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THE INCIDENCE OF SANCTIONS AGAINST U.S. EMPLOYERS OF ILLEGAL ALIENS

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Abstract

This paper assesses the potential significance of sanctions against employers of illegal aliens for resource allocation and income distribution in the United States. Data from the 1980 Census of Population are used to identify the industries likely to be monitored most closely by the immigration authorities. After compiling a list of industries to be monitored, a general equilibrium incidence analysis is carried out using alternative assumptions about the overall level of enforcement. Estimates are made of the effects of sanctions on U.S. production and the real wages of low- and high-skill labor.

THE INCIDENCE OF SANCTIONS AGAINST U.S. EMPLOYERS OF ILLEGAL ALIENS

The Immigration Reform and Control Act of 1986 marked a new phase in efforts to control illegal immigration into the United States.[1] Previously, immigration control had been achieved through border patrol and deportation of illegal aliens apprehended in raids on worksites. The new law adds sanctions against employers of illegal immigrants to the means already available to authorities. Prior to the implementation of the 1986 law, employers who knowingly hired illegal aliens faced no risk of punishment.

Early indications were that the new law was having significant effects. Border crossings had declined significantly and there were numerous reports of employers firing undocumented workers, all before the sanctions had become effective.[2] The long-run effects of the law are likely to be very different from the short-run effects, however. While employers may have been cautious in hiring illegals initially, they are likely to adjust their behavior once they become familiar with the law and the pattern of enforcement. With more than five million business establishments covered by the law, but only a few thousand agents budgeted for enforcement, the authorities will be forced to enforce sanctions selectively.[3]

The purpose of this paper is to assess the potential significance of sanctions for resource allocation and income distribution in the United States. We seek to identify the industries likely to be most affected by the law and provide a sense of the magnitude of its possible effects on the wages of legal U.S. workers. The paper necessarily draws from a number of fields in economics, including the economics of law and regulation, labor

economics, and public finance. Our conclusions are derived by combining basic theoretical principles from these fields with new and existing estimates of essential information on the size and industrial distribution of the illegal alien workforce and the potential for technical substitution between labor groups.

Through the course of the analysis, a number of difficult choices have to be made regarding key issues in enforcement and compliance. Our general philosophy is to bias our assumptions toward making sanctions more successful in achieving their intended objectives. For example, we assume that the authorities deploy their inspection resources with the objective of minimizing national employment of illegal aliens. This is in line with the expressed purpose of the law, but it ignores the possibility that the authorities will be pressured to be less selective and less efficient in their monitoring in order to avoid charges of racial discrimination. As another example, we assume that employers can costlessly distinguish between legal and illegal workers. This ensures that the wages of competing, legal workers will be favorably affected the law. Yet many critics claim that, because of counterfeiting, employers will not know whether they are hiring legal or illegal workers. If the courts are not lenient in cases involving counterfeit documents, employers may reject legal applicants with characteristics that are similar to those of illegal aliens.

Our basic method of analysis is to view sanctions as a tax on the use of illegal immigrant labor by employers targeted for inspection by the immigration authorities. The penalties are levied on a per worker basis.

Therefore, if employers know the probabilities of detection, are risk neutral, and have no ethical or moral reservations about disobeying the law, they will respond to sanctions as they would a tax levied at a rate equal to the fine times the probability of detection.

Much of our analysis of employer sanctions follows the standard theory of factor tax incidence. There is one additional layer of complication, however. It is not immediately apparent which industries face high effective tax rates and which industries face low rates. The law contains no specific provisions as to the pattern of enforcement. It is left up to the immigration authorities to decide which industries to monitor and with what intensity.

We assume that the immigration authorities allocate their limited inspection resources with the objective of minimizing the number of illegal aliens working in the domestic economy. In this framework, a principal determinant of the intensity with which an industry is monitored is the concentration of illegal workers at an individual business establishment. Data from the 1980 Census of Population are used to estimate, for all U.S. industries thought to employ large numbers of illegal workers, the average number of illegal aliens working at an individual establishment shortly before the passage of the new law. This information is used to rank order the industries in terms of the intensity with which they are likley to be monitored.

Having determined which industries make the best targets for inspection, we carry out a general equilibrium analysis under alternative assumptions about the overall level of enforcement. In each enforcement

regime, the economy is partitioned into two sectors: one consisting of industries to be heavily monitored and another comprised of industries to be lightly monitored. The effective tax rates in the two sectors are chosen to conform to the rules for optimal deployment of inspection resources. Incidence calculations are made using a general equilibrium model similar to those commonly used in studies of partial factor taxes. The analysis provides estimates of the effects of employer sanctions on U.S. production, the real wages of low- and high-skill labor, and the size of the illegal alien workforce.

The paper is organized as follows. Section I provides a simple model of the enforcement pattern chosen by the immigration authorities. Industries likely to be monitored most closely are identified. Section II serves to review the basic theory of how employer sanctions affect U.S. labor markets and to identify the parameters that are crucial in determining how effective sanctions can be in reducing the supply of illegal labor and raising the wages of competing labor groups. Section III provides a numerical analysis of the range of effects that sanctions could have on production and wages in the U.S. economy. The principal conclusions of the article are summarized in Section IV.

I. Industry Enforcement Patterns

Three assumptions are central to our analysis of enforcement of employer sanctions. The assumptions are: (1) that the budget authorized for enforcement is inadequate for achieving complete compliance; (2) that enforcement patterns are sufficiently predictable for employers to know their chances of being inspected; and (3) that the goal of enforcement is to minimize the number of illegal aliens working in the economy, i.e., achieve maximum compliance with the law.

The assumption of a limited budget is a safe one. In other countries, immigration authorities do not receive enough resources to eliminate illegal alien workers from their economies. Consequently, large numbers of illegal aliens have remained after the introduction of sanctions in Western Europe, Canada, and Hong Kong.[4] There are good reasons to expect the experience in the United States to be the same. The cost of monitoring increases rapidly as additional employers are brought under surveillance. Also, illegal immigration is a controversial issue, making widespread support for a large enforcement budget difficult to obtain.[5]

The assumption of a predictable enforcement strategy is also consistent with existing practices. The authorities could make their inspections unpredictable. Uncertainty about the probability of detection, even if that probability is low, can serve as a deterrent.[6] However, experience and the plans of the Immigration and Naturalization Service (INS), as reported in testimony before Congress, suggest that the authorities will behave predictably.[7] Law enforcement agencies, from the internal revenue

service to the local police, display a strong tendency toward predictable emphasis on specific targets.

Our formulation of the authorities' enforcement problem has much in common with recent work on the theory of income tax auditing [e.g., Reinganum and Wilde (1985) and Graetz, Reinganum, and Wilde (1986)]. Employers are divided into audit classes, with assignment based on obtainable information that is correlated with the tendency to violate the law. The probability of audit is then conditioned on audit class. Audit probabilities are selected with the particular objective of minimizing the size of the illegal working population. This accords with the expressed purpose of the law. It is also consistent with certain aspects of INS behavior, such as the allocation of resources to assist employers in distinguishing legal from illegal applicants.

A. A simple model of enforcement

We now provide a simple characterization of the enforcement problem of the immigration authorities. Suppose that establishments are identical within industries. Let π_j denote the fraction of all establishments in industry $\underline{j}$ to be inspected ($j=1,\ldots,M$). Thus, π_j represents the probability of inspection for any individual employer in industry $\underline{j}$. Employers take the π_j as given and react to the sanctions as they would a tax levied at a rate equal to the expected penalty.

The authorities choose the π_j in such a way as to minimize $\Sigma\ a_j E_j$, where a_j is the number of illegal workers per establishment and E_j is the

number of establishments in industry j. A displacement of illegal workers is achieved not by seizure and deportation, but by raising the full cost of employing an illegal worker. Establishment inspections are subject to a budget constraint. For present purposes, suppose that all inspections consume the same quantity of resources and that a maximum of R inspections are possible under the given budget.

With this notation, we can write the enforcement problem of the immigration authorities as

$$\underset{\pi}{\text{Min}} \quad \Sigma\, a_j E_j \tag{1}$$

$$\text{subject to} \quad \Sigma\, \pi_j E_j = R$$

$$0 \leq \pi_j \leq 1 \qquad j = 1,\ldots,M.$$

To carry the analysis further, we need a production theory that can be used to relate a_j and E_j to π_j. Suppose that production functions are linear homogeneous and that the ratio of business establishments to industry output is fixed and exogenous for each industry. The demand for illegal labor then has a simple structure. The term a_j is proportional to the quantity of illegal workers that minimizes unit cost, a function that conveniently summarizes the technical substitution possible between illegal labor and other factors of production. The term E_j is proportional to the level of industry output.

In addition to simplifying the form of the labor demand functions, the assumptions of linear homogeneity and fixed establishment size provide the enforcement theory with a structure that is compatible with general equilibrium models commonly used in tax incidence studies. A limitation of the assumptions is that they exclude the possibility of employers escaping detection by reducing plant size. The analysis assumes that the primary way employers can avoid being fined is by substituting legal inputs for illegal inputs.

Another issue to be addressed before analyzing (1) concerns the amount of information assumed to be available to the authorities when they decide on an allocation of inspection resources. At one extreme, the authorities could have a complete understanding of the economy and fully anticipate changes in all economic variables. Otherwise, the authorities could have only a partial knowledge of the demand for illegal labor. We assume that the authorities know the current values of all economic variables and have a general understanding of the reductions in alien employment that are possible from technical factor substitution, e.g., they know the economy-wide compensated elasticity of demand for illegal labor. However, they do not anticipate induced changes in industry outputs, the net illegal wage, or any other factor price. Of course, with their information limited in this way, the authorities may find themselves in error after all adjustments have been made. Thus, in the incidence analysis in Section III, we focus on inspection patterns that are optimal under (1) when all endogenous variables assume their general equilibrium values.

With the enforcement problem now well-defined, the Kuhn-Tucker conditions can be written as

$$\pi_j(\partial Z/\partial \pi_j) \leq 0,\ (1-\pi_j)(\partial Z/\partial \pi_j) \geq 0,\ \text{and}\ 0 \leq \pi_j \leq 1 \qquad (2)$$

where

$$\partial Z/\partial \pi_j = \{E_j/(w+\pi_j f)\}\{a_j \varepsilon f + \mu(w+\pi_j f)\} \qquad j = 1,\ldots,M.$$

Notation not previously introduced is as follows: $(w+\pi_j f)$ is the full cost of employing an illegal worker, with w denoting the net wage earned by illegal immigrants and f the fine per detected violation; ε is the economy-wide compensated elasticity of demand for illegal labor, defined to be negative; and μ is the Lagrange multiplier, which can be interpreted as the reduction in total alien employment made possible by an incremental increase in the enforcement budget.

Under current provisions of the law, the schedule of fines is sufficiently steep that an employer is unlikely to employ illegal workers if detection is certain.[8] This precludes $\pi_j = 1$ as an optimal solution. But it may be optimal to inspect some industries with little or no frequency. The conditions given in (2) help to identify those industries that will and those that will not be monitored by the authorities.

Assuming that the optimal enforcement pattern is unique and that the Kuhn-Tucker conditions are both necessary and sufficient, the frequency of inspection for industry $\underline{j}$ will be positive if and only if $\partial Z/\partial \pi_j$ is negative when $\pi_j = 0$ and all other variables are evaluated at their optimal values. Whether this condition is met depends crucially on the term a_j,

the "alien intensity" of the industry. Let m denote the index of the marginal industry, i.e., the industry for which $\partial Z/\partial \pi_m = 0$ when $\pi_m = 0$. Then it follows from (2) that it is optimal to monitor a given industry if and only if its initial alien intensity exceeds the initial alien intensity of the marginal industry. The reason for this result is straightforward. For industries with a large initial number of illegal workers per establishment, a large reduction in alien employment can be obtained with the first dollar spent on inspection.

Condition (2) can also be used to derive a formula for the optimal rate of tax on industries with a positive probability of inspection. By expressing μ in terms of the parameters of the marginal industry, and then substituting the result into (2), we have

$$1+t_j = a_j/a_m, \tag{3}$$

where t_j is the tax rate expressed as a percent of the net illegal wage. The formula given in eq.(3) will be used later to compute an enforcement equilibrium. At this point, it is instructive to identify some additional properties of an optimal pattern of enforcement. Given the presence of a_j in the formula, it is clear that some noncompliance is optimal even within the set of monitored industries. The formula also illustrates the intuitive result that effective tax rates will be highest for industries that are most alien intensive.

B. Identification of monitored industries

To identify the industries likely to be monitored most closely by the immigration authorities, we estimated the number of illegal workers per establishment in U.S. industries shortly before the passage of the new law. The estimates were developed by combining existing research on the size of the illegal alien population with our own analysis of the industry distribution of illegal immigrant workers.

Much valuable information on the illegal alien population has been obtained from the 1980 Census of Population. Analysis indicates that the illegal population is large, but not as large as many had claimed during the mid 1970s. Census Bureau research places the number of illegal aliens in the country in 1986 between 3 and 5½ million.[9] This range is based on a count of the illegal aliens represented in the 1980 Census together with an estimate of the rate of illegal immigration during the 1980s. The annual flow estimate was derived from a 1983 survey, while the rate of illegal immigration from Mexico is thought to have risen sharply in recent years with the deterioration in the Mexican economy. After adjusting for a possible downward bias in the Census figures, it is reasonable to consider 7 million as an upper bound for the size of the illegal alien population in 1986.

To estimate the industry distribution of illegal workers, we obtained information from the Public-Use Sample of the 1980 Census on the industry locations of employed individuals who were born outside the United States and whose ability to speak English was poor. Language proficiency has also

been used by Pearce and Gunther (1985) and McCarthy and Valdez (1986) as a selection variable to gain information on the illegal alien population. The procedure suffers from two shortcomings: it fails to identify undocumented aliens from English-speaking countries (Canada, Ireland, Jamaica, etc.); and it fails to exclude refugees from Cuba, Vietnam, and other countries who have been granted legal status. Neither of these errors would seem to introduce a significant amount of bias into the results, however. Census Bureau research indicates that the great majority of illegal aliens are indeed from non-English-speaking countries.[10] And it is unimportant whether immigrant refugees have received legal status if, because of similar skills and handicaps, they are distributed across industries in the same way as illegal immigrants.

Because of special provisions in the new immigration law to meet the seasonal needs of agriculture, we considered only nonagricultural industries when preparing our list of penetrated industries. Due to limitations of sample size, we also excluded any industry estimated to have employed less than 3/4 of one percent of the illegal labor force. This left us with the 31 industries shown in Table 1. Together these industries accounted for 74 percent of illegal nonfarm employment.

The first column in Table 1 shows how illegal alien workers are distributed across U.S. industries. Of all the illegal aliens engaged in nonfarm employment, 47 percent are in manufacturing and 39 percent are in service-producing industries (not shown). The four industries employing the largest number of illegal aliens are apparel manufacturing, restaurants, construction, and food processing.

In an optimal enforcement strategy, it is not necessarily the industries that employ large absolute numbers of illegal aliens that will draw the most attention from the immigration authorities. Surveillance is more likely to be focused on industries with a large number of illegal workers at an individual establishment. Estimates of this industry characteristic are shown in the second column of Table 1. To obtain these figures, we first computed the number of illegal aliens employed in each industry by multiplying the frequencies in the first column by an estimate of the total number of illegal aliens working in nonagricultural industries during 1986.[11] The absolute employment figures were then standardized using data on number of business establishments.

First note the wide range obtained for the number of illegal workers per establishment. There are more than 15 illegals per establishment in footwear, apparel, and food processing. Restaurants and construction, on the other hand, average no more than 1 illegal worker per establishment. The disparity in these numbers has two important implications: first, that enforcement of sanctions will not be uniform across industries and, second, that it will prove increasingly expensive to extend surveillance throughout the economy.

The figures in the table also reveal that manufacturing industries are predominant among industries with a large number of illegals at an individual establishment. Of the 21 industries having an average of 2 or more illegal workers per establishment, only 4 are not in manufacturing. Thus, to the extent that enforcement is more thorough on large employers, illegal aliens in manufacturing will be displaced more extensively than

illegals in other sectors of the economy, such as construction and services.

Sensitivity of ordering to omitted factors. Up to this point, we have assumed that the cost of monitoring a business establishment is fixed and independent of the size of the establishment. It is likely, however, that the cost of monitoring also varies with the total number of workers in the establishment. In this event, an optimal enforcement pattern calls for a concentration of surveillance on industries with not only a large number of illegal workers per establishment, but also a large ratio of illegal workers to total workers.

Shown in the third column of Table 1 are estimates of the ratios of illegal to total workers for the 31 penetrated industries. The results indicate that industries with a large number of illegal aliens per establishment also tend to use a high ratio of illegal to total workers. This can be seen by comparing the figures in the second column with those in the third column. The simple correlation coefficient between the two sets of figures is .74. Of the 15 industries with the largest number of aliens per establishment, 9 are in the group of fifteen with the largest ratios of illegal to total workers. And of the 6 who are not in this latter group, only hospitals stand out as having an exceptionally low ratio of illegal to total workers.

The calculations in Table 1 are based on national totals for numbers of illegal workers and numbers of business establishments. This reflects our belief that more can be learned about the long-run effects of sanctions from a model that presumes a high degree of national mobility in labor and

capital than from a model in which there are persistent geographic immobilities.[12] Nevertheless, the current geographic distribution of illegal aliens is highly skewed and, at least in the short run, enforcement efforts are likely to be focused on particular states as well as particular industries.

To determine how sensitive our ordering of industries is to the geographic concentration of illegal aliens, we recalculated numbers of aliens per establishment using only information from the five states California, Florida, Illinois, New York, and Texas. These states account for three-quarters of the illegal nonfarm workforce, but only one-third of all U.S. nonagricultural workers.[13] The new ordering of industries differed little from the one in Table 1. Of the 31 penetrated industries, 14 failed to change position, 13 moved up or down by only one or two positions, and only 2 moved more than three positions.

II. Labor Market Adjustments

Sanctions against employers of illegal workers act as a tax on the use of illegal immigrant labor by industries targeted for inspection by the immigration authorites. A detailed incidence analysis is provided in the next section. Here we review the basic allocative effects of the policy and set out the parameters that are crucial in evaluating its effectiveness in reducing the supply of illegal workers and raising the wages of competing, legal workers.

The primary impact of employer sanctions is on the market for illegal immigrant labor. Figure 1 shows how the policy is likely to affect the wages of illegal workers and the location of their employment. There are two sectors in the domestic economy. Sector A consists of industries subject to inspection by immigration officials. Sector B comprises all other industries, with enforcement in these industries considered negligible. The left panel in the figure shows the supply of illegal workers and the demand for these workers by industries in sector B. These relationships are used to derive the excess supply schedule shown in the right panel. The market for illegal immigrant labor is in equilibrium when the excess supply from sector B equals the demand from sector A.

The effect of sanctions is to reduce the demand for illegal labor in sector A. This drives down the immigrant wage from w to w'. Because of the expected penalty, however, the cost of illegal labor rises for industries in sector A. As a result, $(N_A-N'_A)$ workers are displaced. (N-N') of these workers withdraw from the national labor market. The remaining (N'_B-N_B) workers find employment in sector B where the cost of labor, as given by the immigrant wage, is now lower.

As background for Section III, we now identify the basic parameters that determine how effective employer sanctions can be in reducing the supply of illegal immigrant labor. The formula presented below is derived from a standard comparative-statics analysis of the single-market model. The solution has been simplified by assuming that the elasticity of demand for illegal labor is the same in the two sectors.

$$d\ell nN/d\ell n(1+t) = \lambda_A\{\eta\varepsilon/(\eta-\varepsilon)\} \qquad (4)$$

Eq.(4) shows the percent change in the supply of illegal workers (N) resulting from a one percent rise in (1+t), where t is the ad valorem tax rate for firms in sector A. The size of the decline in N is seen to depend on three parameters: the fraction of all illegal workers employed in the enforced sector (λ_A), the elasticity of supply of illegal immigrant labor (η), and the elasticity of demand for illegal labor (ε). The directions of influence λ_A and η have on the solution are straightforward. The percentage decline in N will be greater the larger is the fraction of the illegal workforce employed in sanctionable industries and the more wage-elastic is the supply of illegal labor. The role of ε in the solution is less obvious, but equally as determinate. If the demand for illegal labor is highly elastic, a large number of illegal aliens are displaced from sector A. This is offset by the fact that, with an elastic demand for labor throughout the economy, it is easier for firms in sector B to absorb displaced workers. The latter effect cannot dominate, however. On balance, greater reductions in the illegal workforce are achieved the more elastic is the demand for illegal labor.

In addition to the effect sanctions have on the supply of illegal immigrant labor, there is considerable interest in the way they affect the wages of competing labor groups. As shown by Ethier (1986), the results depend greatly upon whether employers can distinguish between legal and illegal workers. We will assume that legal and illegal workers are costlessly distinguished. This implies that the wages of legal workers are only altered through normal channels of input substitution.

To keep things simple, consider a model in which there are two markets--the market for illegal workers and a market for a competing group of legal workers, referred to as legal low-skill labor. As before, treat the sanctions program as a tax on the use of illegal workers by industries in sector A. Then the sanctions again serve to raise the cost of illegal labor for firms in the enforced sector and to lower the cost of illegal labor for all other employers. Whether the wage of legal low-skill workers rises or falls depends upon what happens to the aggregate demand for that labor. Suppose the two labor groups are substitutes. Firms in the enforced sector are encouraged to use more legal workers. But firms in the unenforced sector have the opposite incentive. Depending upon the relative strengths of the two effects, the legal low-skill wage may either rise or fall.

The tension in the legal low-skill labor market is resolved in eq.(5). The solution given there has been simplified by assuming that demand elasticities are the same across sectors and that legal labor is in fixed supply.

$$d\ell nw_L/d\ell n(1+t) = \varepsilon_{LI}\{\lambda_{LA}\eta + (\lambda_{LA}-\lambda_{IA})(-\varepsilon_{II})\}/D \qquad (5)$$

where

$$D \equiv -\varepsilon_{LL}(\eta-\varepsilon_{II}) - \varepsilon_{LI}\varepsilon_{IL}$$

In the above equation, w_L denotes the legal low-skill wage, ε_{ik} the elasticity of demand for factor i with respect to the price of factor k, and λ_{ij} the fraction of labor group i employed in sector j. The subscripts I and L refer to illegal and legal labor, respectively.

Market stability requires that the denominator in eq.(5) be positive. Thus, the direction of change in w_L hinges on the sign of the numerator. For the wages of legal workers to rise, it is sufficient that $\varepsilon_{LI} \geq 0$ and $\lambda_{LA} > \lambda_{IA}$. The first condition is satisfied if the two labor groups are substitutes. The second condition requires that the ratio of illegal to legal low-skill workers be lower in the enforced sector than in the unenforced sector. If this is not the case, it is possible for the legal wage to fall despite a substitute relationship between the labor groups. For this to occur, however, the supply of illegal workers must be relatively wage inelastic and the demand for illegal labor relatively wage elastic.

III. Incidence Analysis

In this section we provide a numerical analysis of the effects of employer sanctions on resource allocation and income distribution in the United States. The analysis combines the simple enforcement theory presented in Section I with a general equilibrium model commonly used in tax incidence studies. The enforcement model produces a set of inspection frequencies, or tax rates, that are optimal given particular values for factor prices, commodity prices, and industry outputs. The general equilibrium model produces equilibrium values for prices and outputs given particular values for the tax rates. An enforcement equilibrium is obtained by solving the two models simultaneously.[14]

A. The general equilibrium model

The model used to detail the economic effects of sanctions is similar to the one used by Harberger (1962) in his pioneering analysis of the corporation income tax.[15] There are two sectors of production. Sector A consists of industries that are subject to heavy monitoring by the authorities. Sector B comprises all other nonagricultural industries, with enforcement there either light or negligible. What is meant by the terms "heavy" and "light" in these definitions will be made clear in a later section. Each sector employs four factors of production: illegal immigrant labor (I), legal low-skill labor (L), legal high-skill labor (H), and capital (K). Production in each sector is governed by constant returns to scale, and all markets are competitive. Employer sanctions operate as taxes on the use of illegal immigrant labor by firms in the two sectors of the economy.

We follow Jones (1965) in choosing the mathematical form of the equilibrium conditions.

$$c_{iA}x_A + c_{iB}x_B = N_i \qquad i = I,L,H \qquad (6)\text{-}(8)$$

where

$$N_I = F(r(w_I,p)),\ N_L = \bar{N}_L,\ \text{and}\ N_H = \bar{N}_H$$

$$r(w_K,p) = \bar{r}_K \qquad (9)$$

$$\Sigma\, c_{iA}w_i + c_{IA}w_I t_A = p \qquad (10)$$

$$\Sigma\, c_{iB} w_i + c_{IB} w_I t_B = 1 \qquad (11)$$

$$x_A / x_B = G(p) \qquad (12)$$

Eqs.(6)-(8) are full employment conditions for the three labor markets. The left-hand side of each equation details the economy-wide demand for the particular labor group. The demand for labor of type $\underline{i}$ by firms in sector $\underline{j}$ is written as the product of the quantity of labor that minimizes unit production costs (c_{ij}) and the level of sectoral output (x_j). Factor supplies are denoted N_i. The supplies of legal low-skill and high-skill labor are assumed to be fixed. The supply of illegal immigrant labor, on the other hand, is allowed to vary with the real immigrant wage. Assuming that individual preferences are identical and homothetic, we can define the real value of any factor price w as the ratio of w to the minimum expenditure needed to support a fixed level of utility at current commodity prices. The term r(w,p) is used to represent the general function that converts nominal earnings to real earnings. For computational purposes, all financial variables were measured in terms of good B, which serves as a numeraire. Thus, the term p which appears in the real earnings equation denotes the relative price of good A.

The supply of capital is assumed to be perfectly elastic with respect to its real reward. This allows for the possibility of outflows of capital in response to reductions in the supply of immigrant labor. The elasticity condition is imposed in eq.(9) where the real return to capital is held constant.

Eqs.(10)-(11) are the competitive profit conditions for the two sectors. In a competitive equilibrium, unit production costs must reflect market prices. Note that costs are defined to include the effective rates of tax on employment of illegal workers. The tax rates are expressed as a percent of the wage received by illegal immigrants and are denoted t_j.

Eq.(12) is a simple demand condition used to close the model. Under the assumption that community tastes are identical and homothetic, the ratio of the quantities consumed of A and B depends only on the relative commodity price ratio.

The model described by eqs.(6)-(12) serves to determine seven unknowns: levels of output in the two sectors, the four factor prices, and the commodity price ratio. Information required to solve the model includes the effective tax rates and a complete specification of the various functional relationships contained in the equations. The methods used to obtain this information are described in the next two sections.

B. Defining the enforcement regimes

It is difficult to predict how much of a budget the authorities will receive to enforce the new immigration law. Indeed, given an interest group theory of government, it is reasonable to expect that the budget will vary with cyclical fluctuations in the economy [Shughart, Tollison, and Kimenyi (1986)] and with changes in the age distribution of the U.S. population. We consider three possible enforcement scenarios. The scenarios range from a minimal level of enforcement--in which only large

employers are monitored for compliance--to a very ambitious campaign--in which a significant amount of surveillance is carried out in all parts of the economy.

Each enforcement regime is defined by partitioning the economy into two sectors and then choosing an effective tax rate for each sector. This is accomplished in accordance with the basic principles of optimal enforcement outlined in Section I. The three regimes are defined as follows.

Low enforcement. Inspections are assumed to be limited to industries initially employing an average of 2 or more illegal aliens per business establishment. Sector A consists of all such industries as identified in Table 1. Sector B comprises all other nonagricultural industries. Included within the enforced sector, therefore, are virtually all of the penetrated manufacturing industries. Noteable within the unenforced sector are the restaurant and construction industries.

Following our discussion in Section I, the average rate of tax for industries in sector A can be determined from

$$1+t_A = a_A/a_m, \tag{13}$$

where the marginal industry is defined as having an initial value of a_j equal to 2.0. The tax rate for industries in sector B is zero, by assumption.

Medium enforcement. The budget is increased to allow for some monitoring of all the penetrated industries. Accordingly, sector A is broadened to include all of the industries in Table 1. The average rate of

tax in this sector is determined from eq.(13), with the marginal industry now defined by an initial value of a_j equal to 0.5. Sector B is made up of all nonagricultural industries not included in Table 1. The effective tax rate in this sector is again zero.

High enforcement. Sectors A and B are defined as in the "MEDIUM" enforcement regime. However, the budget is assumed to be sufficiently large to support substantial monitoring efforts in both sectors. Because the alien intensities in the two sectors differ, it is not optimal to monitor them with the same frequency. The optimal differential in tax rates can be determined from

$$(1+t_A)/(1+t_B) = a_A/a_B. \tag{14}$$

The overall level of taxation is chosen to achieve a 50-percent reduction in the illegal alien workforce.

C. Functional specifications and key parameter values

Within the equations of the incidence model are a number of functional relationships that must be specified before the model can be solved. These are: the unit factor demand functions, the immigrant supply function, the real wage function, the product demand function, and the alien intensity functions. Each of these functions is assumed to take a geometric form. Thus, each has a multiplicative constant and exponents which give the elasticities of the function with respect to its individual arguments.

What follows is a brief discussion of the procedures used to evaluate the key parameters in these functions. Additional information is provided in an appendix.

Unit factor demands. Under constant returns to scale, the c_{ij} depend only on the four factor prices, with the price of illegal immigrant labor defined to include the tax. The multiplicative constants in these functions were calculated using initial values for the labor demands and capital's distributive shares. The exponents represent the output-constant elasticities of factor demand. As is well known, these elasticities can be expressed as

$$\varepsilon^j_{ik} = \theta_{kj}\sigma^j_{ik} \quad \text{for } i \neq k \qquad \text{and} \qquad \varepsilon^j_{ii} = -\sum_{i \neq k} \varepsilon^j_{ik},$$

where ε^j_{ik} is the compensated elasticity of demand for factor $\underline{i}$ in sector $\underline{j}$ with respect to the price of factor $\underline{k}$, θ_{kj} is the distributive share awarded to factor $\underline{k}$ in sector $\underline{j}$, and σ^j_{ik} is the elasticity of technical substitution between factors $\underline{i}$ and $\underline{k}$ in sector $\underline{j}$. Thus, the ε^j_{ik} can be calculated using initial values for the distibutive shares and the elasticities of factor substitution.

There is a substantial econometric literature on factor substitution among labor of different skill types and of these labor types for capital. Using information provided in a survey by Hamermesh and Grant (1979), we were able to assign values to σ_{LH}, σ_{LK}, and σ_{HK}. There are two deficient areas in the literature, however. First, estimates of substitution elasticities are generally not available by detailed industry. Therefore,

the chosen estimates were assumed to apply to all industries in the economy. Second, there are no measures of the technical substitution possible between illegal immigrants and other factors. The procedure used to evaluate these parameters is as follows.

In our study, skill classes are defined by educational attainment. The low-skill labor force consists of all workers who failed to complete high school. In terms of education, then, illegal immigrants are very similar to legal low-skill workers. For this reason we assume that the substitution possible between each of these labor groups and high-skill labor or physical capital is the same, i.e., that $\sigma_{IH} = \sigma_{LH}$ and $\sigma_{IK} = \sigma_{LK}$. This leaves us with σ_{IL}, the elasticity of substitution between illegal and legal low-skill labor. Because of differences in English proficiency, the two groups are generally not perfect substitutes. But they are likely to be highly substitutable with respect to other job skill attributes.

Given values for σ_{IH}, σ_{IK}, and the distributive shares of all factors, σ_{IL} can be uniquely determined from a knowledge of ε_{II}, the economy-wide compensated elasticity of demand for illegal immigrant labor.[16] It is this relationship that we exploit in evaluating σ_{IL}. Econometric studies indicate that the elasticity of demand for low-wage labor is around -1.0 [see Zucker (1973) and Cotterill (1975)]. Because illegal immigrant labor constitutes a subset of all low-wage labor, the demand for illegal alien workers is probably somewhat more elastic. In our base case simulations, we assume a value of -1.5 for ε_{II} which, in turn, implies a value of 11.8 for σ_{IL}. This provides for a high degree of substitutability between illegal and legal low-skill labor. A more moderate value for σ_{IL} is considered in a sensitivity exercise.

Immigrant supply. The key parameter in the immigrant supply equation is the wage elasticity of supply. In their survey article, Krugman and Bhagwati (1976) conclude that elasticities of migration with respect to destination earnings generally lie between 0.5 and 2.0. This range is consistent with the results of Greenwood and McDowell (1982) who find a wage elasticity of reported emigration from Mexico to the United States of 1.4. Given that our model ignores the downward pressure on foreign wages that would accompany immigration reform, whatever elasticity is chosen should be adjusted downward. In our base case simulations, we use a value of 1.0 for the elasticity of illegal immigrant supply.

Real wages. The function $r(w,p)$ converts a wage denominated in units of good B into a real wage. The form used for $r(w,p)$ was w/p^{α}. This is equivalent to deflating w using the minimum expenditure function that is dual to a Cobb-Douglas utility function. Because of an absence of detailed consumption or value-added data, the parameter α was measured by the fraction of total nonagricultural employment accounted for by industries in sector A.

Product demand. The key parameter in the function $G(p)$ is the elasticity of commodity substitution along a community indifference curve. To be consistent with the form of the real wage function, we took this elasticity to be unity.

Alien intensities. Given our earlier assumption of a fixed level of output per business establishment, the a_j that appear in eqs.(13) and (14) can be expressed in terms of the c_{Ij} by means of the following equation:

$$a_j = a^o_j(c_{Ij}/c^o_{Ij}),$$

where a^o_j and c^o_{Ij} denote the values of a_j and c_{Ij} in a pre-tax equilibrium. When the index $\underline{j}$ refers to an entire sector, a^o_j is computed by averaging the information in Table 1 on illegal workers per establishment; (c_{Ij}/c^o_{Ij}) is evaluated using initial values for the factor prices and the elasticities of demand computed previously for the given sector. In the case of the marginal industry $\underline{m}$, a^o_m is immediate from the definition of the marginal industry. More problematic is the term (c_{Im}/c^o_{Im}). It is unclear whether this term should be evaluated using the elasticities from sector A or those from sector B. Both methods were considered. Because the two sets of elasticities are similar, there was little difference in the results. The reported results were derived by using the elasticities from sector B to evaluate (c_{Im}/c^o_{Im}).

So that the reader may have a better feel for the data, Table 2 shows some of the basic information used to solve eqs.(6)-(14) for the "MEDIUM" enforcement regime. In reviewing the data, first note the relatively small values for illegal labor's distributive shares. Despite a generous assessment of their numbers, illegal workers constitute only a small part of the total resources in the United States economy. This implies that the effects of sanctions on aggregate output will be small. And except in cases where factors are highly substitutable for illegal labor, it also means that sanctions will produce only moderate effects on the earnings of other factors.

Noteworthy in the data on labor force allocations is that industries in the enforced sector employ a somewhat higher ratio of illegal to legal low-skill labor than do industries in the unenforced sector. This is indicated by the inequality $\lambda_{IA} > \lambda_{LA}$. As shown through eq.(5), this condition serves to moderate the rise in the legal low-skill wage that occurs in response to employer sanctions.

Regarding the elasticities of factor substitution, we have already noted the high value initially assumed for σ_{IL}. The remaining figures indicate that high-skill labor and physical capital are each substitutable for low-skill labor, and that high-skill labor is less substitutable for capital than is low-skill labor.

D. Results

Table 3 reports our numerical findings for the three enforcement regimes. Rows 1.a-1.b show the effective tax rates, with each rate expressed as a percent of the new illegal immigrant wage. Shown in rows 2.a-2.b are the percent changes in sectoral outputs resulting from the sanctions. These and all other percentage changes are computed as deviations from the pre-tax equilibrium. The figures reported in row 2.c indicate the effect sanctions have on U.S. gross domestic product (GDP). These figures were calculated by averaging the relative changes in sectoral outputs using the parameter α from the cost-of-living index. Section 3 of the table shows the changes in the real wages of the three labor groups. Section 4 details the effect sanctions have on the allocation of illegal alien workers. The presentation there is based on the following identity.

$$\%\Delta N_I \equiv (\lambda_{IA})(\%\Delta N_{IA})(\Delta N_I/\Delta N_{IA})$$

The percentage change in the supply of illegal alien workers can be expressed as the product of three terms: (i) the share of the illegal workforce initially employed in sector A, (ii) the percentage reduction in employment of illegal aliens in sector A, and (iii) the fraction of all illegal workers displaced from sector A that leave the U.S. labor market. This equation will serve as a framework for the interpretation of results.

When enforcement is "LOW", sanctions have small effects on production and wages. A weighted average of the changes in sectoral outputs shows only a 0.5-percent decline in the gross domestic product. The real wage rate of legal low-skill workers rises--a result that is expected and desired by most supporters of immigration reform--but it rises only 2.6 percent. Also small are the costs of sanctions on factors that are not close substitutes for illegal workers. In our model, it is high-skill labor that bears the cost of immigration reform in the long run. Results not reported indicate that a portion of this burden would also fall on capital were it not for an external market for capital.

One of the reasons for the small size of these effects is that illegal alien workers account for a small share of domestic value added. Another is the fact that, under "LOW" enforcement, sanctions reduce the supply of illegal workers by only 11 percent. Although 48 percent of the illegal workforce is originally employed in sanctionable industries, surveillance is only thorough enough to achieve a 44-percent reduction in employment.

Taken together, these figures indicate that 22 percent of all illegal workers are displaced. Of these, only one-half withdraw from the U.S. labor market. The other half find work in sector B, where enforcement is nonexistent.

If enforcement is "MEDIUM", sanctions have a larger, but still moderate impact on the economy. It is only when enforcement is "HIGH" that the effects become significant. In this case, employer sanctions succeed in raising the real wages of legal low-skill workers by 12.8 percent, doing so at the expense of high-skill workers who suffer a real-wage decline of 4.1 percent. The reason these effects are more substantial, of course, is that the overall level of enforcement is assumed to be high enough to reduce the illegal alien workforce by 50 percent. Monitoring is sufficiently vigorous to double the cost of illegal labor for firms in sector A, resulting in a 68-percent decline in their employment of illegal aliens. Because sector A initially accounts for 74 percent of the illegal workforce, this means that 50 percent of all illegal workers are displaced. Under "HIGH" enforcement, firms in sector B are also monitored, and with sufficient intensity to prevent their cost of illegal labor from falling. As a result, virtually none of the workers displaced from sector A are absorbed by sector B. This, in itself, requires a substantial monitoring effort, as is evident from the size of t_B.

Implicit in the move from "LOW" to "HIGH" enforcement is a larger enforcement budget. To see what is involved, suppose that the probability of detection in sector $\underline{j}$ can be represented by the ratio of total inspections (R_j) to total number of establishments (E_j). Then, for any enforcement regime $\underline{i}$, the effective tax rate can be expressed as

$$t^i_j = (f^i R^i_j / w^i_I E^i_j),$$

where it is understood that the industry composition of sector j varies with the regime. By making use of this relationship, we can compare the enforcement efforts implicit in any two regimes. This is shown in the equation below.

$$\frac{f^2(R^2_A+R^2_B)}{f^1(R^1_A+R^1_B)} = \frac{w^2_I(t^2_A E^2_A+t^2_B E^2_B)}{w^1_I(t^1_A E^1_A+t^1_B E^1_B)} \qquad (15)$$

By combining data on number of establishments with results from the incidence analysis, it is possible to evaluate the right-hand side of eq.(15). Upon doing so we reach a striking conclusion: to move from "LOW" to "HIGH" enforcement, and to thereby achieve a 50-percent rather than 11-percent reduction in the illegal working population, requires either a 26-fold increase in the fine, a 26-fold increase in the number of worksite inspections, or some combination of the two.[17] These calculations somewhat overstate the incremental cost of achieving broader compliance. Large establishments take more staff time to inspect than do small ones, and large establishments are more prevalent among industries in the "LOW" regime. Nevertheless, it is clear that the marginal cost of enforcement rises sharply with the fraction of the illegal labor force to be removed from the domestic economy.

E. Sensitivity experiments

There are two parameters which are crucial to the success of a sanctions program but which, at the same time, are especially difficult to evaluate. These are the elasticity of immigrant supply and the elasticity of substitution between illegal and legal low-skill labor. Table 4 reports the results of sensitivity experiments performed using alternative values for these parameters in the case where enforcement is "MEDIUM". To make the comparisons meaningful, the tax rate t_A was chosen to provide the same enforcement effort as that implicit in the base case.[18]

The figures in the first two columns show the effects of reducing the elasticity of immigrant supply from 1.0 to 0.5. The most noteable difference between the two sets of numbers is a significant drop in the extent to which sanctions reduce the illegal labor supply. Much of this is due to the fact that, with the supply of workers more wage inelastic, a smaller fraction of those displaced from the enforced sector end up leaving the U.S. labor market. Considering that our original assessment of the immigrant supply elasticity was generously high, it is quite possible, then, that reductions in the illegal working population will prove even more expensive to obtain than our earlier results indicated.

As previously noted, the elasticity of substitution between illegal and legal low-skill labor is derived from a value assumed for the compensated elasticity of demand for illegal labor. In our initial simulations, we assumed a value of -1.5 for ε_{II} which, in turn, implied a value of 11.8 for

σ_{IL}. This provided for a high degree of substitutability between illegal and legal low-skill labor. In the third column of Table 4 we show what happens when the demand elasticity is reduced to -1.0 and the corresponding value for σ_{IL} falls to 3.5. With substitution between the two labor groups more limited, the benefits of immigration reform to legal low-skill workers are greatly reduced. The legal low-skill wage rises by less than one-fourth the amount it did in the base case. It also becomes more difficult to gain compliance within the enforced sector. This illustrates the basic principle of tax theory that the more price inelastic is demand, the larger is the tax needed to achieve a given quantity reduction.

IV. Conclusions

With more than five million business establishments subject to sanctions under the new immigration law, it is unlikely that enforcement will be thorough enough to eliminate illegal aliens from the U.S. labor force. A more likely outcome is that the immigration authorities will focus their enforcement efforts on industries with a large concentration of illegals at an individual establishment. Information presented in this article indicates that manufacturing industries are predominant among large employers of illegal aliens. Thus, the contractionary effects of immigration reform are likely to be felt most strongly in manufacturing. Other sectors, such as services and construction, which employ illegals with a low concentration at the establishment level, are likely to face weak enforcement and may absorb significant numbers of displaced aliens.

Simulation results for an intermediate enforcement regime indicate that roughly one-third of the workers displaced from the enforced sector find employment in other parts of the U.S. economy.

The incidence of employer sanctions will be uneven across factor groups as well as industries. The principal beneficiaries will be legal workers in low-skill occupations. Improvements in their living standards are not likely to be large, however. For sanctions to raise the real wages of legal low-skill workers by ten percent, illegal and legal low-skill labor must be highly substitutable and the law must be enforced with sufficient thoroughness to reduce the illegal alien working population by as much as one-half. The costs of immigration reform will be borne primarily by high-skill labor. But the percentage reduction in their wages will be even more moderate.

Through the course of the analysis, a number of difficult choices had to be made regarding certain key parameter values and basic issues of modeling. In the interest of conservatism, these choices generally were made in a way that enhances the possibility of the law achieving expected results. Given the nature of our findings--that significant reductions in the illegal labor force will be expensive to obtain and that any increases in the general level of wages of legal low-skill workers will be moderate--the fact that our assumptions were conservative only serves to strengthen the basic thrust of the conclusions.

REFERENCES

Calvo, G.A. and S. Wellisz. "Supervision, Loss of Control, and the Optimum Size of the Firm." Journal of Political Economy 86 (October 1978): 943-52.

Cotterill, P. "The Elasticity of Demand for Low-Wage Labor." Southern Economic Journal 41 (January 1975): 520-5.

Dubin, J.A. and L.L. Wilde. "An Empirical Analysis of Federal Income Tax Auditing and Compliance." National Tax Journal 41 (March 1988): 61-74.

Ethier, W.J. "Illegal Immigration: The Host-Country Problem." American Economic Review 76 (March 1986): 56-71.

Graetz, M.J.; J.R. Reinganum; and L.L. Wilde. "The Tax Compliance Game: Toward an Interactive Theory of Law Enforcement." Journal of Law, Economics, and Organization 2 (1986): 1-32.

Greenwood, M.J. and J.M. McDowell. "The Supply of Immigrants to the United States." In The Gateway: U.S. Immigration Issues and Policies, edited by B.R. Chiswick. Washington, D.C.: The American Enterprise Institute for Public Policy Research, 1982.

Hamermesh, D.S. and J. Grant. "Econometric Studies of Labor-Labor Substitution and Their Implications for Policy." Journal of Human Resources 14 (Fall 1979): 518-42.

Harberger, A.C. "The Incidence of the Corporation Income Tax." Journal of Political Economy 70 (June 1962): 215-40.

Jones, R.W. "The Structure of Simple General Equilibrium Models." Journal of Political Economy 73 (December 1965): 557-72.

Krugman, P. and J.N. Bhagwati. "The Decision to Migrate: A Survey." In The Brain Drain and Taxation: Theory and Empirical Analysis, edited by J.N. Bhagwati. Amsterdam: North-Holland, 1976.

McCarthy, K.F. and R.B. Valdez. Current and Future Effects of Mexican Immigration in California. Santa Monica, Calif.: The Rand Corporation, 1986.

McLure, C.E., Jr. "General Equilibrium Incidence Analysis: The Harberger Model After Ten Years." Journal of Public Economics 4 (February 1975): 125-61.

Nelson, A.C. "Statement by Alan C. Nelson, Commissioner, Immigration and Naturalization Service." In Hearings before the Subcommittee on Immigration, Refugees, and International Law. House of Representatives,

98th Congress, 1st Session on H.R. 1510. Washington, D.C.: U.S. Government Printing Office, 1983.

Passel, J.S. "Estimating the Number of Undocumented Aliens." Monthly Labor Review 109 (September 1986): 33.

Passel, J.S. and K.A. Woodrow. "Geographic Distribution of Undocumented Immigrants: Estimates of Undocumented Aliens Counted in the 1980 Census by State." International Migration Review 18 (Fall 1984): 642-71.

Pearce, J.E. and J.W. Gunther. "Illegal Immigration from Mexico: The Effects on the Texas Economy." Federal Reserve Bank of Dallas Economic Review (September 1985): 1-14.

Recio, M.E.; J. Flynn; A. Bernstein; and Staff. "Reform Breeds its Own Crisis: The New Immigration Law Causes Headaches All Over." Business Week (30 March 1987): 26-7.

Reinganum, J.F. and L.L. Wilde. "Income Tax Compliance in a Principal-Agent Framework." Journal of Public Economics 26 (February 1985): 1-18.

Rohter, L. "Immigration Law is Failing to Cut Flow from Mexico." New York Times (24 June 1988): 1,4.

Shugart, W.F.; R.T. Tollison; and M.S. Kimenyi. "The Political Economy of Immigration Restrictions." Yale Journal of Regulation 4 (Fall 1986): 79-97.

Slater, C. "How Many Illegal Aliens?" Institutional Socio-Economic Studies Journal 10 (Winter 1986): 23-32.

Spicer, M.W. "Civilization at a Discount: The Problem of Tax Evasion." National Tax Journal 39 (March 1986): 13-20.

U.S. Congress, Committee of the Whole House on the State of the Union. Going to Pot: Marijuana Cultivation on Public Lands and the Federal Response. 100th Congress, 1st Session. Washington, D.C.: U.S. Government Printing Office, 1987.

U.S. Congress, House Committee on the Judiciary. The Immigration Reform and Control Act of 1986: A Summary and Explanation. 99th Congress, 2nd Session. Washington, D.C.: U.S. Government Printing Office, 1986.

U.S. General Accounting Office. Illegal Aliens: Information on Selected Countries' Employment Prohibition Laws. Briefing Report to the Chairman, Subcommittee on Immigration, Refugees, and International Law, Committee on the Judiciary, House of Representatives. Washington, D.C.: U.S. Government Printing Office, 1986.

Weiss, K.R. "Shift from West: Marijuana Growers Taking Root in Southeast.," Sarasota (Fla.) Herald-Tribune (15 March 1987).

Zucker, A. "Minimum Wages and the Long-Run Elasticity of Demand for Low-Wage Labor." Quarterly Journal of Economics 87 (May 1973): 267-77.

Footnotes

[1]For a summary of the new immigration bill, see U.S. Congress, House Committee on the Judiciary (1986).

[2]See, for example, the article by Recio, Flynn, Bernstein, and Staff (1987).

[3]There is evidence that illegal aliens have already begun to revise their expectations about the effectiveness of the new law. Field observations at Canon Zapata, the busiest illegal crossing point along the U.S.-Mexican border, indicate that the flow of illegal immigrants rose 15 percent during the first six months of 1988 to a level approaching that recorded just before the law went into effect in November 1986. Data on border apprehensions by immigration officials show a similar turnaround. See the report by Rohter (1988).

[4]See U.S. General Accounting Office (1985) for commentaries on the effectiveness of laws that govern the employment of alien workers in other nations.

[5]For an analysis of how the opposing positions of business and organized labor have been reconciled to produce small budgets for border enforcement, see Shughart, Tollison, and Kimenyi (1986).

[6]This principle is noted by Spicer (1986) in his analysis of tax evasion. Also see Calvo and Wellisz (1978) for a discussion of the efficiency of discontinuous and unpredictable monitoring to discourage shirking among employees.

[7]INS Commissioner Nelson testified that plans for enforcing employer sanctions involved targeting specific employers for intensive monitoring. See A.C. Nelson, "Statement by Alan C. Nelson, Commisioner, Immigration and Naturalization Service," in U.S. Congress, House Committee on the Judiciary (1983).

[8]The law contains a graduated penalty system. First-time offenses carry a $250 to $2,000 fine for each illegal immigrant hired. By the third offense, the fines can reach as high as $10,000 per alien. Employers convicted of a pattern or practice of violations can also receive a six-month prison term.

[9]See Passel (1986). For a general summary of the literature on estimating the size of the illegal alien population, see Slater (1986).

[10]Seventy percent of the undocumented aliens counted in the 1980 Census were from Mexico, Central America, or South America. The figure would exceed eighty percent if one were to include non-English-speaking immigrants from Europe, Asia, and the Caribbean. See Passel and Woodrow [1984, p.656].

[11]The nonfarm illegal workforce was assumed to be 4 million. This figure was derived by assuming a total population of 7 million and then making allowances for those working in agriculture, those not working at all, and those receiving amnesty.

[12]Regarding the mobility of criminal activities, there is an interesting example in the case of efforts to reduce the cultivation of marijuana. Production has declined in West Coast states, where enforcement has been concentrated, but it has risen in the Northwest and Southeast, where authorities have been less vigilant. See the report by Weiss (1987) and recent testimony offered in "Going to Pot: Marijuana Cultivation on Public Lands and the Federal Response," U.S. Congress, Committee of the Whole House on the State of the Union (1987).

[13]The figure on illegal workers derives from our analysis of the 1980 Census, as previously described. The figure is very similar to the estimate obtained by Passel and Woodrow (1984). They estimate that 81 percent of all illegal aliens reside in the five states named above.

[14]This methodology is similar to the one used by Graetz, Reinganum, and Wilde (1986) and Dubin and Wilde (1988) in their studies of auditing and income tax compliance. In their models, audits have a deterrent effect on income tax evasion. There is also a yield effect of audits, however, so that an increase in compliance levels leads to a decrease in the audit

rate. These two relationships are solved simultaneously to produce equilibrium audit rates and compliance levels.

[15]See McLure (1975) for a general survey of the use of the Harberger model in public finance.

[16]The theoretical relationship is given by

$$\sigma_{IL} = (1/\theta_L)[-\varepsilon_{II}-(\theta_H\sigma_{LH}+\theta_K\sigma_{LK})],$$

where θ_i is the aggregate share of factor $\underline{i}$.

[17]The interested reader can verify this result with the aid of the following information:

(a) Under "LOW" enforcement, there are initially 275 thousand individual establishments in sector A. In the "HIGH" enforcement regime, there are initially 1,544 thousand establishments in sector A and 3,115 thousand establishments in sector B. Source: 1982 Censuses of U.S. Industries.

(b) Given our assumption of a fixed level of output per establishment, the number of establishments in the post-tax equilibrium can be computed by combining the numbers in (a) with the information on $\%\Delta x_j$ provided in Table 3.

(c) The ratio w^2_I/w^1_I in eq.(15) is .57. Because the price effects are small, a similar number can be derived from the information on $\%\Delta r(w_I,p)$ given in Table 3.

[18]This is accomplished by replacing eq.(13) with "$t_A w_I x_A = t^o_A w^o_I x^o_A$," where a "o" over a variable indicates its new value in the base case.

Appendix: Initial Equilibrium Data and Parameter Values

This section further details the sources of data used in the numerical simulations.

Employment shares. The sectoral distributions of employment were obtained from information in the Public-Use Sample of the 1980 Census of Population. The employment distribution for illegal aliens was estimated from data on the industry location of workers who were born outside the United States, spoke English poorly or not at all, and spoke a language other than English in the home. The employment distribution of legal low-skill workers was derived from data on working individuals who were not in the illegal proxy group and had failed to complete high school. Legal high-skill workers were those not in the proxy group with at least a high-school education.

Distributive shares. The computation of distributive shares is complicated by a paucity of data on value-added for nonmanufacturing industries. For each sector, we assumed that labor's aggregate share was equal to 0.6, the ratio of total employee compensation to GNP. Values for the individual labor shares were derived by combining information on employment shares with data on the size of the three labor groups and their relative wages. As stated in n.11, the illegal nonfarm workforce was assumed to be 4 million in 1986. The numbers of legal low-skill and high-skill workers were taken from 1986 BLS data. The wage rate of illegal alien workers was assumed to equal that of legal low-skill workers. As suggested by data in the 1980 Census, the high-skill wage was taken to be 30 percent higher than the low-skill wage.

Elasticities of factor substitution. In selecting values for σ_{LH}, σ_{LK}, and σ_{HK}, we concentrated on studies that had derived their estimates from cost functions rather than production functions. As noted by Hamermesh and Grant (1979, p.520), estimates of Allen elasticities of substitution computed from parameters of a production function tend to have large standard errors. The general results from these studies are that high-skill labor and physical capital are each substitutable for low-skill labor, and that high-skill labor is less substitutable for capital than is low-skill labor. The parameter values shown in Table 2 are consistent with these results and are representative of the magnitudes of the estimated elasticities.

Figure 1

Effect of Employer Sanctions on the Market for Illegal Immigrant Labor

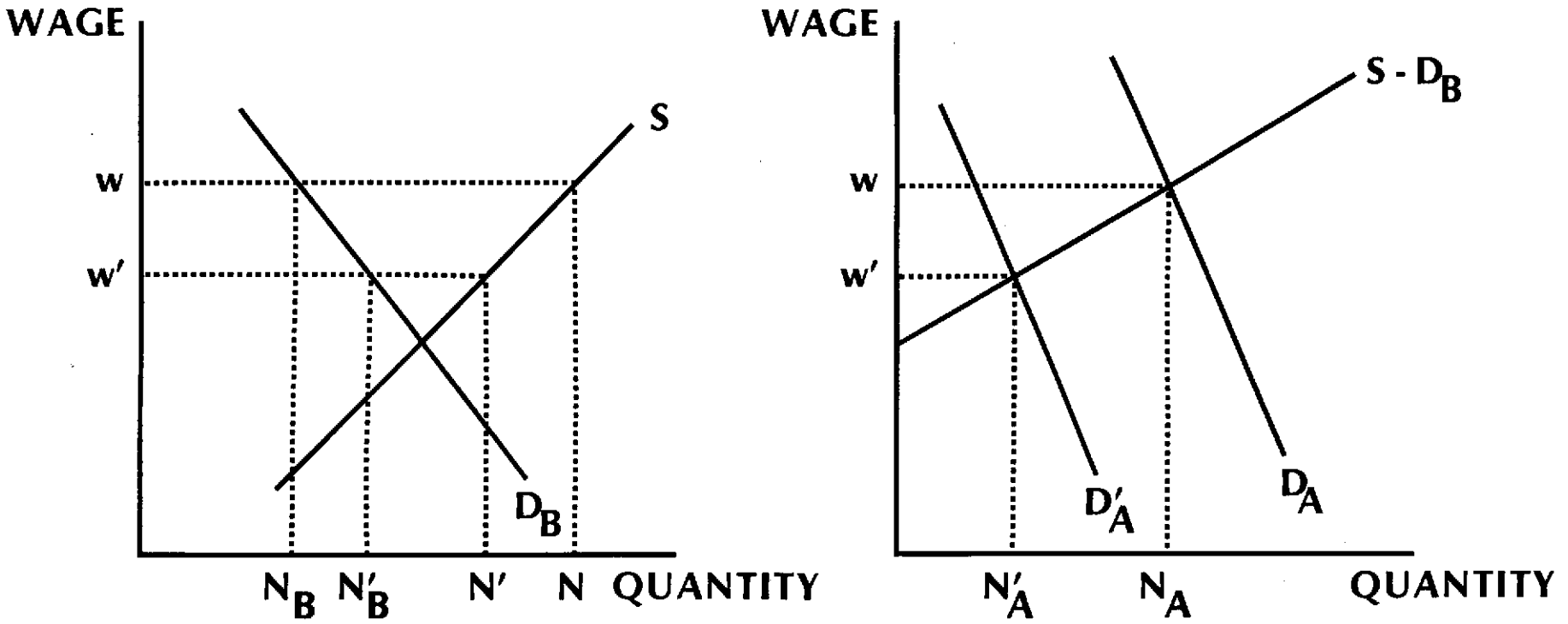

Table 1

ILLEGAL ALIEN WORKERS IN U.S. INDUSTRIES

Industry	Percent of all illegal aliens in nonagricultural employment[1]	Illegal aliens per establishment[2]	Illegal aliens per hundred workers[3]
Canned foods	1.97	37.7	26.0
Leather & footwear	1.81	26.5	25.5
Apparel	11.52	18.9	28.7
Computers	.80	18.4	8.2
Meat products	1.52	16.7	15.6
Grain & bakery products	2.20	13.6	18.2
Transport equipment	2.61	11.0	3.9
Textiles	1.81	10.9	7.1
Primary metals	1.53	8.6	4.7
Hospitals	1.67	8.1	1.4
Furniture & fixtures	2.03	8.1	14.0
Electrical machinery	3.33	8.1	5.7
Paper & allied products	1.09	6.8	6.1
Misc. manufacturing	2.46	6.2	15.7
Chemicals	1.38	4.6	4.2
Rubber & plastics	1.38	4.1	7.9
Beverages & misc. foods	.91	3.6	6.6
Department stores	.87	3.5	1.6
Fabricated metals	2.75	3.1	7.6
Educational institutions	2.46	2.6	1.2
Hotels & motels	2.10	2.4	7.0
Services to buildings	1.30	1.6	3.0
Wholesale grocers	1.45	1.5	7.3
Landscaping	1.01	1.5	13.8
Lumber & wood products	1.09	1.3	5.4
Eating & drinking places	8.04	1.0	5.5
Cleaners	1.01	.9	8.3
Private households	1.96	.8	10.3
Construction	7.03	.6	4.2
Auto repair	1.09	.5	6.1
Retail grocers	1.52	.5	2.4
All other nonfarm industries	26.30	.3	2.1

[1]Estimated using data from the 1980 Census of Population on the industry location of workers who were born outside the United States, spoke English poorly or not at all, and spoke a language other than English in the home.

[2]Computed as the number of illegal alien workers divided by the number of business establishments. Estimates of illegal workers were obtained by multiplying the figures in column one by an estimate of the total number of illegal aliens engaged in nonagricultural employment in 1986. Data on number of business establishments were taken from the 1982 Censuses of U.S. Industries.

[3]Computed as the number of illegal alien workers divided by the total number of workers. Estimates of total workers were made by combining 1980 Census data on the industry location of all U.S. workers with BLS data on total nonfarm employment in 1986.

Table 2

NUMERICAL DATA FOR "MEDIUM" ENFORCEMENT REGIME

Distributive Shares		Employment Shares	
$\theta_{IA} = .03$	$\theta_{IB} = .01$	$\lambda_{IA} = .74$	$\lambda_{IB} = .26$
$\theta_{LA} = .07$	$\theta_{LB} = .05$	$\lambda_{LA} = .61$	$\lambda_{LB} = .39$
$\theta_{HA} = .50$	$\theta_{HB} = .54$	$\lambda_{HA} = .48$	$\lambda_{HB} = .52$

Elasticities of Factor Substitution	
$\sigma_{IL} = 11.8$	$\sigma_{LH} = .75$
$\sigma_{LK} = 1.0$	$\sigma_{HK} = .25$

Table 3

CALCULATED EFFECTS OF SANCTIONS AGAINST EMPLOYERS OF ILLEGAL ALIENS

	Level of Enforcement		
	Low	Medium	High
1. Effective tax rates (percent)			
a. t_A	65	71	321
b. t_B	0	0	105
2. Output effects			
a. $\%\Delta x_A$	-1.4	-1.5	-3.6
b. $\%\Delta x_B$	-.1	.0	-.5
c. $\%\Delta GDP$	-.5	-.7	-2.1
3. Real wage effects			
a. $\%\Delta r(w_I,p)$	-10.6	-19.2	-50.0
b. $\%\Delta r(w_L,p)$	2.6	4.6	12.8
c. $\%\Delta r(w_H,p)$	-1.0	-1.4	-4.1
4. Effects on employment of illegal aliens			
a. λ_{IA}	.48	.74	.74
b. $\%\Delta N_{IA}$	-44	-39	-68
c. $\Delta N_I/\Delta N_{IA}$	.50	.66	.99
d. $\%\Delta N_I$	-11	-19	-50

Table 4

SENSITIVITY RESULTS FOR "MEDIUM" ENFORCEMENT REGIME

	Base Case	Immigrant Supply Less Elastic	Immigrants and Low-Skill Workers Less Substitutable
1. Effective tax rates (percent)			
a. t_A	71	75	69
b. t_B	0	0	0
2. Output effects			
a. $\%\Delta x_A$	-1.5	-1.2	-1.1
b. $\%\Delta x_B$	.0	.1	.1
c. %ΔGDP	-.7	-.6	-.5
3. Real wage effects			
a. $\%\Delta r(w_I,p)$	-19.2	-24.4	-17.0
b. $\%\Delta r(w_L,p)$	4.6	3.7	1.0
c. $\%\Delta r(w_H,p)$	-1.4	-1.1	-1.0
4. Effects on employment of illegal aliens			
a. λ_{IA}	.74	.74	.74
b. $\%\Delta N_{IA}$	-39	-35	-30
c. $\Delta N_I/\Delta N_{IA}$	.66	.50	.77
d. $\%\Delta N_I$	-19	-13	-17