), (5), and (6). Alternatively, if the calculated value of w_s is greater than $w_s^* + M^*$, (4b) holds; labor has an incentive to immigrate to the home country and will do so at a rate sufficient to insure that $w_s = w_s^* + M^*$. The relevant endogenous variables are determined from (1), (2), (3), (4b), (5), and (6).

The effects of parameter changes on the steady state values of the endogenous variables in these three regimes are summarized in tables 1 and 2.¹⁷ Our analysis assumes that these changes are not so large as to move the economy into a different regime. Table 1 applies to the no-migration regime, while table 2 gives corresponding results for a steady state with continuing emigration or immigration of skilled labor.

It should be noted that the model includes three interest rate variables: r_K , r_M , and r_E . In the analysis we use two extreme assumptions about the relationship between r_K , r_E , and r_M . We consider the case in which r_K changes with no effect on r_M or r_E ($dr_E = dr_M = 0$) and the case in which the change in r_K is fully reflected by r_M and r_E ($dr_K = dr_M = dr_E$). Other possible configurations are easily analyzed using the information provided in tables 1 and 2.

¹⁷ A mathematical appendix is available from the authors.

TABLE 1
 SUMMARY OF RESULTS: NO-MIGRATION REGIME
 $w_s^* - M(c_M, r_M) \leq w_s \leq w_s^* + M(c_M^*, r_M^*)$

Change in:	Increase in $r_K(dr_E = 0)$	Increase in c_E	Increase in $r_K(dr_K = dr_E)$
w_s	<0 if $F_{SK} > 0$ or $E_1 \simeq 0$? if $F_{SK} < 0$	>0	<0 if $1 - E_3u > 0$ and $F_{SK} > 0$ >0 if $1 - E_3u < 0$ and $F_{SK} < 0$? otherwise
w_u	<0 if $F_{KU} > 0$ or $E_1 \simeq 0$? if $F_{KU} < 0$	<0	<0 if $F_{KU} > 0$ or $E_1 \simeq 0$? otherwise
e	<0 if $F_{KU} < 0$ >0 if $F_{SK} < 0$ >0 if $F_{KU}, F_{SK} > 0$ and $F_{KU} > F_{SK}$ <0 if $F_{KU}, F_{SK} > 0$ and $F_{SK} > F_{KU}$	<0	<0 if $F_{KU} < 0$ or $F_{KU}, F_{SK} > 0$ and $F_{SK} > F_{KU}$? otherwise
u	>0 if $F_{US} > 0$? if $F_{US} < 0$	>0 if $F_{SK} > 0$ <0 if $F_{SK} < 0$	>0 if $F_{US}, F_{SK} > 0$? otherwise
s	>0 if $F_{US} > 0$? if $F_{US} < 0$	<0 if $F_{KU} > 0$ >0 if $F_{KU} < 0$	>0 if $F_{US} > 0, F_{KU} < 0$? otherwise
k	<0	<0 if $F_{SK} > F_{KU}$ >0 if $F_{SK} < F_{KU}$	<0 if $F_{SK} > F_{KU}$? otherwise
y_1	<0 if $F_{SK}, F_{KU} > 0$? otherwise	<0	>0 if $F_{SK}, F_{KU} > 0$? otherwise

TABLE 2
 SUMMARY OF RESULTS WITH IMMIGRATION OR EMIGRATION OF SKILLED LABOR
 $w_s = w_s^* + M^*(c_M^*, r_M^*)$ or $w_s = w_s^* - M(c_M, r_M)$

Change in:	Increase in $r_K(dr_E = dr_M = 0)$	Increase in c_E	Increase in $w_s^* - M$ or $w_s^* + M^*$	Increase in $r_K(dr_K = dr_E = dr_M)$
w_s	0	0	1	<0
w_u	<0	0	<0	<0 if $1 - M_2s > 0$ >0 if $1 - M_2s < 0$
e	>0	<0	>0	<0 if $[M_2(s+u) + E_3u - 1] > 0$ >0 if $[M_2(s+u) + E_3u - 1] < 0$
m	<0 if $F_{SK} > 0$ or $E_1 \simeq 0$? if $F_{SK} < 0$	>0	<0	?
u	>0	0	>0 if $F_{SK} > 0$ <0 if $F_{SK} < 0$	>0 if $F_{SK} < 0$? if $F_{SK} > 0$
s	>0 if $F_{US} > 0$ <0 if $F_{US} < 0$	0	>0 if $F_{KU} < 0$ <0 if $F_{KU} > 0$	>0 if $F_{KU}, F_{US} > 0$? if $F_{US} < 0$ or $F_{KU} < 0$
k	<0 if $F_{US} > F_{SS}$ >0 if $F_{US} < F_{SS}$	0	<0 if $F_{SK} > F_{KU}$ >0 if $F_{SK} < F_{KU}$	<0 if $F_{US} > F_{SS}$ and $F_{KU} > F_{SK}$ >0 if $F_{US} < F_{SS}$ and $F_{KU} < F_{SK}$? otherwise
y_1	<0	<0	<0 if $m > 0$ >0 if $m < 0$	<0 if $1 - M_2s > 0$? otherwise

II. Changing the Required Rate of Return on Investment

In a world of capital mobility, investors will allocate capital across regions so as to equate *net* returns, adjusted for risk. The required rate of return on capital r_K hence depends on the rate of return on capital elsewhere, the perceived risk of investing in the local economy, and taxation of income from capital. Programs to aid developing countries or depressed regions of modern economies often include measures to stimulate capital inflows by reducing the necessary rate of return, r_K . Examples of such measures are special tax incentive plans and loan guarantee programs.¹⁸ Changes in r_K may also result from secular economic developments abroad or nationalization of foreign capital (which affects the perceived risk to foreign investors).

Using the results presented in the first column of tables 1 and 2, we can evaluate the consequences of a decrease in r_K which has no effect on r_E and r_M .¹⁹ From table 1 it can be seen that when no migration of skilled labor takes place before or after the change in r_K , the effects of a decrease in r_K on net labor income are ambiguous and depend on whether skilled labor and capital are q -complements or q -substitutes in production. Following Hicks (1956), two factors i and j are q -complements if $F_{ij} > 0$ and q -substitutes if $F_{ij} < 0$. The "normal" case is taken to be that in which all three factors are q -complements in production.²⁰

In our normal case, a reduction in r_K leads to an increase in both w_s and w_u . The effect of this change on the fraction of the population acquiring education is ambiguous, however, and depends on whether the skilled-unskilled wage differential narrows or increases. This differential will increase if $F_{SK} > F_{KU}$, so that an inflow of capital raises the marginal product of skilled labor by more than it raises the marginal product of unskilled labor. This result is illustrated in figure 1. The net labor income of native-born individuals is plotted as a function of their natural ability, a , where $0 \leq a \leq 1$; an individual with ability a is more able (in terms of educability) than $a \cdot 100$ percent of the population. The net labor income distribution curve, shown as a solid line in figure 1, is drawn under the assumption that each skilled laborer pays the marginal social cost of his education, which is a function of his ability, so that individual cost of education declines as a increases. The income curve is always flat in the initial region, indicating that individuals with ability less than some critical level a_0 (which depends on values of the parameters) remain unskilled and receive net income equal to w_u^0 . An educated individual with ability a

¹⁸ These include programs administered by IDA, IBRD, or, in the United States, the Economic Development Administration.

¹⁹ The interest rates r_M and r_E reflect the cost of borrowing against expected future income. Because of greater uncertainty surrounding the return to human capital, market-determined rates r_M and r_E might be expected to exceed r_K . However, private and government programs sometimes subsidize human capital investment; to this extent the link with r_K is more tenuous. Similarly, special tax incentives might affect only r_K .

²⁰ Concavity of F implies that at most one cross-partial derivative can be negative.

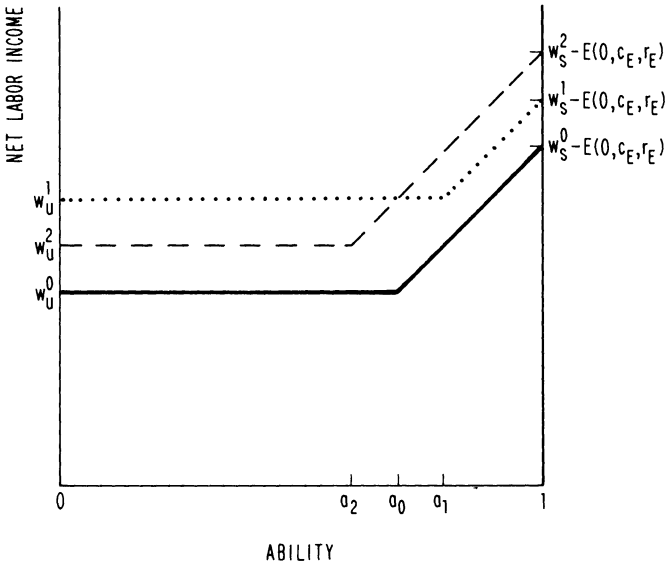


FIG. 1.—Effects of a reduction in r_K in the no-migration regime; $F_{SK}, F_{KU} > 0$

receives net income equal to $w_s - E(1 - a, c_E, r_E)$, an increasing function of a .²¹

The dotted and dashed lines illustrate two possible outcomes of a reduction in r_K in the normal case. Whether the kink in the new distribution curve occurs to the left or to the right of the initial kink depends on whether e increases or decreases. When $F_{KU} > F_{SK}$, there is a stronger q -complementarity between capital and unskilled labor than between capital and skilled labor. Thus, while the wages of both types of labor rise to w_u^1 and w_s^1 respectively, that of unskilled labor rises by more. The reduced differential implies a lessened incentive for educational investment and a correspondingly lower value of e . The resulting net labor income distribution is shown by the dotted line in figure 1. Similarly, with $F_{KU} < F_{SK}$ the skilled-unskilled differential rises to $w_s^2 - w_u^2$, inducing an increased fraction $e_2 = 1 - a_2$ of the population to become educated. The resulting net labor income distribution is shown in figure 1 by the dashed line.²² In the no-migration regime, y_1 and y_2 are identical and must rise in the normal case.

²¹ The difference between the gross and net income of the most able individual, given by $E(0, c_E, r_E)$, is the *minimum* cost of transforming an unskilled worker into a skilled worker. The slope of the net income curve depends on how fast this cost rises with declining ability and the distribution of ability in the population. The rising portion of the curve need not be linear as drawn here.

²² The implications for income inequality measures such as the Gini index are ambiguous in both cases and depend on the distribution of ability and the form of the E function.

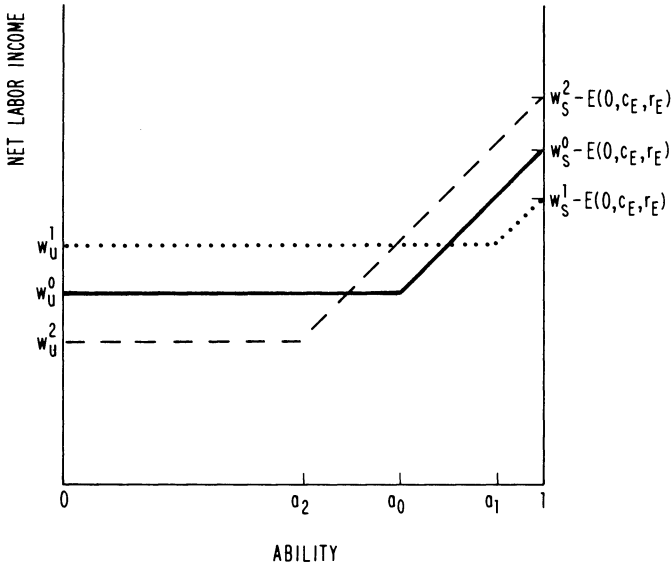


FIG. 2.—Effects of a reduction in r_K in the no-migration regime; $F_{SK} < 0$ or $F_{KU} < 0$

Figure 1 assumes that all factors are q -complements. However, if capital and skilled labor are q -substitutes, the wage of skilled labor may fall while the wage of unskilled labor rises, so that the fraction of the population obtaining education falls. The consequences for labor income distribution are shown by the dotted line in figure 2. Similarly, if unskilled labor and capital are q -substitutes, a decrease in r_K always increases the wage rate of skilled labor but may also lead to a decline in the wage rate of unskilled labor. In this case, skilled labor profits at the expense of unskilled labor and the distribution of net income becomes less equal. This result is illustrated by the dashed income distribution curve in figure 2. Average net labor income, y_1 , can either rise or fall.

It is important to note that these consequences of a change in r_K for the distribution of income hinge on the assumption that the net wage of skilled labor increases with ability; each inframarginal skilled worker receives a rent, determined by his ability. If alternatively the private cost of acquiring education is independent of ability, all labor receives the same net income, equal to w_u in equilibrium. Specifically, suppose that each individual bears the average social cost of education for the entire group. As long as this average cost is less than the skilled-unskilled wage differential, *any* unskilled worker will wish to invest in education. We assume that the queue is ordered by ability, so that inclusion of the marginal trainee brings average cost and the wage differential into equality. But if average cost is equal to the differential, each skilled worker receives a net income equal to the unskilled wage rate, and more able

skilled workers are no better off than less able skilled workers. As (7') and (8') indicate, under the average cost pricing scheme $y_1 = y_2 = w_u$. In this case education raises productivity of the marginal trainee by less than the resulting addition to total educational cost for the group; as one would expect, this leads to overinvestment in education.²³ When the private cost of education is independent of ability, a decline in r_K may produce perverse results. If w_u falls, which can happen if unskilled labor and capital are q -substitutes, every laborer will be worse off after the change than before, in spite of the fact that the fraction of the population receiving education and the gross wage rate of skilled labor both increase.

When the economy experiences either immigration or emigration both prior to the fall in r_K and after it, the consequences of a reduction in the required rate of return are unambiguous. As indicated by the first column of table 2, there is no change in the skilled wage rate, the wage rate of unskilled labor rises, and the fraction of the population acquiring education falls. The change in the net labor income distribution in this case is illustrated in figure 3. The rate of emigration (immigration) declines (increases) if capital and skilled labor are q -complements. Average net labor income of natives, y_1 , must rise. The movement in y_2 , average net labor income of *residents*, depends both on the change in y_1 and the change in the proportion of educated natives emigrating. If this proportion rises sufficiently, y_2 can fall even when y_1 increases and even though no *individual* in the region has lower labor earnings; divergent movements in y_1 and y_2 merely reflect compositional changes in the relevant populations.

The above discussion assumes that the fall in r_K leaves r_E and r_M unchanged. If these discount rates are not independent of r_K , their lower values in turn reduce the amortized cost of education and of migration. The effects of these further changes are discussed in detail in Sections III and IV below. For the special case in which changes in r_K are fully reflected in r_E and r_M , the directions of the total effects are indicated in the third column of table 1 and the fourth column of table 2.

The effect of a reduction in r_K on the net income to local investors depends upon the source of the change. If the fall in r_K reflects reduced attractiveness of investment elsewhere—owing, for instance, to higher tax rates or greater risk—then local capitalists will receive a correspondingly lower net return. However, if the fall in r_K is induced by increased domestic incentives such as loan guarantee programs or special tax treatment, net income from domestic investments will be unchanged.²⁴ In

²³ In terms of efficiency, the average cost scheme results in overinvestment in education unless entry is restricted. However, if entry is limited to those with ability above that for which marginal cost E is equal to the wage differential, charging each individual the average cost for the group would maintain a positive *net* income differential but make this rent independent of individual ability within the group of skilled workers.

²⁴ We do not consider here the efficiency aspects of such incentives. However, unless capital market distortions or other special circumstances exist, investment incentives result in an inefficient allocation of capital between the home and foreign regions.

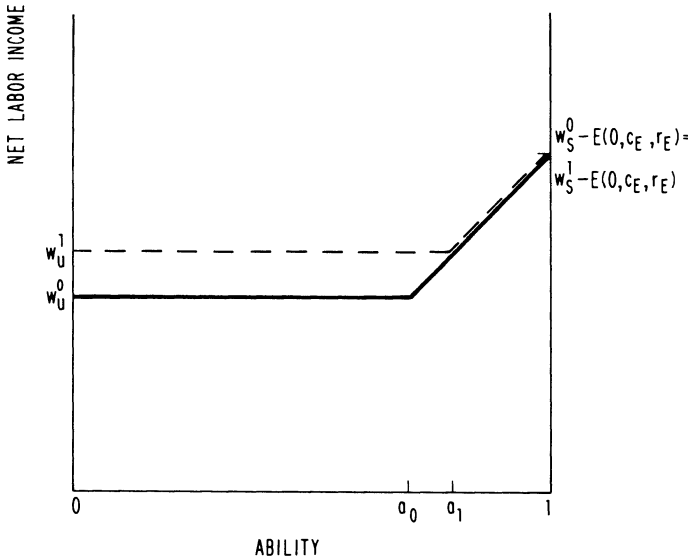


FIG. 3.—Effects of a reduction in r_K in the immigration (emigration) regime

the no-migration regime, capital per worker, k , must rise. Similarly, where there is migration, k will rise unless unskilled labor is a strong q -substitute for skilled labor.

III. Changing the Private Cost of Education

A reduction in the parameter c_E lowers the private cost of education for given values of e and r_E . Government subsidies to education may thus be interpreted as lowering c_E . Likewise, foreign aid programs which finance local education or provide training for local citizens at foreign universities also serve to lower c_E . The effects on net labor earnings of such policies are unambiguous.²⁵ When no migration takes place before or after the reduction in c_E , the gross wage of skilled labor falls, the return to unskilled labor rises, and the fraction of the population acquiring education also rises. Unskilled labor is clearly better off. If the reduction in education costs is neutral with respect to ability, so that the cost falls by the same amount for all individuals acquiring education (and the price of education is related inversely to ability), skilled labor is also better off because its net return rises. This net return is equal to the skilled wage rate less the cost of acquiring education and in this instance w_s falls by less than the

²⁵ As noted in Section III above, a reduction in the discount rate r_E is equivalent in its effects to a reduction in the educational cost parameter c_E . Thus, the second column in tables 1 and 2 may also be interpreted as providing the effects of a change in r_E .

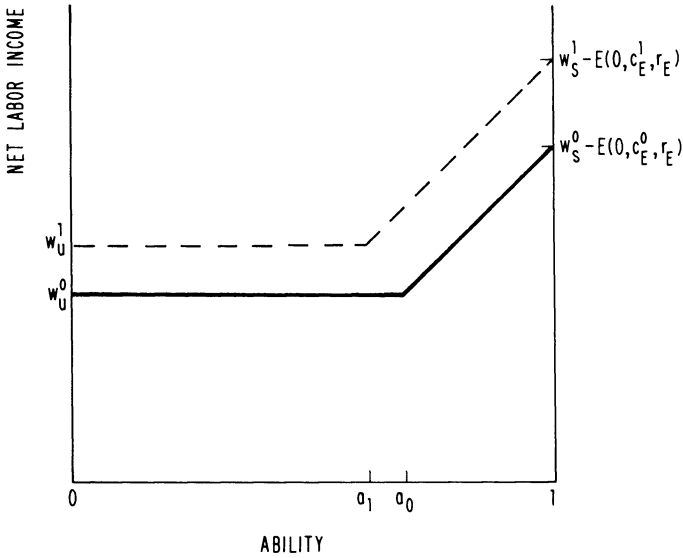


FIG. 4.—Effects of a reduction in c_E in the no-migration regime

fall in the cost of education. Average net labor income must rise. The outcome for the distribution of income is illustrated in figure 4.

If the local economy is an exporter (importer) of skilled labor prior to and after the change in c_E , the results in table 2 indicate that there will be no change in the wage rates of skilled or of unskilled labor. In this instance, the fraction of the labor force acquiring education increases and the economy increases its exports (decreases its imports) of skilled labor. Although there is no change in the net income of individuals who are unskilled before and after the shift in c_E , the net income of skilled labor increases as a result of the decline in the private cost of education. This result is illustrated in figure 5. Average net labor earnings of native-born individuals must rise.

These results depend on the assumption that the private cost of education varies inversely with ability. Under the alternative assumption that all individuals who acquire education pay the *average* cost of this training, there is no gain to any laborer in the migration case. When no migration occurs, the increase in net income of all labor is equal to the increase in the unskilled wage rate w_u .

With regard to the income from capital, the assumption of perfect capital mobility implies that the steady state value of r_K is unaffected by policies which reduce the private cost of education. In the no-migration regime, capital per worker may rise or fall, depending on the relative degrees of q -complementarity between capital, skilled labor, and unskilled labor. When migration occurs, k is unchanged.

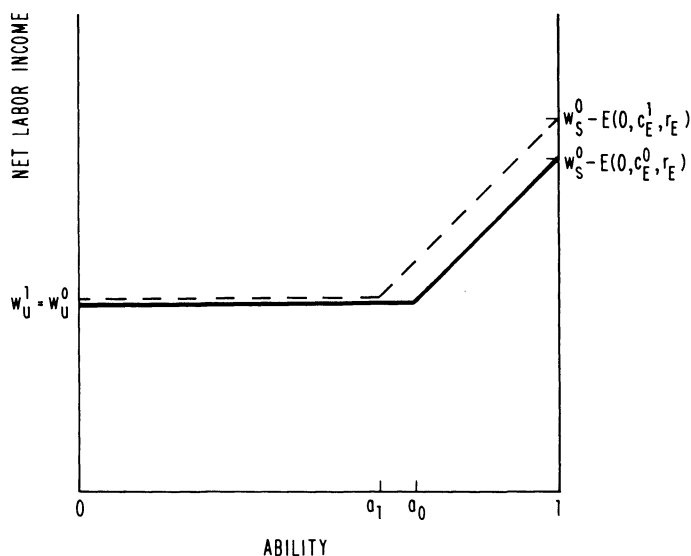


FIG. 5.—Effects of a reduction in c_E in the immigration (emigration) regime

IV. Changing the Returns to Migration

A tool widely regarded as useful in aiding depressed regions is subsidization of the costs of factor migration. If the cost to skilled labor of migration is reduced, one would expect skilled labor to be better off, with the gains shared by migrants and nonmigrants. This view is implicit in the regional policies pursued in many advanced countries. On the other hand, enthusiasm for interregional mobility has not been shared by the policy-makers in most less developed countries, and concern about the brain drain is widespread.²⁶ Many LDC governments favor maintenance of strict immigration controls by the United States and other developed countries.

Our model can be used to examine the effects of lower emigration costs on the distribution of net labor income. When the private cost of education varies inversely with ability, the results in table 2 indicate that there are both gainers and losers from this change. Skilled labor gains through a rise in its wage rate, but the least able members of the population—that fraction of the population which remains unskilled both before and after the change—are clearly hurt. The widening of the differential between the skilled and unskilled wage rates leads some individuals to acquire education after the change who would not have acquired it before. Prior to the change, the marginal untrained worker was indifferent between

²⁶ Recent theoretical contributions on the brain drain issue are surveyed by Bhagwati and Rodriguez (1975).

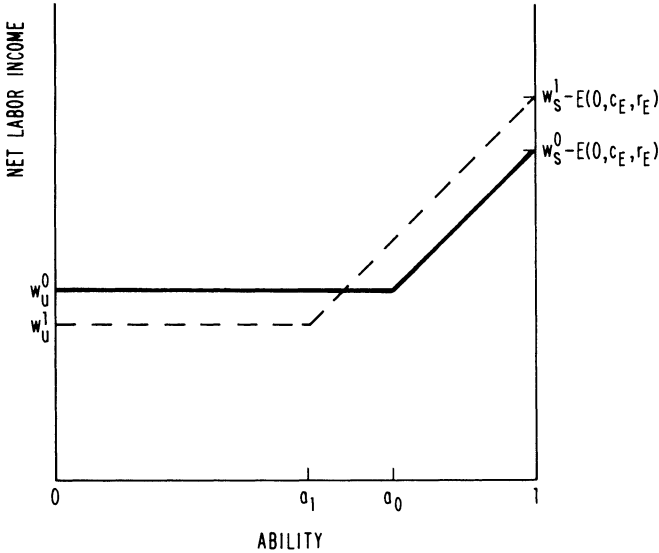


FIG. 6.—Effects of reduced costs of migration

acquiring and not acquiring education; hence his real wage w_u was exactly equal to w_s less the cost of acquiring education. After the change, this worker faces a higher w_s (as well as a lower w_u) and thus acquires education. His net income has risen by the same amount as the gross skilled wage rate. But the worker now on the margin between acquiring education and foregoing it is clearly worse off; his net income is just equal to the new lower value of w_u . This result is illustrated in figure 6 (which assumes that the private cost of education reflects individual ability). As long as the region experiences positive emigration, average net labor income of natives must rise.

Again, it should be noted that if all individuals pay the average cost of education, so that net income is equal to w_u for both types of labor, both groups lose as a consequence of lower emigration costs. Such a result is typical in a second-best world.

In light of this finding, the opposition of less developed countries to relaxation of immigration controls by advanced countries may be rationalized in terms of the redistribution of income from unskilled to skilled labor which would result from such a change. Likewise, skilled labor in more developed countries stands to gain from the imposition of barriers to immigration; a reduction in the cost of immigration leads to a decline in income of skilled labor there and an increase in the earnings of unskilled labor.

V. Conclusion

This paper investigates the distributional consequences of policy changes in a world of differential factor mobility. The results of the analysis underscore the importance of complementarity and substitutability relationships among factors in production. The pricing scheme used by educational institutions is also seen to play a key role in determining distributional effects.

The model developed in this paper deals only with the implications of factor mobility for the pattern of earnings in long-run equilibrium. However, concern over the distributional effects of factor mobility or of changes in mobility incentives may be directed even more at short-run dislocations than at the new steady state pattern of factor rewards.²⁷ Policy-induced changes in factor earnings may be larger in the short than in the long run.²⁸ Furthermore, the adjustment process may entail temporary unemployment of some factors. Hence the extension of our analysis to encompass the dynamics of adjustment is an important avenue for further research.

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²⁷ See Thomas 1967.

²⁸ A movement of any factor in or out of a region creates immediate pressures for changes in the pattern of factor prices within that region, and these changes in turn affect investment decisions, including the decision to invest in education or to move in or out of the region. In the short run, positive and negative quasi-rents appear as prior expectations are falsified by events.

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