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CHANGES IN INCOME DISTRIBUTION AND WELFARE FROM GREATER IMMIGRATION OF UNSKILLED WORKERS

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This paper considers the consequences of greater immigration of unskilled labor on income distribution and welfare in the receiving country. To address these issues, both the sending and receiving countries are represented in a static general equilibrium model which distinguishes between skilled and unskilled labor and which allows prices to be determined endogenously. In this framework an inflow of unskilled labor is likely to reduce wages of unskilled labor, but whether capital or skilled labor benefits depends upon demand elasticities, elasticities of substitution in production, and differences across countries in the productivity of unskilled labor. National welfare in the receiving country is likely to rise, to the extent that the relative price of importable goods falls, non-residents already in the country receive lower wages, immigrants receive lower wages than those paid to domestic workers, and immigrants cause little increased demand for public services and transfer programs.

1. Introduction

The United States and several economically developed European nations have recently considered or actually adopted increasingly stringent measures against immigration of unskilled workers. For instance, in 1973, the Federal Republic of Germany imposed a ban on the entrance of additional foreign workers, a policy that has had its greatest impact on unskilled workers who had previously come in substantial numbers from Mediterranean countries [Rist (1978)]. In France, the Communist party has militantly advocated a halt to all immigration into the country and the French government has offered repatriation bonuses to any foreigners willing to leave. Also, the United States Select Commission on Immigration and Refugee Policy has issued a report [U.S. Select Commission (1981)] calling for the imposition of fines on employers of illegal aliens, many of whom are unskilled workers from Latin America. These restrictive immigration measures, however, have not won universal support. In most developed countries, various employer groups have lobbied strongly in support of more lenient immigration policies. Attitudes of the general public appear somewhat mixed as illustrated by the case of Switzerland. In a 1974 referendum, two-thirds of the voters rejected a measure to expell 500,000 foreign workers, although in 1981 eighty percent of

the voters rejected a proposal to extend greater rights to seasonal foreign workers.

To give some insight into the possible reasons for these conflicting views, this paper identifies key factors affecting income distribution within the recipient country of increased immigration by unskilled workers. A static general equilibrium model is presented which differs from previous research in two important aspects: (1) a broader set of distributional results is generated by allowing for different labor skill groups within the country, in contrast to approaches which assume all domestic employees are affected identically [Mishan and Needleman (1968), Casas and Scully (1972), and Krauss (1976)]; and (2) the important role of terms of trade changes is captured by dropping the small country assumption of exogenously-given prices, which more naturally has been imposed in studies of the brain drain from developing countries [see Bhagwati (1976)]. The model is used to show that the pattern of income redistribution cannot be predicted a priori, although it can be shown to depend upon a set of easily described conditions. These projected changes in income distribution also are used to make an assessment of the economic efficiency effects in the recipient country of greater immigration of unskilled workers. Alternative interpretations of this efficiency condition are discussed in order to give some indication of the potential advisability of restricting such immigration from a national perspective.

2. The analytical model

Because the major implications to be drawn from this paper deal with the recipient developed country, the analytical model is developed more completely with respect to production conditions in it. In that country, denoted Country A, three factors of production, unskilled labor (V_{1A}), skilled labor (V_{2A}), and capital (V_N), are assumed to produce two commodities (X_{1A} and X_{2A}). Skilled and unskilled labor are specific factors in that the former is used only in the production of X_2 and the latter is used only in the production of X_1.[1] Capital, on the other hand, is intersectorally mobile and may therefore be used in the production of either commodity. Supplies of all

[1]Rodriguez (1976) also utilizes a model which assumes unskilled labor is used exclusively in producing X_1, skilled labor is used exclusively in producing X_2, and physical capital is common to both sectors. His dynamic analysis explicitly considers the saving necessary to permit the portion of the labor force that is skilled to vary. That factor is not captured in the present paper, which treats the stock of trained labor as given. Another perspective from which to view this model is that it characterizes an economy with segmented labor markets which results in some sectors of the economy (X_1) offering primarily dead-end jobs, and others (X_2) allowing advancement to more responsible positions. For a summary of the literature dealing with this latter possibility, see Cain (1976).

factors are assumed to be fixed, although the supply of V_{1A} may be augmented by immigration of unskilled workers.

The assumption that the two types of labor are specific factors reflects an important dimension of the current illegal immigration situation in the United States and the influx of guest workers in Europe. In the United States, the incoming illegal migrants tend to be young unskilled males who do not take up permanent residence [Cornelius (1977), Dagodag (1975), North and Houstoun (1976)]. Rather, they frequently make periodic trips to their country of origin in order to maintain contact with their families. Consequently, these individuals are generally employed in the agricultural, service, and light manufacturing sectors of the economy where seasonal or short-term jobs requiring few skills are available. Within Europe the to-and-fro nature of this immigration has been reduced somewhat by a shift in the expected ease of re-entry. The classification of these immigrants as unskilled seems largely correct, though. For instance, a 1972 survey of foreign workers in Germany cited by Blitz (1977) shows that less than half of the foreign workers have more than five years of education.

Nevertheless, these circumstances alone do not justify the use of a specific factor formulation for the production side of the model, as both unskilled and skilled labor from legal domestic sources still may be employed in the production of both X_1 and X_2. Batra and Casas (1976) have analyzed this more general case where all three factors are used in the production of each good. In their analysis, however, commodity prices are treated as fixed internationally, an assumption which is not entirely relevant to treating the problem of unskilled labor migration into developed countries. Generalizing the Batra and Casa approach to allow for endogenous commodity price determination is difficult, since precise assumptions regarding relative factor intensities would have to be made in order to predict the outcome of changing any exogenous variable. In other words, results similar to those presented here would be obtained as factor intensity conditions approached the case of two specific factors adopted here. On the other hand, if input requirements of skilled and unskilled labor were quite similar in the two sectors, the types of redistributive effects projected here would be less relevant.

The production relations in the model are almost identical to those found in Jones (1971). With respect to the developed country: (1) the production functions in both sectors of the economy are linearly homogeneous, and (2) commodity markets are in competitive equilibrium. These two assumptions together imply that all factors of production are fully employed and that all entrepreneurs earn zero profits. Algebraically, these conditions can be expressed as

$$a_{1A}X_{1A} = V_{1A}, \tag{1}$$

$$a_{22}X_{2A}=V_{2A}, \tag{2}$$

$$a_{N1}X_{1A}+a_{N2}X_{2A}=V_{NA}, \tag{3}$$

$$a_{11}R_{1A}+a_{N1}R_{NA}=P, \tag{4}$$

$$a_{22}R_{2A}+a_{N2}R_{NA}=1, \tag{5}$$

where a_{ij} denotes the input–output coefficient describing the average quantity of factor i $(i=1,2,N)$ used to produce one unit of commodity j $(j=1,2)$; R_{iA} $(i=1,2,N)$ denotes the nominal reward paid to factor i; and P denotes the price per unit of commodity 1 relative to the price per unit of commodity 2. Any increased immigration of unskilled labor appears as an increase in V_{1A}, and these workers are assumed to receive the same nominal wage, R_{1A}, as comparable domestic workers.

The less developed country from which this unskilled labor emigrates, denoted as Country B here, is assumed to produce and export only X_1, which requires inputs of capital and unskilled labor. While this framework may over simplify economic relationships in the developing country, the implication of relatively greater diversity of production in the developed country does seem realistic. Neither capital nor labor is assumed to move freely between countries. Rather, only parametric shifts in factor supplies are included. With respect to labor migration, this change might reflect changes in immigration laws or the stringency of current enforcement procedures. If there is full employment of labor in the developing country, then that condition would appear as

$$b_{11}X_{1B}=V_{1B}, \tag{6}$$

where the notation parallels that used in eq. (1). Any reduction in the availability of unskilled labor in Country B would cause output there to fall. On the other hand, if initially there was considerable unemployment in Country B, increased emigration might not require any reduction in national output.

That distinction is particularly important when demand conditions are considered. The relevant equilibrium condition may be written as a balance of trade constraint or in terms of total quantities supplied and demanded internationally for either good. Considering demand and supply conditions for X_2 yields

$$D_{2A}+D_{2B}=X_{2A}, \tag{7}$$

where D denotes quantity demanded. Quantities demanded are functions of relative prices and income, where the income earned in each country is given by

$$Y_A = PX_{1A} + X_{2A}, \tag{8}$$

$$Y_B = PX_{1B}. \tag{9}$$

Tastes in both countries are assumed to be identical and homothetic, so that an influx of immigrants into the developed country does not directly alter national consumption patterns.[2]

The importance of the full employment condition in Country B is that Y_B may or may not fall when unskilled labor emigrates to the developed country. In the polar case where all emigrants initially are unemployed, or can be replaced costlessly by those who are unemployed, then Y_B will not fall at all. If instead output of X_{1B} falls, then income in Country B falls, and correspondingly its demand for imports of X_2 will fall.

Eqs. (1) through (9) provide the basis for projecting the effects of changes in the immigration of unskilled labor into the developed country. As shown explicitly in the appendix, all equations are expressed in relative rates of change to facilitate the derivation of solutions. With respect to the factor reward and output changes considered, two alternative interpretations are given, one where increased immigration does not reduce output in Country B, and one where it does.

3. Distributional consequences of greater immigration of unskilled labor

An influx of unskilled labor into the developed country unambiguously will increase the output of X_1 there. Of the six variables to be analyzed ($X_{1A}, X_{2A}, R_{1A}, R_{2A}, R_{NA}, P$) that is the only change which can be predicted in such an unqualified fashion. A major reason for the ambiguity in the remaining results is the possibility of different output effects in the developing country when labor emigrates from it. For instance, in the case where emigration of labor out of Country B has no effect on the output of X_{1B}, as would occur if all emigrants initially were unemployed in Country B, then the rise in X_{1A} means total output of X_1 increases and its relative price falls. Furthermore, the wage paid to unskilled labor in Country A falls, since the

[2]All income earned in the developed country is spent there. Restated in other terms, for illegal immigrants or guest workers to send part of their earnings back to their country of origin, they must do so through buying goods produced in the developed country. That condition is necessary in a barter model where no financial claims exist.

productivity of this factor declines as the capital–labor ratio falls and the value of the output it produces declines as well.[3]

When emigration of labor out of Country B causes a reduction in output of X_{1B}, then the effect of immigration on total output of X_1 is unclear and the relative price of X_1 need not fall either. However, when tastes are identical and homothetic in both countries, a key condition emerges which allows the case of rising prices to be ruled out: if R_{1A} is greater than R_{1B} then the relative price of X_1 must fall. An intuitive explanation of this condition is that higher wages in Country A reflect the greater productivity of workers there, and the reallocation of labor from Country B to Country A will allow for an increase in the total output of X_1. In that case, which seems likely in the American and European contexts discussed above, the real wage of unskilled labor also must fall in the developed country since R_{1A} declines by a greater percentage than P (see appendix).

Changes in the output of X_{2A}, the return to capital in Country A, and the return to skilled labor in Country A all depend upon a common set of economic factors. Because X_2 is the numeraire good, the percentage change in the return to capital will be a simple multiple, opposite in sign, of the percentage change in the wage of skilled labor. Additionally, whether the return to capital rises depends upon whether output of X_{2A} contracts and capital is released to be utilized with the greater available supply of unskilled labor in the production of X_{1A}.

In the case of initial unemployment in Country B this direction of movement of capital depends upon the following expression:

$$\frac{\alpha+(D_{2A}/X_{2A})\Pi_{1A}+D_{2B}/X_{2A}}{(D_{2A}/X_{2A})\Pi_{1A}}-\sigma_{1A}\gtreqless 0, \tag{10}$$

where α denotes the cross-price elasticity of demand for X_2 given a change in P_1 (assumed to be positive), Π_{1A} represents the share of Country A's income accounted for by X_{1A} output, and σ_{1A} is the elasticity of substitution between unskilled labor and capital in the production of X_{1A}. The numerator of the first term is simply a weighted average of the income compensated cross-price elasticities of demand for X_{2A}, where the weights are the percentages of X_{2A} consumption occurring in the two countries [see appendix, eq. (A.6)]. Also, since $0\leqq(D_{2A}/X_{2A})\Pi_{1A}\leqq 1$, the entire first term can never be less than this pure price elasticity. In any case, the higher the pure price elasticity shown in the numerator of (10), the greater will be the increased output of X_{1A} when P falls. As a result, V_{NA} tends to be transferred

[3]As can be shown through the manipulation of the zero-profit condition for the production of X_{1A}, when P falls then the price of unskilled labor always must fall relative to the returns to capital, giving an incentive to substitute labor for capital.

from X_{2A} production to X_{1A} production, X_{2A} output contracts, and R_{NA} rises. A factor offsetting the tendency for R_{NA} to rise is captured by the second term in eq. (10). This term reflects the fact that the greater availability of unskilled labor in Country A also allows unskilled labor to be substituted for capital in the production of X_{1A}. If this latter effect dominates, capital is released from X_{1A} production to be utilized in the increased production of X_{2A}, where both its physical productivity and its nominal reward must fall when combined with the fixed amount of skilled labor working there.

When emigration of labor from Country B causes a fall in output there, then that factor calls for a modification of eq. (10) since demand for X_{2A} is reduced. Specifically,

$$\frac{R_{1A}V_{1A}}{PX_{1A}}\alpha' - \frac{\sigma_{1A}V_{1A}D_{2A}(R_{1A}-R_{1B})}{X_{2A}Y_A} \gtreqless 0, \tag{11}$$

where α' denotes the first term in eq. (10). Eq. (11) indicates that if $R_{1A}=R_{1B}$, then output of X_{2A} unambiguously must fall. However, if labor productivity in Country A exceeds that in Country B ($R_{1A}>R_{1B}$), the previously discussed focus on elasticities of demand versus elasticities of substitution in production still is relevant.

By way of summary, X_{2A} is more likely to fall the more price elastic is demand for X_{2A}, the smaller the elasticity of substitution between capital and labor in the production of X_{1A}, and the smaller the initial wage gap for unskilled labor between Countries A and B. Correspondingly, when X_{2A} falls, returns to capital rise while wages of skilled labor fall. To the extent that capitalists are a small proportion of the population, an attitude of the general public against greater immigration is understandable since both labor groups experience reductions in wages as a consequence!

4. Efficiency effects of greater immigration of unskilled labor

The distributional results cited above probably are good indicators of public policy decisions when no transfer program exists to compensate groups which lose from increased immigration. An alternative question to consider is whether there are net gains to the developed country from allowing greater immigration, so that compensation could be paid to make all individuals at least as well off as initially. Previous discussions suggest conflicting answers to this question. For instance, Reder (1963) and Jones and Smith (1970) suggest that increased immigration is likely to have a favorable economic impact on the receiving country. However, Mishan and Needleman (1968) reach just the opposite conclusion in the case of Jamaican immigration into the United Kingdom, and Krauss and Baumol (1979) indicate that guest worker programs may leave recipient nations worse off.

To evaluate the change in welfare of the economically developed country, one way of proceeding is to totally differentiate its community utility function, $U_A(C_{1A}, C_{2A})$, where C_{jA} denotes consumption of X_j by citizens of Country A. That is,

$$PC_{1A}+C_{2A}=PD_{1A}+D_{2A}-R_{1A}F_A=PX_{1A}+X_{2A}-R_{1A}F_A, \tag{12}$$

where $R_{1A}F_A$ denotes the income of and the amount of consumption expenditures by foreign workers present in Country A (F_A). The differential of the community utility function may be written as

$$\mathrm{d}U/U_2=P\,\mathrm{d}C_{1A}+\mathrm{d}C_{2A}, \tag{13}$$

since the marginal utility of consuming good 1, U_1, relative to the marginal utility of consuming good 2, U_2, equals the price ratio, P. To re-express eq. (12) in terms of variables analyzed in the model, totally differentiate (12), and make use of the simplification

$$P\,\mathrm{d}X_{1A}+\mathrm{d}X_{2A}=R_{1A}\,\mathrm{d}F=\mathrm{R}_{1A}\,\mathrm{d}V_{1A}. \tag{14}$$

The welfare function in eq. (13) reduces to

$$\mathrm{d}U/U_2=-F\,\mathrm{d}R_{1A}+(X_{1A}-C_{1A})\mathrm{d}P, \tag{15}$$

which can be rewritten somewhat more suggestively as

$$\mathrm{d}U/U_2=-F\,\mathrm{d}R_{1A}+(D_{1A}-C_{1A})\mathrm{d}P+(X_{1A}-D_{1A})\mathrm{d}P, \tag{16}$$

by adding and subtracting $D_{1A}P$ on the right-hand side of (15).

Assume that the initial wage differential favors the developed country so that the relative price of X_1 falls regardless of the extent of unemployment in the developing country. Then, the first term in (16) represents a gain in welfare to the original residents of Country A, since the foreign workers already present now receive lower wages, while the second term represents a welfare loss to those same residents since the foreigners can now purchase X_1 at lower prices. However, the sum of $-F\,\mathrm{d}R_{1A}+(D_{1A}-C_{1A})\mathrm{d}P$ is necessarily positive, regardless of the percentage of income allocated by foreign workers to the consumption of X_1, because, as previously indicated, R_{1A} falls by more than any possible decline in P. In other words, the income decrease suffered by the foreign workers is only partially offset by lower prices on one good that they consume. Finally, the third term on the right-hand side of (16) must be positive, as long as Country A imports X_1 from Country B, indicating a favorable terms of trade effect experienced by the residents of

Country A. Therefore, on balance, the developed country experiences a net welfare gain as a result of the influx of unskilled labor.

This approach also reflects a view mentioned by Reder and empirically estimated by Blitz for the case of Germany: Does the recipient country gain from the inflow of human capital for which it has not had to make health and educational expenditures? The present formulation does not consider this investment process because the direct question of what investment would have been necessary to rear and train a comparable number of domestic workers is not asked. Rather, foreign immigrants capture part of the gains from the human capital which they represent. Thus, the more basic question from the standpoint of original residents of Country A is what they gain from this inflow of labor. The value of additional output available to them is captured by the terms in eq. (15), which simply represent the welfare gain as a current flow and not as a capitalized stock.

Why have other studies obtained negative welfare impacts in recipient countries? Although the actual models applied differ in many respects, one distinction between the present paper and the analysis of Mishan and Needleman is the latter's assumption that the economy only produces a single good. Hence, all immigrants work in the exportables sector, and increased immigration causes the terms of trade to move against the recipient country. Although the authors state that Jamaicans generally work in non-traded service industries, their model does not capture that dimension of the situation.

A second distinction between the two studies revolves around a point developed more thoroughly by Usher (1977) and by Krauss and Baumol: greater immigration may require government outlays for social capital or transfer payments, while immigrants may not pay taxes which fully cover the cost of these programs. In other words, eq. (13) rests on an over-simplified representation of national welfare, since consumption of private goods only is considered. Allowing for public goods, and the likely congestion which would arise in their use from greater immigration, or explicitly incorporating the balance between tax payments made and transfer payments received, would raise the possibility that national welfare could fall, if this negative externality dominated the wage and price effects already cited.

On an empirical level, the importance of these factors does not seem to have been large in the case of the United States. For instance, North and Houston (1976) and Bustamante (1977) both conclude that illegal Mexican immigrants pay more in taxes than they receive through tax-supported services such as public health care, unemployment compensation, income supplements, and primary and secondary education.[4] In the case of Europe,

[4]North and Houstoun (1976) state that their evidence on this point is not at all conclusive. Therefore, ignoring the consumption of public services by illegal migrants may lead to inaccurate conclusions regarding the welfare of domestic residents.

this balance may be somewhat different particularly since the imposition in 1973 of a ban on the recruitment of workers outside of the European Economic Community. Many foreign workers already working in the EEC were less likely to return home, even if they became unemployed, for fear that they might not be readmitted in the future. Thus, the demand for social services by foreign workers may have become greater than during the pre-1973 period. Also, the broader scale of European social programs, particularly with respect to housing and health care, suggests that benefits received would have been greater than in the United States. On the other hand, the greater importance of payroll taxes as a source of government revenue in European countries implies that tax payments by foreign workers and the percentage of benefits financed by their contribution might be greater than in the United States.

A further factor not considered in the present framework is the possibility that foreign workers are paid less than domestic workers. As European restrictions on geographic or occupational mobility are raised, the potential to treat foreign workers differently than domestic workers is increased. Furthermore, European Commission directives in the mid-1970s to standardize penalties against those hiring illegal aliens indicate that even with large numbers of legal foreign workers already in the community, the incentive for illegal aliens to seek work had not evaporated, just as it has not in the case of the United States. The unregulated nature of this employment particularly gives rise to the potential for employers to pay lower wages to these workers. That situation results in an additional gain in national income for the developed country, although the implications with respect to domestic political stability may be less sanguine. Also, if current restrictions already have created the possibility to discriminate against foreign workers, then proposals to levy fines or other penalties on employers of illegal aliens may have no effect on outputs or relative prices. Rather, a rent simply may be transferred from the employers to the government.

5. Conclusion

This paper has sought to systematically treat the implications for income distribution in developed countries of an increase in the rate of emigration of unskilled workers from developing countries. Within the context of a two-sector general equilibrium model it is shown that legal domestic workers who compete directly with the unskilled entrants are harmed in the sense that their total real income falls. However, the total real payments to legal skilled workers as well as to the owners of capital may either rise or fall. This ambiguity was seen to rest principally on three factors: (1) the elasticity of substitution between labor and capital in sector 1; (2) the price elasticity of demand for sector 2 output; and (3) the relative productivity of output in the

developed and the developing country. The overall welfare impact of an increase in immigration of unskilled workers is difficult to assess. If negative externalities are ignored, welfare in the recipient country can be presumed to increase. In that case, measures to limit entry or encourage foreign workers to leave can be justified only on distributional grounds.

Appendix

In this appendix derivations of the various solutions reported in the paper are given. Totally differentiating eqs. (1), (2), (3), (4), (5), and (7) yields the following expressions [see Jones (1965) for details]:

$$X^*_{1A} + \gamma^A_{11}(R^*_{NA} - R^*_{1A}) = V^*_{1A}, \tag{A.1}$$

$$X^*_{2A} + \gamma^A_{22}(R^*_{NA} - R^*_{2A}) = V^*_{2A}, \tag{A.2}$$

$$\lambda^A_{N1}X^*_{1A} + \lambda^A_{N2}X^*_{2A} + \gamma^A_{N1}(R^*_{1A} - R^*_{NA}) + \gamma^A_{N2}(R^*_{2A} - R_{NA}) = V^*_{NA}, \tag{A.3}$$

$$\Theta^A_{11}R^*_{1A} + \Theta^A_{N1}R^*_{NA} = P^*, \tag{A.4}$$

$$\Theta^A_{22}R^*_{2A} + \Theta^A_{NA}R^*_{NA} = 0, \tag{A.5}$$

$$\left(1 - \frac{D_{2A}}{X_{2A}}\Pi_{2A}\right)X^*_{2A} - \frac{D_{2A}}{X_{2A}}\Pi_{1A}X^*_{1A}$$

$$-\left(\alpha\frac{D_{2A}}{X_{2A}} + \frac{D_{2A}}{X_{2A}}\Pi_{1A} + \alpha\frac{D_{2B}}{X_{2A}} + \frac{D_{2B}}{X_{2A}}\right)P^* = \frac{D_{2B}}{X_{2A}}X^*_{1B}, \tag{A.6}$$

where $Z^* = \mathrm{d}Z/Z$, $\lambda^A_{Nj} = a_{Nj}X_{jA}/V_{NA}$ denotes the fraction of V_{NA} employed in the production of commodity j, $\Theta^A_{i1} = a_{i1}R_{iA}/P$ denotes factor i's share of the output of commodity 1, $\Theta^A_{i2} = a_{i2}R_{iA}$ denotes factor i's share of commodity 2, and the γ^A_{ij} are defined as: $\gamma^A_{11} = \Theta^A_{N1}\sigma_{1A}$, $\gamma^A_{22} = \Theta^A_{N2}\sigma_{2A}$, $\gamma^A_{N1} = \lambda^A_{N1}\Theta^A_{11}\sigma_{1A}$, and $\gamma^A_{N2} = \lambda^A_{N2}\Theta^A_{22}\sigma_{2A}$, where σ_{jA} denotes the elasticity of substitution in the production of commodity j in Country A. In the demand equation, the Π_{iA} represent good i's share of national income in Country A, and α is the cross-price elasticity of demand for X_2 with respect to an increase in p_1. If there is unemployment in Country B initially, then a marginal shift of labor out of B leaves X_{1B} unchanged. In that case the right-hand side of eq. (A.6) simply equals zero. In the alternative case where any reduction of available labor in Country B reduces output there, then X^*_{1B} can be approximated by $\Theta^B_{11}V^*_{1B}$, under the assumptions that available capital is fixed in B and that factors of production are paid the value of their marginal product. This term can be

manipulated further, since the total quantity supplied of unskilled labor is fixed, $V_{1A}+V_{1B}=V_1$, to give $X^*_{1B}=-\Theta^B_{11}(V_{1A}|V_{1B})V^*_{1A}$.

The value of the determinant of this six equation system is unambiguously positive as shown below,

$$|D|=\gamma^A_{11}\frac{D_{2A}}{X_{2A}}\Pi_{1A}\lambda^A_{N2}\sigma_{2A}+\gamma^A_{22}\left(1-\frac{D_{2A}}{X_{2A}}\Pi_{2A}\right)\lambda^A_{N1}\sigma_{1A}$$

$$+\left[\frac{D_{2A}}{X_{2A}}(\alpha+\Pi_{1A})+\frac{D_{2B}}{X_{2A}}(\alpha+1)\right](\Theta^A_{22}\lambda^A_{N1}\sigma_{1A}+\Theta^A_{11}\lambda^A_{N2}\sigma_{2A})\geqq 0.$$

Since $(D_{2A}/X_{2A})\Pi_{2A}=D_{2A}/Y_A\leqq 1$ the entire expression for $|D|\geqq 0$.

With respect to the endogenous variables to be determined by the model, the following results are obtained; where the price coefficient in eq. (A.6) has been simplified to appear as α_p,

$$\frac{X^*_{1A}}{V^*_{1A}}=\left[\left(1-\frac{D_{2A}}{Y_A}\right)\gamma^A_{22}\gamma^A_{N1}+\Theta^A_{22}\gamma^A_{N1}\alpha_p+\Theta^A_{11}\lambda^A_{N2}\sigma_{2A}\alpha_p\right.$$

$$\left.+\frac{D_{2B}}{X_{2A}}\Theta^B_{11}\frac{V_{1A}}{V_{1B}}\gamma^A_{11}\lambda^A_{N2}\sigma_{2A}\right]\Big/|D|\geqq 0,$$

$$\frac{P^*}{V^*_{1A}}=\left[\lambda^A_{N1}\sigma_A\Theta^A_{22}\left(\frac{D_{2B}}{X_{2A}}\Theta^B_{11}\frac{V_{1A}}{V_{1B}}-\Theta^A_{11}\frac{D_{2A}}{X_{2A}}\frac{X_{1A}}{Y_A}\right)\right.$$

$$+\lambda^A_{N2}\sigma_{2A}\Theta^A_{11}\left(\frac{D_{2B}}{X_{2A}}\Theta^B_{11}\frac{V_{1A}}{V_{1B}}-\frac{D_{2A}}{X_{2A}}\frac{X_{1A}}{Y_A}\right)$$

$$\left.-\Theta^A_{11}\Theta^A_{N2}\sigma_{2A}\lambda^A_{N1}\left(1-\frac{D_{2A}}{Y_A}\right)\right]\Big/|D|\gtreqless 0,$$

$$\frac{R^*_{1A}}{V^*_{1A}}=\left[\Theta^A_{22}\lambda^A_{N1}\sigma_{1A}\left(\frac{D_{2B}}{X_{2A}}\Theta^B_{11}\frac{V_{1A}}{V_{1B}}-\Theta^A_{11}\frac{D_{2A}}{X_{2A}}\frac{X_{1A}}{Y_A}\right)\right.$$

$$+\lambda^A_{N2}\sigma_{2A}\left(\frac{D_{2B}}{X_{2A}}\Theta^B_{11}\frac{V_{1A}}{V_{1B}}-\frac{D_{2A}}{X_{2A}}\frac{X_{1A}}{Y_A}\right)$$

$$\left.-\Theta^A_{22}\Theta^A_{N1}\lambda^A_{N1}\alpha_p-\lambda^A_{N1}\Theta^A_{N2}\sigma_{2A}\left(1-\frac{D_{2A}}{Y_A}\right)\right]\Big/|D|\gtreqless 0.$$

While output of X_{1A} unambiguously increases when additional unskilled labor flows into the developed country, both the relative price effect and the

change in Country A's unskilled wage rate depend upon the size of the cutback in output of X_{1B}. In the expressions written above, the first terms of P^*/V^*_{1A} and R^*_{1A}/V^*_{1A} are critical; if they are negative, then the second terms of each expression also must be negative, and both the relative price of X_1 and wages paid to unskilled workers in Country A must fall. Given that tastes are identical and homothetic in Countries A and B, then $D_{2A}/Y_A = D_{2B}/Y_B = D_{2B}/pX_{1B}$, which allows the term in brackets to be re-expressed in terms of unskilled wage rates in each country as

$$\frac{D_{2B}}{pX_{1B}} \cdot \frac{V_{1A}}{X_{2A}}(R_{1B} - R_{1A}). \tag{A.7}$$

In other words, when $R_{1A} > R_{1B}$ then total output of X_1 unambiguously rises and its relative price falls.

To see when real wages in Country A will fall as a result of greater immigration of unskilled labor, note that

$$\frac{R^*_{1A}}{V^*_{1A}} - \frac{P^*}{V^*_{1A}} = \left\{ \Theta^A_{N2}\lambda^A_{N2}\sigma_{2A}\frac{1}{X_{2A}}\frac{D_{2A}}{Y_A}(R_{1B}V_{1A} - pX_{1A}) \right.$$

$$\left. - \Theta^A_{N1}\Theta^A_{N2}\sigma_{2A}\lambda^A_{N1}\frac{pD_{1A}}{Y_A} - \Theta^A_{22}\Theta^A_{N1}\lambda^A_{N1}\alpha_p \right\} \Big/ |D| \gtreqless 0. \tag{A.8}$$

When $R_{1A} > R_{1B}$, then this expression unambiguously will be negative since labor accounts for less than the total value of output in X_{1A}.

With respect to the remaining variables, by eq. (A.5) $R^*_{NA} = -(\Theta^A_{22}/\Theta^A_{N2})R^*_{2A}$, so that consideration of either one alone is sufficient. The return to capital and the change in output of X_{2A} depend upon similar conditions,

$$\frac{R^*_{NA}}{V^*_{1A}} = \Theta^A_{22}\lambda^A_{N1}\left(\Theta^A_{11}\alpha_p - \Theta^A_{11}\frac{D_{2A}}{X_{2A}}\frac{pX_{1A}}{Y_A}\sigma_{1A} \right.$$

$$\left. + \frac{D_{2B}}{X_{2A}}\Theta^B_{11}\frac{V_{1A}}{V_{1B}}\sigma_{1A} \right) \Big/ |D| \gtreqless 0. \tag{A.9}$$

$$\frac{X^*_{2A}}{V^*_{1A}} = \gamma^A_{22}\lambda^A_{N1}\left(-\Theta^A_{11}\alpha_p + \Theta^A_{11}\frac{D_{2A}}{X_{2A}}\frac{pX_{1A}}{Y_A}\sigma_{1A} \right.$$

$$\left. - \frac{D_{2B}}{X_{2A}}\Theta^B_{11}\frac{V_{1A}}{V_{1B}}\sigma_{1A} \right) \Big/ |D| \gtreqless 0, \tag{A.10}$$

If eq. (A.7) equals zero, then the latter two terms of eqs. (A.9) and (A.10) sum to zero, and output of X_{2A} unambiguously falls, releasing capital to sector 1 so that its return rises. If output of X_{1B} is not affected by the outflow of labor, then the final term in (A.9) and (A.10) is zero. In that case the change in output of X_{2A} depends upon the extent of the reduced demand for X_{2A}, as its relative price rises, versus the ability to substitute unskilled labor for capital in X_{1A} production, thereby releasing additional capital to use in X_{2A}. This situation is captured by the expression $\alpha_p - (D_{2A}/X_{2A})\ (pX_{1A}/Y_A)\sigma_{1A}$ which may be rewritten as shown in eq. (10).

References

Batra, R. and R. Casas, 1976, A synthesis of the Heckscher–Ohlin and the neoclassical models of international trade, Journal of International Economics 6, 21–38.

Blitz, R., 1977, A benefit-cost analysis of foreign workers in West Germany, 1957–73, Kyklos 30, 479–502.

Bhagwati, J.N., 1976, The brain drain and taxation: Theory and empirical analysis (North-Holland, Amsterdam).

Bustamante, J.A., 1977, Undocumented immigration from Mexico: Research report, International Migration Review 11, 149–177.

Cain, G.C., 1976, The challenge of segmented labor market theories to orthodox theory: A survey, Journal of Economic Literature 14, 1215–1257.

Casas, F.R. and G.W. Scully, 1972, Temporary labour migration and the theory of optimal intervention, Oxford Economic Papers 24, 1966–1979.

Cornelius, W.A., 1977, Illegal Mexican migration to the United States: Recent research findings, policy implications and research priorities, Mimeo., May (MIT, Boston, MA).

Dagodag, W.T., Source regions and composition of illegal Mexican immigration to California, International Migration Review 9, 499–511.

Jones, K. and A.D. Smith, 1970, The economic impact of Commonwealth immigration (Cambridge University Press, Cambridge).

Jones, R.W., 1965, The structure of simple general equilibrium models, Journal of Political Economy 73, 557–572.

Jones, R.W., 1971, A three factor model in theory, trade, and history, in: J.N. Bhagwati, ed., Trade, the balance of payments, and growth (North-Holland, Amsterdam).

Krauss, M., 1976, The economics of the 'guest-worker' problem: A neo Heckscher–Ohlin approach, Scandanavian Journal of Economics 78, 470–476.

Krauss, M. and W. Baumol, 1979, Guest-workers and income-transfer programs financed by host governments, Kyklos 32, 36–46.

Mishan, E.J. and L. Needleman, 1968, Immigration: Some long term economic consequences, Part A/B, Economia Internazionale 21, 281–300/515–524.

North, D.S. and M.F. Houstoun, 1976, The characteristics and role of illegal aliens in the U.S. labor market: An exploratory study (Linton and Co., Washington, DC).

Reder, M.W., 1963, The economic consequences of increased immigration, Review of Economics and Statistics 45, 221–230.

Rist, R., 1978, Guestworkers in Germany (Praeger, New York).

Rodriguez, C., 1976, Brain drain and economic growth: A dynamic model, in: J.N. Bhagwati, ed., The brain drain and taxation: Theory and empirical analysis (North-Holland, Amsterdam).

U.S. Select Commission on Immigration and Refugee Policy, 1981, U.S. immigration policy and the national interest, March 1 (Washington, DC).

Usher, D., 1977, Public property and the effects of migration upon other residents of the migrants' countries of origin and destination, Journal of Political Economy 85, 1001–1020.