Can We Reduce Unskilled Labor Shortage by Expanding the Unskilled Immigrant Quota?

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**Abstract**

We investigate whether we can employ an increased number of unskilled workers after we expand the unskilled immigrant quota. For this purpose, we assume a small open economy with dual labor markets, i.e., a skilled labor market where labor is abundant and an unskilled labor market where labor is scarce. In both the labor markets, wages are determined by the efficiency wage hypothesis. We introduce the skilled (unskilled) immigrant quota in the skilled (unskilled) labor market. We show that even if we expand the unskilled immigrant quota, we cannot always employ an increased number of unskilled workers. In particular, it is likely that unskilled worker employment decreases with the expansion of the unskilled immigrant quota. This is because unskilled native workers might decrease their labor supply with the increases in the quota. On the other hand, we also show that the expansion of the skilled immigrant quota always increases skilled worker employment. Our results suggest that the expansion of the unskilled immigrant quota does not necessarily alleviate unskilled labor shortage. In actual economies, we tend to expand the skilled immigrant quota to increase skilled worker employment. However, such a policy appears to be inapplicable in the case of unskilled worker employment.

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## 1. Introduction

This paper investigates the effects of the skilled and unskilled immigrant quotas on skilled and unskilled worker employment assuming that skilled labor is abundant and unskilled labor is scarce. Further, this paper attempts to clarify whether or not unskilled labor shortage can be reduced by expanding the unskilled immigrant quota.

Many developed countries have been reluctant to accept unskilled foreign workers. This is because the policy authorities of these countries believe that the inflow of unskilled foreign labor is likely to have negative impacts on the host countries, although according to previous studies, this is not necessarily the case.[1]

Labor markets in developed countries have become increasingly segmented into the primary and secondary sectors.[2] This has induced many native workers in these countries to supply their labor to the primary sector, since by participating in this sector, they can secure well-paid skilled jobs. Consequently, the number of native workers who enter the secondary sector to secure poorly paid unskilled jobs has decreased. This has led to unskilled labor shortage in many

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[1] According to the estimate by Borjas (1997), the inflow of large numbers of less-skilled immigrants has an adverse impact on the labor market opportunities for less-skilled U.S. native workers. On the other hand, Friedberg and Hunt (1995) argued that even if native workers are the closest substitutes for immigrant labor, they have not been found to suffer significantly from increased immigration. Based on their theoretical analysis, Schmidt, Stilz, and Zimmermann (1994) and Zimmermann (1996) also derived the possibility that accepting unskilled immigrants increases unskilled native worker employment.

[2] See Puglises (1992) and Massy and Taylor (2004) for the growing segmentation of the labor markets in developed countries.

developed countries. It is true that unskilled labor is often abundant in the large cities of developed countries and many unskilled native workers are unemployed in such cities. However, even in these countries, firms in many regions are unable to easily procure unskilled workers to fill their vacancies, and the unskilled labor available in the whole economy is not necessarily adequate to fulfill the total demand for it. Further, a rise in native workers' expectations of obtaining more attractive jobs in the primary sector is increasing unskilled labor shortage (Stahl 2001).

In response to this situation, the argument that we begin and expand the unskilled immigrant quota in order to formally accept a larger number of unskilled foreign workers is becoming more persuasive.[3] This argument arose from our past experience of encouraging the acceptance of skilled foreign workers and increasing skilled worker employment by expanding the skilled

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[3]Similar to other industrialized nations, Japan is currently suffering from unskilled labor shortage. Faced with this situation, Japanese industries suggest that the government extend the interpretation of technical and technological jobs and legally accept more foreign workers whose jobs have not been classified into skilled ones before. In particular, in order to eliminate current and future chronic shortage of skilled workers in such sectors as manufacturing, construction and machine assembly, *Nippon Keidanran* (Japan Business Federation) (2007) is requesting the government to admit non-Japanese workers who meet requirements such as knowledge of a certain level of Japanese, conditional upon the introduction of a labor test. Additionally, the Japanese government is under pressure from Asian countries to accept nurses and caretakers, and it will accept them by establishing quotas for them through Economic Partnership Agreements (EPAs) with these countries. This will lead to the establishment and/or expansion of quotas for less-skilled foreign workers.

immigrant quota. Another basis for this argument is that unskilled labor shortage has led to a large inflow of illegal unskilled immigrants.[4]

In such a situation, can we actually reduce unskilled labor shortage by implementing a policy similar to the one utilized to increase skilled worker employment? In other words, will unskilled worker employment increase by establishing and expanding the unskilled immigrant quota? As mentioned earlier, unskilled labor is in shortage, whereas skilled labor is not necessarily in shortage. Accordingly, our question can be paraphrased as whether or not the same immigrant quota policy can be applied to labor markets wherein the availability of labor differs.

Many studies on immigrant quotas have attempted to clarify how the quota can be determined by utilizing political economy theories. Shughart et al. (1986) explained it through the interest group theory of government. Labor unions lobby for the enforcement of the restrictive immigration policy to prevent wage reductions during recessions, while employers lobby for the reduced enforcement of the immigration policy to reduce upward pressures on wages during expansions. Benhabib (1996) studied how immigration policies that impose capital and skill requirements on immigrants will be determined under majority voting. Amegashie (2004) built a model in which the number of immigrants is the outcome of a costly political lobbying contest between a firm and a union. It explained how immigrant reservation wages, the firm's product price, union size, and lobbying cost affect immigrant quotas. In Bodvarsson et al. (2007), a political market for an endogenous immigrant quota emerges as a consequence of the conflicting interests of native workers in the substitute industry, native workers in the complement industry, and lobbying groups.

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[4]However, it is possible that the expansion of the quota increases the number of illegal unskilled immigrants.

These analyses did not pay sufficient attention to the availability of labor in the labor market in which the quota is introduced. However, the availability of labor will change the effects of the quota on workers and firms. Therefore, it will be difficult for the government to improve the economy's welfare without considering the availability of labor when it manipulates the quota. It also changes the degree of the influence workers and firms can have in the process of quota determination.

Therefore, this paper explicitly assumes that the availability of labor in the skilled and unskilled labor markets differs and attempts to show whether or not the expansion of the unskilled immigrant quota is effective for increasing unskilled worker employment.

For this purpose, we model a small open economy with dual labor markets consisting of the skilled labor market whose labor supply is abundant and the unskilled labor market whose labor supply is scarce. We manipulate the skilled and unskilled immigrant quotas and examine their effects on skilled and unskilled worker employment.

We demonstrate that the skilled immigrant quota always increases skilled worker employment. Moreover, its expansion does not have any negative effects on unskilled worker employment. On the other hand, the unskilled immigrant quota does not always increase unskilled worker employment. In particular, it is likely that unskilled worker employment decreases with the expansion of the unskilled immigrant quota. This is because the unskilled immigrant quota decreases unskilled worker wages, and decreases in unskilled worker wages may reduce unskilled native worker employment much more than the increase in unskilled immigrant employment. Moreover, decreases in unskilled worker employment always negatively impact skilled worker employment.

Our results suggest that the manipulation of the immigrant quota is asymmetric between the skilled labor market with abundant labor and the unskilled labor market with scarce labor. Many

governments tend to expand the skilled immigrant quota to increase skilled worker employment. However, a similar policy is not necessarily appropriate to reduce unskilled labor shortage, since expanding the unskilled immigrant quota might result in aggravating it rather than alleviating it.

The remainder of the paper is organized as follows. Section 2 presents a small open economic model with dual labor markets and efficiency wages. The availability of labor differs in the skilled and unskilled labor markets. We introduce the skilled and unskilled immigrant quotas in the skilled and unskilled labor markets, respectively. Section 3 examines the effects of the skilled immigrant quota on skilled and unskilled worker employment. Section 4 examines the effects of the unskilled immigrant quota on unskilled and skilled worker employment. The concluding comments are presented in Section 5.

## 2. The Model

We consider a small open economy with dual labor markets consisting of skilled and unskilled labor markets. Jobs in the skilled labor market are attractive and require a certain level of skill, whereas jobs in the unskilled labor market are unattractive and do not require skill. Although native workers include skilled and unskilled ones, most of them have sufficient skills to be employed in the skilled labor market. Accordingly, most of the native workers are in the skilled labor market and the rest of them are in the unskilled labor market.

The small open economy is connected to the rest of the world through the skilled and unskilled foreign worker inflow. To accept them formally, its government establishes skilled and unskilled immigrant quotas, which are small as compared to the skilled and unskilled native labor forces.

The number of skilled native workers is large, and most of them are always willing to supply labor since their wages are sufficiently high. Although whether or not they do so depends on skilled worker wages, the ratio of these skilled native workers to all skilled native workers is near

to 1. The remaining skilled native workers are not always willing to supply labor. They are voluntarily unemployed and supply labor if there is a possibility of reemployment in steady state. We formally accept skilled immigrants by establishing a skilled immigrant quota $\overline{M}_1$, which is manipulated by the government. All skilled immigrants are always willing to supply labor; this is the sole difference between skilled native workers and skilled immigrants, and firms consider them to be the same in terms of input.[5] Moreover, we assume that even if skilled native workers and skilled immigrants are involuntarily unemployed, they do not attempt to enter the unskilled labor market. In other words, there is no internal migration.

Accordingly, labor supply in the skilled labor market, i.e., the number of the skilled workers who are always willing to supply labor $\overline{L}_1$, can be abundant, which is equal to $\phi_1(w_1)\overline{N}_1 + \overline{M}_1$, $0 < \phi_1(w_1) \leq 1$, and $\phi_1'(w_1) > 0$. Here, $\phi_1(w_1)$, which is usually near to 1, is the ratio of skilled native workers who are always willing to supply labor to all skilled native workers, $w_1$ is skilled worker wages, and $\overline{N}_1$ is the number of skilled native workers, which is assumed to be a constant.[6] Skilled labor supply increases with respect to their wages.[7] In steady state, the

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[5]To put it more precisely, there are no differences between skilled native workers who do not have a record of voluntary unemployment and skilled immigrants. See what follows for an assumption on the reemployment of unemployed workers in the skilled labor market.

[6]In this paper, the product price does not change and is assumed to be 1; therefore, we need not differentiate between real and nominal wages.

[7]Greenwood and Hunt (1995) considered several channels through which immigrants affect native worker employment and their wages, including the production structure channel, the local demand channel, the net export demand channel, the labor force participation channel, and the migration channel. In the labor force participation channel, they assumed that the labor force participation

remaining skilled workers $\{1-\phi_1(w_1)\}\overline{N}_1$ are willing to supply labor if there is a possibility of reemployment.[8]

In contrast to skilled native workers, the number of unskilled native workers is less, and some of them are not always willing to supply labor since their wages are not sufficiently high. In other words, whether or not they do so depends on unskilled worker wages, and the ratio of these unskilled workers to all unskilled native workers is not near to 1. The remaining unskilled native workers are not always willing to supply labor. They are voluntarily unemployed and supply labor if there is a possibility of reemployment in steady state. We formally accept unskilled immigrants by establishing an unskilled immigrant quota $\overline{M}_2$, which is manipulated by the government.[9] All unskilled immigrants are always willing to supply labor; this is the sole

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rate (defined as the employment-to-population ratios) depends on wages as well as local prices and non-labor income. They expected that higher wages will lead to a higher participation rate. Thus, as assumed in this paper, labor supply is increasing with respect to wages.

[8]In general, all unemployed workers can get out of unemployment with some probability, which is equal to the accession rate. Unemployed skilled workers consist of voluntarily unemployed skilled native workers whose number is equal to $\{1-\phi_1(w_1)\}\overline{N}_1$ and involuntarily unemployed skilled native and foreign workers whose number is equal to $\phi_1(w_1)\overline{N}_1 + \overline{M}_1 - L_1$. However, as assumed, flow out of unemployment in the skilled labor market does not include the former workers. See what follows for an assumption on the reemployment of unemployed workers in the skilled labor market.

[9]Even if we cannot control the unskilled foreign worker inflow perfectly and we accept illegal unskilled immigrants, the main results of the paper remain unchanged as long as their number is a constant and small as compared to the demand for them.

difference between unskilled native workers and unskilled immigrants, and firms consider them to be the same in terms of input.

Accordingly, labor supply in the unskilled labor market, i.e., the number of unskilled workers who are always willing to supply labor $\overline{L}_2$, can be scarce, which is equal to $\phi_2(w_2)\overline{N}_2 + \overline{M}_2$, $0 < \phi_2(w_2) \leq 1, \quad \phi_2'(w_2) > 0$. Here, $\phi_2(w_2)$, which is not necessarily near to 1, is the ratio of unskilled native workers who are always willing to supply labor to all unskilled native workers, $w_2$ is unskilled worker wages, and $\overline{N}_2$ is the number of unskilled native workers, which is assumed to be a constant. Unskilled labor supply increases with respect to their wages. In steady state, the remaining unskilled workers $\{1-\phi_2(w_2)\}\overline{N}_2$ are willing to supply labor if there is a possibility of reemployment.[10]

Assuming a Cobb-Douglas production technology and considering capital to be fixed, the output in a small open economy $Y$ increases with rises in the employment of skilled labor $L_1$ and unskilled labor $L_2$:

$$Y = L_1^{a_1} L_2^{a_2}, \quad a_1, a_2 > 0, \quad a_1 + a_2 < 1.$$

This suggests that skilled labor and unskilled labor are complements.

Firms are perfectly competitive and they demand skilled labor and unskilled labor in such a way as to maximize profits, which is defined as $\pi \equiv L_1^{a_1} L_2^{a_2} - w_1 L_1 - w_2 L_2$. In the skilled labor market, there is abundant labor supply. Accordingly, firms can demand skilled workers to establish $\partial\pi/\partial L_1\big|_{L_1 \leq \overline{L}_1, L_2 \leq \overline{L}_2} = 0$. On the other hand, since unskilled labor is scarce, $\partial\pi/\partial L_2\big|_{L_1 \leq \overline{L}_1, L_2 \leq \overline{L}_2}$ is positive. Accordingly, firms demand unskilled workers as much as

[10] As assumed, there are no involuntarily unemployed unskilled workers since unskilled labor is in excess demand. Accordingly, flow out of unemployment in the unskilled labor market includes only voluntarily unemployed unskilled native workers.

supplied. Therefore, we derive the following demand functions for skilled and unskilled workers:

$$L_1 = a_1^{\frac{1}{1-a_1}} (\bar{L}_2)^{\frac{1}{1-a_1}} w_1^{-\frac{1}{1-a_1}}.$$

$$L_2 = \bar{L}_2.$$

The labor demand functions are rewritten by substituting $\bar{L}_2 = \phi_2(w_2)\bar{N}_2 + \bar{M}_2$ into the above functions:

$$L_1 = a_1^{\frac{1}{1-a_1}} \{\phi_2(w_2)\bar{N}_2 + \bar{M}_2\}^{\frac{1}{1-a_1}} w_1^{-\frac{1}{1-a_1}}. \quad (1)$$

$$L_2 = \phi_2(w_2)\bar{N}_2 + \bar{M}_2. \quad (2)$$

Since firms are unable to completely identify shirking by the employed workers, they set wages in a manner that prevents shirking (Shapiro and Stiglitz 1984). The instantaneous utility of a representative employed worker in the skilled (unskilled) labor market who does not shirk is equal to the skilled (unskilled) worker wages minus effort $e$, which is a constant and does not differ across labor markets. On the other hand, if he shirks, his instantaneous utility is equal to the skilled (unskilled) worker wages. However, in such a case, he will be identified and fired by the firm at the probability $\rho$, which is a constant and does not differ across labor markets. Moreover, some of the employed workers separate their jobs although they are not fired on the grounds of shirking. This constitutes flow into unemployment. The separation rate in each labor market, which is defined as the ratio of separations due to reasons other than shirking to the number of employed workers, is given by $\beta$, which is a constant and does not differ across labor markets.

Under these assumptions, the expected lifetime utility of a representative employed shirker in the skilled labor market $V_{E_1}^S$ is,

$$rV_{E_1}^S = w_1 + (\beta + \rho)(V_{U_1} - V_{E_1}^S), \quad (3.1)$$

where $r$ is the discount rate and $V_{U_1}$ is the expected lifetime utility of a representative

unemployed worker in the skilled labor market. The expected lifetime utility of a representative employed non-shirker in the skilled labor market $V_{E_1}^N$ is,

$$rV_{E_1}^N = w_1 - e + \beta(V_{U_1} - V_{E_1}^N). \tag{4.1}$$

In order to prevent shirking, firms have to set skilled worker wages that ensure the skilled labor market non-shirking condition $V_{E_1}^N = V_{E_1}^S (\equiv V_{E_1})$. The following is obtained by substituting Equations (3.1) and (4.1) into this condition:

$$w_1 = rV_{U_1} + \frac{r + \beta + \rho}{\rho} e. \tag{5.1}$$

Moreover, $V_{U_1}$ is given by,

$$rV_{U_1} = \overline{w}_1 + \alpha_1(V_{E_1} - V_{U_1}), \tag{6.1}$$

where $\overline{w}_1$ is the unemployment benefit for the workers in the skilled labor market, which is assumed to be a constant, and $\alpha_1$ is the accession rate in the skilled labor market, which is defined as the ratio of new hires, i.e., flow out of unemployment in the skilled labor market, to the number of unemployed workers in the skilled labor market.

Involuntarily unemployed skilled workers $\phi_1(w_1)\overline{N}_1 + \overline{M}_1 - L_1$ as well as voluntarily unemployed skilled native workers $\{1 - \phi_1(w_1)\}\overline{N}_1$ are willing to supply labor if there is a possibility of reemployment. However, since skilled labor is abundant, we assume that firms do not employ the latter workers in steady state. This is because even if there are no real distinctions between voluntarily unemployed skilled native workers and involuntarily unemployed skilled workers, firms tend to underestimate the quality of a worker who has a record of voluntary unemployment. Accordingly, in steady state, firms only reemploy involuntarily unemployed skilled workers in the skilled labor market.

Therefore, in steady state, $\alpha_1$ must be such that flow out of unemployment is equal to flow into unemployment in the skilled labor market, i.e., $\alpha_1\{\phi_1(w_1)\overline{N}_1 + \overline{M}_1 - L_1\} = \beta L_1$. Solving this

for $\alpha_1$ and utilizing Equations (3.1), (4.1), (5.1), and (6.1), steady state skilled worker wages are derived as follows:

$$w_1 = \overline{w}_1 + e + \frac{[\{\phi_1(w_1)\overline{N}_1 + \overline{M}_1\}/\{\phi_1(w_1)\overline{N}_1 + \overline{M}_1 - L_1\}]\beta + r}{\rho} e. \tag{7.1}$$

According to Equation (7.1), steady state skilled worker wages are dependent on skilled worker employment.[11]

Similar to the case of the skilled labor market, the expected lifetime utility of a representative employed shirker in the unskilled labor market $V_{E_2}^S$ is,

$$rV_{E_2}^S = w_2 + (\beta + \rho)(V_{U_2} - V_{E_2}^S), \tag{3.2}$$

where $V_{U_2}$ is the expected lifetime utility of a representative unemployed worker in the unskilled labor market. The expected lifetime utility of a representative employed non-shirker in the unskilled labor market $V_{E_2}^N$ is,

$$rV_{E_2}^N = w_2 - e + \beta(V_{U_2} - V_{E_2}^N). \tag{4.2}$$

Substituting Equations (3.2) and (4.2) into the unskilled labor market non-shirking condition $V_{E_2}^N = V_{E_2}^S (\equiv V_{E_2})$, we are able to derive,

$$w_2 = rV_{U_2} + \frac{r + \beta + \rho}{\rho} e. \tag{5.2}$$

Moreover, $V_{U_2}$ is given by,

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[11] As in the case where there are no voluntarily unemployed skilled workers, i.e., $\phi_1(w_1) = 1$, steady state skilled worker wages increase with respect to their employment and decrease with respect to the skilled immigrant quota. However, the slope of the curve and the amount of the shift due to given changes in the skilled immigrant quota are different from those in the case where there are no voluntarily unemployed skilled workers.

$$rV_{U_2} = \overline{w}_2 + \alpha_2(V_{E_2} - V_{U_2}), \tag{6.2}$$

where $\overline{w}_2$ is the unemployment benefit for the workers in the unskilled labor market, which is assumed to be a constant, and $\alpha_2$ is the accession rate in the unskilled labor market, which is defined as the ratio of new hires in the unskilled labor market to the number of unemployed workers in the unskilled labor market.

Unskilled labor is scarce and there are no involuntarily unemployed unskilled workers. Accordingly, we assume that the voluntarily unemployed unskilled native workers $\{1-\phi_2(w_2)\}\overline{N}_2$, equal to $\overline{N}_2 + \overline{M}_2 - L_2$ from Equation (2), can be employed if there is a possibility of reemployment.

Therefore, in steady state, $\alpha_2$ must be such that flow out of unemployment is equal to flow into unemployment in the unskilled labor market, i.e., $\alpha_2(\overline{N}_2 + \overline{M}_2 - L_2) = \beta L_2$. Solving this for $\alpha_2$ and utilizing Equations (3.2), (4.2), (5.2), and (6.2), steady state unskilled worker wages are derived as follows:

$$w_2 = \overline{w}_2 + e + \frac{[(\overline{N}_2 + \overline{M}_2)/\{1-\phi_2(w_2)\}\overline{N}_2]\beta + r}{\rho} e. \tag{7.2}$$

According to Equation (7.2), steady state unskilled worker wages are independent of unskilled worker employment.

### 3. Effects of the Skilled Immigrant Quota on Skilled and Unskilled Worker Employment

In this section, we examine how the changes in the skilled immigrant quota affect skilled and unskilled worker employment.

Totally differentiating Equations (1) and (7.1) and solving the resulting equations for $dL_1$, the effects of changes in the skilled immigrant quota on skilled worker employment are derived as follows:

$$\frac{dL_1}{d\overline{M}_1} = \frac{\{1/(1-a_1)\}L_1(1/w_1)B}{1+\{1/(1-a_1)\}L_1(1/w_1)A}, \tag{8}$$

where

$$A \equiv \frac{(e/\rho)(\alpha_1+\beta)[1/\{\phi_1(w_1)\overline{N}_1+\overline{M}_1-L_1\}]}{1+(e/\rho)\alpha_1[\phi'_1(w_1)\overline{N}_1/\{\phi_1(w_1)\overline{N}_1+\overline{M}_1-L_1\}]},$$

$$B \equiv \frac{(e/\rho)\alpha_1[1/\{\phi_1(w_1)\overline{N}_1+\overline{M}_1-L_1\}]}{1+(e/\rho)\alpha_1[\phi_1'(w_1)\overline{N}_1/\{\phi_1(w_1)\overline{N}_1+\overline{M}_1-L_1\}]}.$$

According to Equation (8), since $A,\ B>0,$ the skilled immigrant quota increases skilled worker employment ($dL_1/d\overline{M}_1>0$). The intuitions behind this result are as follows: Equation (1) indicates that the demand for skilled workers decreases with skilled worker wages. If $w_1$ is measured on the vertical axis and $L_1$ is measured on the horizontal axis, the curve that describes Equation (1) is downward sloping. On the other hand, the total differentiation of Equation (7.1) indicates that in steady state, skilled worker wages increase with respect to skilled worker employment and decrease with respect to the skilled immigrant quota. This suggests that the curve for skilled worker wages, i.e., the non-shirking condition for skilled workers in steady state is upward sloping and shifts downward to the right with increases in the skilled immigrant quota. Therefore, skilled worker employment increases with the skilled immigrant quota.

As Equation (7.2) shows, unskilled worker wages are independent of the skilled immigrant quota. Accordingly, unskilled worker employment (Equation 2) is also independent of it, i.e.,

$$\frac{dL_2}{d\overline{M}_1} = 0. \tag{9}$$

Equation (9) suggests that the government can manipulate the skilled immigrant quota without considering its effects on unskilled worker employment.

To summarize the results derived in this section, the government can always increase skilled worker employment by expanding the skilled immigrant quota, and this has no negative impacts

on unskilled worker employment.

**4. Effects of the Unskilled Immigrant Quota on Unskilled and Skilled Worker Employment**

In this section, we examine how the changes in the unskilled immigrant quota affect unskilled and skilled worker employment.

For this purpose, we totally differentiate Equation (7.2) and derive the effects of the unskilled immigrant quota on unskilled worker wages.

$$\frac{dw_2}{d\overline{M}_2} = \frac{(e/\rho)(\alpha_2 + \beta)\{1/(\overline{N}_2 + \overline{M}_2)\}}{1-(e/\rho)(\alpha_2 + \beta)[\phi_2'(w_2)/\{1-\phi_2(w_2)\}]}. \tag{10}$$

According to Equation (10), the effects of the unskilled immigrant quota on unskilled worker wages are ambiguous. If the increases in $\alpha_2$ due to the increases in $w_2$ are smaller than the increases in $w_2$, $\overline{M}_2$ has to be larger to ensure Equation (7.2), suggesting that the unskilled immigrant quota increases unskilled worker wages ($dw_2/d\overline{M}_2 > 0$). This corresponds to the case where unskilled native workers are sufficiently unresponsive to unskilled worker wages in their labor supply decision, i.e., $\phi_2'(w_2)$ is sufficiently small. On the other hand, if the increases in $\alpha_2$ due to the increases in $w_2$ are larger than the increases in $w_2$, $\overline{M}_2$ has to be smaller to ensure Equation (7.2), suggesting that the unskilled immigrant quota lowers unskilled worker wages ($dw_2/d\overline{M}_2 < 0$). This corresponds to the case where unskilled native workers are sufficiently responsive to unskilled worker wages in their labor supply decision, i.e., $\phi_2'(w_2)$ is sufficiently large.

From these arguments, we observe that it is possible for unskilled native worker employment to decrease when we expand the unskilled immigrant quota. If $\phi_2'(w_2)$ is sufficiently small and the expansion of the unskilled immigrant quota increases unskilled worker wages, a larger number of unskilled native workers supply labor with increases in the quota, i.e., $d\{\phi_2(w_2)\overline{N}_2\}/d\overline{M}_2 > 0$.

However, if $\phi_2'(w_2)$ is sufficiently large and the expansion of the unskilled immigrant quota lowers unskilled worker wages, a smaller number of unskilled native workers supply labor with increases in the quota, i.e., $d\{\phi_2(w_2)\overline{N}_2\}/d\overline{M}_2 < 0$.

From the above results, we can infer that unskilled worker employment might decrease when we expand the unskilled immigrant quota.

$$\frac{dL_2}{d\overline{M}_2} = \frac{1-(e/\rho)(\alpha_2+\beta)[\phi_2'(w_2)/\{1-\phi_2(w_2)\}][\{\phi_2(w_2)\overline{N}_2+\overline{M}_2\}/(\overline{N}_2+\overline{M}_2)]}{1-(e/\rho)(\alpha_2+\beta)[\phi_2'(w_2)/\{1-\phi_2(w_2)\}]}. \tag{11}$$

According to Equation (11), the effects of the unskilled immigrant quota on unskilled worker employment are ambiguous. If the unskilled immigrant quota increases unskilled native worker employment, the expansion of the unskilled immigrant quota always increases unskilled worker employment. As mentioned earlier, this corresponds to the case where $\phi_2'(w_2)$ is sufficiently small.[12] Moreover, even if the unskilled immigrant quota decreases unskilled native worker employment, unskilled worker employment increases with the unskilled immigrant quota, provided that the decreases in unskilled native worker employment are smaller than the increases in the quota. This corresponds to the case where $\phi_2'(w_2)$ is sufficiently large.[13] However, if the unskilled immigrant quota decreases skilled native worker employment and its decreases are larger than the increases in the quota, unskilled worker employment decreases with the increases

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[12] $d\{\phi_2(w_2)\overline{N}_2\}/d\overline{M}_2 > 0$ implies $1-(e/\rho)(\alpha_2+\beta)[\phi_2'(w_2)/\{1-\phi_2(w_2)\}] > 0$. Moreover, if this is the case, $1-(e/\rho)(\alpha_2+\beta)[\phi_2'(w_2)/\{1-\phi_2(w_2)\}][\{\phi_2(w_2)\overline{N}_2+\overline{M}_2\}/(\overline{N}_2+\overline{M}_2)] > 0$.

[13] Even if it is negative, $d\{\phi_2(w_2)\overline{N}_2\}/d\overline{M}_2$ is approximately equal to $-\{1-\phi_2(w_2)\}\overline{N}_2/(\overline{N}_2+\overline{M}_2)$ for sufficiently large values of $\phi_2'(w_2)$. Since $\left|-\{1-\phi_2(w_2)\}\overline{N}_2/(\overline{N}_2+\overline{M}_2)\right| < 1$, the decreases in unskilled native worker employment are smaller than the increases in the unskilled immigrant quota.

in the quota. This corresponds to the case where $\phi_2'(w_2)$ is neither sufficiently small nor sufficiently large.[14] Therefore, we can conclude that it is likely that an expansion of the unskilled immigrant quota decreases unskilled worker employment.

Totally differentiating Equations (1) and (7.1) and solving the resulting equations for $dL_1$, we show how the changes in the unskilled immigrant quota affect skilled worker employment.

$$\frac{dL_1}{d\overline{M}_2} = \frac{\{a_2/(1-a_1)\}(L_1/L_2)}{1+\{1/(1-a_1)\}L_1(1/w_1)A}\frac{dL_2}{d\overline{M}_2}. \tag{12}$$

According to Equation (12), the effects of the unskilled immigrant quota on skilled worker employment are also ambiguous. Whether or not the unskilled immigrant quota increases skilled worker employment depends on whether or not it increases unskilled worker employment. The intuitions behind this result are as follows: As mentioned earlier, the demand curve for skilled workers is downward sloping, and shifts upward to the right with increases in unskilled worker employment. The curve that describes Equation (7.1) is upward sloping. Accordingly, if $\phi_2'(w_2)$ is sufficiently small or sufficiently large and thereby, the unskilled immigrant quota increases unskilled worker employment, the demand curve for skilled workers shifts upward to the right with increases in the unskilled immigrant quota, resulting in increases in skilled worker employment. However, if $\phi_2'(w_2)$ is neither sufficiently small nor sufficiently large and thereby, the unskilled immigrant quota decreases unskilled worker employment, the demand curve

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[14]As mentioned earlier, if $\phi_2'(w_2)$ is sufficiently small, both the numerator and the denominator of Equation (11) are positive. Further, if $\phi_2'(w_2)$ is sufficiently large, both the numerator and the denominator of Equation (11) are negative. In either case, $dL_2/d\overline{M}_2 > 0$. On the other hand, if $\phi_2'(w_2)$ is neither sufficiently small nor sufficiently large, it is likely that the numerator is positive and the denominator is negative. In such a case, $dL_2/d\overline{M}_2 < 0$.

for skilled workers shifts downward to the left with increases in the quota, resulting in decreases in skilled worker employment. Therefore, we can conclude that it is likely that an expansion of the unskilled immigrant quota decreases skilled worker employment.

To summarize the results derived in this section, an expansion of the unskilled immigrant quota does not always increase unskilled worker employment. Rather, it is likely to have negative impacts on unskilled worker employment. Under the assumption that skilled labor and unskilled labor are complements, it is possible that the unskilled immigrant quota decreases both unskilled and skilled worker employment.

## 5. Conclusions

We investigated how the changes in the skilled and unskilled immigrant quotas affect skilled and unskilled worker employment by assuming a small open economy with dual labor markets where the skilled labor market is labor abundant and the unskilled labor market is labor scarce.

We showed that the expansion of the unskilled immigrant quota does not necessarily increase unskilled worker employment. It is likely that its expansion decreases unskilled worker employment. This suggests that the expansion of the unskilled immigrant quota might lead to further shortage of labor in the unskilled labor market. In contrast, the skilled immigrant quota always increases skilled worker employment.

Our results suggest that if we attempt to employ a larger number of workers in a certain labor market by manipulating the immigrant quota, we have to consider whether the labor supply of that market is abundant or scarce.

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