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MINIMUM WAGE, UNEMPLOYMENT AND INTERNATIONAL MIGRATION

by

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Abstract

This paper develops a two-country model of international migration in order to study the implications of opening a minimum-wage economy to immigration. It is shown that an inflow of foreign labor may lower the level of income enjoyed by the country's native factors of production. Moreover, while an increase in the level of the minimum wage reduces employment opportunities within the economy, it may also give rise to substitution of foreign for native workers in the remaining positions of employment. Finally, the paper studies the effects of capital accumulation in both countries on the pattern of international migration, the rate of unemployment in the host country, and the income of workers in the two economies.

I. Introduction

The pioneering works of Haberler (1950), Johnson (1965) and Brecher (1974) have stimulated considerable interest among trade theorists in the problems associated with real-wage rigidity in open economies. However, most of the research on this topic has been conducted within models which rule out the possibility of international factor movements. Notable exceptions are the works of Bhagwati and Hamada (1974), Hamada and Bhagwati (1975), McCulloch and Yellen (1975), and Rodriguez (1975), which examine the consequences of *emigration* out of an economy that is subject to (among other distortions) a minimum-wage constraint. On the other hand, the implications of opening a minimum-wage economy to *immigration* have received much less attention in the theoretical literature.

The need to study this latter problem is underscored by the recent policy debate in the U.S. on new and more effective ways of controlling the flow of foreign workers from the neighboring countries to the south. Growth in the inflow of migrants in the presence of a persistently high U.S. unemployment rate has generated concerns in Washington over the possible adverse effects of immigration on the incidence of unemployment among the native workers, particularly those who are unskilled.

In contrast with the emerging arguments in favor of limiting immigration, there is the very simple proof, provided by Bhagwati and Srinivasan (1983), showing that in the case of a *fully-employed* host country, restrictions on immigration reduce welfare (unless it is possible to tax migrants in a discriminatory fashion). Thus, when a minimum-wage economy is opened to immigration, a number of interesting questions emerge. The primary objective of this paper is to examine the following: How does immigration affect the level of real income enjoyed by the country's native factors of production? What are the effects of a change in the level of the minimum wage on the economy's unemployment rate, the pattern of international migration, and the distribution of income both in the source and in the host country? What are the effects of capital accumulation in the two economies on these same variables?

These questions are addressed below in the context of a two-country, general-equilibrium model. Section 2 of the paper describes the two economies in the absence of international factor movements. It is assumed that the countries differ in terms of their factor endowments and institutional setting. A binding minimum-wage exists in the capital-abundant country, whereas the other economy's labor market is free of distortions. Assuming that capital is immobile internationally, section 3 opens the two economies to international migration. As might be expected, an inflow of workers from the labor-abundant to the capital-abundant, minimum-wage economy leads to a rise in unemployment among the native workers of the latter and a decline in the international wage differential. Whether the host country experiences a rise or fall in national income is shown to depend on the size of the income loss associated with the immigration-induced rise in unemployment, relative to the size of the usual host-country gain which results from the more efficient allocation of labor between the two economies.

Section 4 turns to the effects of changes in certain parameters of the model on the rate of unemployment in the host country, as well as on the pattern of international migration and income distribution. An increase in the minimum wage in the country of immigration is shown to increase the stationary unemployment rate among its native workers and widen the international wage differential. However, the equilibrium flow of migrants may either rise or fall. Thus, it is possible for an increase in the minimum wage to raise the ratio of foreign to native workers employed in the economy and to simultaneously increase the rate of unemployment among the native workers. On the other hand, an increase in the cost of migration is shown to reduce both the stationary unemployment rate in the host country and its ratio of foreign to native workers. Finally, the effects of changes in the capital endowments of the two economies are analysed. It is found that regardless of which country undergoes an increase in its capital stock, the reward to workers of the labor-abundant country rises by more than that accruing to the native workers of the capital-abundant, minimum-wage economy.

Section 5 concludes the paper by offering suggestions for further research.

2. The Analytic Framework

Following Ramaswami (1968), Bhagwati and Srinivasan (1983), and Calvo and Wellisz (1983), let us assume that the two economies produce a single homogeneous product with the aid of capital and labor. They share the same technology, but differ in terms of their factor-endowment ratios. Using Ramasawami's terminology, let us call the capital-rich country Mancunia (M) and the capital-poor country Agraria (A). Let us suppose further that the real wage is perfectly flexible in A, resulting in a state of continuous full employment. In country M, however, there exists a binding minimum wage.

We begin by analysing the equilibrium positions of the two economies in the absence of international factor movements. Suppose that A and M are endowed with given stocks of physical capital, K_a and K_m, and that every instant a constant number of individuals are born in A and M, L_a and L_m, respectively. For simplicity, assume that each individual's economic life begins at the age of 0 and ends at the retirement age of T. In addition, suppose that everyone (costlessly) becomes more productive as he grows older, so that an individual's efficiency at the age of t is given by the function Q(t), where $Q'(t) > 0$ and $Q''(t) < 0$. This function is assumed identical for all individuals, regardless of their country of residence.

Let us consider first the situation in country A. Recalling that L_a workers are born every instant, that each worker has Q(t) units of efficiency labor at the age of t, and that he is continuously employed until the age of T, we may express country A's endowment (and employment) of efficiency labor in the absence of migration as

$$\varepsilon_a = L_a \int_0^T Q(t)dt. \tag{1}$$

Output is produced competitively according to a constant-returns-to-scale production function with capital and efficiency labor as arguments. Thus, output in A per unit of efficiency labor may be written as

$$x_a = f(k_a), \quad f'(k_a) > 0, \quad f''(k_a) < 0, \tag{2}$$

where $k_a \equiv K_a/\varepsilon_a$. The equilibrium real wage per unit of efficiency labor is given by $w_a(k_a) = f(k_a) - k_a f'(k_a)$, where $w_a'(k_a) = -k_a f''(k_a) > 0$.

In country M, however, there exists a minimum real wage which exceeds the maximum level consistent with full employment. Suppose that this wage is set at $\overline{W}$ units of output per worker per day. Moreover, assume that the real wage paid to workers per unit of efficiency labor, w_m, is determined competitively. Thus, provided that a worker in M has at least $\overline{W}/w_m$ units of efficiency labor, he will have no difficulty in finding employment. However, if his efficiency falls short of $\overline{W}/w_m$ units, he must wait until the age of Θ in order to qualify for work at the prevailing minimum wage. The value of Θ is given (implicitly) by

$$Q(\Theta) = \overline{W}/w_m. \tag{3}$$

Thus, for any given $\overline{W}$, there exists an inverse relationship between the age Θ of the youngest individual eligible for employment in M and the market wage per unit of efficiency labor, w_m. This relationship is depicted by the $\overline{WW}$ schedule in fig. 1.

The equilibrium value of w_m depends, in turn, on the economy's endowment of capital, K_m, and the level of employment measured in efficiency units, ε_m. If no individual younger than Θ is "employable" in M, then ε_m may be written as

$$\varepsilon_m = L_m \int_\Theta^T Q(t)dt, \tag{4}$$

where L_m is the constant number of individuals born at each instant in country M. Thus, ε_m is inversely related to Θ. Since the equilibrium wage per unit of efficiency labor in M may be expressed as $w_m(k_m) = f(k_m) - k_m f'(k_m)$, where $k_m \equiv K_m/\varepsilon_m$ and $w_m'(k_m) > 0$, it is obvious that w_m is an increasing function of K_m and Θ, and a decreasing function of L_m.

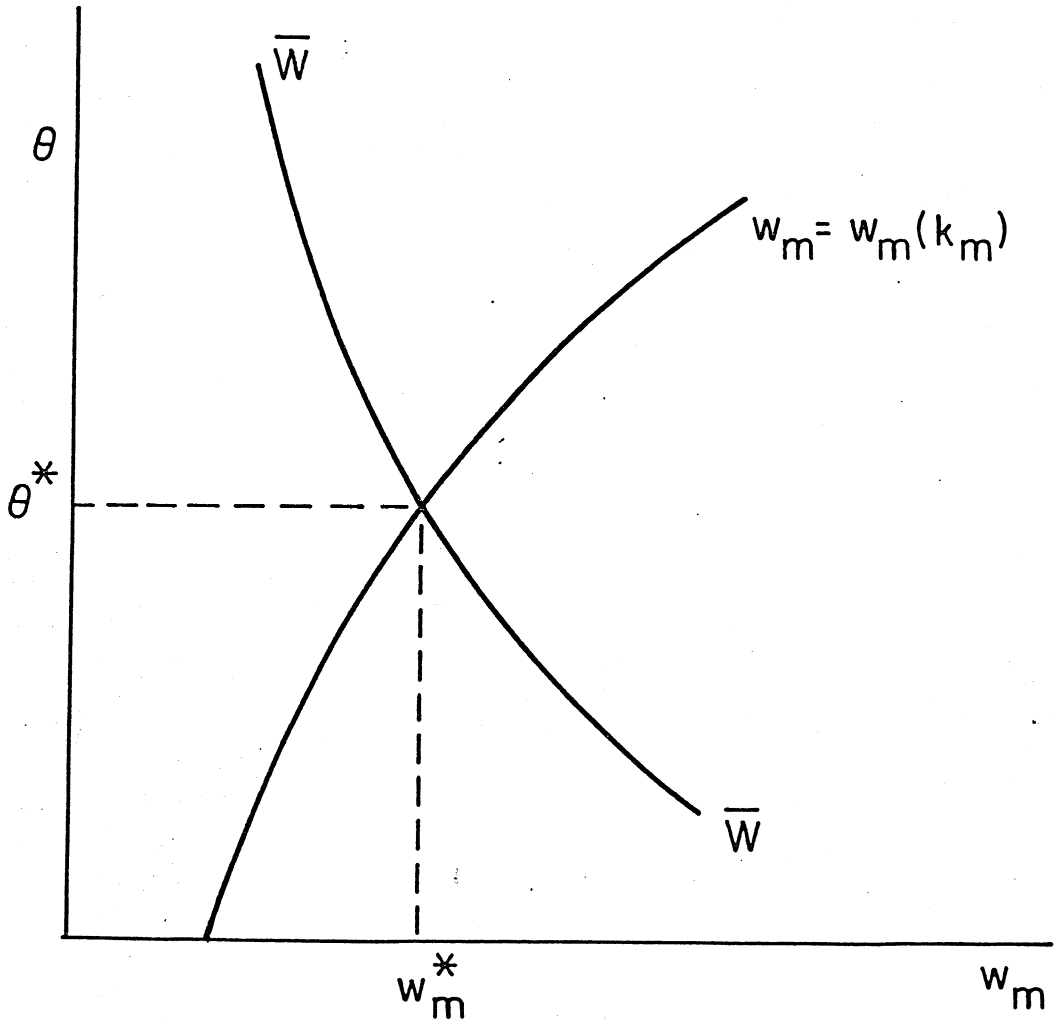

FIGURE 1

The positive relationship between the equilibrium efficiency wage in country M and the age Θ of its youngest workers is represented by the $w_m = w_m(k_m)$ schedule in fig. 1. The point of intersection between this schedule and the $\overline{WW}$ locus determines the equilibrium values of Θ and w_m, Θ^* and w_m^*, respectively. The stationary unemployment rate in country M is then given by Θ^*/T, and the number of unemployed workers by $\Theta^* L_m$.

Assuming that the gap between w_m and w_a is sufficiently large in relation to the cost of moving from A to M, the next section opens the two economies to international migration. Moreover, as is often done in analysing problems associated with international mobility of labor, the possibility of moving physical capital from one economy to another is ruled out. In addition, it is assumed that neither country attempts to control the flow of migrants.

3. International Migration

Let us begin by assuming that individuals who migrate from A to M continue to work in M until their retirement age of T. Moreover, let us suppose that for any given value of the international wage differential, the cost of moving from A to M in relation to the discounted benefits is an increasing function of the age τ of the moving individual. Thus, the smaller the wage differential in favor of country M, the lower the moving age τ_i at which citizens of A are just indifferent between continuing to work in their country and seeking employment abroad. Denoting the stationary value of the efficiency-wage differential in the presence of migration by $\omega \equiv \tilde{w}_m - \tilde{w}_a$ (where a "$\tilde{}$" signifies that the variable is evaluated in the post-migration equilibrium) we may express this relationship between τ_i and ω as

$$\tau_i = \psi(\omega),\ \psi'(\omega) > 0,\ \psi''(\omega) < 0 \quad . \tag{5}$$

It is assumed that $\psi(\omega) \to T$ as $\omega \to \infty$. Moreover, the function $\psi(\cdot)$ is defined only for values of $\omega \geq \omega_{min}$, where ω_{min} is the lowest value of ω consistent with migration from A to M. That is to say, for any $\omega < \omega_{min}$, no citizen of A would seek employment in M even if offered the opportunity to migrate at the age of 0.

Since the cost of moving in relation to the discounted benefits is increasing in τ, every migrant will choose to leave country A as soon as he is able to attract a job offer in M. The moving age of each migrant must then be the same as the age $\tilde{\Theta}$ at which, <u>in the presence of migration</u>, the natives of M receive their first job offers at the minimum daily wage of $\bar{W}$.

Suppose that, in a stationary equilibrium, exactly E citizens of A migrate at each instant to country M at the age of $\tilde{\Theta}$. The level of employment in M (including employment of migrant workers) may then be expressed in efficiency units as

$$\tilde{\varepsilon}_m = (L_m + E) \int_{\tilde{\Theta}}^{T} Q(t)dt. \tag{6}$$

Since the real wage per unit of efficiency labor in country M depends only on $\tilde{k}_m \equiv K_m/\tilde{\varepsilon}_m$, we may use eq. (6) to write $\tilde{w}_m$ as

$$\tilde{w}_m(\tilde{k}_m) = \tilde{w}_m\left(\frac{K_m}{(L_m + E)\int_{\tilde{\Theta}}^{T} Q(t)dt}\right), \tag{7}$$

which is a direct function of K_m and $\tilde{\Theta}$, and an inverse function of L_m and E.

With the minimum daily wage set at $\overline{W}$, each worker in M must have at least $\overline{W}/\tilde{w}_m$ units of skill in order to receive a job offer. That is,

$$Q(\tilde{\Theta}) = \frac{\overline{W}}{\tilde{w}_m\left(\frac{K_m}{(L_m + E)\int_{\tilde{\Theta}}^{T} Q(t)dt}\right)}, \tag{8}$$

which enables us to solve for $\tilde{\Theta}$ as a function of the flow of migrants, E, and the exogenous variables $\bar{W}$, K_m, and L_m. Other things being equal, a rise in E increases $\tilde{\varepsilon}_m$ and therefore lowers $\tilde{w}_m$. This means that each individual must now be relatively more efficient (i.e., older) at the time he begins working in country M in order to earn at least $\bar{W}$ per day. The age $\tilde{\Theta}$ of the youngest worker in M is therefore an increasing function of E.

This positive relationship between $\tilde{\Theta}$ and E is represented by the $\vartheta\vartheta$ schedule in figs. 2a and 2b. Furthermore, it can easily be ascertained that an increase in $\bar{W}$ or L_m shifts the $\vartheta\vartheta$ schedule up and to the left, while an increase in K_m shifts it down and to the right. Hence, if we were to solve equation (8) for $\tilde{\Theta}$, we would obtain

$$\tilde{\Theta} = \vartheta(E;\ \bar{W},\ L_m,\ K_m),\ \vartheta_1,\ \vartheta_2,\ \vartheta_3 > 0,\ \vartheta_4 < 0\ . \tag{9}$$

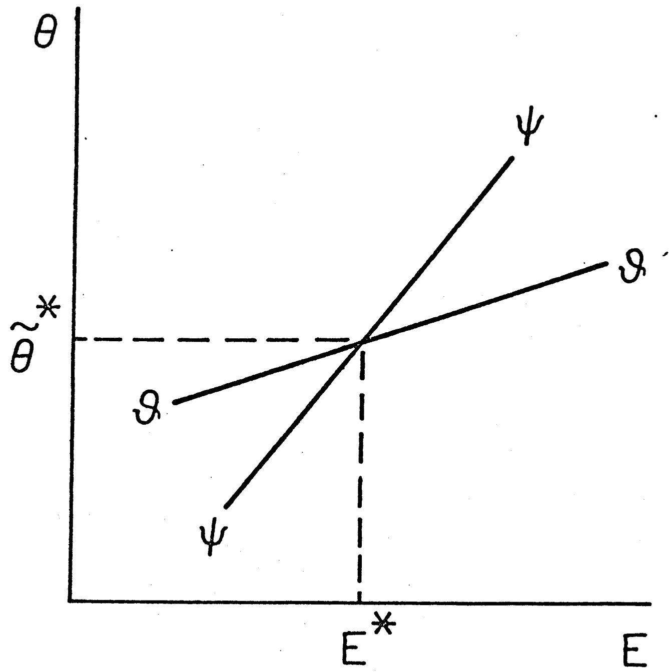

FIGURE 2a

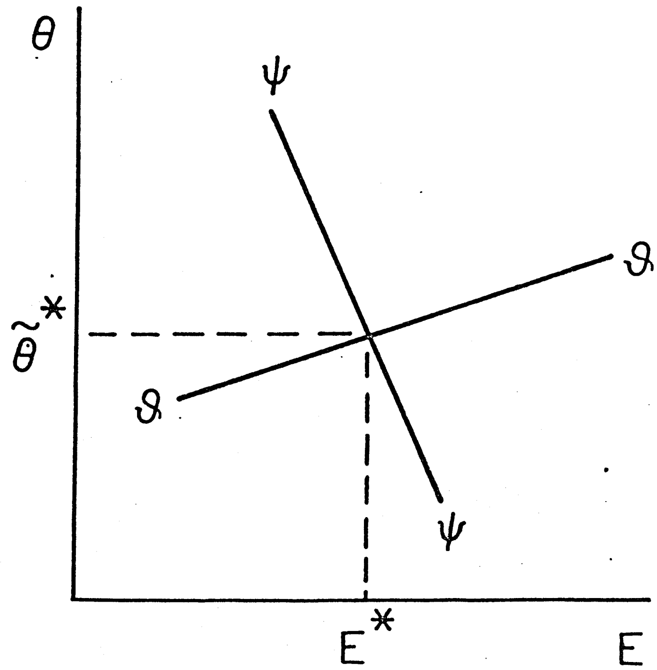

FIGURE 2b

Turning our attention to country A, we know that $\tilde{w}_a$ depends only on $\tilde{k}_a$, the economy's ratio of capital to efficiency labor. Because at each instant E individuals emigrate from A at the age of $\tilde{\Theta}$, the post-migration level of employment in A may be expressed in efficiency units as

$$\tilde{\varepsilon}_a = L_a \int_0^T Q(t)dt - E \int_{\tilde{\Theta}}^T Q(t)dt, \tag{10}$$

and the economy's efficiency wage as

$$\tilde{w}_a(\tilde{k}_a) = \tilde{w}_a \left(\frac{K_a}{L_a \int_0^T Q(t)dt - E \int_{\tilde{\Theta}}^T Q(t)dt} \right) \tag{11}$$

We have assumed that all individuals of a given age are identical. Let us suppose further that the stationary value of $E < L_a$ (i.e., that we have an internal solution to our problem). The moving age of the representative migrant, $\tilde{\Theta}$, must then be identical to the age τ_i, at which he is just indifferent between migrating to M and continuing to work in A. By setting $\tau_i = \tilde{\Theta}$, and substituting eqs. (7) and (11) into (5), we obtain a relationship between $\tilde{\Theta}$ and E such that the welfare of each migrant is identical to that of a remaining resident in A.

$$\tilde{\Theta} = \psi \left\{ \tilde{w}_m \left(\frac{K_m}{(L_m + E)\int_{\tilde{\Theta}}^T Q(t)dt} \right) - \tilde{w}_a \left(\frac{K_a}{L_a \int_0^T Q(t)dt - E \int_{\tilde{\Theta}}^T Q(t)dt} \right) \right\}. \tag{12}$$

In figs. 2a and 2b, this relationship is depicted by the $\psi\psi$ schedule. As shown in Appendix A, the schedule may be either positively or negatively sloped, depending on whether a rise in $\tilde{\Theta}$ increases or reduces the relative attractiveness of the option to migrate. The ambiguity in the effect of a change in $\tilde{\Theta}$ on the decision to migrate emerges for the following reason: On the one hand, an increase in $\tilde{\Theta}$ improves the relative attractiveness of migration by reducing $\tilde{w}_a$ and raising $\tilde{w}_m$. On the other hand, because $\tilde{\Theta}$ is also equal to the moving age of each migrant, an increase in $\tilde{\Theta}$ raises the cost of moving relative to the benefits, making migration less attractive. Thus, if the former effect dominates, an increase in $\tilde{\Theta}$ must be accompanied by an increase in E (and its negative impact on ω) in order to keep citizens of A indifferent between staying at home and moving to M. In this case the $\psi\psi$ schedule is positively sloped, as illustrated in fig. 2a. Alternatively, if an increase in $\tilde{\Theta}$ reduces the relative attractiveness of international migration, the $\psi\psi$ schedule is negatively sloped, as in fig. 2b. Both of these outcomes seem possible for plausible values of the model's parameters. Finally, it can be seen in Appendix A that if the slope of the $\psi\psi$ schedule is positive, it must be greater than that of the $\vartheta\vartheta$ schedule, as depicted in fig. 2a.

The point of intersection between the two schedules determines the stationary values of $\tilde{\Theta}$ and E, $\tilde{\Theta}^*$ and E^*, respectively. The corresponding stock of migrant labor (measured in efficiency units) is given by $E^*\int_{\tilde{\Theta}^*}^{T} Q(t)dt$, and the stock of unemployed labor in country M by $L_m\int_0^{\tilde{\Theta}^*} Q(t)dt$. The equilibrium values of $\tilde{w}_m$ and $\tilde{w}_a$ can be determined by using the solutions for $\tilde{\Theta}^*$ and E^* in eqs. (7) and (11), respectively.

4. Comparative Statics

This section studies the effects of parametric changes on the wage rates of the two economies, the pattern of international migration and the rate of unemployment in country M.

4.1 Effects of Impediments to International Mobility of Labor

Consider first the consequences of an increase in the cost of moving from A to M, reflecting, for example, the introduction of new barriers to international migration by the government of M. At the initial values of $\tilde{\Theta}$ and E, citizens of A will now find migration less attractive than the alternative of remaining employed at home. If $\tilde{\Theta}$ is held constant, a fall in E is required in order to restore equality between the two choices by lowering $\tilde{w}_a$ and raising $\tilde{w}_m$. Thus, the $\psi\psi$ schedule shifts to the left. The position of the $\vartheta\vartheta$ schedule, however, remains unaffected. It follows that both $\tilde{\Theta}^*$ and E^* are lower in the new steady state.

Given the minimum daily wage of $\overline{W}$, the decline in $\tilde{\Theta}^*$ reflects an increase in $\tilde{w}_m$ and a decline in $\tilde{\Theta}^*/T$, the unemployment rate among the native workers of M. Furthermore, with a given stock of capital in that economy, the only way $\tilde{w}_m$ can rise along with a fall in the unemployment rate is if the stock of migrant labor (measured in efficiency units) declines. This, in turn, implies that $\tilde{w}_a$ must fall.

Moreover, while the flow of migrants (as measured by E^*) declines in the new steady state, each of the migrants stays abroad for a longer period of time, enjoying the now higher $\tilde{w}_m$. Nonetheless, his welfare actually falls because the direct impact of the increase in moving costs dominates. This can easily be seen by recalling a) that the level of welfare enjoyed by a migrant must be identical to that enjoyed by each of the remaining residents of A, and b) that $\tilde{w}_a$ is lower in the new steady state.

Because the qualitative effects of an increase in the cost of moving from A to M must be the opposite of those associated with the policy of opening country M to immigration, it immediately follows that the latter policy gives rise to an increase in unemployment in M, a decline in $\tilde{w}_m$, and an increase in $\tilde{w}_a$. Thus, as in full-employment models, international migration lowers the income of host-country workers and source-country capitalists and raises that of source-country workers and host-country capitalists. However, in contrast with the results of those models, the decline in income of the native workers in the country of immigration is the consequence of not only a lower wage, but also a higher unemployment rate.

It is interesting to note that this increase in unemployment gives rise to the possibility that immigration may lower national income in M, the level of real income earned by the country's native factors of production. In order to examine the impact of immigration on national income of a minimum-wage economy, one must compare the usual real-income gain of the host-country (given by the area ABC in fig. 3) with the loss of income associated with the immigration-induced rise in unemployment among the native workers (which is given by the area DCGF, assuming that FG represents the rise in the efficiency stock of unemployed labor in the host country following the inflow of FH efficiency units of foreign labor). As can be seen in the figure, for a given inflow of foreign

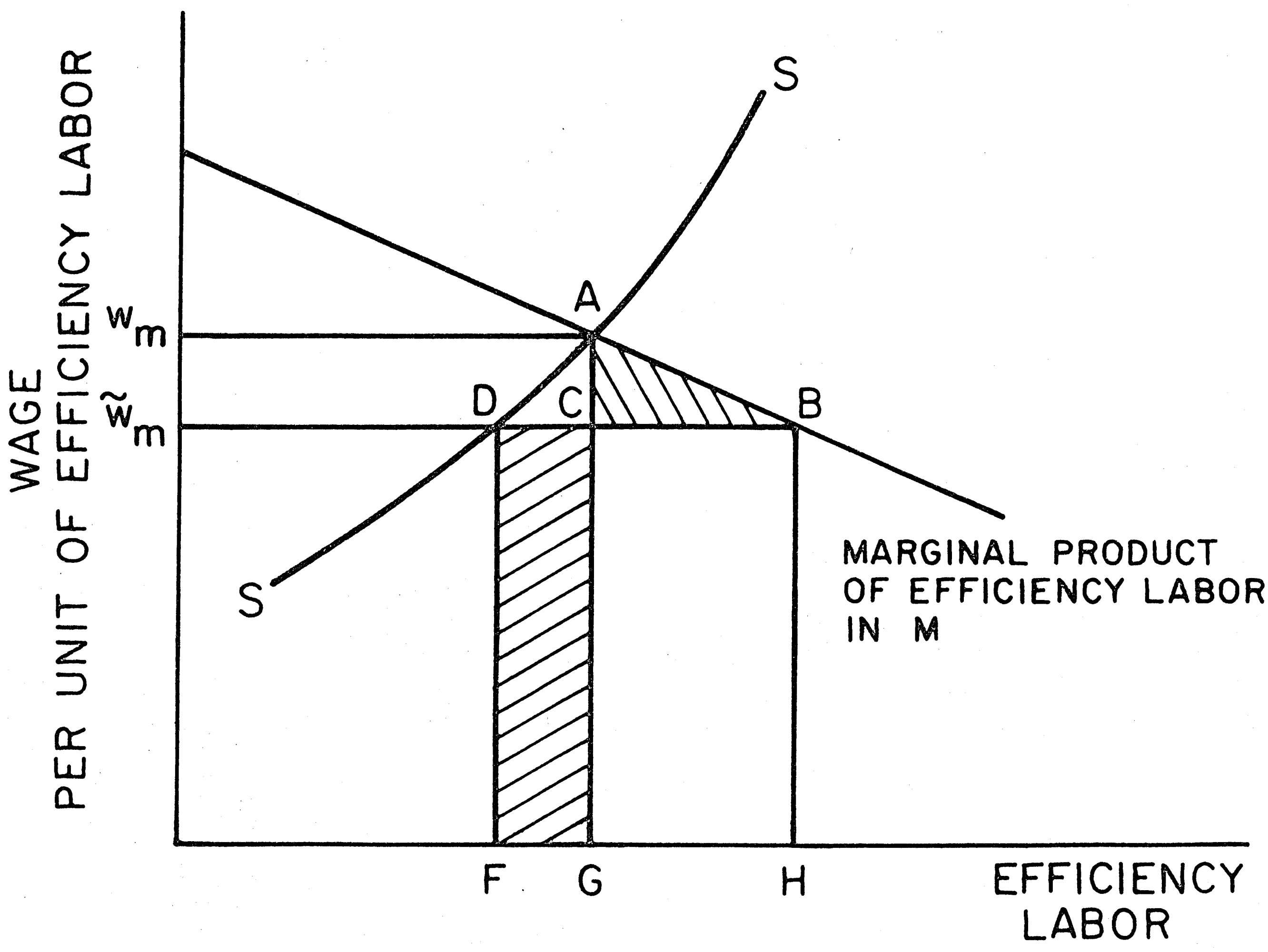
WAGE
PER UNIT OF EFFICIENCY LABOR
S
S
A
w_m
D
C
B
$\tilde{w}_m$
MARGINAL PRODUCT
OF EFFICIENCY LABOR
IN M
F
G
H
EFFICIENCY
LABOR

FIGURE 3

(efficiency) labor, immigration is more likely to reduce real income of the host country, the higher is the elasticity of the SS curve (which relates the equilibrium level of employment of native efficiency labor to the efficiency wage), and the lower is the elasticity of demand for labor along the marginal productivity of labor schedule. In particular, if we let λ and ε_m be (in efficiency units) the stock of migrant labor and the pre-migration level of employment in the host country, respectively, it can be shown that immigration raises or lowers national income depending on whether

$$\frac{\eta_D\lambda}{2(\eta_D+\eta_S)\varepsilon_m} \gtrless \eta_S \quad , \tag{13}$$

where η_D is the elasticity of demand for efficiency labor and η_S is the elasticity of native employment along the SS schedule. The latter elasticity may be expressed as $\eta_S = \gamma(\tilde{\Theta})/\eta_Q$, where $\gamma(\tilde{\Theta}) \equiv Q(\tilde{\Theta})\tilde{\Theta}/\int_{\tilde{\Theta}}^{T} Q(t)dt > 0$. and η_Q is the elasticity of the skill-formation function Q(t). As indicated by (13), opening a minimum-wage economy to "a little" immigration will lower its national income, while opening it to "a lot" may actually raise it. As a first approximation, the stock of migrant labor which leaves national income unchanged is given by $\lambda = 2(\eta_D+\eta_S)\varepsilon_m\eta_S/\eta_D$.

It is interesting to ask how these results would differ if international migration in the presence of unemployment were modelled instead within the framework suggested by Harris and Todaro (1970). We are in the Harris-Todaro world if all individuals are identical (regardless of age), and if the job-selection process is random, so that each worker in M faces the same probability of finding a minimum-wage-paying job. Given the capital endowment of M, there is then a unique level of employment corresponding to the prevailing minimum wage, regardless of what the number of migrants might be. That is to say, entry of migrants merely raises the number of unemployed workers in the economy, leaving output and the distribution of income between capital and labor unaffected. Since the constant wage bill must now be divided between the native workers and the migrants, it follows that, in the context of the Harris-Todaro model, immigration unambiguously reduces national income of the host country.

4.2 A Rise in the Minimum Wage

Consider next the effects of an increase in country M's minimum daily wage. As can be seen in eqs. (9) and (12), a rise in $\overline{W}$ shifts the $\vartheta\vartheta$ schedule up and to the left while leaving the position of the $\psi\psi$ schedule unaffected. Thus, in figs. 4a and 4b, the stationary equilibrium moves from point A to point B. We observe that in both cases $\tilde{\Theta}^*$ rises. On the other hand, E^* may either rise or fall, depending on whether the $\psi\psi$ schedule is positively or negatively sloped.

The increase in $\tilde{\Theta}^*$ implies that $\tilde{\Theta}^*/T$, the unemployment rate among the native workers of M, is higher in the new steady state. However, because the effect of an increase in $\overline{W}$ on E^* is ambiguous, this rise in unemployment may be accompanied by either an increase or a decline in the ratio of foreign to native workers employed in country M. Thus, an increase in the minimum wage does not only eliminate job opportunities, but it may also give rise to substitution of foreign for native workers in the remaining positions of employment.

Turning to the effects of an increase in $\overline{W}$ on the wage rates in the two countries, it can be seen in eq. (12) that a higher value of $\tilde{\Theta}^*$ must be associated with an increase in the international wage differential.

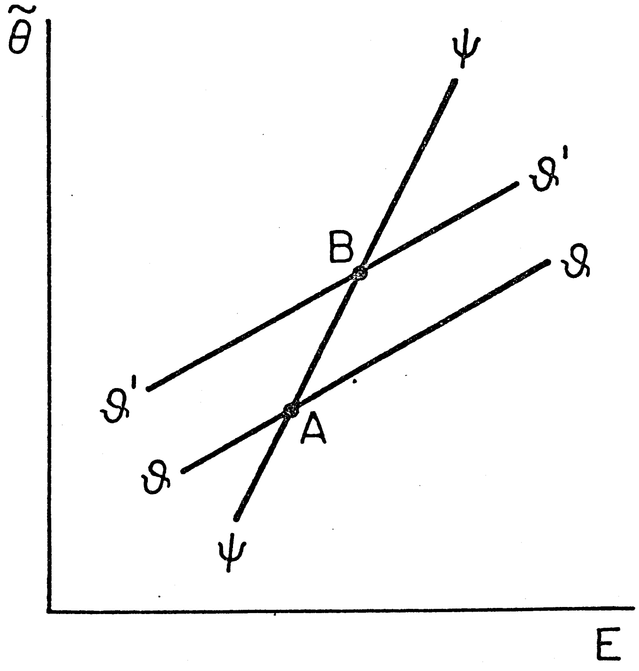

FIGURE 4a

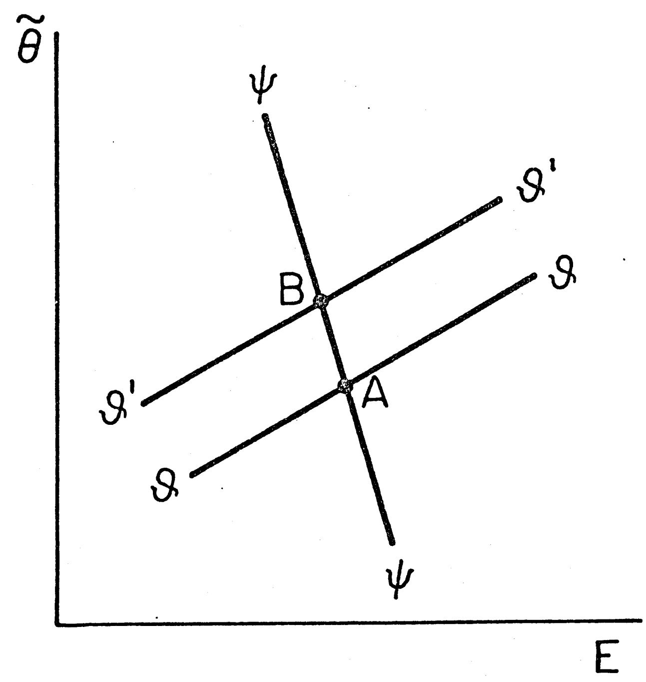

FIGURE 4b

Moreover, as shown in eq. (B.11) of Appendix B, the value of $\tilde{w}_m$ must rise in the new steady state, although less than in proportion to the increase in $\overline{W}$. On the other hand, the effect on $\tilde{w}_a$ is ambiguous. If E^* declines, as in the case depicted in fig. 4b, the stock of migrant labor (measured in efficiency units) obviously falls, resulting in a lower $\tilde{w}_a$. However, in the case of fig. 4a, where the value of E^* rises, the possibility of an increase in the efficiency stock of migrant labor, and hence in the value of $\tilde{w}_a$, cannot be ruled out.

4.3 Effects of Capital Accumulation

Let us begin by examining the consequences of an increase in K_a. Inspection of eqs. (9) and (12) reveals that the position of the $\vartheta\vartheta$ schedule remains unaffected by this disturbance, while the $\psi\psi$ schedule shifts to the left. Thus, regardless of whether the $\psi\psi$ schedule is positively or negatively sloped, the new equilibrium is characterized by lower values of both $\tilde{\Theta}^*$ and E^*.

The fall in $\tilde{\Theta}^*$ implies that the unemployment rate in M is lower and the international wage differential narrower in the new steady state. Given the level of the minimum daily wage in country M, it also implies that $\tilde{w}_m$ is higher. Moreover, knowing that ω falls, we conclude that $\tilde{w}_a$ must increase by more than $\tilde{w}_m$. Finally, the decline in E^* implies that capital accumulation in country A reduces the ratio of foreign to native workers employed in country M.

Consider next the effects of an increase in K_m. As can be seen in eqs. (9) and (12), a rise in K_m shifts both the $\psi\psi$ and the $\vartheta\vartheta$ schedule to the right. However, it can easily be ascertained that the rightward shift of $\vartheta\vartheta$ exceeds that of $\psi\psi$. That is, if $\tilde{\Theta}$ is held constant following a rise in K_m, the increase in E which is required to keep $\tilde{w}_m$ constant is larger than that required to keep ω constant. Thus, regardless of whether the $\psi\psi$ schedule is positively or negatively sloped, $\tilde{\Theta}^*$ must be lower at the new equilibrium point. Moreover, in the case of a negatively sloped $\psi\psi$ schedule, the value of E^* must rise. However, if the $\psi\psi$ schedule is positively sloped, the possibility of a decline in E^* cannot be ruled out, although this outcome is highly unlikely in the relevant range of the model (see eq. [B.7] of Appendix B). In the analysis below, we shall therefore assume that $dE^*/dK_m > 0$.

The decline in $\tilde{\Theta}^*$ and the increase in E^* gives rise to a higher stock of migrant labor in country M and to an increase in the ratio of foreign to native workers employed in that economy. In addition, a lower $\tilde{\Theta}^*$ is associated with a decline in the unemployment rate among the native workers , an increase in $\tilde{w}_m$, and a decline in the international wage differential. Thus, as in the case of an increase in K_a, $\tilde{w}_a$ must rise by more than $\tilde{w}_m$.

Why does $\tilde{w}_a/\tilde{w}_m$ rise irrespective of which economy experiences an increase in its capital endowment? The answer is straightforward. Capital accumulation in either economy tightens the labor market in country M, reducing the minimum age at which a migrant is able to attract a job offer in M. This makes migration relatively more attractive at any given value of the international wage differential. To restore equilibrium, the differential must fall in the long run.

However, one should not draw the conclusion that the native workers of A necessarily benefit more from capital accumulation than those of M do. In addition to the higher efficiency wage, the latter also enjoy a decline in the length of time over which they experience unemployment.

. Concluding Remarks

There are several directions in which the model developed in this paper could be extended. One possibility is to examine further the role of impediments to international mobility of labor. The introduction of barriers to legal migration naturally gives rise to the problem of illegal migration. With the exception of the pioneering work by Ethier (1984), the theoretical aspects of this problem have received very little attention in the literature.

The conflict between special interest groups within the host country and how it gives rise to the equilibrium level of immigration restrictions is another aspect of the problem which requires further attention. Here, a useful starting point is the approach developed by Brock and Magee (1978) and Findlay and Wellisz (1982, 1983) in their analyses of the problem of tariff formation.

Finally, it would be interesting to use the approach developed in the present paper in the context of a two-commodity world. This would enable one to study the interaction between commercial policy and immigration policy in the presence of unemployment. Research along these lines seems particularly useful in light of the fact that the introduction of many recent commercial-policy measures and restrictions on international factor movements has been motivated by the desire to save domestic jobs.

Appendix A

The slope of the $\psi\psi$ schedule is given by

$$\left.\frac{d\tilde{\Theta}}{dE}\right|_{\psi\psi} = \frac{\dfrac{\eta_\psi \tilde{\Theta}}{E}\left(\dfrac{\tilde{w}_a s_a \lambda}{\omega\sigma_a \tilde{\varepsilon}_a} + \dfrac{\tilde{w}_m s_m \lambda}{\omega\sigma_m \tilde{\varepsilon}_m}\right)}{\eta_\psi \gamma(\tilde{\Theta})\left(\dfrac{\tilde{w}_a s_a \lambda}{\omega\sigma_a \tilde{\varepsilon}_a} + \dfrac{\tilde{w}_m s_m}{\omega\sigma_m}\right) - 1} \gtrless 0 \quad , \qquad (A.1)$$

where $\eta_\psi \equiv \omega\psi'(\cdot)/\psi(\cdot) > 0$, $\gamma(\tilde{\Theta}) \equiv \tilde{\Theta}Q(\tilde{\Theta})/\int_{\tilde{\Theta}}^{T} Q(t)dt > 0$, s_j and $\sigma_j > 0$ are, respectively, the distributive share of capital and the elasticity of factor substitution in country $j(j=a,m)$, and $\lambda \equiv E \int_{\tilde{\Theta}}^{T} Q(t)dt$ is the efficiency stock of migrant labor residing in country M. Because the numerator of (A.1) is positive, the slope of the $\psi\psi$ schedule must be of the same sign as the denominator. That sign is positive (negative) if an increase in $\tilde{\Theta}$ gives rise to an increase (a decline) in the relative attractiveness of the option to migrate. Thus, if the decision to migrate is more sensitive to the international wage differential than to the migrant's moving age (so that $\eta_\psi > 1$), and if ω is elastic with respect to $\tilde{\Theta}$, so that $\eta_\omega > 1$, where

$$\eta_\omega \equiv \frac{\partial\omega}{\partial\tilde{\Theta}}\frac{\tilde{\Theta}}{\omega} = \gamma(\tilde{\Theta})\left[\frac{\tilde{w}_a s_a \lambda}{\omega\sigma_a \tilde{\varepsilon}_a} + \frac{\tilde{w}_m s_m}{\omega\sigma_m}\right] ,$$

then an increase in $\tilde{\Theta}$ necessarily improves the relative attractiveness of the option to migrate. In this event, a rise in $\tilde{\Theta}$ must be accompanied by an increase in E if citizens of A are to remain indifferent between staying at home and moving to M at the age of $\tilde{\Theta}$. The $\psi\psi$ schedule is then positively sloped, as it must be whenever $\eta_\psi\eta_\omega > 1$. However, if $\eta_\psi\eta_\omega < 1$, so that an increase in $\tilde{\Theta}$ makes migration less attractive, the $\psi\psi$ schedule is negatively sloped.

Let us compare next the slope of the $\psi\psi$ schedule with that of the $\vartheta\vartheta$ locus. The slope of the latter is given by

$$\left.\frac{d\tilde{\Theta}}{dE}\right|_{\vartheta\vartheta} = \left(\frac{\tilde{\Theta} s_m \lambda}{E\sigma_m \tilde{\varepsilon}_m}\right) \Bigg/ \left(\eta_Q + \frac{s_m \gamma(\tilde{\Theta})}{\sigma_m}\right) > 0 \tag{A.2}$$

where $\eta_Q \equiv \tilde{\Theta} Q'(\tilde{\Theta})/Q(\tilde{\Theta}) > 0$. A comparison of (A.1) with (A.2) reveals that if the slope of the $\psi\psi$ schedule is positive, it must be greater than that of the $\vartheta\vartheta$ schedule, as depicted in fig. 2.a.

APPENDIX B

This Appendix derives some of the comparative statics results of section 4.

By totally differentiating eqs. (8) and (12), we obtain the following:

$$\begin{vmatrix} 1 - \eta_\psi \gamma(\tilde{\Theta}) \left(\frac{\tilde{w}_a s_a \lambda}{\omega \sigma_a \tilde{\varepsilon}_a} + \frac{\tilde{w}_m s_m}{\omega \sigma_m} \right) & \eta_\psi \left(\frac{\tilde{w}_a s_a \lambda}{\omega \sigma_a \tilde{\varepsilon}_a} + \frac{\tilde{w}_m s_m \lambda}{\omega \sigma_m \tilde{\varepsilon}_m} \right) \\ \eta_Q + \frac{s_m}{\sigma_m} \gamma(\tilde{\Theta}) & - \frac{s_m \lambda}{\sigma_m \tilde{\varepsilon}_m} \end{vmatrix} \cdot \begin{vmatrix} \hat{\tilde{\Theta}}^* \\ \hat{E}^* \end{vmatrix}$$

$$= \begin{vmatrix} - \eta_\psi \frac{\tilde{w}_a s_a}{\omega \sigma_a} \hat{K}_a + \eta_\psi \frac{\tilde{w}_m s_m}{\omega \sigma_m} \hat{K}_m \\ \hat{\overline{W}} \quad - \frac{s_m}{\sigma_m} \hat{K}_m \end{vmatrix}, \qquad (B.1)$$

where $\hat{x} = d\,\ell og\ x$, $\eta_\psi \equiv \omega\psi'(\cdot)/\psi(\cdot) > 0$, $\gamma(\tilde{\Theta}) \equiv \tilde{\Theta} Q(\tilde{\Theta}) / \int_{\tilde{\Theta}}^{T} Q(t)dt > 0$, s_j and $\sigma_j > 0$ are, respectively, the distributive share of capital and the elasticity of substitution between capital and labor in country $j (j = a, m)$, $\lambda \equiv E \int_{\tilde{\Theta}}^{T} Q(t)dt$, $\tilde{\varepsilon}_m$ and $\tilde{\varepsilon}_a$ are as defined in eqs. (6) and (10) of the text, respectively, and $\omega \equiv \tilde{w}_m - \tilde{w}_a$. The system (B.1) can be solved for the effects of changes in $\overline{W}$, K_a, and K_m on the stationary values of $\tilde{\Theta}$ and E.

$$\frac{\hat{\tilde{\Theta}}^*}{\hat{\overline{W}}} = - \eta_\psi \left(\frac{\tilde{w}_a s_a \lambda}{\omega \sigma_a \tilde{\varepsilon}_a} + \frac{\tilde{w}_m s_m \lambda}{\omega \sigma_m \tilde{\varepsilon}_m} \right) / \Delta > 0, \qquad (B.2)$$

$$\frac{\hat{E}^*}{\hat{\overline{W}}} = \left[1 - \eta_\psi \gamma(\tilde{\Theta}) \left(\frac{\tilde{w}_a s_a \lambda}{\omega \sigma_a \tilde{\varepsilon}_a} + \frac{\tilde{w}_m s_m}{\omega \sigma_m} \right) \right] / \Delta \gtrless 0, \qquad (B.3)$$

$$\frac{\hat{\tilde{\Theta}}^*}{\hat{K}_a} = \eta_\psi \left(\frac{s_a \tilde{w}_a s_m \lambda}{\sigma_m \omega \sigma_a \tilde{\varepsilon}_m} \right) / \Delta < 0, \tag{B.4}$$

$$\frac{\hat{E}^*}{\hat{K}_a} = \eta_\psi \frac{\tilde{w}_a s_a}{\omega \sigma_a} \left(\eta_Q + \frac{s_m}{\sigma_m} \gamma(\tilde{\Theta}) \right) / \Delta < 0, \tag{B.5}$$

$$\frac{\hat{\tilde{\Theta}}^*}{\hat{K}_m} = \eta_\psi \left(\frac{s_m \tilde{w}_a s_a \lambda}{\sigma_m \omega \sigma_a \tilde{\varepsilon}_a} \right) / \Delta < 0, \tag{B.6}$$

$$\frac{\hat{E}^*}{\hat{K}_m} = \frac{s_m}{\sigma_m} \left[\eta_\psi \left(\gamma(\tilde{\Theta}) \frac{\tilde{w}_a s_a \lambda}{\omega \sigma_a \tilde{\varepsilon}_a} - \eta_Q \frac{\tilde{w}_m}{\omega} \right) - 1 \right] / \Delta \gtrless 0, \tag{B.7}$$

where $\Delta = -\left\{ \frac{s_m \lambda}{\sigma_m \tilde{\varepsilon}_m} + \eta_Q \eta_\psi \left(\frac{\tilde{w}_a s_a \lambda}{\omega \sigma_a \tilde{\varepsilon}_a} + \frac{\tilde{w}_m s_m \lambda}{\omega \sigma_m \tilde{\varepsilon}_m} \right) + \eta_\psi \gamma(\tilde{\Theta}) \frac{s_m \tilde{w}_a s_a \lambda}{\sigma_m \omega \sigma_a \tilde{\varepsilon}_a} \left(1 - \frac{\lambda}{\tilde{\varepsilon}_m} \right) \right\} < 0.$

Consider next the effects of these disturbances on the stationary values of $\tilde{w}_a$ and $\tilde{w}_m$. First, we totally differentiate eqs. (7) and (11) of the text to obtain

$$\hat{\tilde{w}}_a = \frac{s_a}{\sigma_a} \left[\hat{K}_a - \frac{\lambda}{\tilde{\varepsilon}_a} \gamma(\tilde{\Theta}) \hat{\tilde{\Theta}} + \frac{\lambda}{\tilde{\varepsilon}_a} \hat{E} \right], \tag{B.8}$$

$$\hat{\tilde{w}}_m = \frac{s_m}{\sigma_m} \left[\hat{K}_m + \gamma(\tilde{\Theta}) \hat{\tilde{\Theta}} - \frac{\lambda}{\tilde{\varepsilon}_m} \hat{E} \right], \tag{B.9}$$

Then, by using (B.2)-(B.7) we find that

$$\frac{\hat{\tilde{w}}_a}{\hat{\overline{W}}} = \frac{s_a\lambda}{\Delta\sigma_a\tilde{\varepsilon}_a}\left[1 - \eta_\psi\gamma(\tilde{\Theta})\frac{\tilde{w}_m s_m}{\omega\sigma_m}\left(1 - \frac{\lambda}{\tilde{\varepsilon}_m}\right)\right] \gtrless 0, \tag{B.10}$$

$$\frac{\hat{\tilde{w}}_m}{\hat{\overline{W}}} = \frac{-s_m}{\Delta\sigma_m}\left[\frac{\lambda}{\tilde{\varepsilon}_m} + \eta_\psi\gamma(\tilde{\Theta})\frac{\tilde{w}_a s_a\lambda}{\omega\sigma_a\tilde{\varepsilon}_a}\left(1 - \frac{\lambda}{\tilde{\varepsilon}_m}\right)\right] > 0, \tag{B.11}$$

$$\frac{\hat{\tilde{w}}_a}{\hat{K}_a} = \frac{-s_a s_m\lambda}{\Delta\sigma_a\sigma_m\tilde{\varepsilon}_m}\left(1 + \eta_\psi\eta_Q\frac{\tilde{w}_m}{\omega}\right) > 0, \tag{B.12}$$

$$\frac{\hat{\tilde{w}}_m}{\hat{K}_a} = \frac{-s_a s_m\lambda\tilde{w}_a}{\Delta\sigma_a\sigma_m\tilde{\varepsilon}_m\omega}\eta_\psi\eta_Q > 0, \tag{B.13}$$

$$\frac{\hat{\tilde{w}}_a}{\hat{K}_m} = \frac{-s_a s_m\lambda}{\Delta\sigma_a\sigma_m\tilde{\varepsilon}_a}\left(1 + \eta_\psi\eta_Q\frac{\tilde{w}_m}{\omega}\right) > 0, \tag{B.14}$$

$$\frac{\hat{\tilde{w}}_m}{\hat{K}_m} = \frac{-s_a s_m\lambda\tilde{w}_a}{\Delta\sigma_a\sigma_m\tilde{\varepsilon}_a\omega}\eta_\psi\eta_Q > 0. \tag{B.15}$$

Footnote

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