THE BRAIN DRAIN, INTERNATIONAL INTEGRATION OF MARKETS FOR PROFESSIONALS AND UNEMPLOYMENT: A THEORETICAL ANALYSIS*

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*Thanks are due to the National Science Foundation for financial support of the research underlying this paper. We are happy to honor Lloyd Metzler with this article, even though he himself did not consider the question which we have explored in the paper. The topic has been discussed by Metzler's colleagues, especially Harry Johnson, although it is ironic perhaps that the framework and conclusions of our analysis are somewhat "anti-Chicagoesque": but perhaps this is absolutely fitting if one is honoring Metzler whose undoubted and considerable claim to fame rests on work that cannot be fitted into the Chicago tradition either.

The views expressed in this paper are the authors' responsibility and do not reflect those of the National Science Foundation, the Department of Economics nor of the Massachusetts Institute of Technology.
The Brain Drain, International Integration of Markets for Professionals and Unemployment: A Theoretical Analysis

Nearly the entire theoretical literature on the effects of the "brain drain" from the less developed countries on their welfare has been undertaken in the framework of neoclassical models of the Hicks-Samuelson value-theoretic variety.*

While the analysts in this genre have greatly clarified certain issues such as the nature of the objective function to be specified, their analysis and prescriptions have been constrained by the theoretical model which they work with. The central result of their analysis, attributable to Grubel and Scott [3], that brain drain *prima facie* should not be a cause for worry as the drained person will only take away the value of his marginal product which he himself earns anyway, can be rather obviously shown to be subject to the limitations that i) for finite, rather than infinitesimal, shifts of labour, there would still be a loss to those left behind; **ii) if the social marginal product exceeds the private marginal product, thanks to strong externalities, as would seem to be the case with doctors and exceptionally-gifted academics about whose emigration typically the underdeveloped countries

*See, in particular, Grubel and Scott [3] and Johnson [5].

**On the other hand, depending on the size of the emigration and the nature of the production function, this loss may still be very small.
seem to worry, then again there is a loss to those left behind; * and iii) if the State has financed the education which is embodied in the skilled worker who migrates, and if it is assumed that the State would have taxed this skilled worker—a realistic assumption when there is progressive taxation—partially or wholly to "recover" the return on this investment, then his emigration does deprive those left behind of this return and thus worsens their welfare.

These are useful insights into the problem of the "brain drain." However, admittedly, the analysis is overly simple and could be extended in many directions. An obvious growth-theoretic extension would be to bring in savings behaviour and maximization of welfare over time for those left behind. Or, within the confines of the Hicks-Samuelson model, the analysis could be enriched to allow for remittances from the emigrated people: an argument which qualifies the conclusions in favour of permitting the brain drain. The neoclassical model could further be extended fully in the direction of trade-theoretic models with factor movements: the effect of the labour migration on the commodity terms of trade of the labour-losing country could be readily analysed along the lines of the recent Jones [8] and Kemp [9] contributions to the welfare theory of international capital movements. **

* On the other hand, one could stretch things a great deal and argue that, for some emigrants, their contribution to social product still continues to accrue to the home country: e.g. an Indian scientist's achievements abroad "inspire" his countrymen at home; and that this happens without their earning their private product from the home-country's GNP and also that their social product may even increase if their achievements improve in a more efficient and productive environment than the one found in their home country.

**Johnson [6] has extended the analysis of the problem in a yet different direction, by assuming that skilled-labour migration reduces both the labour and the capital stock of the emigrating country.
But few of these extensions of the Hicks-Samuelson value-theoretic model are anything but analytic modifications which admit into the model the kinds of complexities which the model itself, rather than reality, suggests. It is necessary therefore to see whether an alternative value-theoretic model can be devised which comes closer to reality as observed in certain underdeveloped countries.

In particular, certain important aspects of the educated-manpower problem in underdeveloped countries have been noted by the non-theorists:

(1) The presence of international income-inequality implies that, for the educated elite which is better informed about the developed world, and more integrated therewith regarding notions of a "good life" and related values, the salary levels demanded and fixed by the elite groups themselves tend to reflect the salary levels of comparable groups in the more developed countries. Rene Dumont (1969) has argued for French Africa:

During the last phase of colonialism, the policy was to equalize salaries of Africans and Europeans in similar jobs, a defensible position only in the framework of 'assimilation'. The native civil servant, in addition to his regular salary, received a colonial supplement. This has been reduced in some cases, but not abolished. At independence, this pseudo-equality has led to flagrant disparity with the rest of the population, whose standard of living is often a fifteenth of the French.

Massive departure of the French resulted in a high rate of promotion of subordinate African civil servants, who thus earn even more now than before, for the same qualifications. The student returning from France is appointed director if he is the only African technician or graduate in his field.

Indeed, this phenomenon has been noted by Osvaldo Sunkel [10] for Latin America and by Dudley Seers and Richard Jolly [7] for a wider group of

* Rene Dumont, [4], p. 80.
countries. Thus, we can postulate a socio-economic situation in which the real wage levels of the educated elites are set by fiat, legislation, unionisation, etc., at levels which reflect the degree of response to the international-elite-integration effect just outlined.

(2) This phenomenon of educated-elite wages, "way out of line with the average per capita income of the underdeveloped countries" is next regarded as often leading to a "leap-frogging" process under which the lowest wages tend to get pulled up by the highest: hence the phenomenon of such institutionally-defined wages tends to run through the entire labour-market.

(3) With these institutionally-defined wages, it is inevitable that the labour-market must work so as to have open unemployment of labour (except in singular cases); and this too is an observed phenomenon: educated and also uneducated people are often unemployed in the developed countries.

(4) At the same time, the phenomenon of high wages, accruing to the (employed) educated elite, creates a political demand for education. Rene Dumont [4] has again described the French African situation vividly:

PRESENT EDUCATION OBSTRACTS PROGRESS

This statement may appear paradoxical to many readers, particularly coming from the pen of a professor, since education was the essential foundation of development in Europe, America, Japan, the Soviet Union and China. In Africa it has a certain utility, but this is greatly curtailed by the social milieu on to which the educational system was grafted. For most African children, in town and country alike, school represents above all a means of entering the elite class. Even in the most backward areas of the bush everyone has grasped the fact that the official with clean hands earns more and works much less.
Pushed by his parents, a peasant child quickly realizes that he can never go very far in agriculture; the only way to get ahead is to get out. He goes to school and works very hard, to this end, sometimes at the price of incredible sacrifices. I have heard of a child in Chad who walks twice a day the twenty kilometres separating his house from school.

...Before long, these young people end up in the shanty-towns of the capitals and become social parasites. Their days are spent writing requests for jobs, requests that pile up in all the administrations. Some of them, in Douala for example, join the underground.*

But this is a situation which is to be found in a large number of underdeveloped countries, indeed.

(5) And the demand for education is translated into educational expenditures by the State, in these underdeveloped countries, with visible alacrity. In India, for example, the number of colleges expands, with little time lag, to accommodate the students who qualify with "passing marks" from the high schools: and the standards in the latter have, in turn, fallen to accommodate the larger flows of students seeking educational qualifications.

A value-theoretic model which accounts for these phenomena is clearly more relevant for analysis of the questions pertaining to the labour market, such as the welfare effect of the brain drain, in several underdeveloped countries than the neoclassical model (which assumes fully flexible wages, for example).

We proceed therefore to the construction of precisely such a model in Section I and then analyse the phenomena of brain drain and increasing international integration of elite groups in its framework in Section II. In Section III, we discuss a number of variants of this basic model. In Section IV, we draw together the welfare implications of emigration in the

framework of our model and its variants, also examining the effects of taxing emigrants—a policy that has sometimes been advocated in the literature.*

In particular, since our model allows for the existence of unemployment for both educated and uneducated labour, our discussion of welfare will involve examination not merely of the (conventional) impact on the domestic availability of goods and services for final use but also of the effect of each policy measure on the level and the degree of unemployment, if any, of each class of labour.**

*See, for example, Bhagwati and Dellalfar [2].

**We might as well note explicitly that the kind of model we build and analyse in this paper is not universally valid, even on casual empiricism. Thus, for example, in Japan, the (relative) wage level of intellectuals in Japan has managed to remain virtually unaffected by the significantly higher level of remuneration for their counterparts in the West. This may be one of the many respects in which Japan has apparently differed from the other "latecomers" in the process of industrialization and integration of the world economy and polity, exhibiting a remarkable ability to adhere to an "inner-directed" posture in her political and cultural methods.
I. The Basic Model

The simplest general equilibrium model, incorporating the features described above, which can be constructed for our analysis is set out below.

Assume two commodities $m_1$ and $m_2$. Let their outputs $M_1$ and $M_2$ be related to the inputs by the following production functions which possess the standard properties including twice differentiability and linear homogeneity.

$$M_1 = F_1(K_1, L_1)$$  \hspace{1cm} (1)
$$M_2 = F_2(K_2, L_2)$$  \hspace{1cm} (2)

where $K_1$ and $K_2$ are quantities of factor $K$ which are specific to the production activities of $m_1$ and $m_2$ respectively; $L_1$ is the quantity of skilled/educated labor employed in $m_1$, and $L_2$ is the quantity of unskilled/uneducated labor employed in $m_2$. Note that educated labor enters only $m_1$-production and uneducated labor enters only $m_2$-production.

In addition to the simplifying assumption of specificity of $K_1$ and $K_2$ to each industry, we further assume that the country is a "small" country, in Samuelson's sense, so that the commodity price ratio $p_1/p_2 = \pi$ is exogenously fixed.

We next assume that the real wage of educated labor is fixed, by international emulation and associated union-fixation or wage legislation at level $\bar{w}_1$ in $m_2$-units. Note that this automatically defines $(\partial F_1/\partial L_1)\pi$ and hence, given $K_1$, $L_1$ and $M_1$. Similarly, assume that the "leap-frogging" process fixes the minimum wages of unskilled labor $L_2$ at $\bar{w}_2$ ($= \partial F_2/\partial L_2$), and hence, given $K_2$, also $L_2$ and $M_2$. Thus we can write the following two factor market equations:
\[
\frac{\partial F_1}{\partial L_1} = \frac{w_1}{\pi}, \text{ or } L_1 = g_1(\frac{\omega_1}{\pi}) \tag{3}
\]

\[
\frac{\partial F_2}{\partial L_2} = \omega_2, \text{ or } L_2 = g_2(\omega_2). \tag{4}
\]

Then with \(U_1\) and \(U_2\) denoting the unemployed, educated and uneducated labor respectively, \(N_1\) and \(N_2\) denoting educated and uneducated labor supply respectively, and \(\bar{N}\) representing the total fixed labor supply, we have three balance equations:

\[
L_1 + U_1 = N_1 \tag{5}
\]

\[
L_2 + U_2 = N_2 \tag{6}
\]

\[
N_1 + N_2 = \bar{N}. \tag{7}
\]

But we next need to know how the available labor supply will divide between \(N_1\) and \(N_2\). To do this, we need to introduce equations to determine the supply of educated labor \(N_1\). We shall assume that there will be a positive inducement to get educated as long as the expected wage for educated labor exceeds the expected wage for uneducated labor.

Let the expected wage for educated labor \(Ew_1\) then be the average wage for it, namely,

\[
Ew_1 = \omega_1\frac{L_1}{N_1}. \tag{8}
\]

---

*Бхагвати и Сринивасан (1972) have analysed an alternative adjustment mechanism for the labour market, where the unemployment of skilled labour is not permitted as long as there are enough jobs in the unskilled labour market. Under this theory, the available supply of skilled labour first gets absorbed in the skilled labour market, and the spillover then takes the available jobs in the unskilled labour market (where the two kinds of labour are equally productive but the employers sociologically prefer giving jobs to skilled over unskilled applicants). The Bhagwati-Srinivasan model is designed to study the phenomenon of "overqualification," whereby the educated seem to get into the uneducated-level jobs over time: a phenomenon which has sometimes also been called the "upgrading" of jobs.
and the expected wage for uneducated labor $Ew_2$ be the average wage for it:

$$Ew_2 = \frac{w_2 (L_2/N_2)}{9}$$

and the equilibrium condition then is:

$$Ew_1 = Ew_2$$

(10)

Note that this equilibrium condition makes sense insofar as we are assuming that the State undertake the cost of education, and not labour itself. It is assumed therefore that as long as $Ew_1 > Ew_2$, there will be a politically effective excess demand for State-financed educational facilities to be opened up, for $N_2$ to be turned into $N_1$ until $Ew_1 = Ew_2$. However, to analyze the effect of this assumption on the level of national income, we may simply subtract the cost of this education from national production of $m_1$ and $m_2$ to arrive at the national income available for consumption:

$$Y = (\pi M_1 + M_2) - kN_1$$

(11)

where $k$ is the fixed educational cost, in $m_2$-units, per person; this cost being subtracted from total output of $M_1$ and $M_2$ to arrive at the net output available for consumption $Y$. It follows that increasing $Y$ is tantamount to increasing the value of a conventional social welfare function defined in terms of goods and services available for domestic consumption.

This basic model thus has eleven equations and eleven unknowns: $M_1$, $M_2$, $L_1$, $L_2$, $U_1$, $U_2$, $N_1$, $N_2$, $Ew_1$, $Ew_2$, and $Y$. It is also a model in terms of which we can analyze meaningfully a number of questions relating to the brain drain problem and the phenomenon of international integration of the educated-labor markets.

*To ensure proper dimensionality in the analysis that follows, this educational cost must be regarded as the "annual" flow-equivalent of the educational cost incurred to train a man.
II. Brain Drain and International Integration of Market for Professionals

This basic model can be easily contrasted with the case where both wages are flexible and labour pays for the cost of education. Note first that we have here three sources of economic inefficiency: the two sticky wages plus the free education. In the absence of these three inefficiencies, the economy would have reached the standard Pareto-optimal equilibrium with the following first-order conditions:

\[ w_1 - k = \frac{\partial F_1}{\partial L_1} - k = \frac{\partial F_2}{\partial L_2} = w_2 \]  

(12)

with full employment of labour. In analysing the model with the three inefficiencies which we have noted, we now proceed through successive possibilities, analysing the effects on unemployment and national income in four alternative cases:

Case I: Our-Joneses-Keeping-Up-With-Their-Joneses: This is the case where the country's educated/skilled labour, on integrating with the outside-world's educated/skilled labour, demands and achieves an increment in its salary level: this is therefore the case where there is a primary increase in \( w_1 \).

Case II: Keeping-Up-With-Our-Joneses: This is the case where we have the well-observed "leap-frogging" process, so that the rise in \( w_1 \) (the wage of skilled labour) leads to a sympathetic rise in \( w_2 \) (the wage of unskilled labour).

Case III: Emigration-Of-Our-Joneses: This is the case where the emigration of skilled labour to higher-wage areas abroad leads to higher expected wage to skilled labour: either via mere reduction in unemployment of skilled labour at home and consequent increased assurance of the domestic
wage \( w_1 \) or via pushing up the expected wage because the wage-rate abroad is higher than the domestic wage.

**Case IV: The General Case of Emigration and Rise of Wages:** This is the general case where the emigration of skilled labour is also accompanied by a sympathetic rise in the domestic wage \( w_1 \): a case that is plausible because more emigration could imply more integration of the professional markets for skilled labour internationally. This general case therefore considers the totality of effects from Case II and Case III: the emigration effect of Case III being combined with the dual wage-increase effect of Case II.

We now analyse these cases, in turn. The following analysis is carried out on the assumption that a marginal change in wages or emigration still leaves some unemployment in each sector; otherwise, neoclassical competitive analysis would be applicable.

**Case I: Our-Joneses-Keeping-Up-With-Their-Joneses**

This is the case where the educated labour force is getting culturally integrated internationally, and the effect is to exercise an upward pull on its domestic salary level. This phenomenon of "our-Joneses-keeping-up-with-their-Joneses" can be analysed simply then by analysing the effect of a shift in \( w_1 \).

We can see the effect of the increase in \( w_1 \) on employment by differentiating (3) and (4):

\[
\frac{dL_1}{dw_1} = \frac{1}{\pi} g_1(w_1/\pi) < 0, \quad \left\{ \text{because } g_1'(w_1/\pi) = \left( \frac{\partial^2 F_1}{\partial L_1^2} \right)^{-1} < 0 \right\} \quad (13)
\]

\[
\frac{dL_2}{dw_1} = 0. \quad (14)
\]
The employment in $m_1$-sector will decrease in response to the rise in wages in its own sector and the employment in $m_2$-sector remains the same.

However, unemployment in both sectors depends on how labour divides into the two types of labour. In order to see the effect of the wage increase in $m_1$-sector on the division of labour supply into the two types, we shall differentiate the following two equations:

$$N_1 + N_2 = N \tag{7}$$

$$w_1(L_1/N_1) = w_2(L_2/N_2), \tag{15}$$

(15) being derived from (8), (9) and (10). Differentiating with respect to $w_1$ and noting (14), we get:

$$dN_1 + dN_2 = 0 \tag{16}$$

$$w_1L_1dN_2 - w_2L_2dN_1 = -w_1N_2dL_1 - L_1N_2dw_1. \tag{17}$$

Hence,

$$\frac{dN_1}{dw_1} = \frac{w_1N_2L_1}{w_1L_1 + w_2L_2} \tag{18}$$

where $\eta_1 \equiv -\frac{w_1L_1}{L_1dw_1}$ is the elasticity of the demand for labor in $m_1$-industry. By virtue of (15) we have:

$$w_1L_1 + w_2L_2 = w_1(L_1/N_1)N_1 + w_2(L_2/N_2)N_2 = w_1(L_1/N_1)N.$$ 

Accordingly, (18) simplifies to:

$$\frac{dN_1}{dw_1} = (1-\eta_1)N_1N_2/(Nw_1), \tag{19}$$

or, in elasticity terms,
Thus the supply of educated labor increases or decreases depending on whether the elasticity of demand for labor in \( m_1 \)-industry is less or more than unity. This result is easy to understand, of course, because the outcome regarding the supply of educated labor depends on the impact effect of the wage change in \( m_1 \) on the expected wage \( (Ew_1) \) in that sector: and the expected wage will rise insofar as the actual wage rises but fall insofar as (educated) labour is laid off by profit-maximising entrepreneurs in \( m_1 \) in consequence. The net outcome is determined by whether the elasticity of demand for labour in \( m_1 \) is higher or lower than unity: in the former case, the net effect is to lower the expected wage \( Ew_1 \); in the latter case, the net effect is to increase it.

At the same time, it is easy to see that the elasticity of demand for labour, \( \eta_1 \), is the ratio of the elasticity of substitution of the production function, \( \sigma_1 \), and the capital share, \( \alpha_1 \):

\[
\eta_1 = - \frac{w_1}{L_1} \frac{dL_1}{dw_1} = - \frac{F_L^1}{L_1F_{LL}} = \frac{F_L^1}{K_1F_{KL}} = \frac{F_L^1}{F^L_{KK}} \cdot \frac{\sigma_1}{\alpha_1}
\]

We may therefore restate the above proposition: the supply of educated labor increases or decreases depending on whether the elasticity of substitution in \( m_1 \)-industry is smaller or larger than the capital share in \( m_1 \)-industry.

We can now analyze the effect on absolute and relative unemployment of each sector.

(a) Absolute level of unemployment of educated labor.

\[
\frac{d}{dw_1}(N_1-L_1) = (1-\eta_1)N_1N_2/(w_1N) - \frac{dL_1}{dw_1} = (1-\eta_1)N_1N_2/(w_1N) + \eta_1L_1/w_1.
\]
Thus if the elasticity of demand for educated labour is less than unity, the absolute level of unemployment increases because the supply of educated labour increases while the demand decreases. However, even if the elasticity of demand for educated labor is greater than unity, so that the supply of educated labour is reduced (owing to reduced expected wage $E_{w_1}$), the absolute unemployment of educated labour would increase if the demand for such labour reduces even more: this would be the case if:

$$L_1/N_1 \geq \frac{N_2}{N}$$

or

$$L_1/N_1 < \frac{N_2}{N} \text{ but } \eta_1 < \frac{1}{1 - \left(\frac{L_1}{N_1}/\frac{N_2}{N}\right)}.$$  

(22)

(23)

This can be seen by rewriting equation (21) as:

$$\frac{d}{dw_1}(N_1-L_1) = \left\{1 - \eta_1 + \eta_1 \frac{L_1}{N_1} \frac{w_1}{N_2} \right\} \frac{N_1 N_2}{w_1 N}.$$  

In developing countries the elasticity of substitution in industrial sectors seems to be low, so that it is likely that the elasticity of demand for labour in $m_1$-sector is less than unity. Moreover, (22) is quite likely to be satisfied unless the unemployment rate in $m_1$-industry is extremely high. Therefore, we can conclude that the absolute unemployment in educated labour will most probably increase if the wage of educated labor increases.

(b) Relative unemployment of educated labour.

Similarly, from (14) and (20), we can derive:

$$\frac{N}{L} \frac{d}{dw_1} \left(\frac{L_1}{N_1}\right) = \frac{1}{L_1} \frac{dL_1}{dw_1} - \frac{1}{N_1} \frac{dN_1}{dw_1} = -\eta_1 \frac{L_1}{w_1} - (1-\eta_1) \frac{N_2}{N} \frac{1}{w_1}$$

$$= - \frac{N}{N} \frac{1}{w_1} \left(\frac{N}{N_2} - 1\right) \eta_1 + 1 \right\} < 0.$$  

(24)
Thus the relative unemployment of educated labour will always increase when the wage in m₁-industry increases.

(c) Unemployment of uneducated labour.

Since the employment of uneducated labour depends on its unchanged wage, it will clearly not change. However, the unemployment of uneducated labour will increase or decrease, depending on whether the supply of uneducated labour increases or decreases. Thus if \( \eta_1 < 1 \), so that the resulting improvement in \( Ew_1 \) has led to increase in educated labour, the stock of uneducated labour \( (N_2) \) will have been reduced and hence also the unemployment of uneducated labor. Similarly, if \( \eta_1 > 1 \), the unemployment of uneducated labor will have increased.

(d) National Income.

Next, it is easy to see that:

\[
\frac{dY}{dw_1} = \pi \frac{dM_1}{dw_1} + \frac{dM_2}{dw_1} - k \frac{dN_1}{dw_1} = \omega_1 \frac{dL_1}{dw_1} - \omega_1 \frac{dL_1}{dw_1} - k(1-\eta_1) \frac{N_1 N_2}{Nw_1}
\]

\[
= - L_1 \eta_1 - k(1-\eta_1) \frac{N_1 N_2}{Nw_1}
\]

(25)

National income will therefore change, when \( w_1 \) rises, because of two effects: (i) the decline in employment of (educated) labour will diminish output of \( m_1 \) without any offset from increment in output in \( m_2 \) where the employment has not changed; and (ii) the cost of educating labour will change, depending on whether the supply of educated labour increases or decreases. Clearly therefore, when \( \eta_1 < 1 \), the increase in the supply of educated labour will work to accentuate the reduction in income from the first effect: thus the result must be unambiguously to reduce national income, as is evident from (25). Moreover, even if we take the other case where \( \eta_1 > 1 \), provided that condition (22) or (23) is satisfied and \( k < w_1 \),
the net effect will be to reduce national income, again as is evident from (25). The only case when income will increase is where $k$ is large, $\eta_1$ is extremely large and the initial unemployment rate of educated labour is large and violates equation (22).

Case II: **Keeping-Up-With-Our-Joneses**

The next question we ask is what happens if the rise in $w_1$ leads, in turn, to a sympathetic rise in $w_2$ via the well-observed "leap-frogging" process: this may be called the *Keeping-up-with-our-own Joneses* phenomenon. We can indeed explore all the questions considered for Case I, for the case where both $w_1$ and $w_2$ rise.

The effect on employment in $m_1$-sector naturally remains the same as above; but there is now an additional negative effect on employment in $m_2$-sector, thanks to the induced rise in $w_2$:

\[
\frac{dL_1}{dw_1} = \frac{1}{\pi} g'_1(w_1/\pi) < 0, \\
\frac{dL_2}{dw_1} = g'_2(w_2) \frac{dw_2}{dw_1} < 0.
\]

The effect on the division of $N$ into $N_1$ and $N_2$ is next obtained by differentiating equations (7) and (15):

\[
dN_1 + dN_2 = 0 \\
w_2 L_2 dN_1 - w_1 L_1 dN_2 = w_1 N_2 dL_1 + L_1 N_2 dw_1 - w_2 N_1 dL_2 - L_2 N_1 dw_2.
\]

Thus, defining $\frac{dw_2}{dw_1} \equiv \theta (\theta > 0)$ and $\eta_2 \equiv -\frac{w_2}{L_2} \frac{dL_2}{dw_2}$, we get the following results:
Educated Labour: \[
\frac{dN_1}{dw_1} = - \frac{dN_2}{dw_1} = \frac{N_2 L_1 (1-\eta_1) - N_1 L_2 (1-\eta_2)}{w_2 L_2 + w_1 L_1}
\]

\[
= (1-\eta_1) N_1 N_2 / (\omega_1 \bar{N}) - \theta (1-\eta_2) N_1 N_2 / (\omega_2 \bar{N}) \quad (27)
\]

Unemployment of Educated Labour: \[
\frac{d}{dw_1} (N_1 - L_1) = (1-\eta_1) N_1 N_2 / (\omega_1 \bar{N}) + \eta_1 L_1 / \omega_1
\]

\[- \theta (1-\eta_2) N_1 N_2 / (\omega_2 \bar{N}) \quad (28)
\]

Rate of Employment of Educated Labour: \[
\frac{N_1}{L_1} \frac{d}{dw_1} \left( \frac{L_1}{N_1} \right) = \frac{\eta_1}{\omega_1} - (1-\eta_1) N_2 / (\omega_1 \bar{N})
\]

\[+ \theta (1-\eta_2) N_2 / (\omega_2 \bar{N}) \quad (29)
\]

Unemployment of Uneducated Labour: \[
\frac{d}{dw_1} (N_2 - L_2) = \theta \left\{ (1-\eta_2) N_1 N_2 / (\omega_2 \bar{N}) + \eta_2 L_2 / \omega_2 \right\}
\]

\[- (1-\eta_1) N_1 N_2 / (\omega_1 \bar{N}) \quad (30)
\]

Rate of Employment of Uneducated Labour: \[
\frac{N_2}{L_2} \frac{d}{dw_1} \left( \frac{L_2}{N_2} \right) = \theta \left\{ - \eta_2 / \omega_2 - (1-\eta_2) N_1 / (\omega_2 \bar{N}) \right\}
\]

\[+ (1-\eta_1) N_1 / (\omega_1 \bar{N}) \quad (31)
\]

Note that, in contrast to Case I, the signs of these expressions are ambiguous because the induced rise in \(w_2\) can offset the effects of the primary increase in \(w_1\). Thus, contrast (19) with (27), each dealing with the impact of the increase in \(w_1\) on the level of the educated labour force \((N_1)\). Under (19), for Case I, the level of \(N_1\) will rise if \(\eta_1 < 1\); however, under (27), the induced rise in \(w_2\), implying \(\theta > 0\), will work to reduce \(N_1\) if \(\eta_2 < 1\). And so on.

Finally, we may examine the effect on national income.
National Income: \[
\frac{dY}{dw_1} = w_1 \frac{dL_1}{dw_1} + \theta w_2 \frac{dL_2}{dw_2} - k \frac{dN_1}{dw_1}
\]

\[
= -\eta_1 L_1 - k (1 - \eta_1) N_1 N_2 / (w_1 \bar{N})
\]

\[
+ \theta \left( \eta_2 L_2 + k (1 - \eta_2) N_1 N_2 / (w_2 \bar{N}) \right).
\]

(32)

An interesting implication of (32), contrasted with (25), is that it is more difficult to exclude the possibility of increased income from the process of wage-increases. Thus, for example, take the extreme case where \( \eta_1 = \eta_2 = 0 \), and \( d\omega_1 = d\omega_2 \), i.e. \( \theta = 1 \). Then

\[
\frac{dY}{dw_1} = k (w_1 - w_2) N_1 N_2 / (w_1 w_2 \bar{N}) > 0.
\]

In this special case where the elasticities are zero, and where the factor intensities are consequently fixed, the simultaneous wage rise will increase national income because less people will get educated, thus reducing the cost of education, while employment in each sector is kept constant.

Case III: Emigration-of-Our-Joneses

We can now turn to the issue of actual emigration of educated labour. We can set up the problem by assuming an exogenous emigration of educated labour, \( Z \), which does not in itself lead to a simultaneous rise in the (actual) wage \( w_1 \) for educated labour; only in Case IV will we consider the fully general case where the emigration causes rise in \( w_1 \) as also an induced rise in \( w_2 \) as per Case II.

Equation (5) must then be rewritten as:

\[
L_1 + U_1 + Z = N_1
\]

(33)
so that the total educated labour is now the sum of domestically employed and unemployed plus emigrated labour.

There are alternative ways in which we can explore now the impact of such emigration on the system, but all of them must operate through the primary impact on expected wage in the educated-labour market. Let us take three possibilities.

(I): We may assume that the migration of a few educated members of the working force does not have any impact on the expected wage, as the migration is not wage-induced and does not lead to similar expectations. Then, in this singular case, as long as the migration of labour still leaves some unemployment of educated labour, the division of labour into the two types of labour is unaffected, so that the only effect is a reduction in the unemployment of educated labour. Clearly, moreover, production and national income are unchanged. However, since per capita income and the relative employment rate of educated labour are increased, social welfare should be increased by the "brain drain" for any reasonable social welfare function. If, therefore, the migration is welfare-improving for the migrants--an assumption that seems reasonable if they are pursuing self-interest--the emigration is a "good" event, causing welfare improvement for both the migrants and those left behind!

(II): But this "well-behaved" result will no longer carry through if we assume that the expected wage to educated labour will improve with the migration. This may happen in at least two plausible ways. Either the emigration may be treated as reducing the unemployment in the market for educated labour, so that the emigration is treated as raising the wage merely by increasing the number employed, without taking into consideration the
incremental wage accruing to those employed abroad as distinct from those employed at home: this may be called the **Incremental-Employment-Effect** variant of the model. Alternatively, we may assume that the fact that the emigrants earn a differentially-higher wage also affects the expected wage: this may be called the **Incremental-Employment-and-Differential-Wage** variant of the model.

We examine the former variant first.

For the **Incremental-Employment** variant, the effect of the emigration is to change the equation for the expected wage in $m_1$ as

$$Ew_1 = w_1 (L_1 + Z) / N_1.$$  \[34\]

Thus the division of total labour between the two groups (educated and uneducated) is determined now by:

$$w_1 (L_1 + Z) / N_1 = w_2 L_2 / N_2.$$  \[35\]

Noting that the employment of labor in neither sector is affected by $dZ$, we next have:

$$w_2 (L_1 + Z) dN_1 + w_1 N_1 dZ = w_2 L_2 dN_1$$

which gives, in combination with (16), the level of educated labour in the new equilibrium:

$$\frac{dN_1}{dZ} = \frac{w_1 N_2}{(w_1 L_1 + w_2 L_2 + w_1 Z)}$$

which in turn simplifies by virtue of (35) to:

$$\frac{dN_1}{dZ} = \frac{N_1 N_2}{(L_1 + Z) N_1}.$$  \[36\]

We thus see, from (36), that the increase of educated labour supply will be less than the amount of migration of educated labour if $\frac{L_1 + Z}{N_1} > \frac{N_2}{N}$ (which is a relation very similar to (22) earlier). Since the employment
in each sector is unchanged, the effect of an increase in $N_1$ and decline in $N_2$ is to increase the unemployment level of the educated and reduce it for the uneducated. The unemployment rate in the uneducated-labour market will also fall; in the educated market, it will rise if $\frac{L_1 + Z}{N_1} > \frac{N_2}{N}$.

The effect on national income is quite simply:

$$\frac{dY}{dZ} = -k \frac{dN_1}{dZ}.$$  \hfill (37)

National income is seen, from (37), to diminish unambiguously because of the cost of educating the increment in educated labour.

But we may well ask what happens to per capita income, as the total amount of labour in the system is diminished too. To answer this question, note that, for a unit emigration, population decreases by $1/N$ percent, while national income decreases by

$$\frac{kN_1 N_2}{(L_1 + Z) NY}$$

percent, which is smaller than $1/N$ provided that the following (quite probable) relationship holds:

$$\frac{kN_2}{Y} < \frac{(L_1 + Z)}{N_1}.$$

That is, if the ratio of the hypothetical educational cost of training all educated labour to national income is smaller than the employment rate of educated labour, the national income per labour will increase.

(III): We may finally explore the Incremental-Employment-and-Differential-Wage variant. We thus assume now that the labour force will indeed take into account the foreign wage level at which the emigrants get hired. If we then denote the foreign wage as $w_f$, we can write the expected wage in $m_1$ as:
\[ E_{\omega_1} = \frac{(w_1 L_1 + w_f Z)}{N_1} \]  

(38)

In this case, we now can derive the following modified results:

\[ \frac{dN_1}{dZ} = \frac{w_f N_2}{(w_1 L_1 + w_2 L_2 + w_f Z)} = \frac{w_f N_1 N_2}{(w_1 L_1 + w_f Z)} \]  

(39)

\[ \frac{dY}{dZ} = -k \frac{dN_1}{dZ} = -kw_f N_1 N_2/N_1 (w_1 L_1 + w_f Z) \]  

(40)

It is then easy to see that the change in the level of the educated labour force \((N_1)\) in the new equilibrium will readily exceed the emigration if \(w_f\) is large enough relative to \(w_1\). Therefore in case when the high wage rate in foreign countries is taken account of in assessing the expected wage rate, it is quite probable that unemployment in educated sector increases in both absolute and relative sense.

In addition, as is evident from (40), national income will go down; and it is easy to see that the possibility of decreasing per-capita income as well is more likely than before.\(^*\) Therefore in the society whose welfare function depends on per-capita income and unemployment rates, national welfare will quite possibly go down unless the evaluation of reducing unemployment rate in the \(m_2\)-sector more than offsets the loss due to decreasing per-capita income and increasing unemployment in the \(m_1\) sector.

\(^*\)This is seen readily as follows. For a unit of emigration, population decreases by \(1/N\) percent. On the other hand, national income decreases by \(kw_f N_1 N_2/N_1 (w_1 L_1 + w_f Z)\). The fact that the latter may exceed the former can then be readily seen as follows. Let us take the special case of the impact of initiating emigration, that is, \(Z = 0\). If the following, quite possible, relationship holds:

\[ \frac{w_f}{w_1} > \frac{L_1}{N_1} \frac{Y}{kN_2} \]

then the relative rate of decrease in national income is larger than that of decrease in population, thus leading to the reduction of per-capita income.
Case IV: The General Case of Emigration and Rise of Wages

If the wage of educated labour is rigidly fixed because it reflects the salary levels of comparable groups in the more developed countries, it is quite conceivable that \( w_1 \) itself is affected by the amount of migration of educated labour. The more migration there is, the more then could be the upward pull from the internationalization of this educated elite to domestic wage fixation. This rise in \( w_1 \) may in turn trigger additional wage rise in \( w_2 \) as analyzed in Case II.

Thus the effects of migration on employment, supply of educated labour and national income in this fully general case can now be decomposed as the sum of (1) the direct effect of migration keeping wage levels constant and (2) the indirect effect of the resulting wage increases. The latter component is in turn decomposed into (1) the effect of the wage increase in the \( m_1 \)-sector and (2) the effect of a wage-increase in the \( m_2 \)-sector that it induces. Thus we may write the following expressions for the total effect of emigration:

\[
\frac{dL_1}{dZ} = \left. \frac{dL_1}{dZ} \right|_{w_1, w_2 \text{ const}} + \left( \left. \frac{dL_1}{dw_1} \right|_{w_2 \text{ const}} + \left. \frac{dL_1}{dw_2} \right|_{w_2 \text{ const}} \right) \frac{dw_1}{dZ} \\
= \frac{dL_1}{dw_1} \frac{dw_1}{dZ} = -\eta_1 \frac{L_1}{w_1} \frac{dw_1}{dZ} \tag{41}
\]

\[
\frac{dL_2}{dZ} = \left. \frac{dL_2}{dZ} \right|_{w_1, w_2 \text{ const}} + \left( \left. \frac{dL_2}{dw_1} \right|_{w_2 \text{ const}} + \left. \frac{dL_2}{dw_2} \right|_{w_2 \text{ const}} \right) \frac{dw_1}{dZ} \\
= \frac{dL_2}{dw_2} \theta \frac{dw_1}{dZ} = -\eta_2 \frac{L_2}{w_2} \theta \frac{dw_1}{dZ} \tag{42}
\]

* For simplicity, we evaluate the expressions for the initial impact, namely, at the point where \( Z = 0 \).
\[
\frac{dN_1}{dz} = - \frac{dN_2}{dz}
\]
\[
= \frac{dN_1}{dz}_{\left| w_1, w_2 \right. \text{ const}} + \left( \frac{dN_1}{dw_1}_{\left| w_2 \right. \text{ const}} + \frac{dN_1}{dw_2} \right) \frac{dw_1}{dz}
\]
\[
= w_f \left( \frac{N_1 N_2}{N w_1 L_1} \right) + \left\{ \left( 1 - \eta_1 \right) N_1 N_2 \frac{\theta(1-\eta_2) N_1 N_2}{w_1^N} - \frac{\theta(1-\eta_2) N_1 N_2}{w_2^N} \right\} \frac{dw_1}{dz}
\]
(43)

\[
\frac{dY}{dz} = \frac{dY}{dz} \left| w_1, w_2 \right. \text{ const} + \left( \frac{dY}{dw_1} \left| w_2 \right. \text{ const} + \frac{dY}{dw_2} \right) \frac{dw_1}{dz}
\]
\[
= -k w_f \left( \frac{N_1 N_2}{N w_1 L_1} \right) - \left\{ \eta_1 L_1 + \frac{k(1-\eta_1) N_1 N_2}{w_1^N} \right\}
\]
\[
+ \theta \left\{ \eta_2 L_2 - \frac{k(1-\eta_2) N_1 N_2}{w_2^N} \right\} \frac{dw_1}{dz}
\]
(44)

The following observations, based on these results, are in order concerning the effects of emigration of educated labour in our model.

(1) Note that the **direct** effect of emigration on employment in either sector is nil. However, if the foreign wage level is taken into account in calculating the expected wage \((Ew_1)\), this increases the supply of educated labour \((N_1)\) and will reduce national income by the incremental educational cost. If the foreign wage level \((w_f)\) is high enough, we could also have increased unemployment of educated labour and reduced per-capita income.

(2) The induced wage-increase of educated labour, if any, will work to reduce the employment of educated labour. If the elasticity of demand for educated labour \((\eta_1)\) is below unity, the supply of educated labour will increase, thus increasing unemployment of the educated, both absolutely and relatively; further, national income will also be likely to reduce.

(3) Finally, if we have the leap-frogging process, such that \(w_2\) also
rises in response to the rise in $w_1$, the effect thereof will be towards reducing the employment of uneducated labour. This effect would thus work to increase the expected wage ($Ew_2$) in this sector (if $\eta_2 < 1$) and thus to mitigate the increase in the supply of educated labour (when $\eta_1 < 1$): the net result could even be to reduce, in the new equilibrium, the supply of educated labour. The loss of national income would also be reduced insofar as the supply of educated labour is reduced; however, unless the effect of reducing the cost of education is large, it is unlikely that it will offset the loss in national income caused through the contraction of output of $m_1$ and $m_2$ resulting from the rise in $w_1$ and $w_2$ respectively.

Thus, in our model, even without invoking the presence of "externalities" (leading to differences between the private and social marginal product of the emigrants), we see that the emigration of educated labour can easily lead to unfavourable effects on national income, per-capita income and on the unemployment (absolute and relative) of educated and uneducated labour through the effect of the migration on expected-wage formation in the market for educated labour, the upward pull on the (actual) wage of educated labour, and the leap-frogging upward pull on the (actual) wage of uneducated labour. And, as we proceed now to discuss in more detail in Section III, the internalization of the cost of education will not necessarily reduce the income-cost of the migration. Nor will the payment by the foreign country of the cost of education of the immigrants eliminate the adverse effect of the migration.
III: Alternative Assumptions

Before we proceed to an explicit welfare analysis of the effects of brain drain in Section IV, we now sketch briefly the effects of varying some of the assumptions in the model of Sections I and II.

(A) Internalizing the Cost of Education:

The reader may well ask what happens if we let people pay for their own education, so that the educational cost is "internalized." In this case, instead of (10), we will have:

\[ Ew_1 - k^* = Ew_2 \]  (10')

where \( k^* \) is the amount of educational cost that is internalized (\( k^* \leq k \)).

Since employment depends on the actual wage, however, the employment effects in the model are unchanged whereas the allocation of the labour force between the two groups (educated and uneducated) will be directly affected. In consequence of the internalization of the cost of education, equation (16) will remain the same but, instead of (17), we will have:

\[
(w_1 L_1 - k^* N_1) dN_2 - (w_2 L_2 + k^* N_2) dN_1 = -w_1 N_2 dL_1 - L_1 N_2 dw_1 \] (17')

Thus we now have:

\[
\frac{dN_1}{dw_1} = \frac{(1-n_1) N_2 L_1}{[w_1 L_1 + w_2 L_2 - k^*(N_1-N_2)]} \] (18')

Since it is easy to show that the denominator is positive, \(^*\) the behavior of \( N_1 \) continues, as in the earlier case of free education, to depend on the elasticity of demand for labour.

---

\(^*\)By (10'), we have: \( w_1 L_1 + w_2 L_2 - k^*(N_1-N_2) = w_2 N_2 \frac{L_2}{N_2} N + k^* N_2 \).
The resulting impact on the other comparative-statics results established for the case of free education can be readily worked out by the reader. It may be noted, however, that, contrary to general intuition, the internalization of the educational cost does not necessarily reduce the undesirable impact effect of the brain drain in our model: the welfare impact of an increment in \( w_1 \) under free education (\( k^* = 0 \)) is given by (25) for Case I, and under internalized-cost by:

\[
\frac{dy}{dw_1} = -L_1 \eta_1 - k(1-\eta_2)N_2 L_1 / [w_1 L_1 + w_2 L_2 - k(N_1 - N_2)]
\]

(25')

and, in general, when a welfare cost is involved (as when \( \eta_1 < 1 \)), the two costs cannot be uniquely ranked.

Similarly, for Case III, we may note again that the adverse effect of emigration on employment and income is not necessarily reduced if the cost of education is internalized as in (10'). Thus, for example, (39) is modified in the case of internalized educational cost (\( k^* = k \)) to:

\[
\frac{dN_1}{dZ} = w_f N_2 / [w_1 L_1 + w_2 L_2 + w_f Z - k(N_1 - N_2)]
\]

(39')

and it is clear that the new, additional term \(-k(N_1 - N_2)\) could, in principle, work in either direction. Also, equation (40) for impact on national income would modify to:

\[
\frac{dy}{dZ} = -k \frac{dN_1}{dZ} = -k w_f N_2 / [w_1 L_1 + w_2 L_2 + w_f Z - k(N_1 - N_2)]
\]

(40')

And this means that the effect of internalizing the cost of education could well be to increase, rather than diminish, the cost in national income from the emigration in our model: this being yet another instance of second-best theory.
All this, of course, is not to deny that, for any given levels of $w_1$, $w_2$ and $z$, the progressive internalization of the cost of education will be employment-and-income-improving. We can show that the increased internalization of the cost of education will, while leaving unchanged the employment in each sector, reduce the supply of educated labour ($N_1$) and hence its (total) cost ($kN_1$):

$$\frac{dN_1}{dk^*} = - \frac{N_1 N_2}{(w_1 L_1 + w_2 L_2) - k^*(N_1 - N_2)}$$

$$= - \frac{N_1 N_2}{w_2 \frac{L_2}{N_2} N + k^* N_2} < 0. \quad (45)$$

Therefore, as long as unemployment in educated labour exists, increasing the education cost borne by labour itself will save the education cost by $-kdN_1$. Note further that, even if the cost paid by labour (i.e. $k^*$) approaches the "true value" of $k$, the unemployment of educated labour may still exist.* In such a case, the imposition of higher cost ($k^* > k$) for education may turn out to be optimal in this second-best problem with wage rigidities!**

(B) The Introduction of Many Sectors:

Some readers may consider the assumption of only two sectors somewhat unnatural because the brain drain phenomenon in the real world occurs in rather limited and specific industrial or professional classifications of jobs. But, none of our qualitative conclusions depend, given the simple structure of the system, on the assumption of only two sectors. This is

*Suppose $w_1$ and $w_2$ are fixed higher than the equilibrium full employment wage rate indicated by (12). Then the phenomenon discussed in the text could readily occur.

**Note again that the saving in educational costs, which we have been discussing, applies only in the "long run," for comparison of two stationary states in our model.
seen readily by indicating how the analysis can be extended to \( n(n > 2) \) sectors.

Let \( w_i, N_i, L_i, k_i^* \) and \( \lambda_i \) represent the fixed wage, labour supply, employment, the privately-incurred educational cost and the ratio of employment to the labour supply \( (L_i/N_i) \) in the \( i \)th sector. Then, we can write the system determining labour employment and supply as:

\[
\begin{align*}
L_i &= \lambda_i N_i \quad \text{for } i = 1, 2, \ldots, n \\
\lambda_i w_i - k_i^* &= \lambda \quad \text{for } i = 1, 2, \ldots, n \\
\sum_{i=1}^{n} N_i &= N
\end{align*}
\]

where \( \lambda \) is an additional variable to keep the symmetry of the system. Then the division of labour into many categories in response to the initial wage rise in the first sector is given by the following equations:

\[
\frac{dL_1}{dw_1} = \frac{dN_1}{dw_1} \quad \text{for } i = 1, 2, \ldots, n
\]

\[
\begin{bmatrix}
\lambda_1 & 0 & N_1 & 0 & 0 \\
0 & \lambda_n & 0 & N_n & 0 \\
0 & 0 & w_1 & 0 & -1 \\
0 & 0 & 0 & w_n & -1 \\
1 & 1 & 0 & 0 & 0
\end{bmatrix}
\begin{bmatrix}
dL_1 \\
dN_1 \\
d\lambda_1 \\
d\lambda_n \\
dw_1
\end{bmatrix}
= 
\begin{bmatrix}
-dN_1 \\
0 \\
0 \\
0 \\
0
\end{bmatrix}
\]

(46)

*If \( \frac{dw_1}{dw_1} \neq 0 \) then the column on the R.H.S. will obviously read:

\[
\begin{bmatrix}
dL_1/\!\!dw_1 \\
dL_2/\!\!dw_2 \cdot \!\!dw_1/\!\!dw_1 \\
\vdots \\
dL_n/\!\!dw_n \cdot \!\!dw_1/\!\!dw_1 \\
1 \\
\!\!dw_2/\!\!dw_1 \\
\vdots \\
\!\!dw_n/\!\!dw_1 \\
0
\end{bmatrix}
\]
From this, we can derive the relevant comparative static relations. For example, (denoting $\mu_1 = -\frac{dL_i}{dw_1}$),

$$\frac{dN_i}{dw_1} = \mu_1 \left( w_1 - \frac{N_i}{\mu_1} \right) \prod_{i=2}^{n} \left( \frac{\lambda_i w_i}{\lambda_i w_1} \right) \left( \frac{\sum_{i=1}^{n} N_i}{\sum_{i=1}^{n} \lambda_i w_i} \right)$$

which simplifies, if $k^*_1$ is zero (i.e. all educational cost is state-financed as in Sections I and II), to:

$$\frac{dN_i}{dw_1} = \frac{(N-N_i)N_i}{Nw_1} (1-\eta_1)$$

or, in the elasticity form,

$$\frac{w_1 dN_i}{N_i dw_1} = \frac{N-N_i}{N} (1-\eta_1) \quad (47)$$

The result in (47) is, of course, identical to that in (20) for the two-sector case, once we realise that $\left(\bar{N}-N_i\right) = N_2$ when there are only two sectors: and this is indeed as it should be, since the effect on labour supply in section $m_1$ naturally depends, as before, on the impact of the rise in $w_1$ on the expected wage in $m_1$, and this impact is independent of the number of sectors from (or to) which the labour flows in (or out).

Other results of some interest can also be spelled out. Thus,
\[
\frac{d\lambda}{dw_1} = \frac{n}{\ell} \left( \frac{n}{\lambda_1 w_1} \right) \left( \frac{1}{\lambda_1} - \frac{N_1}{\mu_1} \right) = \frac{n}{\ell} \left( \frac{N_1}{\lambda_1} - \frac{\mu_1}{\lambda_1} \right)
\]

From this, it follows that:

\[
\frac{dN_1}{dw_1} = \frac{d}{dw_1} \left( \frac{L_i w_i}{\lambda_i} \right) = \frac{w_i L_i}{\lambda_i^2} \sum_{i=1}^{n} \left( \frac{N_i}{\lambda_i w_i} \right)
\]

which again simplifies, if \(k^*\) is zero, to:

\[
= - \frac{N_i N_1}{N w_1} (1-\eta_1),
\]

or, in elasticity terms:

\[
\frac{w_i}{N} \frac{dN_1}{dw_1} = - \frac{N_1}{N} (1-\eta_1)
\]

Again, therefore, nothing of substance has really changed with the introduction of \(n > 2\) sectors.

(C) Irreversibility of Education:

We may next address ourselves to the question of what happens in the "short run" when the educated labour force cannot be reduced. The effect of this clearly is to accentuate--by eliminating the possibility of reducing the educated-labour supply, \(N_1\), and thus saving on its cost, \(kN_1\)--the loss possibilities in the model. There is thus no relief for the "let-us-not-worry-about-brain-drain" economists from shifting to the short run!
The Case Where the Labour Market in \( m_2 \)-sector is Competitive:

Next, what happens if the "uneducated-labour" sector is "competitive," so that the sticky-wage assumption applies only to educated labour? In this case, instead of (10) we will now have:

\[
\frac{L_1}{N_1} \cdot w_1 = w_2 \tag{10''}
\]

and

\[ N_2 = L_2 \]

Further, since \( w_2 \) is no longer fixed, it will now be determined by:

\[ w_2 = g(L_2) \quad g' < 0 \]

Finally, we will have the total labour supply constraint as:

\[ N_1 + N_2 = \bar{N} \]

Solving these four equations, we would then get now:

\[
\frac{dN_1}{dw_1} = \frac{L_1(1-\eta_1)}{(w_2 - N_1 g')} \tag{49}
\]

and it is easy to see that (49) has the same qualitative property as (19) in our basic model in Sections I and II.*

Cost of Education Paid by Country of Immigration:

It is sometimes asserted that if the host country pays the cost of education, brain drain would cease to be harmful. In our model, this is easily allowed for, of course, by assuming that the country of emigration recovers (kdZ) worth of transfer income from the country of immigration. It is again

*It may be interesting to note, however, that the change in \( w_1 \) will now endogenously change \( w_2 \). And, in the case where \( \eta_1 < 1 \), \( dw_2/dw_1 = - g'(dN_1/dw_1) > 0 \) since \( dN_2 = - dN_1 \), so that a rise in \( w_1 \) leads to a rise in \( w_2 \). This is, of course, not the same as the "leapfrogging" in our Case II, a phenomenon that is ruled out by the "competitive" assumption for section \( m_2 \).
easy to see, as already noted in Section II, that all this does is to modify
(44) by the addition of the term (kdZ) and that the net effect on income,
and the effects on unemployment, can still be adverse.

IV: Welfare Effects of Brain Drain and Integration of Markets
for Professionals

We may now draw together the main analytical results of Section II to
derive welfare conclusions. To do this, however, we need to specify the
social welfare function explicitly.

It is our contention that the traditional trade-theoretic analysis of
the Grubel-Scott-Johnson variety yields conclusions more favourable to the
phenomenon of brain drain and integration of markets for professionals, not
merely because the kinds of effects on unemployment, for example, which
we have discussed in this paper have been ruled out by assumption; it is
also because the social welfare function used for analysis is really
limited in confining itself to arguments which rule out many relevant
variables. Thus, not merely may the phenomenon under discussion actually
lower per capita income and hence the welfare of "those left behind" in that
sense; it may also increase the rate and/or level of unemployment, worsen
income distribution and so on.

In fact, we think that it could make much sense to define a social
welfare function which has at least the following arguments:

(1) National Income: The sense of security, bargaining power in trade
and economic negotiations, the need for defense, and a number of political
and economic variables of importance could depend, not just on per capita
income, but on national income as an aggregate. Thus it may well be meaningful,
in certain cases, to consider national income in the aggregate as an argument
in the social welfare function.
(2) **Level of Emigration:** Those who have lived in the less developed countries know that the emigration of skilled manpower in certain occupations, such as scientific research in particular, creates a sense of inadequacy, which may stifle creative endeavour in domestic environment.

(3) **Level of Educated/Professional Manpower:** The technological ability of the population may matter much to the independence and creativity of the population; hence a fall in the (short-run and long-run) level of the educated labour force due to the phenomena being discussed by us could cause an adverse effect on social welfare.

(4) **Unemployment:** Unemployment, whether absolute or its rate, is also of importance to social welfare. More directly, it affects political stability and social cohesion, if nothing else, and is of immediate concern to the developing countries. In this regard, the unemployment among the educated may be even more explosive than among the uneducated, as is evident from the fact that the leadership of the revolutionary movements in Calcutta, for example, has derived from the unemployed, educated students.

(5) **Income Distribution:** In the absence of fiscal ability to redistribute incomes, the direct income distributional impact of the phenomena under discussion will also often be the final effect. And it should clearly enter the social welfare function. In the context of our model, we could thus include in the argument of the social welfare function, for example, the relative share of wage income in total national income: \((w_1L_1 + w_2L_2)/Y\).

Thus, a realistic social welfare function should probably read as follows:

\[
U = U\{Y, Y/N, Z, N_1L_1/N_1, N_2L_2/N_2, w_1L_1 + w_2L_2 / Y\}\]

\[(50)\]
where
\[ \frac{\partial U}{\partial Y} \geq 0 ; \frac{\partial U}{\partial Z} < 0 ; \frac{\partial U}{\partial \left( \frac{Y}{N} \right)} > 0 ; \frac{\partial U}{\partial N_1} > 0 ; \]
\[ \frac{\partial U}{\partial \left( \frac{L_1}{N_1} \right)} > 0 ; \frac{\partial U}{\partial \left( \frac{L_2}{N_2} \right)} > 0 ; \]
\[ \frac{\partial U}{\partial \left( \frac{(w_1L_1+w_2L_2)/Y}{Y} \right)} > 0 . \]

We forego a taxonomic exercise, exploring the outcomes on welfare and possible tradeoffs among alternative arguments in this welfare function, for different parametric combinations of the elasticities \( \eta_1, \eta_2 \) and other parameters such as \( \theta \) and \( k \) in equations (41)-(44). The reader can readily do this for himself; and we have already discussed briefly in Section II some of the possible outcomes with regard to national income, per capita income, supply of educated labour and the level and rates of unemployment in both classes of labour.*

*The only effects, which we have not worked out in Section II, relate to income distribution. This, however, can be readily worked out. Thus, for the general Case IV, we can write:
\[
\frac{Y}{w_1L_1+w_2L_2} \frac{d\left(\frac{(w_1L_1+w_2L_2)/Y}{Y}\right)}{dZ} = \frac{1}{w_1L_1+w_2L_2} \left[ L_1(1-\eta_1)+L_2(1-\eta_2)\theta \frac{d\omega_1}{dZ} \right] + \frac{kw_1\eta_1N_2}{YNw_1L_1} + \frac{1}{Y} \left[ \frac{k(1-\eta_1)N_1N_2}{w_1N} \right] \frac{d\omega_1}{dZ} + \frac{\theta}{Y} \left[ \eta_2L_2 - \frac{k(1-\eta_1)N_2N_2}{w_1N} \right] \frac{d\omega_1}{dZ} \]
Emigration Tax:

Rather, we may sketch here the answer to the question as to what would happen if the country of emigration were to impose a tax on emigration. To analyse this policy, assume that a recurring poll tax (that would be paid annually by the migrant) is levied on each emigrant.* Restricting our analysis to the effect on the income of those left behind (for reasons of space), we should expect a twofold effect: (i) the direct effect of the tax on revenue, which may then be treated as income redistributed to those left behind; and (ii) the indirect effect on unemployment levels, income, etc., which would operate through the effects on expected and actual wage levels.

(i) If we take \( T \) as the (recurring) poll tax paid by the emigrants (Z), the tax revenue will be \( TZ \). As \( T \) is changed, this revenue will change by:

\[
Z(1-n_f^T)
\]

(51)

where \( n_f^T \) is the elasticity of emigration with respect to the poll tax (i.e. \( - \frac{T}{Z} \frac{dZ}{dT} \)). Clearly, this revenue effect will be positive or negative, depending on the elasticity of emigration with respect to taxation.

(ii) As for the "indirect" effect, this can be indicated via the simplified Case III assumption of the Incremental-Employment-and-Differential-Wage variant: i.e. by assuming that (only) the expected wage is modified downwards by the tax. Thus, we must rewrite (38) as follows:

\[
E_w = (w_1L_1 + (w_f-T)Z)/N_1
\]

(38')

*The effect of the usual poll tax would be of a once-for-all nature. However, in order to conform to our analysis in terms of flows, it would be useful to conceive of a recurring poll tax along the lines of the Bhagwati-Dellalfar (1973) proposal (which relates to an income tax related to the income of the emigrant, a difference of unimportance if we assume a unique \( w_f \)).
Substituting (38') into (10) and differentiating with respect to \( T \), we obtain:

\[
\frac{dN_1}{dT} = - \frac{N_2 Z - N_2 (w_f - T) \frac{dZ}{dT}}{w_1 L_1 + w_2 L_2 + (w_f - T) Z}
\]

which can be written as

\[
\frac{dN_1}{dT} = - \frac{N_2 Z (1 + \varepsilon_f)}{w_1 L_1 + w_2 L_2 + (w_f - T) Z} < 0
\]

where \( \varepsilon_f \) is the elasticity of emigration with respect to effective foreign wages \((w_f - T)\). Thus an increase in \( T \) will always decrease the supply of educated labour in the long run, and this effect is strengthened if the emigrant is responsive to the recurring poll tax. As before, the income change is then:

\[
\frac{dY}{dT} = - k \frac{dN_1}{dT} = \frac{k N_2 Z (1 + \varepsilon_f)}{w_1 L_1 + w_2 L_2 + (w_f - T) Z} > 0
\]

Thus, the net impact on the income of those left behind will be given by the sum of these two, direct and indirect, effects (52) and (53):

\[
Z(1 - \eta_f T) + \frac{k N_2 Z (1 + \varepsilon_f)}{w_1 L_1 + w_2 L_2 + (w_f - T) Z}
\]

A sufficient (but not necessary) condition for the per capita income of those left behind to improve thanks to the emigration tax, therefore, would be that \( \eta_f T < 1 \).

---

*Note that \( \frac{w_f - T}{T} \eta_f = \varepsilon_f \).

**Note that the "indirect" effect works only in the long run. Furthermore, we have ruled out the more general case where the emigration may affect the actual wage as well. If this were allowed, then the emigration tax might well reduce the actual wage in the \( m_1 \) and possibly \( m_2 \) sectors and hence moderate the income loss on that account.
The reader could readily extend the analysis of the poll tax on emigration to examine the impact on the other arguments in the social welfare function; space considerations prevent us from undertaking this task ourselves.

V: Concluding Remarks

It is clear, of course, that our results are in contrast with those of the traditional, fully neoclassical model because of the assumptions of "rigid" wages and resulting unemployment. Under the conventional assumptions of flexible wages and absence of unemployment, the results of emigration are both simpler and easily stated: (i) for internalized cost of education \( k^* = k \), the emigration will reduce national income but, in increasing the average product of labour, will also raise per capita income under the "normal" assumption of diminishing marginal productivity of labour;

*The apparent contradiction between this statement and the earlier Grubel-Scott argument that emigration leaves unchanged the welfare of those left behind is easily resolved. The Grubel-Scott result is based on the fact that the emigre was earning \( w \) (the wage) and thus everyone other than him was getting \( (Y-w) \), whereas his departure reduces \( Y \) itself by \( w \): hence the result for those left behind is the sum of the reduction in income due to emigration \( \frac{dY}{dL} = -w \) and the increment in available income as the emigrant loses his claim on income defined by his wage (+ \( w \)), which means no-impact. On the other hand, \( \frac{d(Y/L)}{dL} = \frac{1}{L}(w-\frac{Y}{L}) < 0 \) as the wage, which equals the marginal product, will be below the average product: hence emigration will raise per capita income, i.e. improve the welfare of those left behind. This contradiction is easily resolved, however, once it is seen that the Grubel-Scott argument assumes that the income accruing to the emigre prior to emigration is \( w \), the wage, whereas the per-capita-income argument in effect assumes it to be \( Y/L (> w) \): the former assumption thus yields no impact whereas the latter yields improvement, for those left behind. In
and (ii) for free education ($k^*=0$), the other polar case, and no compensation for educational costs by the country of immigration, it is possible (though not inevitable) that the average product of labour, and hence per capita income, falls as a result of emigration of educated labour.

Our results are both more complex and less comforting than these. They are also more realistic. They should suffice to raise doubts about the complacency concerning the brain drain phenomenon resulting from the analysis in the existing literature.

In this paper, we have examined the impact on both income and per capita income; results under the Grubel-Scott assumption can however be readily derived by taking the impact on income and adding to it the consumption of the emigrant, defined as his wage rate ($w_1$), on the assumption that the emigrant was employed prior to emigration, or possibly a lower sum if we assume that he was unemployed and was subsisting on someone else's income.
References


