Illegal Immigration in the Presence of Labor Unions

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ILLEGAL IMMIGRATION IN THE PRESENCE OF LABOR UNIONS

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This paper develops a general equilibrium framework of a two-sector economy which incorporates illegal immigration in the presence of labor unions. It demonstrates that stricter enforcement of immigration laws, by reducing the demand for or supply of illegal aliens, benefits all legal workers in the economy. The model is used to evaluate the impact of these policy changes on national income. Results indicate that national income does not necessarily fall when immigration controls are tightened. The existence of a union mitigates the negative welfare impact of a reduction in the number of illegal immigrants. [F 22]

1. INTRODUCTION

Even though illegal aliens have existed ever since national boundaries were drawn, the topic of illegal immigration has not received much attention until recently. As disparities in national income and work opportunities between rich and poor countries have grown larger, the phenomenon of illegal immigration has acquired a new force. In the face of an increasing influx of illegal aliens into industrial nations, the governments of these countries have been forced to implement policies to control this flow. Due to the lack of appropriate research, however, policy makers have had to base decisions on what they "feel" is better for their country. The need to advance knowledge in this field is obvious.

The purpose of this paper is to develop a general framework in which the effects of different policies with respect to illegal immigration can be analyzed. This study differs from other literature on the topic by incorporating a unionized sector in the host country. Since trade unions exist in all the industrialized countries that receive illegal aliens, a complete analysis must include this reality. This paper blends the incipient literature on illegal immigration with the modeling of union behavior.

In a path breaking paper, Ethier (1986) presents a model for studying the effects of different policies on the level of illegal immigration and the distribution of income. In an extension of Ethier's work, Bond and Chen (1987) add international capital mobility to the model. Djajic (1987) uses a Harris-Todaro (1970) framework to study illegal immigration. A contribution of this paper is that it makes the level of border

enforcement an endogenous variable. Dell'Aringa and Neri (1987), whose model assumes that capital is domestically mobile, study the effects of illegal immigration in Italy. Hill and Pearce (1987, 1990) postulate a model that determines which industries are more likely to be monitored by immigration authorities and then study the effects of stricter policies. Finally, Todaro and Maruszko (1987) present a model in which they study not the stock of illegal aliens, but their rate of migration.

A vast literature is devoted to labor unions and their behavior. Oswald (1985) presents an authoritative survey of the economic theory of trade unions, while Pencavel (1985) and Farber (1986) provide critical surveys of microeconomic modeling of union behavior. Although most studies focus on the partial equilibrium level, some work incorporates general equilibrium analysis into union modeling. Johnson and Mieszkowski (1970) and Oswald (1982b) examine the effects of a union on the rest of the economy in a general equilibrium framework. Calvo (1978), Grossman (1984), and Brecher and Long (1989), among others, incorporate union modeling to international trade studies.

This paper is organized as follows. The model is described in the first section of this paper. The unionized sector of the economy is explained first. Drawing on the work of Ethier (1986), a description of the nonunion sector of the economy is then given. Next, the two-sector general equilibrium solution is offered, and the model is then used to study the effects of changes in immigration policy. Finally, conclusions are presented.

2. THE MODEL

The economy is divided into two sectors, a union and a nonunion sector. Illegal aliens can only be employed in the latter, while legal workers may choose the sector in which they want to work. These two sectors are described below.

The union sector is characterized by the existence of a union, which is assumed to be able to choose the wage that maximizes its utility. The utility function of the union is a derivation of the utilitarian form used by Oswald (1982a, 1985), among others. This can be represented as:

$$R = NW^U \tag{1}$$

where R = utility of the union, N = union members employed, and W^U = union wage.

Equation (1) states that the union derives one unit of satisfaction for each dollar going to its employed members. Consequently, in order to maximize utility, the union maximizes the total wage bill in the sector. Output in this sector is a function of the number of union members being employed and the amount of capital in the sector:[1]

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[1]Throughout this paper it is assumed that capital cannot move either internally or internationally.

$$Q^B = q(N, \; C^B) \tag{2}$$

where Q^B = output in union sector, and C^B = capital in union sector.

In order to maximize profits, firms in the union sector hire workers up to the point at which their marginal product equals their wage.[2] Algebraically,

$$W^U = \; q_N \tag{3}$$

As stated before, legal workers are free to work in either the union or the nonunion sector. Furthermore, these workers are assumed to be risk-neutral in their choice of jobs. This implies that workers compare expected wages in both sectors and move between them until these expected wages are equalized. The expected wage in each sector is equal to the sector's actual wage times the probability of employment. Since unemployment is assumed to exist only in the union sector,[3] the expected wage in the nonunion sector is equal to the actual wage while the expected wage in the union sector is lower than the actual wage due to the possibility of unemployment.[4] Equation (4) gives the condition for expected wage equalization:

$$W^L = \; [N \, / \, M]W^U \tag{4}$$

where W^L = wage for legal workers in nonunion sector, M = total union membership = $L^T - L$, L^T = Total legal labor force, and L = Legal workers employed in nonunion sector.

In the nonunion sector, firms produce output by hiring legal and illegal workers:

$$Q^A = f(L+I, \; C^A) = f(n, \; C^A) \tag{5}$$

where Q^A = output produced by nonunion sector, I = illegal workers employed in nonunion sector, C^A = capital in nonunion sector, and n = total employment in nonunion sector.

Firms in this sector hire both legal and illegal workers as long as their costs are the same. The cost of hiring a legal worker is given by the wage, W^L. The cost of hiring an illegal immigrant has two components: the wage and the expected penalty faced by firms hiring illegal aliens. In order to lure illegal immigrants into the country, the nonunion sector must offer them a wage that, given the possibility of being caught and deported, is at least equal to the wage these workers can earn at home.

[2]It is assumed only one good is being produced and its price is equal to one. Therefore, the value of the marginal product is the same as marginal product.

[3]It is assumed throughout that the wage set by the union is high enough to produce some level of unemployment in this sector.

[4]While expected wages are equal in equilibrium, the actual wage in the union sector is larger than that in the nonunion sector.

The probability of being caught while attempting to immigrate, given by g, is a function of the resources the government devotes to border enforcement.[5] In other words,

$$g = g(E), \quad g(0) = 0, \quad g_E > 0, \quad g_{EE} < 0, \quad g < 1, \tag{6}$$

where E = border enforcement (measured in dollars).

Therefore, the expected wage for the prospective immigrant depends on the probability of being caught, the penalty faced if caught,[6] the wage at home, and the wage that could be earned if immigration is achieved. In equilibrium, this expected wage should equal the wage in the foreign country. Algebraically,

$$(W^* - K)g + W^I(1 - g) = W^* \tag{7}$$

where W^* = home-country wage, K = penalty for being caught, and W^I = wage for illegal workers in host country. Solving for W^I, we obtain:

$$W^I = W^* + K[g / (1 - g)] \tag{8}$$

Equation (8) gives the wage which must be paid to illegal immigrants to attract them into the country. This wage is positively related to home-country wages, to the probability of being caught, and to the penalty for being caught crossing the border. In addition to border enforcement, the host government randomly checks firms in search of illegal immigrants already at work. When these are found, the firms employing them are fined.[7] The expected penalty for hiring illegal immigrants is given by the probability of being caught times the level of the fines. The probability of being caught is directly related to government expenditures on domestic enforcement and to the number of illegal aliens in the nation,[8] and negatively related to the total legal labor force of the country. This formulation is an improvement over the ones used before, since it takes into account not only the level of government expenditures but also the number of illegal aliens in the country. Algebraically, we have:

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[5]The government is assumed to raise money for its general expenditures through a constant tax paid by all legal workers in the economy. The money spent on border and/or domestic enforcement comes out of the general budget of the government.

[6]This penalty could be thought of as the opportunity cost of being caught, that is, the wages that could have been earned at home during the time spent on the failed immigration attempt.

[7]It is assumed that once illegal workers find a job, they cannot be deported, even if the employer is fined for hiring them. This assumption is also used by Ethier (1986).

[8]This derives from the fact that as the proportion of illegal immigrants increases, their visibility rises, and it becomes easier for government agents to locate firms employing them.

$$h = h(D, \ I, \ L^T)$$ (9)

$$h_D > 0, \ h_I > 0, \ h_{L^T} < 0, \ h(I = 0) = 0,$$

where h = probability of being caught hiring an illegal alien, and D = resources in domestic enforcement.

Once the total cost of hiring illegal immigrants is defined, it is possible to examine the equilibrium condition for the employment of legal and illegal workers in the nonunion sector. As stated before, both types of workers are hired only when their costs are the same; this is represented by equation (10):

$$W^L = W^I + hS$$ (10)

where S = penalty per worker paid by firms caught employing illegal aliens.

Equation (10) implies that, for any given level of W^L, the wages firms are willing to pay illegal aliens vary inversely with their employment level. The intuition behind this result is simple. As the number of illegal aliens hired increases, the probability of being caught hiring them increases, and this raises the expected penalty. Since their total cost must remain equal to W^L, firms have to lower the wage paid to illegal aliens. When this relationship --which gives the demand for illegal labor-- is combined with equation (8) -- which states that the supply of illegal immigrants is perfectly elastic at W^I --the equilibrium level of illegal aliens hired in the economy is found.

In order to maximize profits, firms in the nonunion sector hire legal and illegal workers up to the point at which their marginal product is equal to their wage. Thus:

$$W^L = f_n$$ (11)

Equation (11) states that employment in the nonunion sector is equal to n. If at W^L the number of illegal immigrants is I, then the demand for legal workers in the nonunion sector must be given by:[9]

$$L^d = n - I$$ (12)

where L^d = demand for legal workers in nonunion sector. With equation (12) the model is complete and its equilibrium can be found. The equilibrium wages (W^U, W^L, W^I), employment levels (N, L, I), and the number of unemployed workers ($M - N$) are determined by the parameters of the model.[10]

[9]Because of the order of the exposition, it might appear that the demand for legal workers is a residual, but this is not the case. Once the whole model is described, the equilibrium values of all variables are found simultaneously. Consequently, none of them are residuals of others.

[10]Gonzalez (1990) uses graphical analysis to show the equilibrium of this model and the different effects of changes in immigration policy.

3. CHANGES IN IMMIGRATION POLICY

A. Changes in Border Enforcement

When expenditures on border enforcement are increased, the probability of an alien being caught in an immigration attempt rises. Looking back at equation (8), when this probability --given by g-- increases, the wage required to attract illegal immigrants into the country also rises. As this wage increases, the number of illegal immigrants hired in the host-country declines, and the demand for legal workers rises. As a result, the wage paid to legal workers in the nonunion sector increases. This causes an erosion of union membership, since workers leave the union sector for higher wages in the nonunion sector. This process continues until the expected wages in both sectors are equal again.

All of these results are summarized by the comparative statics of the model. After some algebra, the following relationships can be found:[11]

$$\frac{dW^I}{dE} = K\left[g_E / (1-g)^2\right] > 0 \tag{13}$$

$$\frac{dW^L}{dE} = \frac{f_{nn}K\left[g_E / (1-g)^2\right]}{f_{nn} - Sh_I + (f_{nn} / f_n)Sh_I(L^T - L)} > 0 \tag{14}$$

$$\frac{dI}{dE} = \frac{K\left[g_E / (1-g)^2\right]\left(1 - (f_{nn} / f_n)(L^T - L)\right)}{f_{nn} - Sh_I + (f_{nn} / f_n)Sh_I(L^T - L)} < 0 \tag{15}$$

$$\frac{dn}{dE} = \frac{K\left[g_E / (1-g)^2\right]}{f_{nn} - Sh_I + (f_{nn} / f_n)Sh_I(L^T - L)} < 0 \tag{16}$$

$$\frac{dL}{dE} = \frac{K\left[g_E / (1-g)^2\right]\left[(f_{nn} / f_n)(L^T - L)\right]}{f_{nn} - Sh_I + (f_{nn} / f_n)Sh_I(L^T - L)} > 0 \tag{17}$$

In sum, stricter border enforcement benefits all legal workers in the economy. Those in the union sector receive a higher expected wage because of reduced union membership, while legal workers in the nonunion sector also receive a higher wage.[12] The wage received by illegal immigrants increases as well. Consequently, those illegal immigrants who manage to enter the country are better off due to tighter immigration control of the government. With respect to employment levels, it should

[11]This and other algebraic derivations and proofs are available from the author upon request.

[12]It should be pointed out that capitalists in the nonunion sector are hurt by stricter border enforcement. They are forced to pay a higher wage, and their output falls. Capitalists in the union sector are not affected by those changes. This explains the lobbying activities with respect to immigration policy of different capitalist groups.

be noted that the gains in employment for legal workers are always lower than the number of jobs lost by illegal aliens. In other worlds, it cannot be assumed that every job left by an illegal immigrant will be available for a legal worker, since some of those positions simply will cease to exist. This derives from the fact that stricter immigration control increases labor costs in the nonunion sector and reduces the level of employment.

Although the predictions of this model seem to coincide with those of models which do not include a union sector, there are some important differences.[13] Referring to equation (14), it can be shown that the existence of a union sector reduces the magnitude of the change in W^L. The intuition behind this result is simple. As the wage paid to illegal workers increases, firms will demand less of them and will try to attract legal workers. When unemployment exists in the union sector, firms will be able to attract these workers without having to increases their wages very much. In the perfectly competitive labor market model, this pool of unemployed workers does not exist, and therefore wages will have to increase more. In the case of equation (15), the change in illegal alien employment will be larger when a union exists than in the perfectly competitive case. This derives once again from the existence of unemployed legal workers in the union sector, whom firms will have the possibility of hiring to replace illegal immigrants. Finally, the change in total employment in the sector, given by equation (16), will be smaller when the union exists. This results from the smaller change in labor costs that firms will face as described by equation (14).

One can use the model developed here to study the changes in national income which result from changes in border enforcement.[14] National income is defined as the sum of the compensation going to all the owners of the national factors of production plus the money the government receives in the form of fines from employers hiring illegal workers:[15][16]

$$NI = NW^U + LW^L + C^B i^B + C^A i^A + hSI \tag{18}$$

where NI = national income, i^B = rate of return on union sector capital, and i^A = rate of return on non-union sector capital.

The change in national income due to a change in resources devoted to border enforcement is given by:[17]

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[13]The Appendix presents an example of a perfectly competitive labor market model in which a union does not exist. All comparisons made in the paper refer to this model.

[14]I thank an anonymous referee for this suggestion.

[15]This last term represents the surplus the country gains when it pays illegal immigrants a wage which is lower than their marginal product. This "economic rent" is captured by the government in the form of fines.

[16]For simplicity sake, the monetary costs of immigration control (E and D) are assumed to be neutral with respect to national income.

[17]By assumption C^B, C^A, and L^T are fixed. Furthermore, as long as the union production function does not change N, W^U, and i^B are also constant. Finally, in this case S and D are fixed.

$$\frac{dNI}{dE} = W^L \frac{dL}{dE} - I \frac{dW^L}{dE} + S(h + Ih_I) \frac{dI}{dE} \tag{19}$$

The first terms of equation (19), which is positive, represents the gains in the wage bill going to legal workers that take place when their employment level increases. The last two terms of this equation are negative and represent the reductions in national income which result from the decline in output in the non-union sector. Substituting equations (14), (15), and (17) into (19), we obtain:

$$\frac{dNI}{dE} = K\left[g_E / (1-g)^2\right]\left[\frac{(f_{nn} / f_n)(L^T - L)(f_n - Sh - SIh_I) - If_{nn} + Sh + SIh_I}{f_{nn} - Sh_I + (f_{nn} / f_n)Sh_I(L^T - L)}\right] \gtrless 0 \tag{20}$$

The denominator of equation (20) is negative, while the sign of the numerator is not definite. In other words, as resources devoted to border enforcement are increased, national income can either go up or down depending on the relative importance of the gains in employment for legal workers vs. the losses from the reduction in the nonunion sector output.[18] This result stands in contrast to the standard outcome of perfectly competitive labor market models in which a tightening in border enforcement always leads to a reduction of national income. Furthermore, it can be shown that even when national income declines in the model developed here, this decline is smaller than the one predicted by the standard models. In other words, the presence of a union diminishes the negative welfare impact of a tightening in border controls.

The intuition behind the previous result is simple. In the perfectly competitive labor market models, an increase in resources devoted to border enforcement leads to higher labor costs which produces a decline in domestic output but no change in the employment level of legal workers. Therefore, national income necessarily falls. In the model developed here, the increase in the employment level of legal workers and the corresponding decline in the unemployment level, represent a positive force for national income not present in other models. Even though the nonunion sector output still falls, the corresponding change in national income is therefore smaller.

Another way to look at the effect of stricter border enforcement relates to the presence of distortions in the economy. The existence of a union produces a distortion in the labor market which is reflected by the difference between the wages legal workers can receive in the economy. When illegal immigration is restricted, the gap between the wages legal workers receive is narrowed; that is, the distortion is reduced. Therefore, the negative impact on national income of reduced output in the nonunion sector is attenuated by the reduction in the labor market distortion.

Therefore, $dC^B = dC^A = dL^T = dN = dW^U = di^B = dS = dD = 0$.

[18]A sufficient condition for the sign of equation (20) to be negative is given by: $SIh_I > W^I$.

B. Changes in Domestic Enforcement

A second means available to the government to hinder illegal immigration is domestic enforcement. By increasing expenditures in this area, the government raises the probability of a firm being caught hiring an illegal immigrant, as stated by equation (9). This, in turn, boosts the expected penalty faced by firms. As illegal labor costs increase, firms reduce their demand for illegal aliens and increase their demand for legal workers. As the demand for illegal immigrants falls, the wage of these workers remains unchanged; consequently, their employment level must decline. As the demand for legal workers increases, their wage and employment levels rise.

The effects of stricter domestic enforcement can also be derived from the comparative statics of the model. After some algebra, we find:

$$\frac{dW^I}{dD} = 0 \tag{21}$$

$$\frac{dW^L}{dD} = \frac{f_{nn}Sh_D}{f_{nn} - Sh_I + (f_{nn}/f_n)Sh_I(L^T - L)} > 0 \tag{22}$$

$$\frac{dI}{dD} = \frac{Sh_D\left(1 - (f_{nn}/f_n)(L^T - L)\right)}{f_{nn} - Sh_I + (f_{nn}/f_n)Sh_I(L^T - L)} < 0 \tag{23}$$

$$\frac{dn}{dD} = \frac{Sh_D}{f_{nn} - Sh_I + (f_{nn}/f_n)Sh_I(L^T - L)} < 0 \tag{24}$$

$$\frac{dL}{dD} = \frac{Sh_D(f_{nn}/f_n)(L^T - L)}{f_{nn} - Sh_I + (f_{nn}/f_n)Sh_I(L^T - L)} > 0 \tag{25}$$

The changes in employment and wages for legal workers which occur as a result of increased domestic enforcement are similar to those which occur when border enforcement is changed. However, there is an important distinction between the effects of the two policies on the earnings of illegal aliens. When border enforcement is used, the wage for those illegal immigrants who remain in the country increases; when the government chooses stricter domestic enforcement, the wage for illegal workers is unaffected. In the latter case, the total increase in the cost of illegal workers is given by higher expected penalties. Therefore, if the government of the host-country does not include the money going to illegal workers as part of its national product, then domestic enforcement is a welfare-superior policy in comparison to border enforcement.[19]

[19]This assumes away the cost efficiency of one policy in comparison to the other. It is conceivable that if border enforcement is a much more cost-efficient policy, then the conclusion just presented could be reversed. Although beyond the scope of this paper, one would expect that when this cost efficiency is taken into account, the government should divide its

The difference between the results of the model presented here and those of perfectly competitive labor market models for the case of stricter domestic enforcement is similar to the difference found in the case of border enforcement. The existence of a union sector decreases the magnitude of the changes in domestic employment and in the wages of legal workers, while it increases the size of the change in illegal alien employment.

In order to evaluate the change in national income which results from a change in domestic enforcement, equation (18) needs to be used. After differentiating this equation and using some algebra, we get:

$$\frac{dNI}{dD} = W^L \frac{dL}{dD} - I \frac{dW^L}{dD} + S(h + Ih_I)\frac{dI}{dD} + SIh_D \tag{26}$$

The first and last terms of equation (26) are positive. The first one, similar to that of equation (19), represents the gains to national income that occur when legal worker employment increases. The last term of this equation shows the gains to national income which result from the increased "economic rent" gained by the nation when the gap between the illegal worker's marginal product and its wage is increased. The second and third terms of equation (26) are negative and are also similar to those of equation (19). These terms represent the reduction in national income which results from the decline in output in the non-union sector. Substituting equations (22), (23), and (25) into (26), we find:

$$\frac{dNI}{dD} = Sh_D \left[\frac{(f_{nn}/f_n)(L^T - L)(f_n - Sh - SIh_I) - If_{nn} + Sh + SIh_I}{f_{nn} - Sh_I + (f_{nn}/f_n)Sh_I(L^T - L)} + I \right] \gtreqless 0 \tag{27}$$

As it was in the case of equation (20), the denominator of equation (27) is negative, while its numerator's sign is not definite.[20] Once again, when immigration controls are tightened, national income can either go up or down depending on the relative importance of the change in legal worker employment and the change in nonunion sector output.[21] Finally, it can be shown that when national income falls in this model, this decline is smaller than that predicted by the perfectly competitive labor market models. Again, the existence of a labor union attenuates the negative impact on

expenditures on both immigration control tools so that the marginal benefits from the last dollar spent on each activity are the same.

[20]Equation (27) can be simplified to:

$$\frac{dNI}{dD} = \frac{Sh_D \left[(f_{nn}/f_n)(L^T - L)(f_n - Sh) + Sh \right]}{f_{nn} - Sh_I + (f_{nn}/f_n)Sh_I(L^T - L)} \gtreqless 0 \tag{27'}$$

[21]It should be noted that the existence of an additional positive term in equations (26) and (27), when compared to equations (19) and (20), signals, as mentioned earlier, that domestic enforcement is superior in terms of welfare to border enforcement.

national income of stricter immigration control.[22]

4. CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The most important contribution of this analysis lies in setting up a general model for the study of illegal immigration in the presence of labor unions. This framework can be used to examine a wide range of policy changes and to evaluate their effects on different sectors of the economy. An important characteristic of the model is that it blends the analysis of illegal immigration with the study of union behavior. Even though the model uses a simple form of the utility function of the union, it is a step in the right direction. The analysis can be extended by changing the definition of this utility function. The labor economics literature offers many alternative specifications to explain union behavior which could be used in this model.[23]

When the conceptual framework developed here is used to study the effects of changes in border and domestic enforcement on the welfare of the two types of workers in the economy, several conclusions emerge. Legal workers benefit from stricter enforcement of the immigration laws. Employment and wages in the nonunion sector increases, while the expected wage in the union sector also rises. With respect to illegal aliens, stricter immigration control reduces their employment either through a fall in their supply (caused by stricter border enforcement) or a decline in their labor demand (due to stricter domestic enforcement). Additionally, domestic enforcement is a welfare-superior policy with respect to border enforcement if policy makers are not interested in the welfare of illegal immigrants.

The inclusion of a union sector in the theoretical analysis of illegal immigration produced interesting results. When compared to the predictions of perfectly competitve labor market models, the model presented here suggests that domestic employment and wages change less, while illegal worker employment changes more when a union sector exists in the economy. Furthermore, the standard result that national income must fall when illegal immigration is restricted does not hold for this model. In sum, the presence of a union in the economy reduces the virulent effects of the tightening of immigration controls.

In addition to the suggestions stated above, numerous extensions of this model are possible. Changes in the functions that give the probability of border apprehensions and the probability of a firm being fined could be made. Furthermore, the model could be changed to allow for deportation of illegal aliens caught at work.[24] Finally,

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[22]In addition to devoting more resources to border and/or domestic enforcement, the government could increase the penalties paid by illegal immigrants caught crossing the border (K) or by firms caught hiring illegal workers (S). The results of increasing K are similar to those of changes in border enforcement, while those of changing S are similar to those of changes in domestic enforcement.

[23]The analysis presented here would remain intact as long as the new specification of the utility function renders a union wage which does not vary with membership.

capital could be allowed to move, either between sectors or among countries.[25]

Some other extensions also come to mind. It would be interesting to add skilled workers to the model and study the changes on their earnings. Both sectors have been assumed to produce the same good; this assumption could be changed and the additional effects of price changes evaluated. The foreign wage has been assumed to be fixed, and the international trade of goods has been ignored; incorporating a second country into the model could give useful insights, since it is well known that goods mobility is a substitute for factor mobility.

APPENDIX. PERFECTLY COMPETITIVE LABOR MARKET MODEL

The economy is assumed to have only one sector. Firms produce output by hiring both legal and illegal workers. It is assumed that legal workers are always employed. The structure of the model is the same as the one presented for the nonunion sector of the economy in this paper. The only difference centers around the wage for legal workers, which is assumed to fluctuate to guarantee their full employment. Therefore, equation (5), (6), (8), (9), (10), (11), and (12) can be used as the basic perfectly competitive labor market model. After some algebra, this model presents the following comparative statics:

$$\frac{dW^I}{dE} = K\left[g_E / (1-g)^2\right] > 0 \tag{A.1}$$

$$\frac{dW^L}{dE} = \frac{f_{nn}K\left[g_E / (1-g)^2\right]}{f_{nn} - Sh_I} > 0 \tag{A.2}$$

$$\frac{dI}{dE} = \frac{K\left[g_E / (1-g)^2\right]}{f_{nn} - Sh_I} < 0 \tag{A.3}$$

$$\frac{dn}{dE} = \frac{K\left[g_E / (1-g)^2\right]}{f_{nn} - Sh_I} < 0 \tag{A.4}$$

$$\frac{dNI}{dE} = K\left[g_E / (1-g)^2\right]\left[\frac{-If_{nn} + Sh + SIh_I}{f_{nn} - Sh_I}\right] < 0 \tag{A.5}$$

$$\frac{dW^I}{dD} = 0 \tag{A.6}$$

[24]The effect would be to reduce the supply of illegal aliens, who then would require a higher wage in order to enter the country.

[25]The model developed by Dell'Aringa and Neri (1987) allows for internal capital mobility, while the one presented by Bond and Chen (1986) permits international flows of capital. However, neither work includes a union sector.

$$\frac{dW^L}{dD} = \frac{f_{nn}Sh_D}{f_{nn} - Sh_I} > 0 \tag{A.7}$$

$$\frac{dI}{dD} = \frac{Sh_D}{f_{nn} - Sh_I} < 0 \tag{A.8}$$

$$\frac{dn}{dD} = \frac{Sh_D}{f_{nn} - Sh_I} < 0 \tag{A.9}$$

$$\frac{dNI}{dD} = \frac{Sh_D Sh}{f_{nn} - Sh_I} < 0 \tag{A.10}$$

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