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## 2 Undocumented Mexican-born Workers in the United States: How Many, How Permanent?

George J. Borjas, Richard B. Freeman, and Kevin Lang

Few issues in the area of immigration to the United States generate as much concern and confusion as the influx of illegal aliens. Estimates of the number of illegal immigrants vary widely. Some observers, noting the explosive growth of Border Patrol apprehensions of aliens to over a million a year, have suggested that the country has harbored five to ten million or more undocumented residents.<sup>1</sup> Others, relying on 1980 Census of Population and related demographic data, put the numbers on the order of two to three million in that year.<sup>2</sup> Some think that illegal aliens are largely transient agricultural workers, slipping across the Mexican border for seasonal work. Others stress the permanence of many illegal aliens, who have sufficiently long stays in the United States to be eligible under the 1986 Immigration Reform and Control Act to attain legal resident status. In light of the difficulties in analyzing illegal immigration, one recent reviewer has written that the issue is “inaccessible to accurate measurement” with no “firm evidence” ever likely to become available (Teitelbaum 1986, 153).

In this paper, we take a more positive approach, analyzing three government data sets and a small survey of illegal aliens in the San Diego area in an effort to evaluate conflicting claims about the illegal Mexican-born migrant population.

Among the government data sets we analyze is, first, the 1980 U.S. Census

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of Population figures on the number of Mexican-born residents of the United States. As pointed out by Warren and Passel (1987), the Mexican-born population in the 1980 Census exceeds by over one million the number of legal immigrants expected in the Census on the basis of Immigration and Naturalization Service (INS) records. We build on the Census analysis by tabulating the family composition and economic characteristics of the nonnaturalized Mexican born most likely to be illegal. Second, we analyze vital statistics on the number of deaths of Mexican-born persons and of births to Mexican-born mothers in the United States. Under specified assumptions, these data provide us with independent estimates of the size and growth of the illegal Mexican population. Third, we analyze INS figures on apprehensions of illegal aliens. We relate these figures to Border Patrol expenditures and measures of economic incentives to migrate and examine the seasonality of apprehensions to make inferences about the growth and nature of border crossings. In addition, we examine the consistency between the level of apprehensions and Census/*Vital Statistics*-based estimates of the size of the illegal Mexican population.

Our original data consist of a survey of 289 illegal Mexican male aliens in fourteen locations around San Diego obtained during the summer of 1986. We use these data to estimate time spent in the United States and apprehensions by the Border Patrol per crossing as well as to determine the characteristics of this part of the illegal alien population.

Our principal findings are as follows.

1. The number of illegal Mexican aliens in the United States in 1980 was on the order of 1.8 million. In addition to the approximately 1.1 million illegal Mexican immigrants counted in the Census, there were perhaps 600,000–700,000 illegal Mexican immigrants not counted in the Census, giving a total illegal Mexican migrant population of less than two million. Births to Mexican-born women and deaths of Mexican-born persons suggest that the illegal population may have increased to 2.0–2.3 million by 1984.

2. The explosive growth of Border Patrol apprehensions is due in substantial part to increased Border Patrol activity, making the growth of apprehensions an upwardly biased estimate of the growth of illegal border crossings and a poor indicator of the growth of the illegal Mexican migrant population. Moreover, the seeming inconsistency between the 750,000–1,000,000 plus annual apprehensions and the estimate of fewer than two million illegals in 1980 appears to be due partly to short-term migrants who cross the border and generate apprehensions frequently but whose spells in the United States contribute less than a person-year to the stock of illegals.

3. The bulk of illegal Mexican aliens in the Census of Population live with their families, are engaged in work activities beyond agricultural labor, and have other characteristics suggesting that they are relatively permanent residents in the country. The earnings of these persons are considerably below those of other Mexican-born residents, but measures of work experience are similar.

The difference between the relatively permanent illegal immigrants who seem to constitute the bulk of those counted in the Census and the more itinerant who cross the border frequently (and are covered in our survey in San Diego) may reflect a life-cycle change to illegal alien migration, as new young migrants come first without their families, go back often at holidays or at breaks in seasonal jobs, but later bring their families to the United States and move toward permanent residence. On the other hand, it may also reflect a substantial difference between permanent immigrant and sojourner populations.

## 2.1 Estimating the Size and Growth of the Illegal Mexican Population

One of the more surprising facts about the 1980 Census of Population documented by Warren and Passel (1987) is that the Census counted a sizable number of illegal Mexican-born migrants (see table 2.1). In part, this results from the fact that, "for the 1980 Census, the Bureau of the Census made extra efforts to count difficult-to-enumerate groups such as undocumented aliens" and had sufficient success that the Bureau's evaluation of population estimates turned up "a large national error of closure between the 1970 and 1980 Censuses" (U.S. Bureau of the Census, *Population Growth and Distribution*, 3, 7). Our tabulations of the 1980 Census in table 2.1 show that 2.18 million Mexican-born persons (exclusive of native Americans born in Mexico) were counted, of whom 1.67 million reported that they were not citizens as of the date of the survey. According to Warren and Passel (1987), who used INS

**Table 2.1** Size of the Mexican-born Population in the 1980 Census of Population

Group	<i>N</i>	%
Reporting as born in Mexico:		
1. Total	2,182,900	100.0
2. Naturalized citizens	509,400	
3. As percentage of total		23.3
4. Not a citizen	1,673,500	
5. As percentage of total		76.7
Illegal immigrants from Mexico:		
6. Estimated number	1,130,000	
7. As percentage of total		51.8
8. As percentage of noncitizens		67.5
9. As percentage of noncitizens arriving after 1970		103.6

Sources: Lines 1–5 tabulated from the Public Use Sample of the U.S. Census of Population, the A Sample (5%). Line 6 from Warren and Passel (1987).

figures on legal alien entry to the United States (modified in various ways) to estimate the number of legal migrants and, as a residual, the number of illegals, the 1980 Census counted 1.13 million illegal Mexican-born aliens. This is more than half the total reported (line 1) and two-thirds of those who were not citizens (line 4), implying that the Census data can be used to make inferences about the characteristics of a large number of illegal Mexican-born aliens. Going a step further, note that the figure of 1.09 million Mexican-born noncitizens in the Census who came after 1970 is approximately equal to Warren and Passel's estimated number of illegal aliens. Given that relatively few illegal Mexican aliens are likely to have come to the United States prior to 1970 and that many legal immigrants are likely to have become citizens, one can reasonably treat Mexican-born noncitizens who came after 1970 as a population dominated by likely illegals, as we do in section 2.3.

These conclusions are, of course, affected by the fact that the counts provided by the 1980 U.S. Census of Mexican nationals and of naturalized Mexicans are measured with error. It is well known, for instance, that naturalization rates calculated from individual responses to the Census questionnaire greatly overstate the naturalization rates recorded by the official INS documents. The careful study of the 1980 Census data by Warren and Passel, however, attempts to correct the counts for errors in misreporting both of country of birth and of citizenship status. Using these corrected population counts in our analysis does not alter the qualitative nature of any of our conclusions and does not greatly affect the order of magnitude of the statistics reported in table 2.1.

How many illegal Mexican migrants might be missed in the Census count—one million, two million, ten million?

To provide an answer to this important question, we make use of two pieces of data from the *Vital Statistics of the United States*: the number of deaths of persons of Mexican birth and numbers of births to Mexican-born women. Assuming, as seems reasonable, that mortality and birth data are more complete than the Census count of the population, we expect to find more deaths/births for the Mexican born than the counted population could plausibly generate.<sup>3</sup> Given assumptions about true death and birth rates, the "excess" deaths or births will yield estimates of Census undercounts and thus of the true population. Algebraically, the structure of our analysis can be most simply seen in the following accounting equation:

$$(1) \quad R_i = r_i(\text{POP}_i) + r'_i (\text{HPOP}_i),$$

where  $R_i$  = number of events, deaths or births, in *Vital Statistics*,  $r_i$  = the true rate of occurrence of events to the measured population,  $r'_i$  = the rate of occurrence of events to the hidden population,  $\text{POP}_i$  = measured population,  $\text{HPOP}_i$  = hidden population, and  $i$  indexes an age/sex group. Then  $\text{HPOP}_i = (R_i - r_i\text{POP}_i)/r'_i$  provides an estimate of the undocumented population of age  $i$ .

The accuracy of estimates of the hidden or undocumented population based on (1) depends on two factors: the extent to which funeral directors and hospitals accurately record country of origin on death and birth forms and the accuracy of the postulated “true” death or birth rates for the measured population and the hidden population. While there may be some tendency for friends and relatives of illegal aliens to disguise country of origin, the head of Registration of Methods of the Public Health Service informed us that in his opinion these records are no less accurate for illegal aliens than for other groups, leading us to discount this potential source of error.<sup>4</sup> The problem, then, is to estimate “true” birth or death rates for the undocumented population. Our approach is to assume that the rates for the undocumented are the same as those for the population as a whole (death rates) or for the documented migrant population (birth rates). This approach yields the following formula for estimating the hidden population:

$$(2) \quad \text{HPOP}_i = R_i / r_i - \text{POP}_i.$$

If, as seems reasonable, Mexican-born immigrants have higher death rates than native Americans ( $r'_i > r_i$ ), estimates of the uncouneted population based on national death rates will provide an upper bound to the population. Similarly, if undocumented Mexican-born women have higher birth rates than documented immigrants, estimates of the hidden population based on national birth rates will also provide an upper bound to the number of undocumented Mexican-born female migrants.<sup>5</sup>

### 2.1.1 Mortality of the Mexican Born

Since 1979, *Vital Statistics* has published data on the number of deaths of the Mexican-born persons in the United States. Beginning in 1984, data are also available by age, allowing us to use equation (1) above to estimate the likely number of such persons by age. Columns 1–2 of table 2.2 record the basic data for this analysis: the number of deaths to Mexican-born persons in the United States by age (col. 1) and the 1984 mortality rates for all Americans by age (col. 2). Assuming that the U.S. mortality rate represents the true death rate for the Mexican born, we obtain the estimated 1984 population of Mexican-born persons by age in column 3. Summing down the column gives an estimated total population of 2.97 million persons. As we expect the mortality of the Mexican born to be higher than that of native Americans, this is likely to be an upper bound to the true number.

To use our 1984 estimates to obtain estimates for 1980 when the Census was conducted, we must adjust them for potential changes in the Mexican-born population from 1980 to 1984. According to *Vital Statistics*, the number of deaths of Mexican-born persons rose from 13,180 in 1980 to 14,050 in 1984, suggesting that the population may have been 6.6% higher in 1984 than in 1980. By this calculation, the Mexican-born population in 1980 was about 2.8 million persons, which implies that the Census missed 600,000–700,000

**Table 2.2 Mortality and Undocumented Mexican-born Population Estimated from Deaths of the Mexican Born**

Age Group	1984	1984 U.S.	1984	1980	"Uncounted"
	Deaths (1)	Mortality Rate/ 100,000 (2)	Mexican-born Population (3)	Population (4)	Mexican Born (5)
< 1	16	1,085.6	1,500	7,800	-6,300
1-4	39	51.9	75,100	52,300	22,800
5-14	70	26.7	262,000	271,000	-9,000
15-24	922	96.8	952,000	516,000	436,000
25-34	1,093	121.1	902,600	551,800	350,800
35-44	742	204.8	362,000	310,000	52,000
45-54	819	521.1	157,000	186,000	-29,000
55-64	1,252	1,287.8	97,200	126,000	-28,800
65-74	2,308	2,848.1	81,000	94,900	-13,900
75-84	4,150	6,399.3	64,900	53,600	11,300
85+	2,627	15,233.6	17,300	13,900	3,400
Total	14,038		2,972,600	2,183,000	789,600

Sources: Columns 1 and 2 from *Vital Statistics of the United States*. Column 3 = (column 1)/(column 2). Column 4 tabulated from 1980 U.S. Census of Population tapes. Column 5 = column 3 - column 4.

persons—roughly 25% of the Mexican-born population. Adding the 600,000–700,000 undocumented persons to Warren and Passel's estimated 1.1 million in the Census yields a total illegal Mexican population in 1980 on the order of 1.8 million persons.

As a check on the plausibility of our calculations, we record in column 4 of table 2.2 the number of Mexican-born persons by age in the 1980 Census and in column 5 the difference between these numbers and the 1984 numbers implied by the mortality data. The calculations show the biggest divergence to be among 15- to 24-year-olds and 25- to 34-year-olds, which seems plausible in terms of the likely age distribution of transient illegal aliens. The implication is that the mortality data are, indeed, giving us a reasonable handle on the order of magnitude of the missing population.

### 2.1.2 Births

The number of births to Mexican-born women provides another source of information on the potential size of the population not counted in the Census. To estimate the size of the undocumented Mexican-born female population, we return to equation (1): as our measure of the number of events  $R$ , we take the number of births reported for Mexican-born women by age from *Vital Statistics* (col. 1 of table 2.3); as our measure of the true event rate, we take birth rates for Mexican-born women estimated by Bachu and O'Connell (1984) from the April 1983 Current Population Survey (col. 2 of table 2.3).<sup>6</sup> We then divide the number of births by the birth rates to estimate the Mexican immigrant female population in 1980 (col. 3). For the group aged 18–39,

**Table 2.3** Births and Undocumented Mexican-born Female Population Estimated from Births to Mexican-born Women

Age	(1) 1980 Births to Mexican-born Women	(2) 1983 Birth Rates per 1,000	(3) Estimated Population	(4) 1980 Census Population	(5) Hidden Female Population
18-24	52,464	173	303,300	174,700	128,600
25-29	31,730	144	220,300	133,500	86,800
30-34	17,322	110	157,500	112,100	45,400
35-39	7,276	78	93,300	84,400	8,900
Total			774,400	504,700	269,700

Sources: Column 1 from *Vital Statistics of the United States*. Column 2 provided by Martin O'Connell from April 1983 CPS tapes. Column 3 = (column 1)/(column 2). Column 4 tabulated from 1980 Census of Population tapes. Column 5 = column 3 - column 4.

which accounts for most births, this sums to 774,000. The difference between these figures and those in the Census given in column 4 is our estimate of the unrecorded Mexican-born female population in the child-bearing years: 269,000. If we take 700,000 as our estimate of uncounted Mexicans from mortality statistics and assume no illegal alien women outside the 18-to-39 age bracket, then women would constitute slightly less than 40% of the uncounted illegal Mexican migrant population. As the Census shows that 46% of Mexican-born nonnaturalized immigrants who came after 1970 were women, the implication is that the undocumented population contains more males than females, but not by as much as one would think on the basis of apprehensions of illegals, some 80%-85% of whom are males. One possible reason may be that Mexican women are more permanent migrants than men so that they contribute more to the total stock of persons in the country than to apprehensions at the border.<sup>7</sup>

All told, both the death and the birth figures support the growing consensus among demographers (see Passel 1986) that the number of illegal Mexican immigrants is on the order of two to three million.

Finally, we also note that the estimated size of the illegal alien population revealed by the demographic data is roughly consistent with the number of persons who applied for legalization under the provisions of the Immigration Reform and Control Act of 1986 (IRCA). This legislation provides amnesty to illegal aliens under one of two provisions. First, amnesty is granted to aliens who have been present in the country illegally and continuously since before 1 January 1982 and who applied for amnesty in the year ending on 4 May 1988. Second, amnesty is granted to agricultural workers through the Special Agricultural Worker (SAW) program if the illegal alien worked in perishable crop agriculture in the United States for at least ninety days in the year ending on 1 May 1986 (Immigration and Naturalization Service 1989). Approximately 1.2 million Mexican-born persons applied for amnesty under the regular program, and an additional 1.1 million Mexicans applied under



the SAW program. Because of widespread fraud in applications to the SAW program (“A Million Late Arrivals” 1988), the number of undocumented Mexicans who qualified for amnesty was probably under two million, a number roughly of the same order of magnitude as the estimates reported in this paper.

### 2.1.3 Trends in Mexican Immigration

In addition to providing estimates of the numbers of illegal aliens in the United States, the *Vital Statistics* data can be used to estimate the growth rates of the underlying population. For the brief period in which we have deaths for the Mexican-born population, there is no dramatic trend upward, as the following numbers of deaths indicate: 1979: 12,288; 1980: 13,180; 1981: 13,135; 1982: 13,078; 1983: 13,066; 1984: 14,050. Taking the end periods, we have a rate of growth of 14% over the five years, or 2.7% per year compounded. For the longer period over which we have birth rates, the figures are more dramatic: in 1980, there were 117,126 births to Mexican-born women, compared to 48,796 in 1970. This implies a near two-and-a-half-fold increase in the Mexican-born female population, given constant birth rates. However, comparisons of the number of Mexican-born women counted in the 1970 and 1980 Censuses show that this is entirely consistent with the measured growth of the number of Mexican-born women—an approximate two-and-a-half-fold increase from 419,754 in 1970 to 1,038,700 in 1980 and a larger increase in the number in prime child-bearing years.<sup>8</sup> Overall, there were 817,000 Mexican-born persons in the 1970 Census, compared to the 2,182,000 in the 1980 Census. If we take 700,000 as the number of Mexican immigrants missing from the Census, the true population of Mexican-born immigrants increased by some 260% over the period to nearly 2.9 million. This, in turn, implies a net immigration of 2.1 million persons to the United States in the 1970s—210,000 persons per year—of whom roughly three-quarters were illegal. This is an enormous increase in the Mexican-born population due to illegal immigration, but far below the growth in the number of apprehensions of Mexicans at the border that underlies much alarmist concern. We turn next to the apprehension data.

## 2.2 The Number and Growth of Apprehensions

Apprehensions of illegal Mexican immigrants have increased at truly extraordinary rates since the late 1960s. In 1967, 100,000 persons were apprehended for trying to cross the border; in 1986, nearly 1.7 million persons were apprehended—a seventeenfold increase that dwarfs our estimated growth of the Mexican-born population.<sup>9</sup> The level of apprehensions as well as the growth also seems exceptionally large relative to the estimated size of the population: from 1970 to 1979 there were some 7.5 million apprehensions (three-quarters of a million per year), while from 1980 to 1986 there were 6.2

million apprehensions (nearly a million per year). If the number of persons who successfully crossed the border was, say, four times as large as the number of apprehensions, and if those who crossed successfully averaged a two- to three-year stay in the United States, these figures would indicate an illegal Mexican alien population of about six to nine million persons in 1980 and perhaps eight to twelve million in the mid-1980s.<sup>10</sup>

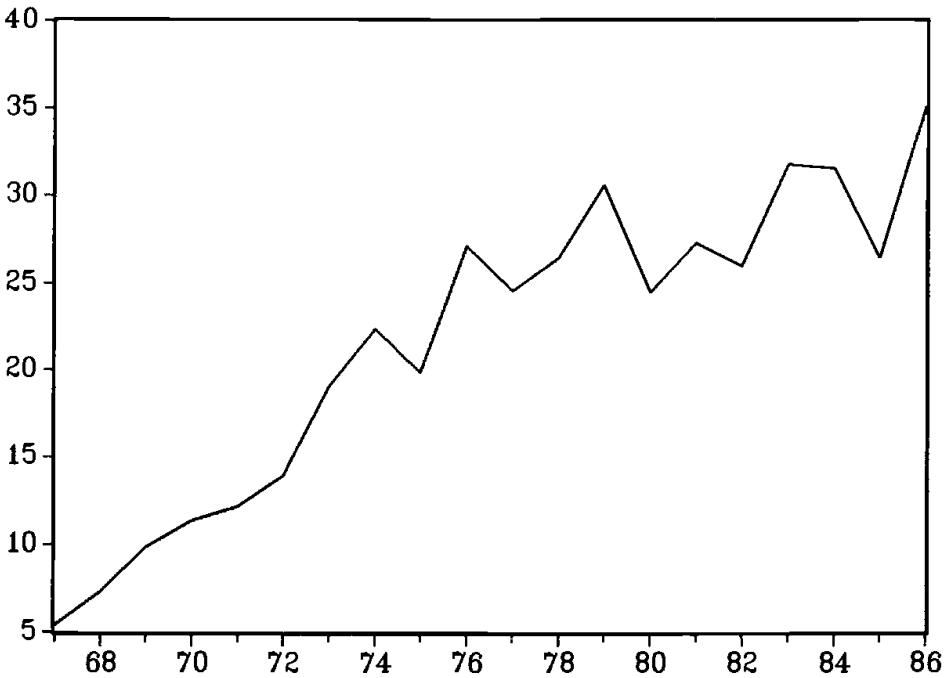
Do the apprehension data really imply such a large and rapidly growing illegal alien population? What caused the explosion in apprehensions? Is there a way to interpret apprehensions that would make this consistent with Census- and *Vital Statistics*-based estimates of the size and growth of the illegal immigrant population, or are the different data incommensurate?

We suggest in this section that the growth of the number of illegal aliens trying to enter the United States is much less than indicated by the apprehension figures because a sizable part of the increase in apprehensions is due to the increased efficacy of the Border Patrol. We further suggest, on the basis of estimates of durations of time in the United States and of the ratio of apprehensions to successful crossings for a sample of relatively transient illegal migrants, that a population of illegals of the magnitude suggested by Census and *Vital Statistics* data together with a modest population of Mexicans who fail to cross the border could have generated the bulk of the apprehensions.

### 2.2.1 The Effect of Border Patrol Activity on Apprehensions

The first factor that suggests that increased Border Patrol activity is a substantial determinant of the growth of apprehensions is the sharp increase in real expenditure on the Border Patrol in the 1970s and 1980s. In 1967, the Border Patrol spent twenty million dollars; in 1986, they spent forty-eight million in 1967 dollars—a 140% increase. If there were no change in the productivity of a dollar of resources in apprehending illegal border crossers, this increase in expenditures could by itself explain over half the growth of apprehensions. Indeed, as figure 2.1 shows, from the late 1970s to 1986, when so much concern was expressed about the explosion of apprehensions, apprehensions per dollar of Border Patrol expenditures rose only modestly, implying that the trend in apprehensions could have resulted largely from increased Border Patrol resources. From 1967 to 1976, on the other hand, the number of apprehensions per real dollar expenditure on the Border Patrol increased greatly.

There are two possible explanations for the sharp pre-1976 increase in apprehensions shown in figure 2.1. The first is that the number of attempted illegal border crossings rose, presumably in response to economic incentives to migrate illegally to the United States in the wake of the termination of the Bracero Program. Increased real hourly earnings in the United States in the late 1960s and early 1970s may have made working in the United States more attractive, while the growth of real earnings in Mexico may have eased possible credit constraints in risking an illegal trip to the United States. On the



**Fig. 2.1 Ratio of apprehensions to real Border Patrol expenditure (in constant dollars)**

other hand, the number of legal Mexican immigrants exempt for family reasons from the INS quota limits fell in the period, which is the opposite of what one would expect given greater economic incentive and capital to enter the United States. Perhaps more important in terms of long-term immigration, the Census of Population data seem inconsistent with an explosion of permanent illegal migration in the period. According to the Census, the number of Mexican-born persons who immigrated in 1970–74 is just about twice the number who immigrated during 1965–69, whereas the number of apprehensions in 1970–74 is four times the number in 1965–69. Similarly, the number of Mexican-born persons who arrived during 1975–80 is about 40% higher than the number who arrived during 1970–74. The apprehension figures for 1975–80 are more than twice those for 1970–74.<sup>11</sup> Given that a higher proportion of individuals who immigrated in the earlier period are likely to have returned to Mexico, these figures raise serious doubts about interpreting the increased number of apprehensions as reflecting economically induced increases in the number of long-term illegal immigrants.

The second possible interpretation of the 1967–76 spurt in apprehensions is that it represents a “learning curve” for the Border Patrol following the end of the Bracero Program. There is scattered evidence that the effectiveness of the Border Patrol increased over the period. Cornelius (1977) reports that the use of “coyotes” (smugglers of illegal aliens) increased over time in his sample, which suggests greater difficulty in crossing over time. And the Border Patrol introduced more capital intensive and modern technologies to detect illegal

aliens, ranging from helicopters to sophisticated electronic detection devices planted along the border.

As both increased border crossings and increased Border Patrol resources and effectiveness are likely to have contributed to the observed growth of apprehensions, a quantitative analysis is needed to evaluate the potential magnitude of each. Accordingly, we have regressed the log of the number of apprehensions on the log of the Border Patrol budget measured in real dollars; the log of average hourly earnings in the United States and the log of GDP per capita in Mexico, as indicators of the relative incentive to come to the United States; and a trend term. Our analysis covers the period 1967–84, when apprehensions skyrocketed following the end of the Bracero Program. Table 2.4 presents the regression results. As a base for judging the effect of the Border Patrol budget and other factors on apprehensions, column 1 records a regression estimate of the annual compound growth in apprehensions—approximately 12% per year. Column 2 includes the effect of real Border Patrol expenditure. The estimated elasticity of apprehensions with respect to Border Patrol expenditure exceeds two, and the annual growth rate in apprehensions falls to 5%, indicating that over half the observed increase in apprehensions can be attributed to the growth of Border Patrol spending. Column 3 gives the regression coefficients and standard errors for the estimated effect of the log of real Border Patrol expenditures, average hourly earnings in the United States and GDP per capita in Mexico and the trend variable. Here, the estimated effect of Border Patrol resources on apprehensions has a near unit elasticity, and economic factors also appear to affect apprehensions, with U.S.

**Table 2.4** Determinants of Apprehensions of Illegal Mexican Aliens (time-series estimates, 1967–84)

	(1)	(2)	(3)	(4)	(5)
Budget		2.22 (7.1)	.94 (2.3)	1.06 (2.6)	.99 (2.3)
Budget (– 1)				1.10 (2.8)	.29 (.4)
U.S. wage			5.17 (3.5)		3.44 (1.3)
Mexican GDP per capita			.66 (1.5)		.48 (1.0)
Time trend	.12 (8.8)	.05 (4.1)	.08 (3.3)	.04 (4.3)	.07 (2.0)
Constant	12.05 (78.7)	– 10.14 (3.3)	– 4.07 (1.3)	– 9.48 (4.0)	– 5.22 (1.2)

*Sources:* Apprehensions data from INS Budget, Central Border Patrol Office. U.S. nonagricultural average hourly wages from the *ILO Yearbook* (Geneva: ILO). Mexican GDP, population, and deflator from *International Financial Statistics*. U.S. CIP from *Economic Report of the President* (Washington, D.C.: U.S. Government Printing Office).

earnings increasing apprehensions and Mexican GDP per capita also increasing them, perhaps as a result of the greater ability of poor Mexicans to raise capital for migration to the United States. As real wages in the United States and per capita income in Mexico declined in the late 1970s and early 1980s, we can treat the coefficient on trend as our estimate of the increase in illegal border crossings independent of the level of Border Patrol activity and with economic factors held fixed. It implies that one-quarter of the observed growth of apprehensions can be attributed to the increased border Patrol spending. Columns 4 and 5 include lagged Border Patrol expenditure in the regressions of columns 2 and 3 to capture potential learning effects. The results show a continued effect for Border Patrol spending, with residual trend effects ranging from one-third to over half the .12 coefficient in column 1.

While we are leery of crude time-series regressions with just seventeen observations, it seems reasonable to conclude that Border Patrol activity has influenced the trend in apprehensions and thus that the trend uncorrected for Border Patrol activity exaggerates the growth of the flow of illegal Mexican immigrants. Quantitatively, the regressions in table 2.4 indicate that something on the order of half the increase in apprehensions is due to increased Border Patrol expenditure and thus that the growth of illegal crossings was perhaps half as great as the growth of apprehensions.

### 2.2.2 Relating Apprehensions to the Stock of Illegal Immigrants

To analyze the relation between the level of apprehensions and the size of the stock of illegal immigrants, we decompose apprehensions into three categories: those that result from the apprehensions of new illegal aliens who eventually cross the border for a first trip to the United States ( $P_1$ ); those generated by experienced illegal aliens who make repeated crossings and are living in the United States ( $P_2$ ); and those generated by persons who fail to cross successfully ( $P_3$ ). The annual number of apprehensions per successful new crosser we denote as  $a_1$ ; the number of apprehensions per successful repeat crosser we denote as  $a_2$ ; the number of apprehensions per failed crosser we denote as  $a_3$ . Then total apprehensions ( $A$ ) will be

$$(3) \quad A = a_1(P_1) + a_2(P_2) + a_3(P_3).$$

This equation shows that apprehensions depend not only on the number of successful border crossers resident in the United States and the number of times they are apprehended in a year but also on the number of unsuccessful crossers and their rate of apprehension.

To obtain information on the number of apprehensions per successful border crosser in the United States, we use the survey described in section 2.3. In that survey, we asked the illegal aliens in the United States the number of times they were apprehended and the number of visits they made to the United States.<sup>12</sup> The ninety-one persons in the sample who were on their first visit reported that they had been apprehended by the Border Patrol at least 95

times, giving a ratio of apprehensions to successes of slightly more than one, which we will use to estimate  $a_1$  in (3). The 132 individuals who were on a second or later trip had been apprehended at least 242 times in the course of 356 reported trips.<sup>13</sup> Assuming that they were apprehended an average of once on their first trip, the implication is that these illegal migrants were apprehended about 110 times in the course of 224 second or later trips. The ratio of “successes” to apprehensions thus seems to be about two to one for “experienced” border crossers.

While estimates of successful border crossings to apprehensions range all over the ballpark, the one-to-one and two-to-one ratios in our data are in line with the views of some informed observers. Alan Eliason, the chief Border Patrol agent in San Diego, estimates that “we’re locating, at best, about half the flow of illegal entrants” (Eliason 1986). “Official” estimates reported in the newspapers have been in the range of two to three to one.<sup>14</sup>

The ratio of successes per apprehension for repeat crossers does not, however, give us the  $a_2$  parameter in equation (3). This is because repeat crossers may have made more than one trip to the United States in a year, generating more than one apprehension a year. To estimate the number of annual apprehensions generated by repeat crossers residing in the United States, we use the following steady-state condition:

$$(4) \quad a_2 = (\text{apprehensions per successful trip}) /$$

$$(\text{average length of trip measured as a fraction of year}).$$

According to (4), shorter trips generate more apprehensions per person in the United States because they imply that each person makes multiple trips per year. Put differently, we must “blow up” apprehensions per trip to obtain  $a_2$  because more than one successful trip is required to make up a full “person-year” in the United States. In our sample of illegal aliens, the average completed duration of the most recent trip of persons who were on at least their second trip was six months—.5 years—which, together with the estimated number of apprehensions per trip, yields a value of  $a_2$  of about one.

This estimate, however, may be biased. First, there is sample bias in our survey group that is due to the greater likelihood of our reaching those with longer spells. Put differently, failure to interview persons who made successful crossings but are now in Mexico biases our results. Data from CENIET’s Encuesta Nacional de Emigración a la Frontera Norte del País y a los Estados Unidos suggests, however, that our estimates may not be that far off. The CENIET figures show that, of the nearly one million persons considered by their families to be living in Mexico who had migrated to the United States in the 1978–79 period, half were in Mexico at the time of the study (see Diez-Canedo in this volume). This is consistent with the notion that these migrants average about half their time in each country. Another problem with our sample is that it may not be representative of persons uncounted in the Census or of the sojourner population. Still, for want of better data, we shall use the

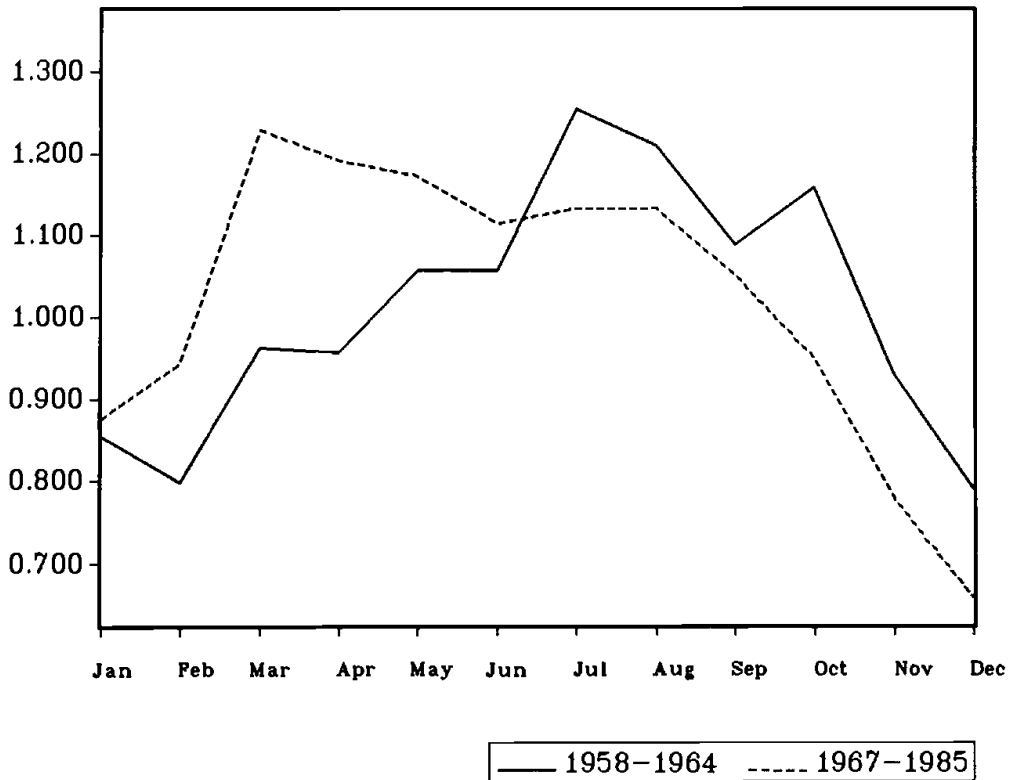
estimate that both new and repeated border crossers in the United States are likely to have generated one apprehension. Finally, while we have no information on how many times unsuccessful crossers were apprehended, they had to have at least one apprehension so that  $a_3 > 1$ .

Given our estimate of one apprehension generated per successful crosser, what is the likely size of the relevant populations that made a successful crossing ( $P_1 + P_2$ ) in a year? As a crude estimate of the number who may cross frequently, we will take persons who were sufficiently transient to have been missed by the Census and those in the Census who have come after 1970 and are without their families. Estimates in the previous section suggest that there were 600,000–700,000 persons in the first category, while calculations given in the next section suggest that there were about 275,000 persons in the Census who came after 1970 and were living without their immediate families, giving a 1980 population of prospective new and repeated border crossers close to one million. Given our estimates of  $a_1$  and  $a_2$ , this is large enough to have generated apprehensions of the same magnitude. As additional apprehensions were undoubtedly generated by persons who failed to cross the border, we conclude that the observed number of apprehensions is more consistent with the estimated population of illegal Mexican migrants in the United States than first appears to be the case.

### 2.2.3 Seasonality of Apprehensions

The notion that there is a significant population of Mexican migrants who cross the border often, generating apprehensions, can be checked further by examining the seasonal pattern of migration. While permanent illegal immigration to the United States might be seasonal, it seems more plausible that seasonality in apprehensions would reflect sojourner migration, with the same or different persons crossing regularly after short trips that do not add greatly to the stock of illegals in the United States at a moment in time.<sup>15</sup>

To estimate the seasonality of apprehensions, we obtained monthly apprehension data from the INS. For each month, we took the ratio of apprehensions in that month to a twelve-month moving average centered on that month and averaged the fraction over the sample period. Figure 2.2 gives the monthly seasonality factors for the period 1957–64, when the Bracero Program was operative, and for 1967–85, when apprehensions skyrocketed.<sup>16</sup> The figure shows substantial seasonality in both periods, but of quite a different kind. In the post-Bracero period, apprehensions peak in March and bottom out in December, consistent with the view that many immigrants return to Mexico for extended Christmas/winter vacations. In contrast, in the earlier period, February has the lowest apprehension level, while there is a strong peak from July through October, which would appear to indicate workers heading to the U.S. harvests. While a more detailed analysis of the likely causes of seasonality in apprehensions is needed, the marked seasonality from 1967 to 1985 is consistent with the argument that illegal migrants with short



**Fig. 2.2 Seasonality of alien apprehensions**

stays in the United States may have generated a large proportion of the apprehensions. Had we found no seasonal pattern, we would feel less comfortable with our argument that large numbers of apprehensions may be generated by short-term migrants.

### 2.3 Characteristics of Illegal Mexican Aliens

In this section, we turn from counts of illegal Mexican aliens to the characteristics of those Mexican-born persons in the 1980 Census of Population who are likely to be illegal aliens and the characteristics of the illegal male Mexican-born migrants in our survey in the San Diego area.

#### 2.3.1 Likely Illegal Immigrants in the Census

As the Census does not contain direct information on whether a Mexican-born migrant entered the country legally or illegally, we exploit the fact, noted earlier, that the number of Mexican-born noncitizens in the Census who came after 1970 was approximately equal in size to Warren and Passel’s (1987) estimate of illegal Mexican aliens in the Census. We define this group of persons as “likely illegal aliens” and compare them to naturalized Mexican-born persons for the purpose of making inferences about the correlates of illegal alien



status.<sup>17</sup> Errors of classification in this (or any similar) scheme are likely to bias downward estimates differences between the groups.

Tables 2.5–2.7 present our analysis of the likely illegal alien population in the Census. To begin with, table 2.5 records information on the distribution of the Mexican born by family status. Column 1 gives the percentage distribution of Mexican-born citizens; column 2 gives the distribution for noncitizens; column 3 focuses on noncitizens arriving after 1970 (our likely illegal migrant group); while column 4 records distributions for male noncitizens who arrived after 1970. Family status in these data is divided into householders (primarily adult males) and persons (primarily females and children), with subdivisions to reflect whether the individual is living with his immediate family (spouse, children, parents), other relatives (primarily siblings), or unrelated persons. Rows 8 and 9 at the bottom of the table show the proportion of the entire group living with close relatives and the proportion in all other categories.

What stands out in the data is the large number of Mexican-born noncitizens who live with their families: 77% of all noncitizens, 73% of the recent immigrants, and even 65% of recently arrived male noncitizens live with their immediate families. Given that the bulk of these populations consist of illegals, the implication is that the majority of illegal Mexican-born residents in the 1980 Census reside here with their families. To the extent that immigrants living with their families should be viewed as relatively permanent migrants, table 2.5 suggests that most illegal Mexican migrants counted by the U.S. Census are permanent migrants.

**Table 2.5 Percentage Distribution of Mexican Born by Family Status**

Family Status	All Citizens	Noncitizens Arrived:		Male Non-citizens Arrived after 1970
		Before 1970	After 1970	
Householders living with:				
1. Closely related persons	36.2	26.6	20.3	32.9
2. "Other relatives"	2.0	2.1	2.1	3.1
3. Unrelated persons	1.1	1.2	1.3	2.2
4. Single householders	8.0	4.1	3.1	4.9
Persons living with:				
5. Closely related householder	45.1	49.9	52.2	31.6
6. Other relative householder	4.9	10.5	13.7	15.6
7. Unrelated householder	2.7	5.6	7.3	9.6
Total householders and persons living with:				
8. Close relatives	81.3	76.5	72.5	64.5
9. All other	18.7	23.5	27.5	35.5
Number (000s)	509.0	1,674.0	1,090.0	593.0

Sources: Tabulated from the U.S. Bureau of the Census.

**Table 2.6** Means of Socioeconomic Variables

Variable	Noncitizens					
	Citizens		Likely Legal		Likely Illegal	
	Male	Female	Male	Female	Male	Female
Education	7.47	7.17	7.02	6.88	5.92	5.57
Age	37.64	39.40	40.62	42.68	23.77	23.96
LFP	.77	.43	.80	.41	.88	.46
Farm	.11	.04	.15	.07	.16	.06
Maid	.00	.01	.00	.02	.00	.02
LWKS	3.70	3.47	3.72	3.46	3.65	3.39
LWeekly	5.27	4.88	5.35	4.83	5.04	4.76
Size	4.51	4.51	4.83	4.72	5.33	5.71
Year of migration:						
1975-80	.16	.14	.00	.00	.59	.56
1970-74	.18	.18	.00	.00	.41	.44
1965-69	.14	.14	.41	.37	.00	.00
1960-64	.11	.10	.22	.23	.00	.00
1950-59	.17	.17	.23	.23	.00	.00
< 1950	.24	.27	.22	.17	.00	.00
Sample size	2,623	2,471	2,886	2,945	5,933	4,971

Note: LFP = 1 if participating in the labor force; 0 otherwise. Farm = 1 if employed in the agricultural sector, 0 otherwise. Maid = 1 if employed in the personal services industry, 0 otherwise. LWKS = log of weeks worked in 1979. LWeekly = log of weekly earnings in 1979. Size = household size. The labor force variables are calculated among persons aged 16 or older.

**Table 2.7** Determinants of Labor Market Outcomes

Variable	Dependent Variable			
	LFP	LWKS	LWeekly	Farm
Likely illegal	.026 (3.09)	-.014 (-.93)	-.179 (7.90)	-.009 (-.83)
Citizen	-.003 (-.50)	-.003 (-.16)	-.073 (-2.89)	-.005 (-.43)
Education	.0003 (.38)	.004 (3.09)	.029 (13.40)	-.017 (-17.14)
Age	.047 (28.78)	.049 (15.71)	.075 (15.50)	-.015 (-6.48)
Age squared	-.0006 (-27.88)	-.0006 (-14.03)	-.0008 (-13.29)	.0002 (6.66)
R <sup>2</sup>	.09	.04	.09	.05

Note: The *t*-ratios are presented in parenthesis. The regressions are restricted to men aged 16-64.

Table 2.6 gives the means of selected socioeconomic characteristics for the likely illegal alien group, for citizens, and for noncitizen Mexican-born persons who are likely to be legal. The differences between the groups shown in the table suggest that our classification succeeds in capturing important aspects of the likely illegal alien group. For example, the average age of a likely illegal alien man is 23.8 years, while the average age of other Mexican-born groups (citizens and noncitizens who arrived before 1970) is between 38 and 41 years. Similarly, the mean years of schooling of a likely illegal alien man is between 1 and 1.5 years below that of other Mexican-born men. The means in the table also reveal differences in labor force participation rates (higher for likely illegals) and in earnings (lower for likely illegals). These differences notwithstanding, table 2.6 is also remarkable for what it does not show. It does not show the likely illegal population to be primarily male: only 54.4% of the group are men, compared to 50.4% of the remainder of the Mexican-born population. It does not show the likely illegal alien population to be heavily concentrated in agriculture; only 16% of men are employed in agriculture, as contrasted to 11%-15% of other Mexican-born men.

What about the labor market experience of likely illegals? Table 2.7 examines the effect of likely illegal status on four aspects of market performance for men aged 16–64: labor force participation (LFP); ln weeks worked over the year (LWKS); ln weekly earnings (LWKLY); and the probability of agricultural employment (FARM). It shows that, with other variables held fixed, the likely illegals have somewhat higher rates of participation in the work force than other Mexican-born persons, which makes sense if they migrate to obtain work and leave when they are out of work, and have much lower earnings than other Mexican-born persons, which also makes sense given their likely lower level of skill and lack of recourse to legal protections.

The equations in table 2.7 constrain the coefficients of various socioeconomic characteristics to be the same for likely illegal aliens and other Mexican-born groups. This constraint is implausible given that illegals are likely to have less incentive to invest in human capital than legal migrants because of the likely shorter periods of time that they spend in the United States and are likely to have education that is less suitable to the job market. Accordingly, we estimated earnings equations separately for likely illegals and likely legal migrants, obtaining substantial differences in the effect of age (*A*) and education (*E*) and citizen status (*C*) on log weekly earnings, as the following regressions show for likely legal:

$$\text{LWKLY} = .034 * E + .105 * A - .001 * A^2 - .063 * C, \quad R^2 = .09$$

(11.6)      (15.0)      (13.3)      (2.4)

and for likely illegals:

$$\text{LWKLY} = .023 * E + .061 * A - .001 * A^2, \quad R^2 = .04,$$

(7.6)      (8.1)      (7.0)

where both regressions include a constant term, and the *t*-statistics are in parentheses.

The finding that the earnings of legal migrants are more responsive to traditional human capital variables than the earnings of illegal migrants is consistent with evidence provided by Chiswick (1986a, 1986b) using a survey of undocumented workers in Chicago. The similarity between our results and those for the undocumented workers in Chicago suggests that problems of misclassification are not overly serious for our sample. Moreover, it suggests that Chiswick's results for Chicago generalize to the broader population of illegal Mexican immigrants.

### 2.3.2 Results from Our Survey

As noted earlier, we conducted a small survey (289 observations) of illegal Mexican male migrants in the San Diego area; the participants were chosen to cast light on aliens unlikely to be counted in the Census.<sup>18</sup> Interviews took place at downtown "shape-ups," in agricultural "residences," or wherever community contacts led us to illegal Mexican workers. The sample therefore captures the least stable and lowest-paid segment of the illegal immigrant community. While this sample of male illegal immigrants is by no means random, it is still instructive to look at their characteristics.

As can be seen in table 2.8, the men in the sample are lower paid and more

**Table 2.8** Sample Characteristics in Survey of Illegal Aliens

Education	6.37
Age	28.36
Farm	0.26
LWeekly	4.90
Year of first trip (%):	
1986	25
1985	26
1984	17
1983	7
1982	10
1981	3
1980	6
Before 1980	6
Family status: (number):	
With wives living in U.S.	39
With children but without wives	3
Potential immigrant status:	
Intend to stay in U.S. permanently	37
Will remain in U.S. indefinitely	87
Will return to Mexico and not come back to U.S.	50
<i>N</i>	289

Sources: 1986 Summer Survey of Illegal Aliens in the San Diego Area.

**Table 2.9** Determinants of Log-weekly Wages (survey sample)

Education	-.002 (1.2)
Age	.045 (3.1)
Age squared	-.005 (1.3)
$R^2$	.12

Note: The *t*-ratios are presented in parentheses.

heavily concentrated in agriculture than the likely illegal group in the Census (compare table 2.6). Adjusting for the fact that the survey was conducted six years after the Census, the survey sample arrived more recently than the illegal immigrants in the Census, implying that the sample does indeed reach the group we intended. Even so, a substantial number of persons in the sample appear to be on their way to becoming permanent immigrants: almost one in seven had wives living in the United States, a figure below that for likely illegals in the Census but still nonnegligible; thirty-seven said they intended to remain in the United States permanently, and eighty-seven intended to remain indefinitely, at least if they find employment. Only fifty said that they intended to return to Mexico and not come back to the United States.

Finally, table 2.9 gives the results of the estimation of the weekly earnings equation for our sample. Relative to the estimates for the likely illegals in the Census, the effects of age on earnings are attenuated, and the effect of education is negative and statistically insignificant, further suggesting that human capital variables do not do much for the pay of illegal aliens. Whether these results reflect the differential experience of relatively recent and temporary immigrants or our sample design, which includes largely low-wage workers, is an open question. They do, however, confirm that we have indeed identified a very different set of illegal immigrants than those in the Census.

## 2.4 Conclusions

Given the difficulties in trying to measure any illegal activity, conclusions about the size and socioeconomic characteristics of the illegal Mexican population in the United States must inevitably be subject to numerous caveats. Our response to the problem of “inaccessibility” of the population of illegals has been to examine several different data sets, to search for consistencies among them that would allow for firm conclusions, and to make “strong” assumptions to obtain bounds on critical statistics. We found that the bulk of the data are consistent with the existence of an illegal Mexican-born population on the order of 1.8 million in the 1980s, that this population has grown rapidly over the decade but at a rate far below the growth of apprehensions, that a large portion of the illegal Mexican migrant population consists of “per-

manent" migrants, but that border crossings by the transient part of the illegal migrant population may underlie a large portion of apprehensions. Despite the diverse data problems that we encountered, the consistency in our results across data sets lends some credence to our conclusions.<sup>19</sup>

## Notes

1. The estimates from top officials in the 1970s included four to seven million (former Attorney General William Saxbe) and four to twelve million (Commissioner Chapman of the Immigration and Naturalization Service [INS]). Lesko and Associates estimated through a Delphic technique that there were 8.2 million illegal aliens in 1975, of which 5.2 million were Mexicans. The INS used a similar consensus method and came up with 5.5–6 million as of late 1975.

2. Census demographers have consistently come up with estimates below those in n. 1 above. See Lancaster and Sceuren (1977), Heer (1979), Robinson (1980), and Warren and Passel (1987). Other studies of the illegal alien population include Bean, King, and Passel (1983), Brown and Shue (1983), Corwin (1982), Cuthbert and Sterens (1981), Fogel (1978), Heer and Passel (1985), Jones (1984), North and Houstoun (1976), Passel and Woodrow (1984), Reichert and Massey (1979), and Siegal, Passel, and Robinson (1980).

3. The insight that death statistics can be used to measure the hidden population can be attributed to Robinson (1980). Death rate statistics by country of origin were not available at the time he conducted his research. Instead, he used changes in death rates in states such as California that were expected to have large illegal immigrant populations compared with changes for the United States as a whole. Since Robinson's technique is not subject to bias if country of origin is misrecorded, we attempted to use it to get estimates of the "missing" illegal population. Unfortunately, our experience suggests that the technique is not robust. Robinson implicitly assumes that the death rate in California (or in other states with large illegal alien populations) changes by the same amount as death rates in other states unlikely to have many illegal aliens. The assumed unit coefficient linking death rates is, however, inconsistent with the actual pattern of death rates for the period 1960–70, when changes in the size of the illegal immigrant population are expected to be small: regression analysis shows very little connection between changes in state death rates and national totals. The problem is that state death rates are very "noisy." When we "smoothed" the data, we found strikingly different results depending on whether we started our analysis in 1969, 1970, or 1971 and whether we ended it in 1980 or 1984. Without smoothing, the results are even more sensitive to the choice of base year. Hence, we have eschewed use of Robinson's technique in this paper.

4. Telephone interview, 10 August 1987.

5. We are less certain about the bias in the birth rate calculations since some of the Mexican-born women not counted in the Census may be temporary sojourners who are unlikely to have children. Others, however, may resemble the Mexican-born women in the Census, be living with their families, and have birth rates more like those in Mexico than like those of immigrants permanently established in the United States.

6. In their published article, Bachu and O'Connell (1984) do not report birth rates for Mexican-born women by detailed age. They kindly provided us with the relevant numbers from their computer printouts.

7. There is an important conceptual problem with the use of birth data to estimate

the size of the illegal alien population. Because fertility decisions are endogenous, many Mexican women may temporarily migrate to the United States simply to bear their children. This ensures that their offspring are American citizens and thus have the option, on reaching adulthood, of migrating legally to the United States. To the extent that this type of migration is common among Mexican-born women, the illegal alien estimates provided by the birth data are biased upward.

8. The 1980 Census has 474,000 Mexican-born women in the age group 15–34, whereas the 1970 Census reports 156,000 in the age group 14–34. This is a threefold increase.

9. There was also a sizable number of apprehensions of illegal aliens in the 1950s. We have not contrasted the situation then to that in the 1970s and 1980s.

10. These estimates are obtained by multiplying the number of apprehensions per year by the postulated ratio of successful crossings to apprehensions by the postulated duration under steady-state assumptions.

11. Our tabulations of the 1980 Census show that 13% of migrants came in the 1965–69 period, compared to 25% in the 1970–74 period, while 33% of migrants came in 1975–80. Dividing these percentages gives the figures in the text.

12. There is some problem with interpretation of the questions. We have added together the total number of times individuals report having been refused entry to the United States and the number of people who report having been caught by the Border Patrol within the United States. The interviewer who conducted the survey believes that respondents interpreted the questions as meaning that they had been caught by the Border Patrol entering the United States (refused entry) or having made significant progress into the United States (apprehended by the Border Patrol within the United States) but before having reached their destination. Assuming that this interpretation is correct, we underestimate the number of apprehensions because we do not know how many times an individual was apprehended after having made significant progress into the United States.

13. Because not all illegal immigrants answered all questions, the number of responses we use to generate various statistics does not necessarily sum to the total in the survey.

14. *New York Times*, 21 February 1986; *Newsweek*, 17 March 1986. On the other hand, we note that our interviews with Border Patrol agents produced noticeably higher estimates, averaging around four to one.

15. In particular, there are no strong economic reasons for permanent migrants to move at one time in the year rather than another, given that any seasonal differences in returns to moving would be amortized over a long period.

16. We allowed a two-year gap for adjustment to the end of the Bracero Program.

17. For a comparable analysis, see Bean, Browning, and Frisbie (1984).

18. The survey was conducted by Eric Waggoner, a student at Harvard University.

19. Our conclusions are also consistent with the number of illegal Mexican immigrants who sought amnesty under the new immigration law and with the apparent reluctance of many of those eligible to apply for amnesty because of fears that other members of their families might not be eligible. Our analysis also suggests that the decline in apprehensions that began in about October 1986 may reflect in part not only fears by potential new illegal immigrants that employer sanctions will destroy their chances to obtain employment but also the fact that the new law made it potentially costly for current immigrants to return to Mexico for brief visits since being caught might jeopardize their claim to being continuously resident in the United States. Moreover, the “grandfather” clause exempting existing employees from the employer sanctions may also have the unintended consequence of turning sojourner laborers into permanent residents owing to the increased cost of giving up their jobs to return to Mexico.

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