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Abstract

We investigate the effects of changes in the quota for skilled immigrants on the welfare of native workers, legal immigrants, and illegal immigrants under different levels of employer sanctions, assuming a small open economy with dual labor markets and efficiency wages. We demonstrate that if fines are large (small), increases in the quota are likely to increase (decrease) the welfare of native workers and legal immigrants. Our results suggest that the policy authority has to manipulate the immigration quota and employer sanctions simultaneously in order to increase the welfare of native workers and legal immigrants.

Keywords: International Migration; Efficiency wages; Dual labor markets; Immigration quotas; Employer sanctions

1. Introduction

This paper investigates the effects of the quota for skilled immigrants on the welfare of native workers, legal, and illegal immigrants under the different levels of employer sanctions, i.e., fines imposed by the authorities on the firms that employ illegal immigrants, assuming a small open economy with dual labor markets and efficiency wages.

Today, many countries are faced with a large inflow of foreign workers.[1]

1 See Agiomirgianakis (2006) for recent developments of migration in Europe and related theories.

Foreign workers have various impacts on the host countries. It is often argued that the inflow of legal skilled immigrants should be encouraged because their inflow seems to have positive impacts on the host countries. On the other hand, we tend to argue that the acceptance of illegal and/or unskilled immigrants should be prohibited since they are likely to have negative impacts on the host country. Moreover, there are strong arguments to support the implementation of concrete measures to control the inflow of such foreign workers, and many countries are, in fact, attempting to moderate this inflow by utilizing a variety of control methods.

In response to these developments and on the basis of studies on the effects of immigration on the receiving countries, there has been a rapid proliferation of literatures suggesting effective methods to control foreign worker inflow.[2] Ethier (1986) provided the first formal analysis on the impact of illegal immigration by examining the effects of border and domestic

2 The effects of immigration have been analyzed by many authors by utilizing open economic models with dual labor markets; this paper implements a similar approach. These analyses can be divided into two groups. One group of analyses that include Agiomirgianakis and Zervoyianni (2001), Kemnitz (2003), and Shimada (2005) is based on the labor union models that were developed by Dunlop (1944), Oswald (1985), and McDonald and Solow (1981). Another group assumes the efficiency wage hypothesis in the tradition of Shapiro and Stiglitz (1984) and Bulow and Summers (1986). This group comprises researchers such as Carter (1998, 1999) and Müller (1999, 2003a, 2003b). Results regarding the effect of immigration on the receiving countries are not uniform because these effects differ depending on the manner in which the model of the receiving countries is formulated. For example, Agiomirgianakis and Zervoyianni (2001) focused on the problem arising from illegal unskilled foreign worker inflow and demonstrated that its effects depend on the receiving country's regime. In particular, when skilled native workers and policymakers do not cooperate, illegal immigration is likely to have positive impacts on the entire native labor force. However, when they do cooperate, illegal immigration may have negative impacts on native workers.

enforcement policies. Bond and Chen (1987) extended the analysis of Ethier (1986) by deriving a formula for the optimal level of enforcement that can be implemented against firms that employ illegal workers. Carter(2005) explored the effects of deportations, employer sanctions, and amnesties by assuming an economy wherein undocumented workers are endogenously sorted into the secondary labor market. Canto and Udwadia (1986) examined the effects of the immigration quota on the average quality of migrating labor and income distribution. Myers and Papageorgiou (2002) made a comparison between the effectiveness of the immigration quota and the proposed system of immigration tolls and emigration subsidies. Lundborg and Segerstrom (2002) analyzed the effects of the immigration quota on growth and welfare in a North-South version of the quality ladder growth model.

In actual economies, many governments usually manipulate multiple control methods at once to control migration flow. However, most of the previous analyses on immigration controls did not adequately address the issues pertaining to the manipulation of the multiple control methods.[3] In particular, they did not pay sufficient attention to the probable relationship between control methods. Accordingly, these analyses on immigration control are not necessarily fully satisfactory.

The immigration quota and employer sanctions are the most frequently combined control methods in many countries.[4] Both of these influence the

3 Ethier (1986) is one of a few exceptions. He examined the effects of combining border enforcement policies and domestic enforcement policies.

4 See Robin and Barros (2000) for the actual measures that were implemented by OECD member countries in order to prevent and combat the illegal employment of foreigners. Certainly, there are doubts regarding the effectiveness of employer sanctions. See Chiswick (1988) and Boswell and Straubhaar (2004) for the problems pertaining to employer sanctions.

decisions taken by the firms regarding labor demand and wages. Moreover, the manipulations of these methods seem to be closely related through the labor market. This suggests that we cannot independently determine the amount of the immigration quota from the levels of employer sanctions. However, many governments fail to take the probable relationship between them into account and they are often manipulated independently.[5]

Therefore, this paper introduces these most frequently combined control methods and aims to demonstrate that the immigration quota and employer sanctions are not independent for the improvement of native worker and legal immigrant welfare by showing the effects of the changes in the immigration quota for skilled immigrants on the welfare of legal and illegal workers at different levels of employer sanctions.

For this purpose, we assume a small open economy wherein the labor market possesses a dual structure and the wages in the primary and secondary labor markets are determined according to the non-shirk model. A large number of skilled and unskilled immigrants are flowing into the small open economy due to the higher wages in the primary and secondary labor markets than those in the rest of the world; however, this economy wants to accept only a limited number of skilled immigrants. For this purpose, it sets up a quota for skilled immigrants and imposes fines on firms that employ illegal immigrants. Skilled immigrants who meet the immigration quota and thereby acquire legal status and all native workers can enter the primary labor market, whereas the skilled immigrants who do not meet the immigration quota and all the unskilled immigrants cannot acquire legal status and enter

5 The analysis by Gonzalez (1994) is also in accordance with actual policy-making. He introduced the border enforcement and employer sanctions into the same model; however, he manipulated these control methods independently.

the secondary labor market as illegal immigrants. The primary and secondary labor markets are distinct in the sense that jobs in the former are characterized by imperfect observations, whereas jobs in the latter have perfect observations. They also differ in the sense that the firms run the risk of being detected and punished by the authorities if they employ workers in the secondary labor market, whereas they have no risk in employing workers in the primary labor market.

We demonstrate that if the authorities impose large fines on the firms that employ illegal immigrants, increases in the quota for skilled immigrants are likely to benefit the legal workers, i.e., wages and the expected lifetime utilities of native workers and legal immigrants will be greater. This can be explained as follows: An increase in the immigration quota raises the legal worker accession rate. Since wages and the expected lifetime utilities of legal workers are increasing with respect to the legal worker accession rate, the larger quota implies higher wages and higher expected lifetime utilities.

On the other hand, if the fines are small, increases in the quota for skilled immigrants are likely to decrease wages and the expected lifetime utilities of legal workers. In other words, they might worsen the legal worker welfare. This is because increases in the immigration quota lower the legal worker accession rate, leading to lower wages and lower expected lifetime utilities of legal workers.

We also demonstrate that wages and the expected lifetime utilities of illegal workers are independent of the immigration quota and fines. This can be explained as follows: As with the legal worker accession rate, the illegal worker accession rate also depends on migration flow and the immigration quota. However, wages and the expected lifetime utilities of illegal workers remain constant because the jobs in the secondary labor market—all of

which are performed by illegal workers—are perfectly observable; this renders illegal worker wages and expected lifetime utilities independent of the migration flow.

These results have the following implications: Increasing the immigration quota in order to accept a larger number of skilled immigrants does not always impact native workers positively. Accordingly, it is necessary for the government to manipulate the immigration quota taking into account the magnitude of the fine that will be imposed on the firms that employ illegal workers. In particular, if a country wants to accept a large number of skilled immigrants by expanding the quota for them, the government will have to impose larger fines accordingly.

The remainder of this paper is organized as follows: Section 2 presents a small open economic model with dual labor markets and the efficiency wages. In this section, we assume the manner in which the foreign workers flow into the small open economy and how the authorities penalize firms that employ illegal immigrants. Section 3 examines the effects of the immigration quota on the welfare of legal and illegal workers, and tries to show that the immigration quota and fines are not independent. The concluding remarks are presented in section 4.

2. The Model

We consider a small open economy with dual labor markets consisting of the primary and secondary labor markets.[6] Jobs in the primary labor mar-

6 Other studies exist that have the similar structure to us. Carter (1999) assumed efficiency wages both in the primary and secondary labor markets for their analyses on the effects of immigration. On the other hand, Müller (1999) considered efficiency wages only in the primary labor market, and the wages and employment in the secondary labor market were determined competitively.

ket are attractive and require skill; therefore, the marginal product of labor is high. In such a market, workers are required to be skilled and legal. In contrast, jobs in the secondary labor market are unattractive and do not require skill; therefore, the marginal product of labor is low. Workers are required to be neither skilled nor legal in order to enter this market.

A small open economy is connected to the rest of the world through immigration. For economic and non-economic reasons, the small open economy is making an attempt to accept only a limited number of skilled immigrants by setting up an immigration quota $\bar{M}$.

The number of native workers is denoted by $\bar{N}$, which is assumed to be a constant. All these workers are both skilled and legal by definition, and thereby, they participate only in the primary labor market.[7] In the secondary labor market, jobs are unattractive to the extent that the native workers do not want to be employed there. Accordingly, even if they are not employed in the primary labor market, they do not enter the secondary market.

All immigrants can acquire legal status provided that they are skilled and their numbers do not exceed the immigration quota. However, if the number of skilled immigrants exceeds the quota, only those skilled immigrants who meet the quota can acquire legal status. The remainder of the skilled immigrants is unable to acquire this status; therefore, they become illegal immigrants.[8]

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7 According to Massey and Taylor (2004), labor markets in developed nations become increasingly segmented into a primary sector containing the " good " jobs that are attractive to the native workers and a secondary sector of poorly paid, " bad " jobs that are shunned by native workers. This explains why firms turn to legal and illegal unskilled immigrants. Even if unskilled native workers existed, their number would be small, and their effects on the economy would not be significant. Accordingly, we assume that unskilled native workers do not exist in the secondary labor market.

8 In order to simplify the analysis, it is assumed that legal and illegal immigrants do not to voluntarily return to their home countries.

Due to wage differentials, skilled and unskilled workers migrate between a small open economy and the rest of the world. In general, if the wages of skilled and unskilled workers are higher (lower) in the small open economy than in the rest of the world, skilled and unskilled workers will migrate from the rest of the world (the small open economy) to the small open economy (the rest of the world).[9] Two ways of migration are possible. In this paper, however, we assume that the wages in the rest of the world, i.e., the wages of skilled and unskilled foreign workers in their home countries—these are given to the small open economy and remain constant throughout the analysis—are sufficiently lower than those in the small open economy. As a result, the small open economy will be confronted by an inflow of skilled foreign workers that exceeds the immigration quota as well as by a significant inflow of unskilled foreign workers.

Accordingly, the actual number of the skilled and unskilled foreign workers $\delta(w_2-w^*)$ is always sufficiently larger than the immigration quota $\bar{M}$ and only $\bar{M}$ of the skilled immigrants can acquire legal status, where w_2 denotes the secondary labor market wages in the small open economy, w^* denotes higher wages among those of skilled and unskilled foreign workers in their home countries, and δ which is a positive constant, measures the sensitivity of migration flow to the changes in the differentials between w_2 and w^*.[10] The remainder of the immigrants, i.e., the skilled immigrants who

9 In this paper, the product price does not change and is assumed to be one; therefore, we have no need to make distinctions between the real and nominal wages.

10 Workers from the rest of the world are aware of the fact that, even though they are skilled, all of them cannot acquire legal status after migration; hence, some of them are left with no option than to enter the secondary labor market. In other words, no skilled foreign worker is certain of acquiring legal status before migration. Rather, since the quota for the skilled immigrants is very small, the probability that they participate in the primary labor market is low. Accordingly, skilled immigrants approximate their expected

cannot acquire legal status and all unskilled immigrants $\delta(w_2-w^*)-\bar{M}$ are left with no other option than to become illegal immigrants.

Therefore, there are $\bar{N}$ native workers and $\bar{M}$ legal skilled immigrants in the primary labor market of a small open economy.[11] In the secondary labor market, $\delta(w_2-w^*)-\bar{M}$ illegal skilled or unskilled immigrants exist.

Assuming a Cobb-Douglas production technology and considering capital to be fixed, the output in a small open economy Y increases with an increase in employment in the primary labor market, i.e., legal worker employment L_1 and employment in the secondary labor market, i.e., illegal worker employment L_2.

$$Y=L_1^{a_1}L_2^{a_2},\ \ a_1>a_2>0,\ \ a_1+a_2<1.$$[12]

Firms are perfectly competitive and they demand labor in the primary and secondary labor markets in such a way as to maximize profits. The native workers and legal skilled immigrants, who are regarded as perfect substitutes by firms, are employed in the primary labor market to an extent wherein their marginal product is equal to the primary labor market wages w_1. In the secondary labor market, similar to Agiomirgianakis and Zervoyianni (2001), firms are aware of the fact that by employing illegal

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wages in the small open economy by the secondary labor market wages. Moreover, undoubtedly, the difference between w_2 and home country's wages is larger for immigrants with lower wages than for those with higher wages. However, we consider that immigrants with lower wages have to pay the costs for migration since they are likely to be inefficient in migration as well as in production. Accordingly, we approximate the wage difference that motives migration for both types of workers by w_2-w^*.

11 We assume that all workers in the primary labor market have an identical employment probability. As with native workers, legal immigrants too do not enter the secondary labor market even if they are not employed in the primary labor market once they entered the primary market.

12 The relation $a_1>a_2$ reflects the assumptions that the marginal product of labor is high in the primary labor market and low in the secondary labor market.

skilled or unskilled immigrants, they run the risk of being detected by the authorities, in which case they will be forced to pay a fixed fine f, $f>0$, for each illegal immigrant employed by them; f is a constant and does not change throughout the analysis.[13] We assume that as the number of illegal immigrants increases, firms will be faced with a higher probability of being detected. This assumption reflects the following facts: In actual economies, we cannot perfectly control all the resources that contribute to tracing the firms that employ illegal immigrants.[14] However, as the number of illegal immigrants increases, the government tends to invest more resources into locating such firms; consequently, the authorities are likely to detect them with more efficiency. We represent the probability that the authorities will discover firms employing illegal immigrants by p, $0<p<1$, that is assumed to be an increasing function of $\delta(w_2-w^*)-\bar{M}$. Accordingly, illegal immigrants are employed to the extent wherein their marginal product is equal to the sum of w_2 and the expectation of a fine for employing an illegal immigrant $p(\delta(w_2-w^*)-\bar{M})f$. The demand functions for legal and illegal workers are derived as follows:

$$L_1=a_1^{\frac{1-a_2}{1-a_1-a_2}}a_2^{\frac{a_2}{1-a_1-a_2}}w_1^{-\frac{1-a_2}{1-a_1-a_2}}\{w_2+p(\delta(w_2-w^*)-\bar{M})f\}^{-\frac{a_2}{1-a_1-a_2}}. \qquad (1)$$

13 The authorities are fully aware that all the immigrants in the secondary labor market are illegal. However, in order to penalize firms for employing illegal immigrants, the authorities are required to prove that the firms are actually employing those immigrants in the secondary labor market. Since many firms may circumvent rules by adopting strategies such as sub-contracting (Boswell and Straubhaar 2004), it is not possible for the authorities to detect all the firms that employ illegal immigrants.

14 For example, even if the government does not increase the direct expenditure on tracing them, we will have a larger resource allocation and thereby a higher detection probability if the government spends more on employing police officers. Therefore, this paper does not solve the maximization problem in order to determine the optimal level of the resource devoted to tracing firms that employ illegal immigrants.

$$L_2 = a_1^{\frac{a_1}{1-a_1-a_2}} a_2^{\frac{1-a_1}{1-a_1-a_2}} \{w_2 + p(\delta(w_2 - w^*) - \bar{M})f\}^{-\frac{1-a_1}{1-a_1-a_2}} w_1^{-\frac{a_1}{1-a_1-a_2}}. \quad (2)$$

Equations (1) and (2) indicate that legal and illegal workers are gross complements.

Since firms are unable to completely detect shirking by employed workers, they set wages in a manner that prevents shirking by assuming workers' effort as given (Shapiro and Stiglitz 1984). As in Bulow and Summers (1984) and Carter (1999), this paper assumes that a shirker will be detected and fired at different probabilities in the primary and secondary labor markets. This is because, as mentioned already, jobs in the two labor markets are of different types.

The wages and expected lifetime utilities in the primary and secondary labor markets are derived similarly. If a representative employed worker in the primary labor market does not shirk, his instantaneous utility is measured by primary labor market wages minus effort. On the other hand, if he shirks, his instantaneous utility is measured by primary labor market wages. However, in such a case, a representative employed worker in the primary labor market will be detected and fired by firms at the probability ρ_1. Moreover, some of the employed workers in the primary labor market separate from their jobs, even though they are not fired on the grounds of shirking. The separation rate in the primary labor market, which is defined as the ratio of separations due to reasons other than shirking to the number of employed workers in the primary labor market, is given by β. The separation rate is assumed to be identical in the primary and secondary labor markets.[15]

15 The results of this paper remain unchanged even if the separation rates differ in the primary and secondary labor markets.

The expected lifetime utility of a representative employed shirker in the primary labor market $V_{E_1}^S$ is,

$$rV_{E_1}^S = w_1 + (\beta + \rho_1)(V_{U_1} - V_{E_1}^S), \tag{3}$$

where r is the discount rate and V_{U_1} is the expected lifetime utility of a representative unemployed worker in the primary labor market. Equation (3) can be rewritten as,

$$V_{E_1}^S = \frac{w_1 + (\beta + \rho_1) V_{U_1}}{r + \beta + \rho_1}. \tag{3'}$$

On the other hand, the expected lifetime utility of a representative employed non-shirker in the primary labor market $V_{E_1}^N$ is,

$$rV_{E_1}^N = w_1 - e + \beta(V_{U_1} - V_{E_1}^N), \tag{4}$$

where e is effort exerted by a representative employed non-shirker in the primary labor market. We assume that workers in the primary and secondary labor markets exert the same level of effort.[16] The level of effort is exogenous and remains constant throughout the analysis.[17] Equation (4) can be rewritten as,

$$V_{E_1}^N = \frac{w_1 - e + \beta V_{U_1}}{r + \beta}. \tag{4'}$$

The employed workers in the primary labor market may or may not shirk based on a comparison of $V_{E_1}^N$ and $V_{E_1}^S$. In order to prevent the workers from

16 Even if the workers in the primary and secondary markets exert different levels of effort, the paper's main results remain unchanged as long as effort is exogenous.

17 The analysis will be more general if the employed workers determine the optimal level of effort in a manner that will maximize their expected lifetime utility given that the wages are set by firms. See Shimada (2007) for the determination of the optimal level of effort.

shirking, firms have to set primary labor market wages to ensure that $V_{E_1}^N \geq V_{E_1}^S$. However, since there is no reason for firms to pay more than what is essential to eliminate shirking by employed workers in the primary labor market, they will set primary labor market wages such that $V_{E_1}^N = V_{E_1}^S (\equiv V_{E_1})$. The following is obtained by substituting Equations (3') and (4') into this condition:

$$w_1 = rV_{U_1} + \frac{r+\beta+\rho_1}{\rho_1} e. \tag{5}$$

Moreover, V_{U_1} is given by,

$$rV_{U_1} = \bar{w} + \alpha_1 (V_{E_1} - V_{U_1}), \tag{6}$$

where $\bar{w}$ is the unemployment benefit, which is a constant, and α_1 is the accession rate in the primary labor market, which is defined as the ratio of new hires in the primary labor market to the number of unemployed workers in the primary labor market. We assume that the unemployment benefits are zero in both primary and secondary labor markets. In steady state, α_1 must be such that the flow out of unemployment in the primary labor market is equal to the flow into unemployment in the primary labor market, i.e., $\alpha_1(\bar{N} + \bar{M} - L_1) = \beta L_1$.

Utilizing Equations (3'), (4'), (5), and (6), the primary labor market wages are derived as follows:

$$w_1 = e + \frac{\alpha_1+\beta+r}{\rho_1} e. \tag{7.1}$$

Equation (7.1) suggests that the primary labor market wages increase with an increase in the accession rate in that market.

The expected lifetime utility of a representative employed worker in the primary labor market under the non-shirk condition takes the form of,

$$V_{E_1}=\frac{1}{\rho_1}\left(1+\frac{\alpha_1}{r}\right)e. \tag{8.1}$$

According to Equation (8.1), the legal worker expected lifetime utility is also increasing with respect to their accession rate.

Based on a similar argument, the wages and the expected lifetime utility of a representative employed worker in the secondary labor market under the non-shirk condition V_{E_2} are obtained as follows;

$$w_2=e+\frac{\alpha_2+\beta+r}{\rho_2}e, \tag{7.2}$$

$$V_{E_2}=\frac{1}{\rho_2}\left(1+\frac{\alpha_2}{r}\right)e, \tag{8.2}$$

where α_2 is the accession rate in the secondary labor market—which is defined as the ratio of new hires in the secondary labor market to the number of workers unemployed in the secondary labor market.[18] In steady state, α_2 must be such that the flow out of unemployment in the secondary labor market is equal to the flow into unemployment in the secondary labor market, i.e., $\alpha_2\{\delta(w_2-w^*)-\bar{M}-L_2\}=\beta L_2$.

As assumed earlier, ρ_1 and ρ_2 are different. In general, firms cannot easily monitor effort that is exerted by the workers on skilled jobs, whereas they can easily monitor effort exerted by the workers on unskilled jobs. This is because jobs in the primary labor market tend to be complicated, and thereby it is difficult for the firms to confirm that the workers actually exerted effort. On the other hand, since jobs in the secondary labor market are likely to

18 Illegal immigrants in actual economies might be deported to their home countries if the authorities are able to locate the firms employing them. However, as long as the deportation probability is a constant, the main results of this paper remain unchanged even if illegal immigrants might be deported to their home countries.

be not so complicated as those in the primary labor market, the firms can easily confirm their effort. Accordingly, following Carter (1999), we assume that jobs in the primary labor markets have imperfect observations, i.e., ρ_1 is finite, whereas jobs in the secondary labor markets have perfect observations, i.e., ρ_2 is infinite.[19]

Taking the limit of Equations (7.2) and (8.2) as ρ_2 becomes arbitrarily large, the secondary labor market wages and the expected lifetime utility of a representative employed worker in the secondary labor market will be as follows:

$$w_2 = e. \tag{7.2'}$$

$$V_{E_2} = 0. \tag{8.2'}$$

Equations (7.2') and (8.2') suggest that even in steady state, the wages and the expected lifetime utility of a representative employed worker in the secondary labor market are independent of the migratory flow. This can be explained as follows: In steady state, migration affects the accession rate in the secondary labor market since $\alpha_2 = \beta L_2 / \{\delta(w_2 - w^*) - \bar{M} - L_2\}$. However, the accession rate has no effect on the wages and the expected lifetime utility of a representative employed worker in such a market since ρ_2 is infinite.

In contrast, wages and the expected lifetime utility of a representative employed worker in the primary labor market in steady state are affected by

19 As formulated by Carter (1999), we define ρ_1, ρ_2 as the probabilities per unit time that a shirker in the primary and secondary labor markets will be detected and fired. Therefore, $\rho_i t$, $i=1,2$, is the probability that a shirker will be detected and fired during a short interval, $[T_0, T_0+t]$. With perfect observation, $\rho_i t$ is equal to 1—even with a very small t—i.e., ρ_i is infinite.

migration. On substituting α_1 that holds in steady state into Equations (7.1) and (8.1), we can solve them as follows:

$$w_1=e+\frac{\{(\bar{N}+\bar{M})/(\bar{N}+\bar{M}-L_1)\}\beta+r}{\rho_1}e. \tag{7.1'}$$

$$V_{E_1}=\frac{1}{\rho_1}\left[1+\frac{\{L_1/(\bar{N}+\bar{M}-L_1)\}\beta}{r}\right]e. \tag{8.1'}$$

Equations (7.1') and (8.1') suggest that, in steady state, the wages and the expected lifetime utility of a representative employed worker in the primary labor market are dependent on the migratory flow. This can be explained as follows: As in Equation (1), the demand for skilled workers changes with the number of immigrants. This suggests that the accession rate in the primary labor market depends on migration indirectly as well as directly. Moreover, this rate affects wages and the expected lifetime utility in such a market since ρ_1 is finite.

3. Effects of the Immigration Quota on Legal and Illegal Workers under the Different Levels of Employer Sanctions

In this section, we examine how changes in the immigration quota affect the welfare of the workers in the primary and secondary labor markets when the levels of employer sanctions are different.

For this purpose, we substitute Equation (7.2') into Equation (1) and totally differentiate the resulting equation and Equation (7.1'). Eliminating dw_1 from these equations, the effects of the immigration quota on legal worker employment are derived as follows:

$$\frac{dL_1}{d\bar{M}}$$

$$=\frac{\frac{1-a_2}{1-a_1-a_2}L_1 w_1^{-1}\frac{\beta}{\rho_1}\frac{e}{(\bar{N}+\bar{M}-L_1)^2}L_1}{1+\frac{1-a_2}{1-a_1-a_2}L_1 w_1^{-1}\frac{\beta}{\rho_1}\frac{e}{(\bar{N}+\bar{M}-L_1)^2}(\bar{N}+\bar{M})}$$

$$+\frac{\frac{a_2}{1-a_1-a_2}L_1\{e+p(\delta(e-w^*)-\bar{M})\}^{-1}pf}{1+\frac{1-a_2}{1-a_1-a_2}L_1 w_1^{-1}\frac{\beta}{\rho_1}\frac{e}{(\bar{N}+\bar{M}-L_1)^2}(\bar{N}+\bar{M})}. \qquad (9.1)$$

Since both the terms on the right-hand side in Equation (9.1) are positive, increases in the immigration quota will increase legal worker employment, which is the sum of native worker employment and legal immigrant employment, i.e., $dL_1/d\bar{M}>0$. This result stems from the two effects; the effects on the legal workers' wages in steady state that satisfy their non-shirk condition (Equation 7.1')—these effects are expressed by the first term on the right-hand side in Equation (9.1)—and the effects on the demand for legal workers (Equation 1), which are expressed by the second term on the right-hand side in Equation (9.1).

The effects of the former are explained as follows: For any demand for legal workers L_1, increases in the immigration quota exacerbates legal worker unemployment $\bar{N}+\bar{M}-L_1$, whereas legal worker separation due to reasons other than shirking βL_1 remains constant. Accordingly, for any demand for legal workers, the accession rate in the primary labor market α_1 decreases with increases in the immigration quota. This causes the expected duration of being unemployed in the primary labor market $1/\alpha_1$ to be longer, suggesting that legal workers are more severely punished for being unemployed. Therefore, for any demand for legal workers, the legal worker

wages that will prevent shirking by them will decrease with increases in the immigration quota. If w_1 is measured on the vertical axis and L_1 is measured on the horizontal axis, the curve that describes Equation (7.1') is upward-sloping and shifts downwards to the right with increases in the immigration quota.

The effects of the latter are explained as follows: Since the illegal worker wages in steady state satisfy their non-shirk condition (Equation 7.2'), and thereby, the number of immigrants $\delta(e-w^*)$ do not depend on the immigration quota, the number of illegal immigrants decreases with increases in the immigration quota. This decreases the expected fine and thereby the expected cost that firms have to pay for employing an illegal immigrant $e+p(\delta(e-w^*)-\bar{M})f$. Since legal and illegal workers are gross complements as in Equations (1) and (2), the demand for legal workers increases with decreases in the expected cost for employing an illegal immigrant. Moreover, as suggested in Equation (1), the demand curve for legal workers is downward-sloping. Accordingly, it shifts upward to the right with increases in the immigration quota.

These two effects always increase the legal worker employment when the immigration quota increases.

However, the effects on native worker employment and legal immigrant employment are not always the same. For larger values of f, by increasing the immigration quota, the demand curve for legal workers that describes Equation (1) shifts upward to the right to a larger extent.[20] On the other hand, the curve that describes Equation (7.1') shifts downward to the right to a smaller extent.[21] If f is sufficiently large, the former effect dominates,

20 $\partial(\partial L_1/\partial\bar{M})/\partial f>0$ and $\lim_{f\to 0}\partial(\partial L_1/\partial\bar{M})/\partial f=0$, where L_1 and $\bar{M}$ satisfy Equation (1).

21 $\partial(\partial L_1/\partial\bar{M})/\partial f<0$ and $\lim_{f\to\infty}\partial(\partial L_1/\partial\bar{M})/\partial f=0$, where L_1 and $\bar{M}$ satisfy Equation (7.1').

and $dL_1/d\bar{M}$ becomes larger than the employment probability for legal workers $L_1/(\bar{N}+\bar{M})$.[22] In such a case, increases in the immigration quota increase the employment probability, i.e., $d\{L_1/(\bar{N}+\bar{M})\}/d\bar{M}>0$.[23] Therefore, if f is sufficiently large, both native worker employment and legal immigrant employment increase corresponding to an increase in the immigration quota.

If f is small, a given increase in the immigration quota shifts the demand curve for legal workers that describes Equation (1) upward to the right to a smaller extent, whereas a given increase in the immigration quota shifts the curve that describes Equation (7.1') downward to the right to a larger extent. If f is sufficiently small, the former effects dominate and $dL_1/d\bar{M}$ is smaller than $L_1/(\bar{N}+\bar{M})$; hence, the employment probability for legal workers decreases as the immigration quota increases.[24] Therefore, for sufficiently small values of f the native worker employment decreases; however, legal immigrant employment increases with increases in the im-

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22 The first term on the right-hand side in Equation (9.1) is smaller than 1 for any values of f. On the other hand, the partial derivative of the second term on the right-hand side in Equation (9.1) with respect to f is equal to,

$$a_1^{\frac{1-a_2}{1-a_1-a_2}} a_2^{\frac{a_2}{1-a_1-a_2}} w_1^{-\frac{1-a_2}{1-a_1-a_2}} \frac{a_2}{1-a_1-a_2} p\,(\delta(w_2-w^*)-\bar{M})$$

$$\times\left\{\left(-\frac{a_2}{1-a_1-a_2}-1\right)\frac{p(\delta(w_2-w^*)-\bar{M})f}{1+p(\delta(w_2-w^*)-\bar{M})f}+1\right\}.$$

This becomes positive if the marginal product of labor in the secondary labor market is low and a_2 is sufficiently small. Accordingly, in such a case, $dL_1/d\bar{M}$ becomes larger for larger values of f.

23 $d\{L_1/(\bar{N}+\bar{M})\}/d\bar{M}=\{1/(\bar{N}+\bar{M})^2\}\{(dL_1/d\bar{M})(\bar{N}+\bar{M})-L_1\}$.

24 If $f=0$, the second term on the right-hand side in Equation (9.1) is equal to 0 and the first term is smaller than $L_1/(\bar{N}+\bar{M})$.

migration quota.[25]

The immigration quota affects the legal worker accession rate as follows:

$$\frac{d\alpha_1}{d\bar{M}}=\frac{\beta}{(\bar{N}+\bar{M}-L_1)^2}\left\{\frac{dL_1}{d\bar{M}}(\bar{N}+\bar{M})-L_1\right\}=\begin{cases}>0, & \text{if } dL_1/d\bar{M}>L_1/(\bar{N}+\bar{M}).\\ <0, & \text{if } dL_1/d\bar{M}<L_1/(\bar{N}+\bar{M}).\end{cases}$$

These results have the following interpretations: As shown by Equation (9.1), increases in the immigration quota increase the legal worker employment. Moreover, as legal worker employment increases, legal worker separation due to reasons other than shirking increases and legal worker unemployment decreases. These indirect effects lead to a larger accession rate. However, for any demand for legal workers L_1 increases in the immigration quota directly increase legal worker unemployment. This direct effect leads to a smaller accession rate. If f is sufficiently large and $\partial L_1/\partial\bar{M}$ is larger than $L_1/(\bar{N}+\bar{M})$, then the former indirect effects dominate, and thereby, $\partial\alpha_1/\partial\bar{M}>0$. On the other hand, if f is sufficiently small and $\partial L_1/\partial\bar{M}$ is smaller than $L_1/(\bar{N}+\bar{M})$, then the latter direct effect dominates, and thereby, $\partial\alpha_1/\partial\bar{M}<0$.

These results suggest that in a scenario in which the authorities impose large fines, an increase in the immigration quota results in a higher likelihood for the unemployed legal workers to be reemployed. However, in a scenario in which the authorities impose small fines, a decrease in the immigration quota results in a higher likelihood for the unemployed legal workers to be reemployed.

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25 Since the number of native workers does not change, decreases in the employment probability reduce their employment. However, even if f is small, the sum of native worker employment and legal immigrant employment increases with increases in the immigration quota as shown in Equation (9.1). Therefore, it is necessary for legal immigrant employment to increase.

According to Equations (7.1) and (8.1), wages and the expected lifetime utility of a representative employed worker in the primary labor market are increasing with respect to the legal worker accession rate. Therefore, the effects of changes in the immigration quota on the legal worker wages and expected lifetime utility are derived as follows:

$$\frac{dw_1}{d\bar{M}}=\frac{\beta}{\rho_1}\frac{e}{(\bar{N}+\bar{M}-L_1)^2}\left\{\frac{dL_1}{d\bar{M}}(\bar{N}+\bar{M})-L_1\right\}=\begin{cases}>0, & \text{if } dL_1/d\bar{M}>L_1/(\bar{N}+\bar{M}).\\ <0, & \text{if } dL_1/d\bar{M}<L_1/(\bar{N}+\bar{M}).\end{cases} \tag{10.1}$$

$$\frac{dV_{E_1}}{d\bar{M}}=\frac{1}{\rho_1}\frac{e}{r}\frac{\beta}{(\bar{N}+\bar{M}-L_1)^2}\left\{\frac{dL_1}{d\bar{M}}(\bar{N}+\bar{M})-L_1\right\}=\begin{cases}>0, & \text{if } dL_1/d\bar{M}>L_1/(\bar{N}+\bar{M}).\\ <0, & \text{if } dL_1/d\bar{M}<L_1/(\bar{N}+\bar{M}).\end{cases} \tag{11.1}$$

We see from Equations (10.1) and (11.1) that increases in the immigration quota are likely to increase legal worker wages and expected lifetime utility if fines are large, whereas increases in the immigration quota are likely to decrease these two if fines are small.[26]

Therefore, the changes in the immigration quota have different effects on legal worker wages and expected lifetime utilities depending on the values of fines, and the expansion of the immigration quota does not necessarily lead to the improvement of the legal worker welfare. This confirms our inference that the immigration quota and employer sanctions are related for the improvement of the legal worker welfare.

Our results have the following policy implications: The immigration quota

26 If fines are large, legal worker employment increases with the immigration quota. Accordingly, the legal worker welfare in terms of their employment as well as their wages and expected lifetime utilities increases with the immigration quota. Moreover, it is likely that if fines are small, the legal worker welfare in terms of their employment as well as their wages and expected lifetime utilities decreases with the immigration quota. This is because, even if legal immigrant employment increases with their quota, the ratio of native workers among legal workers is large and native worker employment decreases with the immigration quota.

and fines cannot be manipulated independently. If large fines are imposed, the government can increase the native worker welfare by increasing the immigration quota. On the other hand, if the government can only impose small fines, it will have to decrease the immigration quota in order to increase the native worker welfare.

As shown in Equations (7.2') and (8.2'), the immigration quota has no effects on the wages and the expected lifetime utility of a representative employed worker in the secondary labor market.

$$\frac{dw_2}{d\bar{M}}=0. \tag{10.2}$$

$$\frac{dV_{E_2}}{d\bar{M}}=0. \tag{11.2}$$

Equations (10.2) and (11.2) suggest that as long as immigrants are illegal and their jobs are perfectly monitored by firms, their wages and expected lifetime utilities remain unchanged even if the government manipulates the immigration quota.

To summarize the results derived in this section, the effects of changes in the immigration quota on the welfare of the native workers and the legal immigrants differ according to the values of the fine. However, the immigration quota and fines have no effects on the illegal immigrant welfare if firms can monitor their effort perfectly.

4. Concluding Remarks

This paper investigated how changes in the quota for skilled immigrants affect the welfare of legal and illegal workers under the different levels of employer sanctions by utilizing a small open economic model with dual labor

markets and the efficiency wages hypothesis.

We demonstrated that the immigration quota cannot be manipulated independently of the levels of employer sanctions if we try to improve the native worker welfare. Whether the immigration quota should be increased or decreased depends on the levels of fines. We also showed that the welfare of illegal workers is independent of the immigration quota and fines.

Our results suggest that expanding the immigration quota in order to accept a larger number of skilled immigrants does not always improve the native worker welfare and that if an attempt is made to increase the number of skilled immigrants by raising the immigration quota, it is necessary for the government to impose larger fines.

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