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

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Abstract

This paper assesses the significance of sanctions against employers of illegal aliens for resource allocation and income distribution in the United States. A model is developed to identify the characteristics of industries likely to be monitored most intensively by the immigration authorities. Data from the 1980 Census of Population are then used to measure these characteristics for U.S. industries. Having determined which industries make the best targets for inspection, an incidence analysis is carried out under alternative assumptions about the overall level of enforcement. Estimates are made of the effects of sanctions on aggregate U.S. production, the real wages of native low- and high-skill labor, and the size of the illegal alien work force.

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

After years of debate, the U.S. Congress in 1986 gave its final approval to an immigration bill that radically alters the nature of U.S. immigration laws.[1] The cornerstones of the bill are amnesty provisions for illegal aliens who have resided continuously in the United States since 1982 and sanctions, or penalties, for employers who continue to hire illegal alien workers. The principal objectives of the legislation are to extend to those aliens with a long history of U.S. residency the full array of privileges and opportunities available to other citizens, but to otherwise limit or reduce the alien population by discouraging employers from offering jobs to illegal workers.

The purpose of this paper is to examine the economic consequences of the employer sanctions feature of the new immigration bill. Specifically, we wish to assess the potential significance of the sanctions program for production and wages in the U.S. economy. Our basic approach 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 alien basis.[2] Therefore, if employers know the pattern of enforcement, 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.

In many respects, 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 statutory provisions regarding the pattern of enforcement. It is left up to the immigration authorities to decide which industries to monitor and with what intensity.[3] Unfortunately, there are no public records of employer raids carried out under the old immigration law. Nor are there any plans to document future inspections. Thus, the industry pattern of enforcement must be inferred using indirect methods.

We assume that the immigration authorities allocate their limited inspection resources in a way that maximizes the number of detected violations. In this framework there are two characteristics that are important in determining whether a given industry will be monitored: the number of illegal aliens working at an individual business establishment and the ratio of illegal to total workers employed by firms in the industry. Data from the 1980 Census of Population are used to assess each of these characteristics for U.S. industries thought to employ large numbers of illegal alien workers.

Having determined which industries make the best targets for inspection, we carry out an incidence analysis using alternative assumptions about the overall level of enforcement. For any given level of enforcement, a group of industries is selected for inspection. Monitoring in that sector is assumed to be sufficiently intensive to achieve a complete displacement of illegal workers. Monitoring in the remaining sector, on the other hand, is assumed to be negligible. Higher levels of enforcement are considered by adding to the list of industries targeted for inspection.

Incidence calculations are performed using a general equilibrium model similar to those commonly used in studies of partial factor taxes.[4] Estimates are made of the effects of employer sanctions on aggregate U.S. production, the real wages of native low- and high-skill labor, and the size of the illegal alien work force.

The paper is organized as follows. Section I provides a simple model of the enforcement pattern chosen by the immigration authorities. Industries likely to receive the most frequent inspection are identified. Section II reviews the basic theory of how employer sanctions will affect U.S. labor markets. Section III then provides a numerical analysis of the range of effects that sanctions could have on resource allocation and income distribution in the United States. The principal conclusions of the article are summarized in Section IV.

I. Industry Enforcement Patterns

Given the sheer size of the U.S. economy, it is unlikely that the immigration authorities will receive resources sufficient to completely eliminate illegal alien workers from the economy. This is the case in other countries, where large numbers of illegals remain after the introduction of sanctions.[5] The cost of monitoring increases rapidly as more and more employers are brought under surveillance. And because illegal immigration is a controversial issue, widespread support for a large enforcement budget is difficult to obtain.[6]

Given a limited budget, the immigration authorities must formulate an enforcement strategy. One strategy could be to be unpredictable. Uncertainty about the probability of detection, even if low, can serve as a deterrent.[7] However, experience, as well as the plans of Immigration and Naturalization Service as reported in testimony before Congress, suggests that the authorities will not behave unpredictably.[8] Law enforcement agencies, from the Internal Revenue Service to the local police, display a strong tendency toward predictable emphasis on specific targets.

A. A model of enforcement

We will assume that the industry pattern of enforcement is derived from a Stackleburg-type game between employers and the immigration authorities. Employers take as given their chances of being inspected. They are risk neutral and react to sanctions as they would a tax levied at a rate equal to the fine times the probability of detection. The immigration authorities seek to maximize the number of detected violations subject to a fixed enforcement budget. In doing so, they are assumed to know, and to take into account, the economic adjustments that firms will make in response to different frequencies of inspection.

To develop this problem formally, let v_i denote the fraction of all establishments in industry i to be inspected (i=1,...,M). The v_i will be the choice variables of the authorities. The number of violations detected in industry i can be expressed as $a_i v_i N_i$, where a_i is the number of illegal aliens working at an individual establishment and N_i is the total number of establishments in the industry.

Inspections under the new law take the form of an audit of employee records. The cost of inspecting a single establishment is written as the sum of a fixed component, denoted k_0, and a variable component, which is assumed to be proportional to the total number of employees in the establishment. The variable component is expressed as $k_1(a_i/b_i)$, where b_i denotes the ratio of illegal workers to total workers in industry i. The constraint faced by the authorities is that the sum of all inspection costs not exceed a fixed budget R.

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

$$(1) \quad \underset{v_1,\ldots,v_M}{\text{Max}} \quad \sum_i a_i v_i N_i$$

$$\text{subject to} \quad \sum_i v_i N_i [k_0 + k_1(a_i/b_i)] = R$$

$$0 \le v_i \le 1 \quad i = 1,\ldots,M.$$

Industries are distinguished by three variables: the number of illegal workers per establishment (a_i), the ratio of illegal to total workers (b_i), and the number of establishments in the industry (N_i). The immigration authorities know not only the initial values of these variables, but also how each will respond to different values of v_i. An increase in v_i is equivalent to an increase in the rate of tax on illegal labor. It is reasonable then to expect $a_i' < 0$, $b_i' < 0$, and $N_i' < 0$.

The Kuhn-Tucker conditions for the enforcement problem are

(2) $v_i(\partial Z/\partial v_i) \geq 0$, $(1-v_i)(\partial Z/\partial v_i) \leq 0$, and

$0 \leq v_i \leq 1$ $i = 1,\ldots,M$

where $\partial Z/\partial v_i = a_i N_i \phi_i^{-1}(\phi_i-\mu) - a_i v_i N_i \phi_i^{-1}\{(-N_i'/N_i)(\phi_i-\mu) +$
$(-a_i'/a_i)\phi_i(1-\mu k_1 b_i^{-1}) + (-b_i'/b_i)\phi_i \mu k_1 b_i^{-1}\}.$

In writing $\partial Z/\partial v_i$, we have used the symbol ϕ_i as shorthand for the expression $[(k_0/a_i)+(k_1/b_i)]^{-1}$. In general, ϕ_i represents the average number of violations detected per dollar spent inspecting establishments in industry i. When evaluated at $v_i = 0$, ϕ_i also gives the number of detections made possible from the first dollar spent inspecting the industry.

The term μ in (2) is the Lagrange multiplier that is associated with the budget constraint. It serves to partition all industries into those that will be and those that will not be monitored. Industries receiving some measure of surveillance are those with a value of ϕ_i that, when evaluated at $v_i = 0$, is greater than μ.[9] Two factors determine the initial size of ϕ_i--the initial number of illegal workers per establishment and the initial ratio of illegal to total workers. The larger is either term, the more likely it is that the industry will be monitored.

For industries with establishments that face a probability of inspection that is positive, but less than one, v_i is given by

(3) $v_i = (\phi_i-\mu) \div \{(-N_i'/N_i)(\phi_i-\mu) + (-a_i'/a_i)\phi_i(1-\mu k_1 b_i^{-1})$
$+ (-b_i'/b_i)\phi_i \mu k_1 b_i^{-1}\}.$

Eq.(3) identifies five industry characteristics that jointly determine the optimal frequency of inspection. Two of these--a_i and b_i--measure the intensity with which illegal alien workers are used by individual establishments in the industry. The other three--$(-a_i'/a_i)$, $(-b_i'/b_i)$, and $(-N_i'/N_i)$--indicate how sensitive the key industry variables are to changes in inspection frequencies.

It can be shown from eq.(3) that optimal v_i varies directly with both a_i and b_i. The reason for this is that, when evaluated at a common v_i, the increase in detected violations resulting from an incremental change in inspection expenditures is highest for industries with establishments that employ a large absolute number of illegal workers or a high ratio of illegal to total workers. Thus, it is optimal to inspect these industries with relatively great frequency. On the other hand, detections are low at the margin for industries that display a large percentage response in either a_i, b_i, or N_i to increased frequencies of inspection. Surveillance in these industries will tend to be less thorough.

B. Estimates of targeted industries

In establishing which U.S. industries are likely to be monitored most intensively by the immigration authorities, we concentrate on two of the industry characteristics identified as being important in the previous section: the initial number of illegal alien workers per business establishment and the initial ratio of illegal to total workers employed in the industry. Estimates of these characteristics are 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 1970's. Census Bureau research places the number of illegal aliens in the country in 1986 between 3 and 5½ million.[10] This range is based on a count of the illegals represented in the 1980 Census together with an estimate of the rate of illegal immigration during the 1980's. 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. Nevertheless, after adjusting for a possible downward bias in the Census figures, it seems reasonable to use 6 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. Not all of the individuals in this group were illegal aliens. Nor was the Census Bureau able to interview all illegals, despite a special effort to obtain information on noncitizens. However, because the two groups have similar skills and handicaps, their industry employment distributions should be similar.[11]

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 targeted 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 30 industries shown in Table 1. Together these industries
accounted for 73 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 illegals engaged in nonfarm
employment, 48 percent are in manufacturing and 38 percent are in
service-producing industries (not shown). The four largest employers are
apparel manufacturing, restaurants, construction, and food processing.

It is not necessarily the industries that employ large absolute numbers
of illegal aliens that will draw the most attention from the immigration
authorities, however. Surveillance is more likely to be focused on
industries with a large number of illegal workers at an individual
establishment or a large ratio of illegal to total workers. Estimates of
these industry characteristics are shown in the second and third columns 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.[12] The absolute employment
figures were then standardized using data on number of business
establishments and total workers.

First note the wide range obtained for the number of illegal workers per establishment. For example, 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: that enforcement of sanctions will not be uniform across industries and that it will prove increasingly expensive for the authorities to monitor additional employers.

The figures in the table also reveal that manufacturing industries are predominant among industries with a large number of illegals at the 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, illegals in manufacturing will be displaced more extensively than illegals in other sectors of the economy, such as construction and services.

Industries with a large number of 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 .77. Alternatively, of the 15 industries with 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. Our assessment of these results is that, if the object of the analysis is to determine the effects of sanctions on the general level

of production and wages in the economy, then little is lost by focusing exclusively on the number of aliens per establishment as the characteristic used to group industries into those that will and those that will not be monitored under alternative enforcement regimes.

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 labor groups.

The primary impact of employer sanctions is on the market for 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 is comprised of 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 from 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 industries in sector A.

The effect of sanctions is to reduce the demand for illegal labor in sector A. This drives down the net immigrant wage from w to w'. Given the expected penalty, the cost of illegal labor is still higher for industries in sector A. As a result, $(I_A - I_A')$ workers are displaced. $(I-I')$ of these withdraw from the national market. The remaining $(I_B' - I_B)$ find employment in sector B.

From a public policy viewpoint, it is the flow of workers between sectors of the national economy that is particularly noteworthy. Not all of those displaced from the enforced sector end up leaving the country. The immigration policy then appears more effective than it really is. The single-market model outlined above can be used to uncover the economic parameters that bear crucially on the way the displaced workers are allocated between countries.

(4) $dI/dI_A = \eta/(\eta - \lambda_B \varepsilon_B)$

Eq.(4) expresses the number of illegal workers leaving the national labor market as a fraction of the total number of workers displaced from the enforced sector. The value of dI/dI_A is seen to depend upon three parameters: the elasticity of supply of illegal labor (η), the share of illegal workers employed in the unenforced sector (λ_B), and the elasticity of demand for illegal labor in the unenforced sector (ε_B). The direction of influence each parameter has on the solution is straightforward. The more responsive is the supply of immigrant labor to a decline in wages, the greater the share of the displaced workers who withdraw from the national

labor market. On the other hand, if a large fraction of illegal workers are employed in the unenforced sector and the capacity of that sector to absorb additional workers is high, as measured by a large elasticity of demand, then a greater number of the workers who leave the enforced sector find jobs in the unenforced sector.

In addition to their effect on immigrant labor supply, there is considerable interest in the way employer sanctions will 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 assume that legal and illegal workers are costlessly distinguished. This means that the wages of legal workers will only be altered through normal channels of input substitution.

To keep things simple, consider a model in which there are only two markets: the market for illegal workers and a market for a competing group of legal workers, referred to as 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 low-skill 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 low-skill wage may either rise or fall.

The tension in the low-skill labor market can be resolved with the aid of comparative statics. The solution given below has been simplified by assuming that demand elasticities are the same across sectors and that low-skill labor is in fixed supply.

(5) $dw_L/dt = \varepsilon_{LI}[w_L/(1+t)][\lambda_{LA}(\eta-\varepsilon_{II}) + \lambda_{IA}\varepsilon_{II}] \div$
$[-\varepsilon_{LL}(\eta-\varepsilon_{II}) - \varepsilon_{LI}\varepsilon_{IL}]$

In the above equation, w_i denotes the wage of labor group i, "t" the effective rate of tax on illegal labor, λ_{ik} the fraction of labor group i employed in sector k, and ε_{ij} the elasticity of demand for factor i with respect to the price of factor j. The subscripts I and L refer to illegal and low-skill labor, respectively. Market stability requires that the denominator in eq.(5) be positive. The direction of change in the low-skill wage then hinges on the sign of the numerator. The degree of substitutability between illegal and legal labor, ε_{LI}, clearly plays an important role in the solution. The remaining terms indicate that the low-skill wage is more likely to rise the larger is the elasticity of supply of illegal labor and the larger is the enforced sector's share of low-skill labor in relation to its share of illegal labor.

III. Incidence Analysis

The purpose of this section is to provide a numerical analysis of the effects of employer sanctions on resource allocation and income

distribution in the United States. The analysis is based on a simple general equilibrium model similar to the one that has been used to study, among other things, the incidence of the corporate income tax [Harberger (1962)], the distributional consequences of unionism [Johnson and Mieszkowski (1970)], and the general trends in American earnings during the twentieth century [Williamson and Lindert (1980)].

A. The model

The general model contains two sectors of production. Sector A consists of all sanctionable industries. Sector B comprises all other nonagricultural industries, with enforcement there considered negligible. Each sector employs four factors of production: illegal immigrant workers (I), native low-skill labor (L), native high-skill labor (H), and capital (K). Production in each sector is governed by constant returns to scale, and all markets are competitive. Incidence is determined by treating the sanctions program as a partial tax levied on the use of illegal labor by firms in sector A.

We follow Jones (1965) in choosing notation and the mathematical form of the equilibrium conditions. The equations shown below are obtained by linearizing the system about the initial undistorted equilibrium.

$$(6) \qquad \omega\hat{p} = \hat{x}_A$$

$$(7) \qquad \sum_k \lambda_{Ik}(\hat{x}_k + \sum_j \varepsilon_{Ij}^k \hat{w}_j) + \lambda_{IA}\varepsilon_{II}^A dt = \eta(\hat{w}_I - \alpha\hat{p})$$

(8)-(9) $\sum\limits_{k} \lambda_{ik}(\hat{x}_k + \sum\limits_{j} \varepsilon_{ij}^{k}\hat{w}_j) + \lambda_{iA}\varepsilon_{iI}^{A}dt = 0$ $i = L,H$

(10) $\hat{w}_K = \alpha\hat{p}$

(11) $\sum\limits_{j} \theta_{jA}\hat{w}_j + \theta_{IA}dt = \hat{p}$

(12) $\sum\limits_{j} \theta_{jB}\hat{w}_j = 0$

The equations of the model are expressed in rates of change, with a "∧" over a variable denoting a percentage change. The endogenous variables are the outputs of the two sectors (denoted x_k with k=A,B), the four factor rewards (denoted w_j with j=I,L,H,K), and the price of good A. All financial variables are defined in terms of good B which serves as a numeraire. There are three sets of elasticity parameters: the compensated elasticity of demand for product A (ω), the wage elasticity of supply of illegal immigrant labor (η), and the output-constant elasticity of demand in sector k for factor i with respect to the price of factor j (ε_{ij}^{k}). The remaining notation is as follows: λ_{ik} is the fraction of factor i absorbed by sector k, θ_{jk} the distributive share awarded to factor j in sector k, α the share of aggregate consumption accounted for by products in sector A, and "t" the effective tax rate expressed as a percent of the initial illegal wage.

Eq.(6) is the equilibrium condition for product market A. The equation

gives the change in relative product prices required to adjust demand in the face of changes in production in sector A. Ignored are any changes in real income that may contribute to a shift in the demand for product A.[13]

Eqs.(7)-(9) are full employment conditions for the three labor markets. The left-hand side of each equation details the relative change in the economy-wide demand for the particular labor group. The change in labor demand in a given sector consists of an output effect (equal to the relative change in production) and a sum of factor substitution effects (each expressed as the product of a demand elasticity and the relative change in the cost of the factor). The right-hand side of each equation gives the change in the relevant labor supply. In the case of illegal aliens, labor supply responds directly to changes in the real wage. The supplies of native workers, on the other hand, are assumed fixed.

The supply of capital is assumed to be perfectly elastic with respect to real earnings. 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.(10) where the real return to capital is held constant.

Eqs.(11)-(12) require that distributive-share weighted sums of the relative changes in factor prices equal the relative changes in product prices. These conditions follow from the assumptions that markets are competitive and that production techniques are chosen to minimize unit costs.

B. Data and parameter values

An appendix offers a complete discussion of all the information needed to solve the equations of the model. Here we focus on two sets of parameters: the elasticity of immigrant supply and the elasticities of factor substitution. These parameters are especially crucial in gauging the extent to which employer sanctions achieve their expected results.

Elasticity of immigrant 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.

Elasticities of factor substitution. The elasticities of factor demand that figure so prominently in eqs. (7)-(9) reflect the extent of technical substitution possible among factors of production. Indeed, for $i \neq j$, ε_{ij}^k is simply $\theta_{jk}\sigma_{ij}^k$, where σ_{ij}^k denotes the Allen elasticity of substitution between factors i and j. Given the adding-up condition $\sum_j \varepsilon_{ij}^k = 0$, it is clear that each ε_{ii}^k can also be expressed in terms of the σ_{ij}^k. Thus, to evaluate the elasticities of factor demand we require estimates of elasticities of factor substitution for all pairs of factors.

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 the elasticities of substitution between native low-skill labor, native high-skill labor, and capital. Nevertheless, there are two deficient areas in the literature. First, estimates of substitution elasticities are generally not available by detailed industry. Therefore, the chosen estimates were assumed to apply to all sectors of 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 native 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 native 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 information on ε_{II}, the output-constant own-price elasticity of demand for illegal labor.[14] 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)]. Since 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.

So that the reader may have a better feel for the data, Table 2 shows all of the information used to solve eqs.(6)-(12) for the intermediate 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 for cases where factors are highly substitutable for illegal labor, it also means that changes in the cost of illegal labor will have only moderate effects on the earnings of other factors.

Also noteworthy is the fact that industries in the enforced sector employ a 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 low-skill wage that occurs in response to employer sanctions. So, while a pattern of selective enforcement may constitute an efficient use of inspection resources and be optimal with regard to achieving reductions in the illegal working population, it tends to undermine whatever success sanctions may have in raising the living standards of competing native workers.

C. Results for different levels of enforcement

Table 3 reports simulation results for three enforcement regimes. In a "LOW" enforcement regime, monitoring is assumed to be limited to the industries in Table 1 that employ an average of 8 or more illegal aliens per business establishment. This group of industries initially accounts for 33 percent of all illegals employed in nonfarm occupations. In a "MEDIUM" regime, enforcement is extended to industries with at least 2 illegals per establishment. Together these industries absorb 49 percent of the illegals. Finally, in a "HIGH" enforcement regime, all of the industries in Table 1 are assumed to be sanctionable. These industries initially account for 73 percent of the nonfarm illegal work force.

In each enforcement regime, surveillance is assumed to be sufficiently thorough to eliminate all illegal workers from the enforced sector. The tax rates shown in Table 3 are the implicit rates required to achieve this result. Each rate is expressed as a percent of the initial illegal wage.

When enforcement is "LOW", sanctions have very small effects on production and wages. A weighted average of the changes in sectoral outputs shows only a 0.5-percent decline in gross domestic product. The real low-skill wage rises--a result that is expected and desired by most supporters of immigration reform--but it rises only 2.7 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 total value added. Another is the fact that, in the "LOW" enforcement regime, sanctions reduce the supply of illegal workers by only 16 percent. Even though 33 percent of illegal nonfarm workers are originally employed in sanctionable industries, only one-half of these withdraw from the U.S. labor market. The other half find work in industries of the economy where enforcement is weak. This does not mean that it would be more efficient for the immigration authorities to deploy their limited resources inspecting all establishments with equal frequency. But when coverage is not complete, the sanctions will appear more effective than they really are.

If enforcement is "MEDIUM", sanctions have a larger, but still moderate effect on the economy. It is only when enforcement is "HIGH" that the sanctions produce significant results. In this case, the nonfarm illegal work force is reduced by 52 percent and the real low-skill wage rises by 9 percent. Of course, a greater administrative effort is required to achieve these results. To see what is involved, suppose that the probability of detection can be represented by the ratio of total inspections to total number of establishments in the enforced sector. Then, for any enforcement regime i, the effective tax rate expressed as a percent of the initial illegal wage rate is given by $t_i = (f_i/w)(E_i/N_i)$, where f_i is the fine per detected violation, E_i the inspection budget, and N_i the number of establishments in the enforced sector. By making use of this relationship, we can compare the enforcement efforts implicit in any two regimes.

(13) $(f_1/f_0)(E_1/E_0) = (t_1/t_0)(N_1/N_0)$

Table 3 provides information on implicit tax rates and number of establishments for each of the enforcement regimes. When this information is inserted into eq.(13), we reach a striking conclusion: to move from "LOW" to "HIGH" enforcement, and to thereby achieve a 52-percent rather than 16-percent reduction in the illegal working population, requires either a 23-fold increase in the fine, a 23-fold increase in the number of worksite inspections, or some combination of the two. 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 most 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.

D. 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, we have used the base-case tax rate in each sensitivity experiment. This ensures that the enforcement budget is the same in all cases.

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 illegal workers are induced to leave the U.S. labor market. Considering that our original assessment of the immigrant supply elasticity was generously high, it is quite possible that reductions in the illegal working population will prove even more difficult to achieve 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 output-constant 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 native low-skill workers are greatly reduced. The real low-skill wage rises by only one-fourth the amount it did in the base case. It also becomes more expensive to gain compliance within the enforced sector. This illustrates the basic principle of tax theory that the more inelastic is demand, the larger is the tax needed to achieve a given quantity reduction.

IV. Conclusions

With more than 4 million business establishments subject to sanctions under the new immigration law, it is unlikely that enforcement will be sufficiently complete 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 to absorb significant numbers of displaced aliens. Simulation results for cases of incomplete enforcement indicate that as many as one-half of the workers displaced from the enforced sector may 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 native workers in low-skill occupations. Improvements in their living standards are not likely to be large, however. Our numerical results suggest that even if enforcement is vigorous enough to reduce the nonfarm illegal population by one-half, the average real wages of native workers with less than four years of high school will rise by less than ten percent. The costs of

immigration reform will be borne primarily by high-skill workers. 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 legislation achieving expected results. For example, we assumed that employers could easily distinguish between legal and illegal workers. This ensured that reductions in the illegal labor force would bring about some improvement in the living standards of competing native workers. However, strong opposition to sanctions has been voiced by Hispanics who are concerned that the law will lead to racial discrimination in hiring. This pressure may lead to an enforcement strategy that is less selective and efficient. It may also cause the immigration authorities and the courts to be lenient on employers who hire illegals bearing counterfeit documents. Developments along either of these lines would make sanctions less effective. Nevertheless, given the nature of our findings (i.e., that significant reductions in the illegal labor force will be expensive to obtain and that any increases in the general level of wages of low-skill native workers will be modest), the fact that our assumptions were conservative only serves to strengthen the basic thrust of the conclusions.

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Footnotes

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

[2]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.

[3]Enforcement responsibilities are divided between the Department of Labor and the Immigration and Naturalization Service.

[4]See McLure (1975) for a survey of the use of general equilibrium models in tax incidence analysis.

[5]See U.S. General Accounting Office (1985) for a compilation of commentaries on the effectiveness of laws that govern the employment of alien workers in Hong Kong, Canada, and several European nations.

[6]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).

[7]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.

[8]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).

[9]To see this, evaluate $\partial Z/\partial v_i$ at $v_i=0$. The resulting expression will be positive if and only if ϕ_i is greater than μ.

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

[11]See Pearce and Gunther (1985) for further evidence supporting the use of the Census group as a proxy for illegal immigrants.

[12]The nonfarm illegal work force was assumed to be 4 million. This figure was derived by assuming a total population of 6 million and then making allowances for those working in agriculture and those not working at all.

[13]If sector A consists primarily of tradeable goods industries, as it does here, the relevant income concept is real _world_ income. World income will fall if employer sanctions serve to interrupt an international labor movement that is welfare-promoting. But deadweight losses such as these typically prove small in calculation.

[14]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 i.

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 native 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. Native 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 noted in section I, the current nonagricultural work force of illegal aliens was assumed to be 4 million. The numbers of 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 native 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 indicative of the magnitudes of the estimated elasticities.

Other parameters. Our selection of the elasticity of immigrant supply was discussed in section III. The compensated elasticity of demand for products from the enforced sector was assumed to be 1.0. The moderately high value for this parameter reflects the predominance of manufacturing industries in the enforced sector. Because of an absence of detailed consumption data, the parameter α used to compute changes in real wages was measured by the percent of total nonagricultural employment accounted for by the enforced sector.

Figure 1
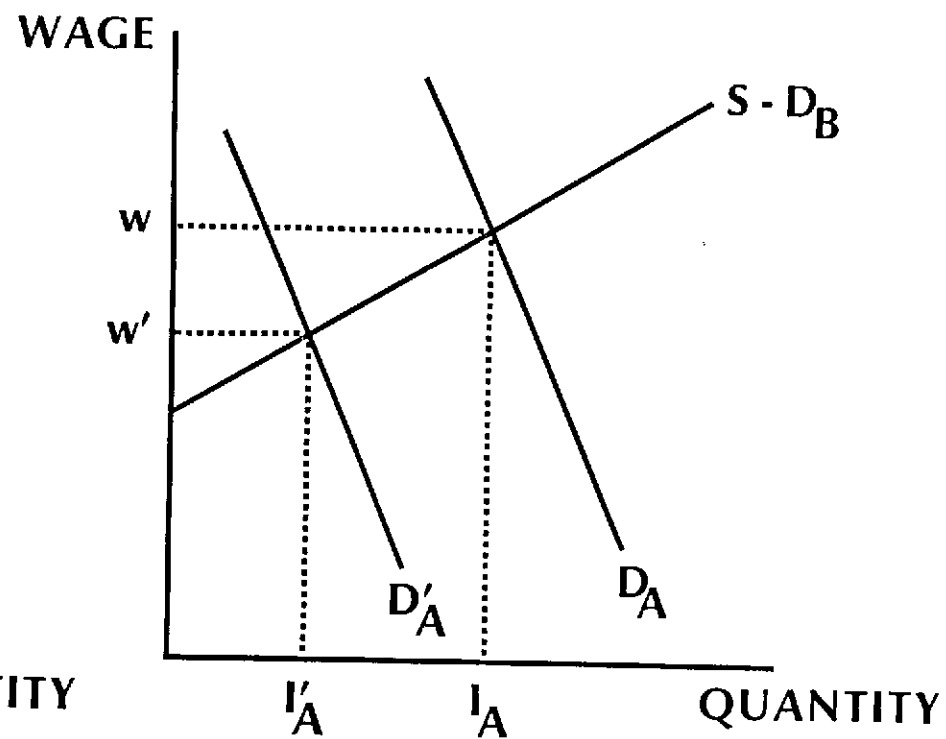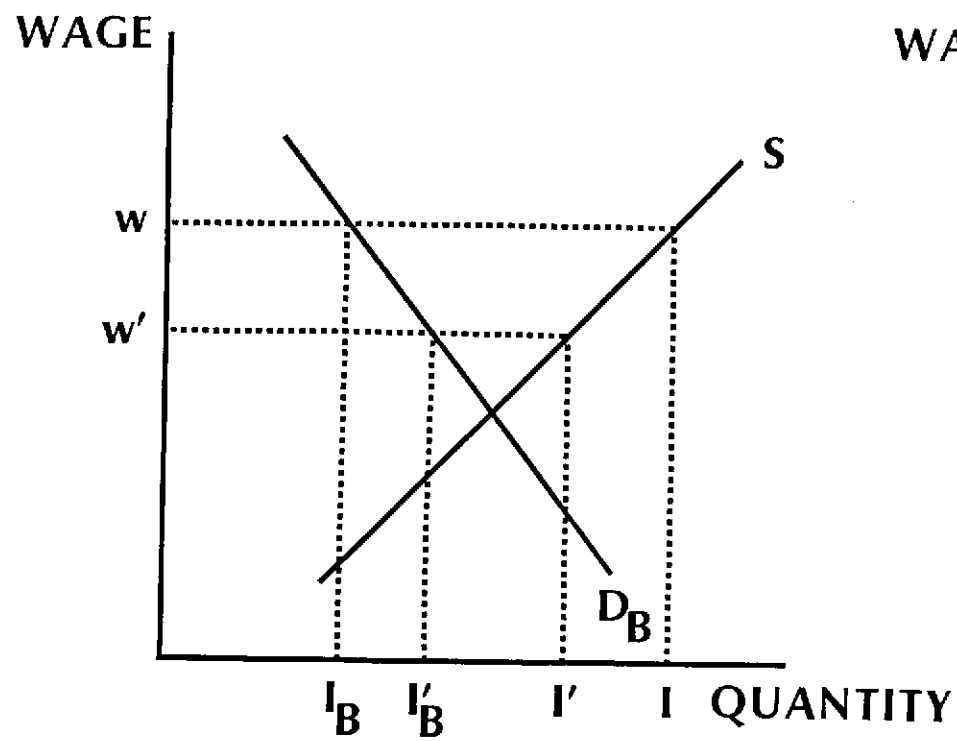## Effect of Employer Sanctions on the Market for Illegal Immigrant Labor

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	1.83	26.8	25.9
Apparel	11.64	19.1	28.9
Computers	.81	18.5	8.4
Meat products	1.54	17.0	15.9
Grain & bakery products	2.23	13.8	18.6
Transport equipment	2.64	11.2	3.9
Textiles	1.83	11.0	7.1
Primary metals	1.53	8.7	4.7
Hospitals	1.68	8.2	1.4
Furniture & fixtures	2.05	8.2	14.0
Electrical machinery	3.37	8.2	5.7
Paper & allied products	1.10	6.9	6.1
Misc. manufacturing	2.49	6.3	15.9
Chemicals	1.39	4.7	4.3
Rubber & plastics	1.39	4.1	7.9
Beverages & misc. foods	.92	3.7	6.6
Department stores	.88	3.5	1.6
Fabricated metals	2.79	3.1	7.7
Educational institutions	2.49	2.6	1.2
Hotels & motels	2.12	2.4	7.1
Services to dwellings	1.32	1.7	3.0
Wholesale grocers	1.46	1.5	7.3
Lumber & wood products	1.10	1.3	5.4
Eating & drinking places	8.13	1.0	5.6
Cleaners	1.02	.9	8.3
Private households	1.98	.8	10.4
Construction	7.10	.6	4.2
Auto repair	1.10	.5	6.2
Retail grocers	1.54	.5	2.4

[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	
$\theta_{IA} = .03$	$\theta_{IB} = .01$	$\lambda_{IA} = .49$	$\lambda_{IB} = .51$
$\theta_{LA} = .06$	$\theta_{LB} = .06$	$\lambda_{LA} = .30$	$\lambda_{LB} = .70$
$\theta_{HA} = .51$	$\theta_{HB} = .53$	$\lambda_{HA} = .32$	$\lambda_{HB} = .68$

Elasticities of Factor Substitution and Other Key Parameters			
$\sigma_{IL} = 11.8$	$\sigma_{LH} = .75$	$\omega = -1.0$	
$\sigma_{LK} = 1.0$	$\sigma_{HK} = .25$	$\eta = 1.0$	$\alpha = .32$

Table 3

NUMERICAL ANALYSIS OF SANCTIONS AGAINST EMPLOYERS OF ILLEGAL ALIENS

	Level of Enforcement		
	Low ($\lambda_{IA}=.33$)	Medium ($\lambda_{IA}=.49$)	High ($\lambda_{IA}=.73$)
Percent Change In:			
Aggregate output	-0.5	-0.7	-1.4
Real illegal wage	-15.9	-27.1	-52.3
Real low-skill wage	2.7	3.8	8.6
Real high-skill wage	-.8	-1.3	-2.4
Illegal labor supply	-15.9	-27.1	-52.3
Effective Tax Rate (percent)	78	94	117
Establishments in Enforced Sector (thousands)	99	275	1516

Table 4

SENSITIVITY RESULTS FOR "MEDIUM" ENFORCEMENT REGIME

	Base Case	Immigrant Supply Less Elastic	Immigrants and Low-Skill Workers Less Substitutable
Percent Change In:			
Aggregate output	-0.7	-0.5	-0.6
Real illegal wage	-27.1	-34.0	-23.5
Real low-skill wage	3.8	2.8	.8
Real high-skill wage	-1.3	-1.0	-1.1
Illegal labor supply	-27.1	-17.0	-23.5
Employment of illegals in enforced sector	-100.0	-89.5	-72.3