Unemployment has been observed in developed countries as well as developing countries. The unemployment in the developed countries can be characterized as being voluntary because they have excessive expectations of their jobs and rely on others for a living. This type of unemployment has been increasing, particularly among the younger generation in industrialized countries, for example, Japan. On the other hand, there has been an extensive movement of labor among countries. Thus, this paper investigates the effects of international labor (as well as capital) movement and other policies on domestic labor market, particularly when there is a widespread unemployment in the domestic economy.

**Keywords**: Unemployment; Immigration; Welfare

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1. Introduction

In certain developed countries, there has been a remarkable increase in unemployment of the younger generation. This type of unemployment is characterized as being voluntary because they have excessive expectations of their jobs and rely on others for a living. In other words, the youth can be employed in certain suitable industries if they wish. However, they prefer voluntary unemployment in the hope that someday they can obtain their ideal jobs. It seems as if the Snow White believes that “someday my prince will come”. This is highly similar to the situation in developing countries. In those countries, rural workers are attracted to “the city lights” and migrate to the urban area at the risk of unemployment, although they can be fully employed in the rural area at the prevailing rural wage rate. Harris and Todaro (1970) formulated this labor allocation mechanism between the rural and urban areas in the developing countries. Thus, the problem of unemployment of the younger generation can be analyzed by employing their approach. Various aspects of the Harris-Todaro (HT, hereafter) model have been discussed by several trade theorists such as Bhagwati and Srinivasan (1974), Corden and Findlay (1975), Khan (1980), Marjit (1981), Batra and Naqvi (1987), Beladi and Naqvi (1988), Hazari and Sgro (1991), Neary (1991), Gupta (1993), Yabuuchi (1993), Chao and Yu (1996).

Our analysis is the extension of the mobile-capital HT model developed by Corden and Findlay (1975) and followed by Batra and Naqvi (1987) and Yabuuchi (1998, 2005) among others. Yabuuchi (2005) introduces the difference between skilled-labor and unskilled-labor into the standard mobile-capital HT model and analyzes the relation between unemployment and the international movement of two types of labor and capital. In this paper, we examine the unemployment problem of the younger generation by explicitly introducing financial support for the unemployed workers into the model. In a different context, Carter (1999) examines the effects of illegal immigration and regulation policies in an economy with unemployment by using the efficiency wage model developed by Shapiro and Stiglitz (1984). The analysis by Carter is extended further by Kondo (2003) who introduces legal immigrants as well as illegal ones, and investigates the effects of various regulation policies of immigrants.

The unemployment in the HT model is inherently involuntary because it is caused by the fixed wage rate in one sector of the economy. However, it has an aspect of voluntary unemployment in a sense that they can be employed in another sector where the wage rate is
flexible. This is also true for the unemployment of the unskilled younger generation in developed countries because employment is voluntary and the youth are self-indulgent. Therefore, it seems that unemployment itself is not a serious problem for the workers themselves. Whether or not they are employed in a suitable job is merely a problem of their choice. However, this might cause social instability or loss of opportunity of accumulation of technical knowledge in the most appropriate period, if the period without jobs lasts long. This type of unemployment is sometimes called NEET (Not in Employment, Education or Training). Thus, they tend to remain unemployed and unskilled. In these respects, therefore, this problem is an extremely important concern for the country as a whole as well as the unemployed workers themselves. Subsequently, we consider the efficient policies to reduce this type of unemployment.

The remainder of this paper is organized as follows. Section 2 presents the model and basic assumptions. Section 3 and 4 examine the effects of international factor movement and production subsidies on unemployment, respectively. Section 5 is devoted to the analysis of the influences of international factor movement and production for welfare. The concluding remarks are provided in section 6.

2. The model and assumptions

Let us consider a small open economy in which there are two sectors. One sector produces good 1, $X_1$, and the other sector produces good 2, $X_2$. We suppose that sector 2 is attractive and sector 1 is not attractive to the workers. For simplicity, we label sectors 1 and 2 as traditional and advanced manufacturing sectors, respectively. Production of each good requires unskilled-labor ($L_j$), skilled-labor ($H_j$), and capital ($K_j$). Thus, the production functions are as follows:

$$X_j = F^j(L_j, H_j, K_j), \quad j = 1,2. \quad (1)$$

It is assumed that $F^j$ has positive and diminishing marginal products and it is homogeneous of degree one. We suppose that unskilled labor mainly consist of younger generation.

Under perfect competition, we have

$$p_j = a_{Lj}w_1 + a_{Hj}s + a_{Kj}r, \quad j = 1,2. \quad (2)$$
where $a_{ij}$ is the amount of the $i$th factor used in the $j$th industry to produce one unit of the output, $w_j$ is the wage rate of unskilled labor in the $j$th sector, $s$ is the wage rate of skilled labor, $r$ is rental of capital, and $p_j$ is the price of the $j$th good ($j = 1, 2$). We assume that all goods are tradable and then their prices are exogenously given.

In the standard HT model, it is assumed that the wage rate in (manufacturing) sector 2 ($w_2$) is set at a relatively high level, and it is rigid due to some political and/or institutional considerations, while the wage rate in (agricultural) sector 1 ($w_1$) is flexible. In this situation, the rural workers have two alternatives of staying in rural areas in order to obtain a job at a low wage rate or migrating to urban areas in order to seek a high wage income at the risk of unemployment. Thus, the labor allocation mechanism between the sectors is shown as follows:

$$w_1 = w_2 L_2 / (L_2 + L_u)$$

or

$$w_1 (1 + \lambda) = w_2,$$

where $L_2$ and $L_u$ are the employed and unemployed labor in the urban area, respectively, and $\lambda = L_u / L_2$. In the labor market equilibrium, therefore, the wage rate in the sector 1 ($w_1$) equals the expected wage income in sector 2, which equals the manufacturing wage rate ($w_2$) times the probability of finding a job in the urban manufacturing sector ($L_2 / (L_2 + L_u)$).

We apply this labor allocation mechanism to the job search behavior of unskilled labor in developed countries. Thus, the unskilled labor can obtain secure (but boring) jobs in the labor-absorbing sector (for example, traditional manufacturing sector) at a low wage rate, while simultaneously they can seek high wage and/or attractive jobs at the risk of unemployment in the other sector (for example, advanced hi-tech sector). This seems to reflect the behavior of several young unskilled job-seekers in developed countries. On the basis of HT model, we assume that the advanced-sector wage rate is fixed at a higher level than the traditional-sector wage rate. This is because the firms in the advanced sector have well organized trade unions and/or there might be certain agreements or laws on the level of the minimum wage rate. Alternatively, it might be argued that the high and constant wage rate in the sector captures various types of benefits for the workers, which include pecuniary rewards, stability, and interest in the job. We also assume that skilled labor is fully employed in either the advanced and traditional sectors.
In the HT labor allocation mechanism, it is implicitly assumed that unemployed labor is supported by employed labor, such as other members of the family, or the job is allocated daily (or monthly and so on) to all applicants by lottery. Otherwise, unemployed labor cannot survive since unemployment allowance is not considered in the standard HT model. The former assumption fits well to our present set-up. The unemployed young people are supported by the advanced generation, for example, their parents and/or grandparents. They are rather wealthy, and they are often willing to support their children or grandchildren. This phenomenon has been increasingly observed in the Japanese society.

Subsequently, we introduce this mechanism explicitly into the standard HT labor allocation mechanism as follows:

\[
\begin{align*}
    w_1 &= w_2 L_2 / (L_2 + L_u) + \alpha w_2 L_u / (L_2 + L_u) \quad (2) \\
    \text{or} \quad w_1 (1 + \lambda) &= w_2 (1 + \alpha \lambda), \quad (3')
\end{align*}
\]

In other words, we assume that the unemployed obtain a certain amount of income \((\alpha w_2)\) as a gift. We can consider the gift as unemployment allowance, subsidies on education and/or training, and generous support from their relatives. The amount or the level of \(\alpha(0 < \alpha < 1)\) depends on the characteristic feature of the society. It is not very unrealistic to assume that \(w_1 > \alpha w_2\). We also assume that the necessary “fund” is collected in a lump-sum manner. This might be justified as a first approach to this issue. For further examination, we have to specify the agents who supply the fund to the unemployed.

Exogenously given endowments impose the following resource constraints:

\[
\begin{align*}
    a_{L_1} X_1 + a_{L_2} X_2 + \lambda a_{L_2} X_2 &= L + L^*, \quad (4) \\
    a_{H_1} X_1 + a_{H_2} X_2 &= H + H^*, \quad (5) \\
    \text{and} \quad a_{K_1} X_1 + a_{K_2} X_2 &= K + K^*, \quad (6)
\end{align*}
\]

where \(L, H,\) and \(K\) are the domestic endowments of unskilled-labor, skilled-labor, and capital, respectively, while \(L^*, H^*,\) and \(K^*\) are the foreign inflows of unskilled-labor, skilled-labor, and capital, respectively. This completes the specification of our model with the fixed
endowment of factors and the internationally determined prices. We have six unknown variables \( w_1, s, r, X_1, X_2, \) and \( \lambda \), which are solved by six equations (2)–(6) for given parameters, \( w_2, p_1, p_2, L, H, K, L^*, H^*, \) and \( K^* \).

In the following discussion, the factor intensities between factors play an important role. In this case, we make the following assumptions:

**Assumption 1.** Advanced sector 2 is capital-intensive relative to unskilled-labor compared to traditional sector 1 in the value sense, i.e.,

\[
\frac{rK_2}{w_2L_2} > \frac{rK_1}{w_1L_1} \iff k_2 > (1 + \lambda)k_1 \\
\iff \Lambda_{LK} = \lambda_{K2} - (1 + \lambda)\lambda_{L2}\lambda_{K1} > 0 ,
\]

where \( k_j = K_j / L_j, (j = 1,2) \), and \( \lambda_{ij} \) the allocative share of the \( i \)th factor in the \( j \)th industry (e.g., \( \lambda_{K2} = a_{K2}X_2 / K \)).

This assumption is well known as the Khan-Neary stability condition in literature. This implies that the advanced sector 2 is capital intensive relative to unskilled-labor compared to the traditional sector 1 also in the physical sense, i.e.,

\[
\frac{K_2}{L_2} > \frac{K_1}{L_1} \iff \lambda_{L2}\lambda_{K2} > \lambda_{L2}\lambda_{K1}.
\]

**Assumption 2.** Advanced sector 2 is skilled-labor intensive relative to unskilled-labor compared to traditional sector 1 in the value sense, i.e.,

\[
\frac{sH_2}{w_2L_2} > \frac{sH_1}{w_1L_1} \iff \Lambda_{LH} = \lambda_{H2} - (1 + \lambda)\lambda_{H1}\lambda_{L2} > 0 .
\]
The assumption is not unrealistic since traditional sectors absorb considerable unskilled-labor. This implies that the advanced sector 2 is skilled-labor intensive relative to unskilled-labor compared to the traditional sector 1 also in the physical sense, i.e.,

\[ \frac{H_2}{L_2} \geq \frac{H_1}{L_1} \iff \lambda_{L1}\lambda_{L2} > \lambda_{L2}\lambda_{L1}. \]

Finally, we define the factor intensity between skilled labor and capital.

**Definition 1.** Advanced sector 2 is skilled-labor (capital) -intensive relative to capital (skilled-labor) compared to traditional sector 1, if and only if

\[ \frac{H_2}{K_2} > \frac{H_1}{K_1} \iff \Lambda_{HK} \equiv \lambda_{K2}\lambda_{K1} - \lambda_{K1}\lambda_{K2} > 0. \]

Contrary to the previous two assumptions, this intensity ranking depends on the situation of the economy in question. Thus, the results and its application to the real economy will change drastically according to the intensity.

3. International factor movement and unemployment

(3-1) Immigration of unskilled labor

In the present set-up of the model, the positive effects of the changes in factor endowment on the variables do not depend on whether they are autonomous increases or inflows from abroad, as far as the positive aspects of this analysis are concerned. The normative effects differ according to the cause of the changes. If the change is caused due to the inflow of foreign factor, it additionally affects welfare through the change in the remittance. Therefore, the following results on unemployment apply to the case of an autonomous increase in the domestic endowment of unskilled-labor.

First, we examine the effect of an inflow of unskilled foreign labor on the rate of unemployment (\( \lambda \)). \( \lambda \) shows the ratio of the unemployed to employed labor in the advanced sector. It is not the rate of unemployment in the economy as a whole. However, it plays an
important role in the analysis of HT model and used as a variable to show the degree of unemployment.

Comparative statics yields (see Appendix A)

\[ (1/l^*) (\hat{\lambda} / \hat{L}^*) = -w_2 \Theta_{HK} \Lambda_{HK} / \Delta, \]

(7)

where \( \Delta \) is the value of the determinant of the coefficient matrix of the system, and

\[ \Theta_{HK} = \theta_{K1} \theta_{H2} - \theta_{K1} \theta_{H2}. \]

is the distributive share of the \( i \)th factor in the \( j \)th industry (e.g., \( \theta_{K1} = ra_{K1} / p_1 \)). It can be seen that \( \text{sign} \Theta_{HK} = \text{sign} \Lambda_{HK} \) by definition, and \( \Delta < 0 \) if the system is stable (see Appendix B). Thus, we have the following proposition:

**Proposition 1.** The increase in foreign unskilled labor increases the rate of unemployment.

The result is rather straightforward and consistent with our intuition. In fact, considerable legal and illegal unskilled labor is employed in certain industries characterized by low wage and dirty, dull, dangerous, and demanding conditions. Most people in developed countries do not want to work in such industries even if they are unskilled. This tendency is observed quite clearly among young people. Then, foreign workers replace domestic ones in these industries. Domestic workers quit and seek jobs in other attractive industries. However, sufficient jobs are not available for all of them. Thus, this provides a partial explanation of why unemployment of the younger generation has been increasing.

Thus, the simple solution for the problem is to limit the immigration of unskilled labor. There are other reasons for the increase in unemployment, such as recession and the change in the work ethic of the people. However, such an economy is in the vicious circle of
excess labor, low wage, outflow of domestic labor, and inflow of further inflow of foreign labor. Therefore, the policy to reduce the inflow of unskilled labor is effective to decrease the rate of unemployment in the advanced sector.

This result is also interesting in consideration of the development of the HT model itself. Corden and Findlay (1975) formulated the mobile-capital HT model. However, the model has the property that labor growth causes unemployment to fall and capital accumulation causes it to rise. This is rather paradoxical and lowers the credibility of the model. Subsequently, Beladi and Naqvi (1988) restored the credibility by showing that labor growth causes the rate of unemployment to rise and capital accumulation causes it to fall if another specific factor (land) is introduced into the agricultural sector. Our result confirms Beladi and Naqvi’s result in the case where there exists another mobile factor in the industries, that is, two industries use three mobile factors. On the other hand, Yabuuchi (1998) discussed the effects of factor changes on the level (not the rate) of unemployment in the same model developed by Beladi and Naqvi (1998).

(3-2) Immigration of skilled labor

Now consider the effect of the inflow of skilled labor on unemployment. Solving the system for $\hat{\lambda}$ with respect to $\hat{H}^*$, we have

$$\Delta \Lambda \Theta - \hat{\lambda} / \hat{H}^* = -w_2 \Theta_{hk} \Lambda_{lk} / \Delta,$$

where $h^* = H^* / H$.

Under Assumption 1, $\Lambda_{lk} < 0$. Thus, it can be observed that the result depends on the factor intensity between skilled labor and capital. Our result can be summarized in the following proposition:

**Proposition 2.** Under Assumption 1, the increase in (foreign) skilled labor decreases the rate of unemployment if and only if the advanced sector is capital intensive relative to skilled labor compared to the traditional sector (i.e., $\Theta_{hk} < 0$ or equivalently $\Lambda_{hk} < 0$).
The proposition shows the possibility that the inflow of foreign skilled labor decreases unemployment. For example, this might occur when the domestic firms recruit skillful engineers or excellent professionals from abroad. The increase in foreign skilled-labor decreases the rate of unemployment if the (attractive) advanced sector is capital intensive relative to skilled labor; for example, a capital-using industry such as machinery and automobile industries. On the other hand, the effect is reversed and becomes harmful if the advanced sector is skilled-labor intensive relative to capital; for example, a high technology industry such as computer and biochemical industries.

The results are primarily attributed to the Rybczynski effect due to the increase in skilled labor. If the advanced sector is capital intensive relative to skilled labor, the increase in skilled-labor expands the output of the traditional sector and contracts that of the advanced sector. This induces skilled labor as well as capital from the advanced to the traditional sector. This, in turn, increases the marginal value of the product of the traditional sector and expands employment in the sector. This implies that some of the unemployed workers obtain jobs in the traditional sector, which becomes more attractive than before the inflow of foreign skilled labor.

(3-3) Capital inflow

We can examine the effect of foreign capital inflow on unemployment similar to that of the increase in skilled labor. We have in this case

\[
(1/k^*)(\lambda / \hat{K}^*) = w_2 \Theta_{\mu K} \Lambda_{LK} / \Delta, \tag{9}
\]

where \( k^* \equiv K^* / K \).

The equation (9) is formally very similar to equation (8). Thus, the proposition given below follows.
Proposition 3. Under Assumption 1, the increase in (foreign) capital decreases the rate of unemployment if and only if the advanced sector is skilled-labor intensive relative to capital compared to the traditional sector (i.e., \( \Theta_{HK} > 0 \) or equivalently \( \Lambda_{HK} > 0 \)).

Note that the results are reversed compared with Proposition 2; however, the implication is similarly interpreted. In this case, therefore, if the (attractive) manufacturing sector is skilled labor intensive with respect to capital, relative to the (unattractive) traditional sector, the increase in (foreign) capital expands the output of the service sector and contracts that of the advanced sector. This induces skilled labor as well as capital from the advanced to traditional sector. This, in turn, increases the marginal value product of the traditional sector and expands employment in the sector. This implies that some of the unemployed workers will obtain jobs in the traditional sector, which becomes more attractive than before the inflow of foreign capital.

The previous two propositions imply that in the economy where unskilled young people are willing to obtain jobs in the traditional capital-using sector (for example, machinery and automobile industries), the introduction of foreign skilled labor is effective, while in the economy where young people are willing to obtain jobs in the high technology sector (for example, computer and biochemical industries), the introduction of foreign capital is effective. This has an important implication for policy makers to apply these policies to their economies with regard to unemployment by considering their own industrial structure.

4. Production subsidies and unemployment

(4-1) Subsidy on the advanced sector and unemployment

Now let us investigate the other policy tools to alleviate the unemployment problem. Here, we consider the production subsidies to the sectors. In this section, the effect of the subsidy on the advanced sector is examined.

Comparative statics shows

\[
\frac{\lambda}{\hat{p}_1} = w_2(\theta_{H2}H - \theta_{K2}N)/\Delta, \quad (10)
\]

and

\[
\frac{\lambda}{\hat{p}_2} = -w_2(\theta_{H1}H - \theta_{K1}N)/\Delta, \quad (11)
\]
where
\[ H = B \Lambda_{HK} + D \Lambda_{LK} - F \Lambda_{LH}, \quad N = A \Lambda_{HK} + C \Lambda_{LK} - E \Lambda_{LH}, \]
\[ A = (1 + \lambda) \lambda_{L2} S_{LH}^2 + \lambda_{L1} S_{LH}^1 \geq 0, \quad B = (1 + \lambda) \lambda_{L2} S_{LK}^2 + \lambda_{L1} S_{LK}^1 \geq 0, \]
\[ C = \lambda_{HH} S_{HH}^2 + \lambda_{H1} S_{HH}^1 < 0, \quad D = \lambda_{HH} S_{HK}^2 + \lambda_{H1} S_{HK}^1 \geq 0, \]
\[ E = \lambda_{KK} S_{KH}^2 + \lambda_{K1} S_{KH}^1 \geq 0, \quad F = \lambda_{KK} S_{KK}^2 + \lambda_{K1} S_{KK}^1 < 0, \]
and \[ S_{Li}^2 \equiv \left( w_i / a_{Li} \right) \left( \partial a_{Li} / \partial w \right), \] and so on. We assume that the cross partials of the input coefficients are not negative, i.e., \( S_{ij}^i \geq 0, \) \( i \neq j. \) In the case with three factors of production, one cross partial can be negative. However, it may not be very unrealistic to assume that all factors are substitutes or independent of each other. Thus, the signs of \( A \) to \( F \) follow the assumption.

After a simple but tedious calculation (see Appendix C), we obtain the following proposition from (10) and (11):

**Proposition 4.** Under Assumptions 1 and 2, a production subsidy to the traditional sector lowers the rate of unemployment, and a subsidy to the advanced sector raises it if

\[ \Lambda_{HK} > 0, \quad \sigma_{L2}^2 > 0, \quad \lambda_{H2} \theta_{K1} \sigma_{L2}^1 > 0, \quad \theta_{H1} \sigma_{L1}^1 > 0, \quad \] and

\[ \Lambda_{HK} > 0, \quad \theta_{H2} \theta_{K2} \sigma_{L2}^2 > 0, \quad \theta_{K1} \theta_{H2} \sigma_{L2}^1 > 0, \quad \] and

\[ \sigma_{L1}^1 > 0, \quad \] respectively, where \( \sigma_{ik}^j \) is the partial elasticity of factor substitution between factors \( i \) and \( k \) in sector \( j \) in the sense by Allen-Uzawa, for example, \( \sigma_{L2}^2 \equiv S_{L2}^2 / \theta_{K2} \).

The production subsidy to the traditional sector leads to its expansion and increases employment of of unskilled-labor as well as other factors. Under the assumption that the traditional sector is capital intensive relative to skilled labor (i.e., \( \Lambda_{HK} > 0 \)), this implies that
the traditional sector demands capital relative to skilled labor, and that the skilled-labor wage-rental ratio \(s/r\) then decreases. On the other hand, since the traditional sector is unskilled-labor intensive relative to capital, the expansion of the traditional sector leads to an increase in the demand for unskilled-labor relative to capital, which increases the unskilled-labor wage-rental ratio \(w_u/r\). Similarly, since the traditional sector is unskilled-labor intensive relative to skilled labor, the expansion of the traditional sector leads to an increase in the demand for unskilled labor relative to skilled labor. This increases the unskilled-labor wage-rental ratio \(w_u/s\). Thus, unskilled labor is substituted for both capital and skilled labor.

By the way, note that the increase in \(w_u/s\) is larger than that in \(w_u/r\) because \(s/r\) decreases. Therefore, the substitution effect between unskilled labor and skilled labor is larger that that between unskilled labor and capital. Together, the decrease in \(s/r\) and the increase in \(w_u/r\) imply a decrease in the skilled to unskilled wage ratio \(s/w_u\). This leads to the substitution of skilled labor for unskilled labor in both sectors. However, as long as the elasticity of substitution between unskilled and skilled labor is sufficiently small, the total substitution effect is not very large. As a result, the initial expansion effect dominates the substitution effect. Thus, the production subsidy to the traditional sector increases the overall employment of unskilled labor, and then lowers the rate of unemployment. The effect of a subsidy to the manufacturing sector can be interpreted in a similarly manner.

5. International factor movement and welfare

In section 3, we examined the effect of factor change on the rate of unemployment. If the change is induced due to domestic reasons, for example, labor growth and capital accumulation, the domestic welfare is affected by the growth itself and induced factor reallocation. However, if the change is induced due to the inflow of foreign factors, the effect on welfare will become slightly more complicated, primarily because of the interaction between the two domestic effects stated above and the remittance by the foreign factors.

Now, we investigate the implications of factor inflow for welfare. The demand side of the model is represented by a quasi-concave social utility function. Let \(U\) denote the social
utility that depends on the consumption demand for the service and the manufacturing good denoted by $D_1$ and $D_2$, respectively. Thus,

$$U = U(D_1, D_2).$$  (13)

The balance of trade equilibrium requires that

$$D_1 + pD_2 = X_1 + pX_2 - w_iL^*-wH^*-rK^*,$$  (14)

where $p \equiv p_2 / p_1$.

Differentiating (12) and (13) yields (see Appendix D)

$$(dU / U_1) = (\alpha w_2 - w_i) L_2 d\lambda - \alpha w_1 dL_u - L^* d\omega_i - H^* dw - K^* dr,$$  (15)

where $U_1 = \partial U / \partial D_i$.

First, we consider the inflow of unskilled labor under the condition that there are no inflows of skilled labor and capital. Considering $(1+\lambda) dw_i = (\alpha w_2 - w_i) d\lambda$ by definition, we have from (14)

$$(dU / U_1 dL^*) = (w_i - \alpha w_2) \{L^* - (1+\lambda)L_2\} (d\lambda / dL^*) / (1+\lambda) - \alpha w_2 (dL_u / dL^*).$$  (16)

It can be seen that the first term of (16) is negative since $\{L^* - (1+\lambda)L_2\} = (L_4 - L) < 0, (w_i - \alpha w_2) > 0$ and $d\lambda / dL^* > 0$. Thus, the result depends on the change in unemployment ($L_u$). However, the change in unemployment is ambiguous.

This leads to the following proposition:

**Proposition 5.** The inflow of foreign unskilled labor decreases welfare if $\alpha \geq 0$.
The inflow of foreign unskilled labor reduces the wage rate in the (unattractive) traditional sector. This decreases the average wage income and it leads to decreased welfare. On the other hand, the decrease in the wage rate in sector 1 reduces the amount of foreign remittance. This contributes to improvement in the welfare. Our result shows that the negative employment effect dominates that of the positive remittance. Therefore, the inflow of foreign unskilled labor definitely decreases welfare if $\alpha$ is zero or sufficiently small, that is, if it is implicitly supposed that the unemployed labor is supported by someone in the economy, possibly parents, grandparents, friends, and so on.

Now, let us focus our attention on the inflow of skilled labor. We assume that there is no initial holding of foreign skilled labor. In this case, the welfare effect can be shown as follows:

\[
\left(\frac{dU}{U_1 dH^*}\right) = (\alpha w_2 - w_1) L_2 (d\lambda / dH^*) - \alpha w_2 (dL_u / dH^*).
\]  

(17)

Considering Proposition 2 and \( (1 + \lambda)dw_1 / dH^* = (\alpha w_2 - w_1) d\lambda / dH^* < 0 \), the inflow of skilled labor tends to decrease welfare through the decrease in the average wage income if the manufacturing sector is skilled-labor intensive relative to capital (i.e., $\Lambda_{HK} < 0$). The first term of (17) captures this effect, and it leads to decrease welfare (see Appendix E). Furthermore, we can demonstrate that the inflow of skilled labor increases the level of unemployment of unskilled labor (i.e., $dL_u / dH^* > 0$) under certain conditions on the substitutability among factors. This leads to an increase in the supporting cost to the unemployed and a decrease in welfare. On the other hand, if the advanced sector is capital intensive relative to unskilled labor (i.e., $\Lambda_{HK} > 0$), the welfare effect of the inflow is ambiguous because the effect of a decrease in the rate of unemployment is beneficial while the change in the level of unemployment is ambiguous.

The result is rather pessimistic. However, if the advanced sector is capital intensive relative to unskilled labor (i.e., $\Lambda_{HK} > 0$), the welfare effect of the inflow is ambiguous
because the effect of a decrease in the rate of unemployment is beneficial while the change in the level of unemployment is ambiguous. Thus, there is a possibility that the inflow of skilled labor improves welfare in this case. The results are summarized in the following proposition (see Appendix E):

**Proposition 6.** Under Assumptions 1 and 2, the inflow of foreign skilled labor lowers welfare if the advanced sector is skilled labor intensive relative to capital compared to the traditional sector (i.e., $\Lambda_{HK} > 0$), and $\theta_{K2} S_{LH}^i > \theta_{H2} S_{LK}^i$, ($j = 1, 2$), or else, the effect is ambiguous.

The effect of capital inflow can similarly be investigated and interpreted. Thus, we have the following proposition:

**Proposition 7.** Under Assumptions 1 and 2, the inflow of foreign capital lowers welfare if the advanced sector is capital intensive relative to skilled labor compared to the traditional sector (i.e., $\Lambda_{HK} < 0$), and $\theta_{K2} S_{HH}^j < \theta_{H2} S_{HK}^j$, ($j = 1, 2$), or else, the effect is ambiguous.

6. **Concluding remarks**

We have analyzed the problem of unemployment that can be observed in developed countries by applying the so-called Harris-Todaro model. This type of unemployment is characterized as being voluntary because they have excessive expectations of their jobs and rely on others for a living. It has been increasing, especially among the younger generation, in industrialized countries, for example, Japan. On the other hand, there is an extensive movement of labor and capital among countries. Thus, this paper investigates the effects of international factor movement and other policies on the domestic labor market, particularly when there is widespread unemployment in the market.

It has been shown that the inflow of unskilled labor is detrimental to both unemployment and welfare; the effects of the inflow of skilled labor or capital on the rate of
unemployment and welfare depend on factor intensities among sectors and the substitutability among factors. The analysis is a first attempt to approach the problem. However, it presents a useful framework by suggesting an important relation between the unemployment of the unskilled younger generation and that of the original HT model.
Appendices

[A] Comparative statics

Differentiating (2) to (6), we obtain

\[
\begin{pmatrix}
0 & \theta_{H2} & \theta_{K2} & 0 & 0 & 0 \\
\theta_{L1} & \theta_{H1} & \theta_{K1} & 0 & 0 & 0 \\
\lambda_{L1}S_{LH}^1 & A & B & (1 + \lambda)\lambda_{L2} & \lambda_{L1} & \lambda_{L2} \\
\lambda_{H1}S_{HL}^1 & C & D & \lambda_{H2} & \lambda_{H1} & 0 \\
\lambda_{K1}S_{KL}^1 & E & F & \lambda_{K2} & \lambda_{K1} & 0 \\
(1 + \lambda)w_1 & 0 & 0 & 0 & 0 & 0 \\
\end{pmatrix}
\begin{pmatrix}
\hat{w}_1 \\
\hat{\theta}_1 \\
\hat{r}_2 \\
\hat{\lambda} \\
\end{pmatrix}
= 
\begin{pmatrix}
\hat{p}_2 \\
\hat{p}_1 \\
\hat{h}_2 \\
\hat{k} \\
\end{pmatrix}
\]

(A1)

where \( l^* \equiv L^*/L \), \( h^* \equiv H^*/H \), \( k^* \equiv K^*/K \), \( G = \lambda(w_1 - \alpha w_2) \).

\[
A \equiv (1 + \lambda)\lambda_{L2}S_{LH}^2 + \lambda_{L1}S_{LH}^1 > 0, \quad B \equiv (1 + \lambda)\lambda_{L2}S_{LH}^2 + \lambda_{L1}S_{LH}^1 > 0,
\]

\[
C \equiv \lambda_{H2}S_{HL}^2 + \lambda_{H1}S_{HL}^1 < 0, \quad D \equiv \lambda_{H2}S_{HL}^2 + \lambda_{H1}S_{HL}^1 > 0,
\]

\[
E \equiv \lambda_{K2}S_{KL}^2 + \lambda_{K1}S_{KL}^1 > 0, \quad F \equiv \lambda_{K2}S_{KL}^2 + \lambda_{K1}S_{KL}^1 < 0,
\]

and \( S_{LH}^2 \equiv (s / a_{L2})(\partial a_{L2} / \partial s) \), and so on.

Solving (A1) for \( \hat{\lambda} \) with respect to \( \hat{L}^* \), we have equation (7) in the main text. Other results on comparative statics are similarly obtained.

[B] Stability

Under the present setup, the dynamic adjustment process for the supply side of the model is specified as follows:

\[
\begin{align*}
\dot{X}_1 &= d_1(p_1 - a_{L1}w_1 - a_{H1}r - a_{K1}r) \\
\dot{X}_2 &= d_2(p_2 - a_{L2}w_2 - a_{H2}s - a_{K2}r) \\
\dot{\psi}_1 &= d_3(a_{L1}X_1 + a_{L2}X_2 + \lambda a_{L2}X_2 - (L + L^*)) \\
\dot{\psi} &= d_4(a_{H1}X_1 + a_{H2}X_2 - (H + H^*)) \\
\dot{r} &= d_5(a_{K1}X_1 + a_{K2}X_2 - (K + K^*)) \\
\dot{\lambda} &= d_6(w_2 - (1 + \lambda)w_1 / (1 + \alpha \lambda)),
\end{align*}
\]

(A2) \quad (A3) \quad (A4) \quad (A5) \quad (A6) \quad (A7)
where “." denotes differentiation with respect to time and \( d_j \) is the positive coefficient measuring the speed of adjustment. A Marshallian adjustment process is assumed with quantities adjusting as the demand price (i.e., the exogenously given good price) differs from the supply price (i.e., the average cost of producing a given commodity) in the goods markets. In factor markets, we are facing a Walrasian adjustment mechanism with the fixed endowment assumption implying that returns will have to adjust.

The Jacobian matrix of the system of simultaneous equations (A2)–(A7) is

\[
\begin{bmatrix}
0 & 0 & 0 & \theta_{h2} & \theta_{k2} & 0 \\
0 & 0 & \theta_{l1} & \theta_{h1} & \theta_{k1} & 0 \\
(1+\lambda)\lambda_{l1} & \lambda_{l2} & \lambda_{l1}S^1_{ll} & A & B & \lambda\lambda_{l2} \\
\lambda_{h1} & \lambda_{h2} & \lambda_{h1}S^1_{hl} & C & D & 0 \\
\lambda_{k1} & \lambda_{k2} & \lambda_{k1}S^1_{kl} & E & F & 0 \\
0 & 0 & (1+\lambda)w_j & 0 & 0 & G \\
\end{bmatrix}
\]

(A8)

Therefore, we can show that

\[
|J| = -(d_1d_2d_3d_4d_5d_6w_1s_{rl}X_1X_2 / p_1p_2p_3LKV)\Delta.
\]

(A9)

According to the Routh-Hurwitz theorem, a necessary condition for the local stability of the system is that \( \text{sign}|J| = (-1)^k \), where \( k \) is the row (and hence, column) number of the system of the simultaneous equations. Hence, we assume that our equilibrium is stable, which implies that \( |J| > 0 \), therefore \( \Delta < 0 \) from (A9).

[C] Proof of Proposition 4

From (10), we have

\[
(\hat{\lambda}/\hat{p}_i) = w_2\{\theta_{h1}(B\Lambda_{hk} + D\Lambda_{lk} - F\Lambda_{lh}) - \theta_{k2}(A\Lambda_{hk} + C\Lambda_{lk} - E\Lambda_{lh})\}/\Delta,
\]

\[
= w_2\{(\theta_{h1}B - \theta_{k2}A)\Lambda_{hk} + \theta_{h1}(D\Lambda_{lk} - F\Lambda_{lh}) - \theta_{k2}(C\Lambda_{lk} - E\Lambda_{lh})\}/\Delta,
\]

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\[ w_2 \{(\theta_{h1}B - \theta_{k2}A)\Lambda_{HK} + (\theta_{h1}D - \theta_{k2}C)\Lambda_{LK} - (\theta_{h1}F - \theta_{k2}E)\Lambda_{LH} \}/\Delta \].

(A10)

The last two terms in the curly bracket in (9) are positive since \( D>0,\ F<0,\ C<0,\ E>0,\ \Lambda_{LK} = \lambda_{L1}\lambda_{K2} - (1 + \lambda)\lambda_{L2}\lambda_{K1} > 0,\) and \( \Lambda_{LH} = \lambda_{H1}\lambda_{L2} - (1 + \lambda)\lambda_{H2}\lambda_{L1} > 0.\) Therefore, the result depends on the first term in (9). We can show from the definitions of \( A\) and \( B\) that

\[ (\theta_{h1}B - \theta_{k2}A)\Lambda_{HK} = \{((1 + \lambda)\lambda_{L2}\theta_{h2}\theta_{k2}(\sigma^2_{LK} - \sigma^2_{LH}) + \lambda_{L1}(\theta_{h2}\theta_{k1}\sigma^1_{LK} - \theta_{k2}\theta_{h1}\sigma^1_{LH})\}\Lambda_{HK}.\]  

(A11)

Thus, from (A11) and \( \Delta < 0 \) it can be observed that \((\theta_{h1}B - \theta_{k2}A)\Lambda_{HK} < (<)0\) and then \( \hat{\lambda}/\hat{p}_1 < (<)0 \) if

\[ \Lambda_{HK} < (<)0,\ \sigma^2_{LK} > (<)\sigma^2_{LH} \text{ and } \theta_{h2}\theta_{k1}\sigma^1_{LK} > (<)\theta_{k2}\theta_{h1}\sigma^1_{LH}. \]

Therefore, this proves the former part of Proposition 4. The effect of the subsidy on the advanced sector is similarly proved.

[D] Derivation of (14)

Differentiating (12) and (13), and considering (1)–(2), we have

\[ dU / U = dD + pdD_z = dX_1 + pdX_2 - L^*dW_1 - H^*dw - K^*dr - w^*_dL^* - wdH^* - rdK^*. \]

\[ = (\alpha v_2 - w_1)\Lambda L^*d\lambda - L^*dw_1 - H^*dw - K^*dr - \alpha w_2dL^*, \]  

(A12)

since

\[ dX_1 + pdX_2 = (F_1dL + F_1^*dH_1 + F_1^*dK_1) + p(F_2^*dL_2 + F_2^*dH_2 + F_2^*dK_2) \]

\[ = w^*_dL^* + (\alpha v_2 - w_1)\Lambda L^*d\lambda + wdH^* + rdK^* - \alpha w_2dL^*. \]  

(A13)

[E] Proof of Proposition 6

It is shown from (A1) that
\[ \frac{\hat{w}}{\hat{H}^*} = h^* \theta_{L_1} \theta_{K_2} G \Lambda \Delta / \Delta < 0. \]  \hspace{1cm} (A14)

Since the first two terms of (17) in the text are positive from the Proposition 2 and (A14), it is sufficient to show that \( dL_u / dH^* > 0 \).

Note that \( \hat{L}_u = \hat{\lambda} + \hat{L}_2 \) and \( \hat{L}_2 = \hat{a}_{L_2} + \hat{X}_2 \). By definition, we have

\[ \hat{a}_{L_2} / \hat{H}^* = h^* \theta_{L_1} (\theta_{K_2} S_{LH}^2 - \theta_{H_2} S_{Lk}^2) G \Lambda \Delta / \Delta. \]  \hspace{1cm} (A15)

Comparative statics yields

\[
\left( \frac{\hat{X}_2}{\hat{H}^*} \right) \left( \frac{\Delta / \hat{H}^*}{h^*} \right) = -\lambda \hat{\lambda}_{L_2} \hat{\lambda}_{K_1} (1 + \hat{\lambda}) w_j \Theta_{Hk} + G \theta_{L_1} [\hat{\lambda}_{L_2} \hat{\lambda}_{K_1} (1 + \hat{\lambda})(\theta_{K_2} S_{LH}^2 - \theta_{H_2} S_{Lk}^2) \\
+ \hat{\lambda}_{L_2} \hat{\lambda}_{K_2} ((\theta_{H_2} S_{Lh}^2 - \theta_{K_2} S_{Kh}^2) + (\theta_{K_2} S_{Lh}^1 - \theta_{H_2} S_{Lk}^1) \\
+ (\theta_{H_2} S_{Lk}^1 - \theta_{K_2} S_{Kh}^1) + \Theta_{Hk} (S_{Lh}^1 - S_{Lk}^1)]
\]

Thus, if \( \Theta_{Hk} > 0 \), and \( \theta_{K_2} S_{Lh}^j < \theta_{H_2} S_{Lk}^j \), \( (j = 1, 2) \), it is shown that \( \hat{L}_2 / \hat{H}^* = (\hat{a}_{L_2} / \hat{H}^* + \hat{X}_2 / \hat{H}^*) > 0 \), and then \( \hat{L}_u / \hat{H}^* = (\hat{\lambda} / \hat{H}^* + \hat{L}_2 / \hat{H}^*) > 0 \). This proves Proposition 6.
References


