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Temporary and Permanent Immigration under Unionization*

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Abstract

This paper investigates permanent and temporary immigration and remittance under the coexistence of unionized and non-unionized manufacturing firms in a two-sector economy. The impacts of immigration and remittance on respectively wages, employment, the union-nonunion wage gap and national welfare are analyzed. It is found that both permanent immigration (economy-wide) and temporary immigration in agriculture bring positive effects on most variables (except the competitive wage), but widens the wage gap and causes income redistribution in the host country. However, if temporary immigrants work in manufacturing only, then all wages and the union-nonunion wage gap fall. That is, workers become more equally paid but poorer. In addition, remittance and globalization cause negative effects on union workers and employers. It is perhaps such consequences and the income redistribution effect of immigration that cause the media to paint a negative image of immigration.

1. Introduction

Some argue that labor is the least mobile factor of production in the real world due to legal barriers set up by sovereign states. Despite of being an integral part of globalization, immigration is viewed negatively in public opinion. Often when related issues appear in the media, they are about illegal immigrants, or some other negative images such as taking jobs away and depressing wages, etc. It seems the imperfections in the labor market, such as unionization, also serve to create the negative images. For instance, it is alleged that, "mass immigration helps employers and hurts workers, and unions flourish when immigration is low and they flounder when immigration is high" (*Salt Lake Union Tribune*, September 3, 2001). There are also cries that the AFL-CIO has abandoned American workers, because the Executive Council of the AFL-CIO in February 2000 announced a reversal in its posture, by proclaiming that it now "proudly stands on the side of immigrant workers". While before that, the AFL-

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CIO had sought to protect wages of native-born workers by excluding immigrants. However, by making immigrants more vulnerable, such sanctions also helped put pressure on the wages of native-born workers. Also, in Japan while many employers hire immigrants (sometimes illegal ones), it is the local workers and the government that are against immigration.

With the launch of the European Union, NAFTA, APEC, etc., globalization is bound to increase labor migration across borders. Already, Migrant Watch International based in Switzerland estimates that 130 million people in the world live outside their countries of birth. Immigration is a routine issue in presidential campaigns in the US, Europe and Australia. In Japan, due to the aging population and the young generation's tendency to have fewer kids, labor shortage especially in agriculture and heavy manual work is becoming a problem. Already small numbers of seasonal foreign workers are being introduced. Sooner or later more lenient immigration policies may have to be adopted.

Despite the importance of labor market imperfections on immigration issues, theoretical research has been rare. Recently, Schmidt, Stilz and Zimmermann (1994) and Fuest and Thum (2001) analyze immigration in unionized markets, focusing on skill differences. They demonstrate that immigration can be beneficial to the host country due to the complementarity of unskilled immigrants to skilled natives. Fuest and Thum (2000) show that immigration increases welfare if the wage elasticity of labor demand in the competitive sectors is smaller than in the unionized sectors.

The present paper is related to the above, but adopts a different structure and with a different focus. To capture the possible conflicts between natives and immigrants, we allow immigration to be either permanent or temporary, in addition to incorporating the activities of labor unions. While permanent immigrants are treated identically as host-country residents and can become union members, temporary immigrants work on contracts and must return to the home countries when contracts expire. As such, they can only work in contracted firms and are ineligible to become union members, even if the contracted firms have unions. Temporary immigrants also remit earnings back to their home countries.

Specifically, we consider a host-country economy consisting of two sectors: manufacturing and agriculture. While agriculture is perfectly competitive, manufacturing is characterized by mixed oligopoly

– some firms are unionized while others are not, and all firms engage in oligopolistic competition. We investigate the impacts of immigration and remittance on respectively wages, employment, the union-nonunion wage gap and national welfare, and find that an increase in permanent immigration brings positive effects on these variables (except the competitive wage), and widens the wage gap. That is, while permanent immigration increases the welfare of the whole nation, it also causes income redistribution, benefiting relatively the labor unions and landowners, and hurting those receiving the competitive wage.

Both temporary immigration and their remittance raise the national welfare of the host country under certain conditions. These arise because temporary immigration has two effects: (i) a wage effect--immigration increases agricultural production, driving down the competitive wage; and (ii). an employment-shift effect--the decrease in the competitive wage induces more agricultural and less manufacturing production. Since immigrants remit earnings back home, the wage effect helps to improve the national welfare of the host country (by lowering immigrant earnings), while the employment-shift effect does the opposite by expanding too much agricultural output. The former effect dominates the latter one if the unionized firm hires more temporary immigrants than union members.

However, if temporary immigrants can only work in manufacturing, then an increase in immigration reduces the competitive wage, the union wage and employment. The union utility falls and the union-nonunion wage gap narrows. Workers become more equally paid but poorer, while firms and landowners become better off. It is perhaps these consequences and the income redistribution effect of immigration, which cause the media to paint a negative image of immigration.

In practice, host countries usually start to introduce immigration gradually, and from temporary to permanent. Our model predicts that the gains of immigration increase as more immigrants are introduced (i.e., the gains outweigh the losses if unionized firms employ large numbers of immigrants). Policies that could smooth out the gains/pains of immigration include redistributing the gains from landowners to union members at early stages of introducing immigration. As the number of immigrants grows, even union members can gain directly. These seem to be consistent with the experiences in North

America, Australia and Europe, which have recognized the positive effects of immigration on national welfare and adopted constructive immigration policies.

2. Basic Model Setup

2.1 Consumers

Consider a host-country economy consisting of two sectors: Manufacturing (*x*) and Agriculture (*y*), with *y* as the numeraire good. While perfect competition prevails in agriculture, manufacturing is characterized by Cournot-Nash competition of a fixed number of *n* firms. We assume that a typical consumer maximizes the following homothetic utility function, $\mu = C_x^{\alpha} C_y^{1-\alpha}$, where C_x and C_y are respectively the domestic consumption of goods *x* and *y*, and α is a positive constant. Utility maximization subject to the standard budget constraint yields the following inverse demand function,

$$p(C_x, C_y) = \alpha C_y / (1-\alpha) C_x . \qquad (1)$$

We assume that the host country is import competing in manufacturing, i.e., it imports good *x* and exports good *y*. This country is small and takes world price as given. However, it imposes a quota, *q*, on foreign imports. The choice of a quota instead of a tariff is based on the simplifying assumption that labor is the only factor of production in manufacturing and that this sector is imperfectly competitive. As is well known that under a non-prohibitive tariff, the market power of the domestic firm disappears and there is no rents left for the union to bargain over with management. Another justification for this assumption might be that under the WTO system, while tariffs are on the decrease, non-tariff barriers still exist in various forms, limiting trade flows. To maintain balanced trade, we must also have $C_x = x + q, \quad C_y = y - p^* q$, where *x* and *y* denote the total outputs of respectively manufacturing and agriculture produced in the host country, and p^* is the world price.

2.2 Agriculture

In agriculture, the production of good *y* uses labor and land: $y = y(L_y, T)$, where *y* is output, L_y and *T* are inputs of labor and land respectively. Perfect competition prevails in this sector, such that labor is hired until the marginal product of labor is equal to the competitive wage:

$$w_0 = y_1(L_y, T). \tag{2}$$

2.3 Manufacturing

This sector is characterized by mixed oligopoly. There are *n* oligopolistically competitive firms, *m* of which are unionized, and the rest, *n-m*, are non-unionized. The number of each type of firms is exogenous. In a typical unionized firm, employment and wages are determined by negotiation. All firms behave as Cournot-Nash oligopolists and take the actions of their competitors as given. Further, the production of good *x* uses labor only in a one-to-one ratio by a proper choice of units: $x^i = L_x^i$, where x^i is output, and L_x^i is the labor input for firm *i*.

A typical non-unionized firm j pays its workers the reservation wage w_0 and maximizes profits:

$$\pi_0^j = (p - w_0)L_0^j. \tag{3}$$

All *n-m* non-unionized firms behave in the Cournot fashion, which results in the following FOCs:

$$w_0 = p + p_1 L_0^j, . \tag{4}$$

where $p_1 = \partial p / \partial L_0^j = -p / C_x$, using (1) and the trade balance condition.

In contrast, the profit function of a typical unionized firm *k* is:

$$\pi_u^k = (p - w^k)L_u^k, \tag{5}$$

where w^k is the wage paid to union members in firm *k*, and L_u^k is the union employment. In a unionized firm, all domestic workers join in the union. In other words, the unionized firm does not hire non-unionized domestic workers. For instance, most unionized firms in Japan hire non-unionized workers only as part-timers, not regular employees.

A typical union *k*, has a Stone-Geary type utility function (see Mezzetti and Dinopoulos, 1991):

$$u^k(w^k, L_u^k) = (w^k - w_0)L_u^k. \tag{6}$$

That is, it is interested in employment as well as a union wage premium above the competitive wage. The wages and employment in unionized firms are determined through negotiations. The solution concept we adopt is Nash bargaining. The union and the firm jointly choose employment and wages to maximize the following Nash product: $G(L_u^k, w^k) = \pi_u^k u^k$. The equilibrium satisfies the following conditions:

$$2(p - w^k) + L_u^k p_1 = 0, \tag{7a}$$

$$p - 2w^k + w_0 = 0, \tag{7b}$$

In equilibrium, we seek a symmetric solution. That is, we assume all the non-unionized firms are identical, and the same applies to all the unionized firms. Thus, each non-unionized firm in manufacturing employs $L_0^j = L_0$ of labor and pays the competitive wage w_0, while each unionized firm employs $L_u^k = L_u$ of labor and pays the union wage $w^k = w$.

Substituting $x^i = L_x^i$ into (7a) and (7b) to obtain

$$L_0 = L_u, \tag{8}$$

which says that in equilibrium, a unionized firm and a non-unionized firm employs identical number of workers. This arises because the union utility function in (6) implies that the union is not biased toward either employment or wage premium. Hence unionization does not cause employment distortion in this model. In other words, the firm and the union negotiate to maximize the joint rents/profits by choosing employment first, and then divide the realized rents by choosing a wage cooperatively, as shown in (7a) and (7b). Since there is no employment bias by the union, they choose a level of employment equal to that under no unionization. Note that if unionization causes employment distortion, then equation (8) would be adjusted by a parameter of union bias (see Zhao, 2001).

And finally, there is full employment and full mobility of labor among non-unionized firms between the two sectors:

$$L_y + \sum_m L_u + \sum_{n-m} L_0 = L\,, \tag{9}$$

where $\sum_m L_u + \sum_{n-m} L_0 = L_x$ is the total employment in manufacturing. Therefore, eqs. (2), (4), (7a), (7b) and (9) determine the endogenous variable, L_y, L_0, L_u, w and w_0. This completes the basic model setup.

3. Permanent Immigration

We first investigate the case of permanent immigration, under which immigrants are treated identically with home workers in the host country. Immigrants can work in both sectors, and can become union members if they work in manufacturing. Let L_M denote the total number of immigrants. Under permanent immigration, using (8), condition (9) becomes

$$L_y + L_x = L + L_M\,. \tag{9'}$$

where $L_x = nL_u = mL_u + (n-m)L_0$.

By total differentiation, we derive the following comparative statics results (see Appendix 1 for detailed calculations): $dL_x / dL_M > 0$, $dL_y / dL_M > 0$, and $dw_0 / dL_M < 0$, which are as expected. While the sign of dw / dL_M is ambiguous, the union premium over the competitive wage is our focus. We find,

$$d(w - w_0) / dL_M = pL_u\{py_1 / C_y - (A - C_x)y_{11} / C_x\} / \Delta > 0\,. \tag{10}$$

In general, it is unclear if immigration raises or reduces the union wage, because it is affected in three ways. The first is that an increase in permanent immigration causes a reduction in the marginal product of labor in agriculture. In turn the competitive wage decreases, putting downward pressure on the union wage; The second comes from the increase in manufacturing output, reducing the relative price; The third is just the opposite of the second—agricultural output expands, raising the relative price. However, as shown in (a5) in appendix 1, if $y_{11} \approx 0$, i.e., if the marginal product of agricultural labor y_1 does not fall too fast, then an increase in immigration raises the union wage. This could arise, for instance, in countries richly endowed with land such as Australia, Canada and the US. In any case, even if the union wage decreases, the fall in the competitive wage outweighs it, leading to a widening of the union-

nonunion wage gap. Thus, permanent immigration causes income redistribution, relatively benefiting the union while hurting those earning the competitive wage. As a consequence, landowners also gain.

Using Appendix 1, the impact on union utility of immigration can be obtained as

$$du / dL_M = d(w - w_0) / dL_m L_u + (w - w_0) dL_u / dL_m > 0 \quad (11)$$

Condition (11) states that a rise in permanent immigration leads to increases in union employment and the union wage premium over the competitive wage, resulting in higher utility for the union. Similarly, the effects on profits are

$$d\pi / dL_M = (p - w + L_u p_1) dL_u / dL_M + L_u (p_2 dL_y / dL_M - dw / L_M) > 0 \quad (12)$$

To investigate the impact of immigration on national welfare, let us define the indirect utility function as $v \equiv v(p, I)$, where $I = px + y$ is national income. Total differentiation yields $-v_1 / v_2 = C_x$, using (1) and the trade balance condition. Further, we derive:

$$dv / dL_M = v_1 dp / dL_M + v_2 (C_x dp / dL_M + p dx / dL_M + dy / dL_M) = v_2 (p dx / dL_M + dy / dL_M) / \Delta > 0 \quad (13)$$

Summarizing the above, we establish

Proposition 1: *Under permanent immigration, an increase in immigration raises the union wage gap over the competitive wage. It also raises the utility of the union, the profits of the manufacturing firms, the income of landowners and national welfare.*

Thus, even under labor market imperfections such as unionization in some manufacturing firms, permanent immigration unambiguously benefits the host country. Though the competitive wage decreases, the combined effects of increased output and employment more than offset the loss in wages. As a result, union utility, firm profits and national welfare all increase. Only those earning the competitive wage lose. The experiences in America, Australia and Europe seem to have provided justification to this result.

Next, we examine the effect of globalization. Appendix 1 shows that $dL_u / dq < 0$, $dw_0 / dq < 0$, $dw / dq < 0$, $dL_y / dq > 0$, $d(w - w_0) / dq < 0$, and $dv / dq < 0$. Using these, it can seen

straightforwardly from (6) that the union utility must decline as a result of an increase in *q*. Furthermore, by (7b), $u = \pi$ holds in equilibrium, i.e., the union and the firm always share the realized profits equally. It then follows that an increase in *q* reduces the firm profits also. The above leads to

Proposition 2: *Globalization in the form of an increase in the import quota raises the employment in the non-unionized sector, but it reduces the union and non-union wages, the union employment, the union wage gap over the competitive wage. It also reduces the utility of the union, the profits of the manufacturing firms, and the national welfare.*

4. Temporary Immigration into Agriculture and Remittance

In this section, we analyze temporary immigration, which can be introduced either in agriculture or manufacturing. In the former case, foreign workers sign short-term contracts to work in agriculture only. And upon contract completion, they must return to their home countries. They are ineligible to become members of labor unions in the host country because they are on short-term contracts. An example is that farms in the U.S. employ temporary Mexican workers during busy seasons.

Because temporary immigrants return to their home countries after the contract is finished, their income is excluded from the national income of the host country, such that

$$I_y = npL_u + y - w_0 L_M \,. \tag{14}$$

A temporary immigrant worker sends a fraction of the earnings back to the source (home) country, and consumes the other fraction in the host country. Remittance is done only in good *y*, because the binding quota renders the domestic price of good *x* to stay above the world price. Suppose each immigrant worker sends back home γ units of good *y*. Since it is the numeraire good, we must have $\gamma \le w_0 \le p$, i.e., the worker cannot remit more than the net earnings, and the competitive wage cannot exceed the price of good *x*. Then using the trade balance condition, the demand function in (1) can be rewritten as

$$p(x,y) = \alpha[y(L_y) - p^* q - \gamma L_M]/(1-\alpha)(x+q) \equiv \alpha Y/(1-\alpha)X \,, \tag{15}$$

where $X = x + q$, $Y = y(L_y) - p^* q - \gamma L_M$, and γL_M indicates the total amount of remittance. Differentiation of (15) gives rise to

$$\partial p / \partial \gamma = -pL_M / Y < 0, \quad \partial p / \partial L_M = -\gamma p / Y < 0, \tag{16}$$

which says that an increase in either remittance or immigration reduces the relative price of good *x*.

Under temporary immigration into agriculture, labor-management bargaining in manufacturing is affected not directly, but only indirectly through adjustments in the labor market, i.e., the full employment condition (9'), and the competitive wage in (2). It follows that under temporary immigration into agriculture, the endogenous variables L_y, L_u *w*, and w_0 are determined by equations (2), (7a), (7b) and (9'), with the inverse demand function given by (15). The detailed comparative statics calculations are reported in Appendix 2, from which we can establish:

Proposition 3*: Under temporary immigration in agriculture, (i) an increase in immigration reduces the competitive wage, but raises the union employment and total employment in both sectors. National welfare increases if immigration does not cause large changes to domestic prices; (ii) an increase in remittance reduces wages in both sectors, the utility of the union and employment in manufacturing, but raises employment in agriculture and the income of landowners.*

Now we provide some intuition for proposition 3. Part (i) is similar to permanent immigration. When temporary immigrants can only work in agriculture, domestic workers will migrate to manufacturing to clear the labor market (see Filer, 1992, for empirical evidence). And if remittance does not distort domestic prices by too much, then the effects are close to permanent immigration, under which national welfare rises. In part (ii), an increase in remittance across borders causes several distortions. When agricultural remittance goes up, this sector gains in employment, while the output of manufacturing falls, driving down the union wage and the competitive wage as well. As a consequence, landowners gain. These are similar to the effects of globalization in Proposition 2, which works through a reduction of the domestic price of the manufacturing good.

5. Temporary Immigration into Manufacturing and Remittance

In this case, foreign workers sign short-term contracts to work in manufacturing only and remit a portion of their wage earnings back to their home countries. They cannot become union members in the host country, and upon contract completion, they must return to their home countries. An example is that Chinese workers were hired for construction in Nagano, Japan, before the Nagano Winter Olympics in 1998, along with Japanese *unionized* workers. Zimmermann (1995) documents that in Europe, guest workers are more likely to work in construction and manufacturing.

Let the number of foreign workers in a typical firm be L_m. Then the total number of immigrants is $L_M = nL_m$ in *n* manufacturing firms, and the employment conditions in (9') becomes

$$L_y + L_x = L + nL_m . \tag{17}$$

Accordingly, a typical unionized firm hires L_u union members and L_m immigrant workers. With remittance considered, the inverse demand function becomes

$$p(x,y) = \alpha[y(L_y) - p^* q - n\gamma L_m]/(1-\alpha)\{\sum_n (L_u + L_m) + q\} \equiv \alpha Y/(1-\alpha)X , \tag{18}$$

where $n\gamma L_m$ indicates the total amount of good *y* the temporary workers remit back home.

We continue to assume that the unionized firm does not hire non-unionized domestic workers. However, it hires temporary immigrant workers on short-term contracts, who return to their home countries when the contracts are finished.[1] The union members receive the union wage w, while the immigrant workers receive the competitive wage w_0. Thus the profit of the unionized firm becomes

$$\tilde{\pi}(L_u, w) = (p - w)L_u + (p - w_0)L_m . \tag{19}$$

If bargaining breaks down, the union still obtains zero employment and wages, but since the firm now employs immigrant workers on short-term contracts, its profit (threat-point payoff) becomes,

$$\tilde{\pi}_0(L_m, w_0) = (p_0 - w_0)L_m , \tag{20}$$

where p_0 $(> p)$ is the price if bargaining breaks down, i.e., if only immigrant workers are hired. p_0 can be obtained by substituting $L_u = 0$ into (18). Because temporary immigrants are on short-term contracts, the firm does not re-choose the number of immigrant workers to hire if bargaining with the union breaks down; that is, it employs the same number of temporary immigrants regardless bargaining breaks down or not. However, the price of good *x* rises to p_0 because output is lower at the threat point. Thus, $\tilde{\pi}_0$ can be treated as a constant from now on. Then the Nash product in this case can be written as $\tilde{G}(L_u, w) = (\tilde{\pi} - \tilde{\pi}_0)u$, where $\tilde{\pi} - \tilde{\pi}_0$ is the firm's net gain from the bargaining game. Maximizing $\tilde{G}(L_u, w)$ with respect to L_u and *w* gives rise to the following first order conditions:

$$2(p - w) + (L_u + L_m)p_1 + (p - p_0)L_m / L_u = 0, \tag{21a}$$

$$(p - 2w + w_0) + (p - p_0)L_m / L_u = 0. \tag{21b}$$

We compare conditions (21a) and (21b) with (7a) and (7b). The former two equations contain extra terms, which are negative. This implies, union wages and employment both are driven down by temporary immigrant employment in manufacturing. This arises because firms can hire a positive number of immigrant workers even if bargaining with the unions break down, which improves the threat-point payoff of the firms and puts them in a stronger bargaining position.

Finally, the national income of the host country becomes

$$I_x = (L_u + L_m)np + y - w_0 nL_m. \tag{22}$$

And the corresponding national welfare can be obtained by substituting (22) into $v(p, I)$. It follows that the endogenous variables L_y, L_u, *w*, and w_0 are determined by equations (2), (21a), (21b) and (17), with the inverse demand function given by (18). The detailed comparative statics calculus is reported in Appendix 3, from which we can establish:

Proposition 4: *Under temporary immigration in manufacturing only, (i) an increase in immigration raises employment in agriculture but reduces the competitive wage. It also reduces the union wage and employment, and the union-nonunion wage gap. National welfare increases if the number of temporary immigrants is large; (ii) an increase in agricultural remittance raises agricultural employment but reduces union employment and the competitive wage; (iii) an increase in remittance could raise national welfare, if the unionized firm employs more temporary immigrants than union workers.*

The intuition for proposition 4 is in order. Part (i) says that when temporary immigrants can only work in manufacturing, domestic workers will migrate to agriculture to clear the labor market, which leads to decreases in the competitive wage and increases in agricultural output. Immigration also puts downward pressure on the union wage and employment, narrowing the union-nonunion wage gap. This arises in two channels. One is the fall of the competitive wage, and the other is the improvement of the unionized firm's threat-point payoff, which leaves the union in a weaker bargaining position. The former is dominated by the latter. In part (ii), when agricultural remittance increases, agricultural employment also rises, while manufacturing output and the competitive wage fall. As a consequence, landowners also gain. And finally, part (iii), which follows from (ii), says that under certain conditions remittance increase the host-country's welfare. This arises because the competitive wage goes down, reducing the income of the temporary immigrants, which in turn improves national income of the host country.

6. Concluding Remarks

We have investigated cases of permanent and temporary immigration, with some firms unionized and others non-unionized in manufacturing. The different effects of immigration and remittance are summarized in Table 1. Signs in parentheses are obtained conditionally. Detailed explanations are contained in the Propositions. We hope these results could help to explain the experience in North America, Australia and Europe,[2] to shed light on the negative images of immigration in the media, and most importantly to provide some guidance to immigration policy in other host countries.

From Table 1, the following implications can be drawn: (a) If there are sufficient adjustments in the labor market, permanent as well as temporary immigration in agriculture causes identical effects on employment, wages and the inter-sectoral wage gap; (b) Temporary immigration in manufacturing reduces not only all wages, but also the union-nonunion wage gap. That is, workers become more equally paid, but poorer. Nonetheless, national welfare rises if the firm hires more temporary immigrants than union workers, in which case the increase in output and profits offsets the fall in wages.

Often the wage is higher in the host country than in the source country, sometimes substantially higher. When introducing temporary immigration, the host country government could adopt some policy to tax the earnings of immigrants. Adequate policies increase the earnings of the immigrants as well as the welfare of the host country, and help to create positive images of immigration in the media.

It is argued that in countries with stricter immigration rules, immigrants are `segregated' to the service sector such as restaurants, ethnic grocery, babysitting, etc., where their services immigrants are non-traded. The present model can be extended to cover such a non-traded sector. For instance, suppose sector X produces non-tradable services instead of manufacturing, then the import quota q becomes zero. Even thought non-tradable goods cannot be remitted, one sees that remittance of the other good will change domestic prices, leaving additional impacts on other variables. These can be calculated straightforwardly using our model.

Notes

1. Here the crucial difference is that immigrants are guest workers, whom the firm can refuse to rehire, whereas domestic workers cannot subject to such `discrimination'. Thus the firm rather chooses to hire `foreigners'. See the allegations on page 1, paragraph 1. In addition, many large Japanese firms negotiate with the (firm-specific) union over both employment and wages. Nevertheless, the firms still hire temporary workers (including immigrants), whose contracts are not negotiated with the union but determined by firms only. This to some extent provides justification for our setup in this section.
2. Two recent books present contrasting current immigration conditions in Europe and the U.S. (see Borjas, 1999; Boeri, Hanson and McCormick, 2002).

Appendix 1

This appendix deals with the case of permanent migration. Totally differentiating (7a), (7b), (2) and (9'), using inverse demand (1), yields the following matrix.

$$\begin{pmatrix} -p/C_x & -2 & py_1/C_y + y_{11} \\ -(A+C_x)p/C_x & -2C_x & Apy_1/C_y \\ 1 & 0 & 1 \end{pmatrix} \begin{pmatrix} dL_u \\ dw \\ dL_y \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} dL_M - p_q \begin{pmatrix} 1 \\ A \\ 0 \end{pmatrix} dq$$

where $A = 2C_x - L_u > 0$ and $p_q = -\alpha(p^* C_x - C_y)/(1-\alpha)C_x^2 < 0$. The determinant of the matrix is $\Delta = -2C_x y_{11} + 2p\{A/C_x + y_1(A-C_x)/C_y\} > 0$, provided $A - C_x = C_x - L_u \geq 0$. A sufficient condition for this is $q \geq \theta L_M$, which is satisfied by the assumption that the host country is a net importer of good *x*.

Straightforward calculations yield:

$$\Delta dL_u / dL_M = -2C_x y_{11} + 2py_1(A-C_x)/C_y > 0, \quad \text{(a1)}$$

$$\Delta dw_0 / dL_M = 2Apy_{11}/C_x < 0, \quad \text{(a2)}$$

$$\Delta dL_y / dL_M = 2Ap/C_x > 0, \quad \text{(a3)}$$

$$\Delta dw / pdL_M = (A+C_x)y_{11}/C_x + py_1/C_y, \quad \text{(a4)}$$

$$\Delta dL_u / dq = 2p_q(A-C_x) < 0, \quad \text{(a5)}$$

$$\Delta dw_0 / dq = -2p_q y_{11}(A-C_x) < 0, \quad \text{(a6)}$$

$$\Delta dw / dq = p_q(p - Ay_{11}) < 0, \quad \text{(a7)}$$

$$\Delta dL_y / dq = -2p_q(A-C_x) > 0, \quad \text{(a8)}$$

$$\Delta d(w-w_0)/dq = p_q\{p + (A-2C_x)y_{11}\} < 0, \quad \text{(a9)}$$

$$\Delta dv / dq = 2(A-C_x)(p-y_1) < 0. \quad \text{(a10)}$$

Appendix 2

This appendix deals with the case of temporary immigration in agriculture only. Totally differentiating (7a), (7b), (2) and (9'), using demand function (15), yields the following matrix.

$$\begin{pmatrix} -p/X & -2 & py_1/Y + y_{11} \\ -(A'+X)p/X & -2X & A'py_1/Y \\ 1 & 0 & 1 \end{pmatrix} \begin{pmatrix} dL_u \\ dw \\ dL_y \end{pmatrix} = \frac{pL_M}{Y} \begin{pmatrix} 1 \\ A' \\ 0 \end{pmatrix} d\gamma - \begin{pmatrix} \partial p/\partial L_M \\ A'\partial p/\partial L_M \\ -1 \end{pmatrix} dL_M$$

where $A' = 2X - L_u > 0$. The determinant is $\Delta_y = -2Xy_{11} + 2p\{A'/X + y_1(A'-X)/Y\} > 0$, provided $A' - X = X - L_u \geq 0$, which is guaranteed if $q \geq 0$. Straightforward calculations yield:

$$\Delta_y dL_u / d\gamma = -2(A' - X) pL_M / Y < 0, \tag{a11}$$

$$\Delta_y dw_0 / d\gamma = 2(A' - X) pL_M y_{11} / Y < 0, \tag{a12}$$

$$dL_y / d\gamma = -dL_u / d\gamma > 0, \tag{a13}$$

$$\Delta_y dw / d\gamma = -pL_M (p - A' y_{11}) / Y < 0. \tag{a14}$$

$$\Delta_y du / d\gamma = pL_M \{y_{11}(A' - 2X) + p\} / Y + (w - w_0) dL_u / \Delta_y d\gamma < 0, \tag{a15}$$

$$d\pi / d\gamma = du / d\gamma < 0, \tag{a16}$$

$$\Delta_y dL_u / dL_M = 2p(A' - X)(y_1 - \gamma) / Y - 2Xy_{11} > 0, \tag{a17}$$

$$\Delta_y dw_0 / dL_M = 2py_{11} \{A' / X + (A' - X)\gamma / Y\} < 0, \tag{a18}$$

$$\Delta_y dL_y / dL_M = 2p\{A' / X + (A' - X)\gamma / Y\} > 0, \tag{a19}$$

$$\Delta_y dw / dL_M = \{A'\gamma / Y + (A' + X) / X) py_{11} + (y_1 - \gamma) p^2 / Y. \tag{a20}$$

If immigrants remit most of their earnings, then $y_1 \approx \gamma$, and (a20) is negatively signed.

$$\Delta_y d(w - w_0) / dL_M = y_{11} p_1 [(X - A') / X + \gamma(2X - A') / Y] + (y_1 - \gamma) p_2 / Y, \tag{a21}$$

where $p_1 = -p / X < 0$, and $p_2 = py_1 / Y > 0$.

$$dv / v_2 dL_M = 2p(y_1 - \gamma)(A' - X)(p - y_1) / Y - 2(p - y_1) Xy_{11} - 2y_{11} pL_M [A' / X + \gamma(A' - X) / Y] > 0. \tag{a22}$$

Appendix 3

This appendix deals with the case of temporary immigration in manufacturing only. Totally differentiating (21a), (21b), (2) and (17), using demand function (18), yields the following matrix.

$$\begin{pmatrix} a & -2L_u & b \\ c & -2L_u & d \\ 1 & 0 & 1 \end{pmatrix} \begin{pmatrix} dL_u \\ dw \\ dL_y \end{pmatrix} = \begin{pmatrix} e \\ f \\ 0 \end{pmatrix} dL_m + \begin{pmatrix} i \\ j \\ 0 \end{pmatrix} d\gamma$$

where $p_{11} = -p_1 / X > 0$, $p_{12} = -p_2 / X < 0$; $a = p - 2w + w_0 + (L_u + L_m) p_1$,

$b = (L_u + L_m) p_2 + L_u y_{11}$, $c = 2(p - w) + 2(2L_u + L_m) p_1 + (L_u + L_m) L_u p_{11}$,

$d = (2L_u + L_m) p_2 + (L_u + L_m) L_u p_{12}$, $e = -(p - p_0) - (L_u + L_m)(p_1 - \gamma p_2)$,

$f = -(p - p_0) - L_u p_1 - (2L_u + L_m)(p_1 - \gamma p_2) - (L_u + L_m) L_u (p_{11} - \gamma p_{12})$,

$g = (L_u + L_m) L_m p_1$, $h = (2L_u + L_m) L_m p_1 + (L_u + L_m) L_m L_u p_{11}$,

$i = (L_u + L_m) L_m p_2$, $j = (2L_u + L_m) L_m p_2 + (L_u + L_m) L_m L_u p_{12}$.

The determinant of the matrix above is $\Delta_x = -2L_u^2 y_{11} + 2L_u(a-c) + 2L_u(d-b) > 0$, provided $A' - X = X - nL_u \geq 0$, which is satisfied by the assumption that the host country is a net importer of good *x*. Straightforward calculations yield:

$$\Delta_x dL_u / d\gamma = 2L_u(i-j) < 0, \tag{a23}$$

$$\Delta_x dw_0 / d\gamma = -2L_u y_{11}(i-j) < 0, \tag{a24}$$

$$dL_y / d\gamma = -dL_u / d\gamma > 0, \tag{a25}$$

$$\Delta_x dw / d\gamma = -\{(id-bj) - jL_u y_{11}\} - (aj-ic). \tag{a26}$$

$$\Delta_x dv / v_2 d\gamma = 2L_u(i-j)(p - y_1 + L_m y_{11}). \tag{a27}$$

Condition (2) gives $y_1 = w_0$. We also derive $p - y_1 + L_m y_{11} < (p - w_0)(1 - L_m / L_u)$, which is negative if $L_m \geq L_u$, using $y_{11} < -(p - w_0)/nL_u$. It follows that the sign of (a27) can be determined to be positive if $L_m \geq L_u$. In words, if the unionized firm employs more temporary immigrants than unionized workers, then an increase in remittance of the agricultural good raises national welfare.

$$\Delta_x dL_u / dL_m = 2L_u(e-f) < 0, \tag{a28}$$

$$\Delta_x dw_0 / dL_m = -2L_u y_{11}(e-f) < 0, \tag{a29}$$

$$dL_y / dL_m = -dL_u / dL_m > 0, \tag{a30}$$

$$\Delta_x dw / dL_m = -\{(ed-bf) - fL_u y_{11}\} - (af-ec), \tag{a31}$$

$$d(w - w_0) / dL_m = (e-f)(L_u y_{11} + a - b) - e\{(a-c) + (d-b) - L_u y_{11}\}. \tag{a32}$$

If $y_{11} < -(p - w_0)/nL_u$, i.e., if the land endowment T is sufficiently small, then condition (a32) is negatively signed. Furthermore, given the negative signs of (a29) and (a32), condition (a31) must also be negative, i.e., an increase in temporary immigration in manufacturing reduces the union wage. And because (a28) states that immigration reduces union employment, it follows that the union utility must decrease.

$$\Delta_x dv / v_2 dL_m = 2L_u(e-f)(p - y_1 + L_m y_{11}) + (p - w_0)\Delta_x. \tag{a33}$$

Using (2), and $y_{11} < -(p - w_0)/nL_u$, we find that if $L_m \geq L_u$, the sign of (a33) becomes positive. That is, if the unionized firm employs more temporary immigrants than unionized workers, then an increase in immigration raises national welfare.

Table 1: Comparative Statics Results

		Permanent	*y sector only*	*x sector only*
dL_M	dL_u	+	+	-
	dw_0	-	-	-
	dL_y	+	+	+
dL_m	dw-dw_0	+	?	-
	dv	+	+	(+)
			(y, y)	*(x, y)*
$d\gamma$	dL_u		-	-
	dw_0		-	-
	dL_y		+	+
	dw		-	?
	dv		?	(+)

(i, j): Temporary immigration in sector *i* and increase in remittance of good *j*.

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