Estimating the Legal Status of Foreign-Born People

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Working Paper 2021-02
March 2021

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The authors thank the following staff members: Jordan Berne (formerly of CBO), Pranav Bhandarkar, David Burk (formerly of CBO), Daniel Crown, Molly Dahl, Mark Doms, Wendy Edelberg (formerly of CBO), Joseph Kile, Jeffrey Kling, Xiaotong Niu, Sam Papenfuss, David Rafferty, and Julie Topoleski, who provided helpful discussion and comments and reviewed drafts of this work. The authors also thank Bryan Baker (Department of Homeland Security), George Borjas (Harvard University), and Robert Warren (Center for Migration Studies of New York). Elizabeth Schwinn was the editor. Any views expressed in this paper are those of the authors and do not necessarily reflect CBO’s views. This paper complements CBO’s report The Employment of Foreign-Born People.
Abstract

The Congressional Budget Office recently adapted a methodology to estimate, on an annual basis, the total number of people in the United States without legal status and to assign legal status to the foreign-born population in survey data to match those annual totals. This paper describes CBO’s methodology, the analytical choices made in developing that methodology, and the sensitivity of the outcomes to alternative choices.

Keywords: Immigration, Demographic and Labor Economics

JEL Codes: J15, J21, J60
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1 Summary

Of the 46 million foreign-born people who lived in the United States in 2018, the Congressional Budget Office estimates that 11 million were here illegally.1 Residents without legal status are generally not counted in administrative data and are difficult to identify in survey data because the federal government does not collect that information. Nonetheless, information on the number, demographic characteristics, and labor market outcomes of foreign-born residents without legal status is necessary to assess the cost of federal programs and to estimate the economic impact of immigration policies. This paper explains CBO’s methods for estimating the number of residents without legal status and imputing legal status by using individual-level data from federal surveys.

CBO used a demographic residual method to estimate the number of foreign-born people without legal status by year and country of birth. That method relied on the Census Bureau’s annual estimates of the number of foreign-born residents and the count by the Department of Homeland Security (DHS) of the annual inflows of people with legal status who entered the country throughout the year. The demographic residual method enabled CBO to account for the differences between the Census Bureau’s point-in-time estimates and DHS’s flow measures.

To examine the characteristics of those without legal status, CBO used estimates of the total number of people without legal status to impute the legal status of survey respondents in the Current Population Survey (CPS). (Imputation is subject to error, and the imputations were used for statistical purposes only.) CBO first assigned legal status to foreign-born people in the CPS on the basis of their responses to survey questions that were indicative of legal status. For example, people who reported that they were naturalized citizens or that they served in the armed forces were very likely to have legal status.

The total number of foreign-born people with legal status that CBO identified through information collected in the CPS was less than the count suggested by the residual method. The difference between the two counts depended on the individual’s country of origin. CBO estimated the probability that residents from particular regions had legal status and made adjustments to ensure that the counts from the CPS were consistent with the totals from the demographic residual method.

CBO’s annual estimates of the total number of people without legal status are comparable to estimates by other research institutions. However, the match between CBO’s estimates and those other estimates is better for some countries than for others.

CBO’s estimate of the number of people without legal status is sensitive to the analytical decisions it made in the demographic residual method. This paper contains a sensitivity analysis.

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1 This paper is a more detailed explanation of the methodology outlined in a recent report. See CBO (2020).
that shows how different analytical decisions would have affected the results. The analysis found that two choices had the most impact on CBO’s results: correcting for errors in survey data and modeling the length of time before people became lawful permanent residents (LPRs). Choices that related to estimating death or emigration rates, as well as the choice of methods for counting new temporary residents, had less impact.

The remainder of this paper is organized as follows: Section 2 describes how CBO’s estimation method builds on prior literature and indicates how CBO’s estimates may be used for policy analysis; Section 3 describes how CBO estimated the total number of people without legal status; Section 4 describes how some people were assigned likely legal status on the basis of survey responses; Section 5 describes how CBO applied probabilistic assignment and reweighting to that survey data; Section 6 compares CBO’s estimates of the total number of people without legal status with estimates from other sources; Section 7 contains CBO’s sensitivity analysis; and Section 8 concludes.

2 Background and Overview

Measuring how many foreign-born people do not have legal status and which residents in particular lack legal status is a challenge. Few surveys have sufficient information to identify people as either having or lacking legal status. People without legal status may be more likely to avoid or be suspicious of government field representatives administering a survey, and therefore they may be less likely to respond to the survey or to particular questions.

Administrative data about foreign-born arrivals generally only contain information about people with legal status. Further, a person’s status can change over time. People with temporary legal status lose legal status if they remain in the country after their temporary status expires; some administrative sources count the number of lawful admissions into the country and do not always record those residents’ departures. Under certain laws, some people who were living in the United States without legal status were permitted to obtain that status. Some of those people would have had no entry record, so they would not be included in the administrative data between the year of entry and the year in which they obtained legal status. Patterns related to the national origin and age of new arrivals, how legal status is obtained or lost, and ways to obtain legal status have changed over time.

2 Until 2014, the Survey of Income and Program Participation (SIPP) asked for type of status upon arrival in the United States and listed several options, including different types of legal status and “other.” Some researchers have assumed that “other” indicated the respondent did not have legal status. The General Social Survey also asked for status, offering “undocumented” as part of one choice, but it was not a separate category. Researchers use various terms (including “undocumented”) to refer to the foreign-born population without legal status.

3 See Brown and others (2019); Baker (2018); Van Hook and others (2014); and Passel (2001).

4 Examples include the Immigration Reform and Control Act (IRCA) of 1986, the Legal Immigration and Family Equity (LIFE) Act of 2000, and the Nicaraguan Adjustment and Central American Relief Act (NACARA) of 1997.
Researchers have adopted different approaches to estimate the number of people without legal status. Robert Warren and Jeffrey Passel, the originators of the residual method, began developing it in 1987 to count the number of foreign-born people present in the United States. Over time, they improved and refined their method. Their approach involves estimating the total number of foreign-born people, estimating the number of people with legal status, and subtracting the second estimate from the first. The number of people with legal status in a reference period (such as a census year) is estimated on the basis of the number of people with legal status in the previous period, as well as the number of people who flowed out of the population with legal status and the number of people who flowed into the population with legal status between the two periods.

In contrast, a methodology created by Mohammed Fazel-Zarandi, Jonathan Feinstein, and Edward Kaplan relies exclusively on measuring inflows and outflows of foreign-born people. Their work required a number of assumptions; in particular, their estimates were highly sensitive to the number of people crossing the border illegally and the number of people returning to their country of birth. Their estimates of the rate of return migration to Mexico in the 1990s are of particular concern and are at odds with other data sources; reasonable alternative assumptions lead to very different results. Further, their estimates did not align with existing demographic data, such as the U.S. census, the Mexican census, and data from the National Center for Health Statistics.

Further research, including additional work by Passel, analyzed the characteristics of the population without legal status by identifying those people in the Annual Social and Economic Supplement of the CPS (CPS ASEC). Passel used the CPS ASEC to identify which people likely have legal status because of their demographic, social, economic, geographic, and family characteristics, and made adjustments so those numbers would agree with the totals estimated in the residual method. George Borjas reverse-engineered Passel’s work, using certain criteria to identify which individuals in the CPS ASEC had legal status, and assumed that the remainder of the population was without legal status. Examples of the criteria Borjas used include whether someone served in the armed forces or received government benefits for which they would have been ineligible unless they had legal status.

Another way to identify people by legal status in survey data is the multiple imputation method. That method uses a survey that has information on legal status: It estimates relationships that predict legal status, and then applies those relationships to a survey that does not have

7 See Capps and others (2018); Warren (2018); and Camarota (2018).
8 See Passel and Cohn (2018).
9 See Borjas (2017).
information on legal status but that is of analytical interest. Very few surveys contain sufficient information on immigration status to distinguish those without legal status from others. The Survey of Income and Program Participation (SIPP) had more information about legal status than most surveys, but it did not specifically cover current legal status—it only asked about legal status upon arrival in the United States. Further, the questions about legal status upon arrival were eliminated in 2014, so those data are not available for newer cohorts of immigrants. Other surveys with information about legal status are limited in sample size or focus on a particular geographic area.

CBO’s goal in estimating legal status in survey data was to examine the demographic characteristics and work experience of the foreign-born population. That required accurately estimating the number of people with and without legal status, as well as identifying them in survey data (the CPS ASEC.)

CBO combined the work of counting the number of people without legal status and identifying people in the CPS ASEC without legal status. To obtain a total count of people without legal status, CBO adapted the residual method initially developed by Warren and Passel. To identify that population in the CPS ASEC, CBO employed a set of criteria similar to those Borjas used. However, based on those criteria, approximately two million more individuals were identified as people without legal status than the aggregate count found with the residual method. Moreover, the birthplaces of those two million individuals were not distributed randomly among countries or regions. In CBO’s assessment, the residual method produced a more accurate estimate of the number of people without legal status because it incorporated all legal arrivals counted in administrative data, and some of those arrivals would not have been identifiable based on information collected in a survey.

To reconcile differences between the count of people from some countries who have legal status and the number of people with legal status from those countries who could be identified in the CPS ASEC, CBO probabilistically assigned legal status to additional foreign-born people in the CPS ASEC on the basis of their country or region of birth and the data year. Lastly, for people from places of birth where the assignment criteria identify too many people with legal status compared with the residual method, CBO reweighted the sample of those with and without legal status so that the number of people from various birthplaces matched the number found using the residual method.

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10 See Van Hook and others (2014).
12 See Borjas (2017).
CBO’s methodology for estimating legal status in survey data can be summarized as follows:

- **Demographic Residual Method.** CBO followed the demographic method developed by Warren, Passel, and others to estimate the total number of people without legal status for each year from 1982 through 2018.

- **Assignment of Likely Legal Status Using Survey Data.** CBO used information reported in the CPS ASEC to estimate which people were likely to have legal status.

- **Probabilistic Assignment and Reweighting.** CBO used probabilistic assignment to account for people who may have legal status but could not be identified as such from the information available; the agency then reweighted the survey data to align with the population totals by region calculated in the first step.

### 3 Demographic Residual Method

CBO estimated the number of people without legal status using the residual method. The agency first estimated the number of people without legal status in four major survey years (1990, 2000, 2010, and 2018) by subtracting the number of people with legal status from the total foreign-born population. The agency focused on those four years because the decennial census long form contained the best data available for 1990 and 2000 on year of entry and country of birth, and thereafter CBO continued to use the same data from the American Community Survey (ACS) every 10 years, with 2018 being the most recent year available. CBO calculated the number of people without legal status in each year between 1982 and 2018 by estimating the annual flows of people without legal status.\(^\text{13}\) The demographic residual method CBO followed can be broken down into four steps:

1. Count the number of legal arrivals in the years studied;
2. Estimate how many people with legal status remain in the next major survey year (1990, 2000, 2010, or 2018) who did not emigrate, die, or overstay a temporary legal admission;
3. Estimate the number of people without legal status in the major survey years by subtracting the legal population from the total foreign-born population in the major survey year;
4. Estimate inflows and outflows of people without legal status by estimating how many people without legal status left before and after the major survey year and then calculating the total number of people without legal status, starting with zero in 1982.

\(^{13}\) Under IRCA, most foreign-born people who were living in the United States at the beginning of 1982 were able to become lawful permanent residents (LPRs) even if they had entered the country without legal status. Even though the law was passed in 1986 and took some time to implement, IRCA was widely used. Therefore, in the sample period, CBO expected that anyone who arrived before 1982 would eventually be eligible for lawful permanent residency and assumed they had legal status.
Foreign-born people can arrive in the United States without legal status or with different types of legal status, and there are many ways they can make a transition between types of status or exit the U.S. population. Only some of those transitions were modeled in this work (see Figure 1). With few exceptions, people generally must become LPRs before becoming naturalized citizens.\textsuperscript{14} Because naturalization does not represent a change in whether someone has legal status, or a flow into or out of the foreign-born population, naturalization was not measured separately in this model. Similarly, refugees and asylees are eligible to adjust their status to LPR, but that adjustment was not modeled because it did not change the legal status.

\textsuperscript{14} Exceptions are made for people who performed active duty military service for particular periods, U.S. nationals, and certain children. See USCIS (2016).
3.1 Legal Arrivals
CBO ultimately estimated the total foreign-born population that arrived legally each year from 72 countries or regions.\textsuperscript{15} Although there are many paths to lawful admission into the United

\textsuperscript{15}CBO combined data from some areas to form regions because a small number of people from countries in those regions immigrated to the United States, or to maintain consistent boundaries over time. CBO also ensured that the countries and regions were consistently identified across data sources.
States, in this paper lawful foreign-born arrivals were classified into four groups: new LPRs (which DHS calls “new arrivals”), refugees, affirmative asylees, and temporary residents. Data for counting legal arrivals come from the *Yearbook of Immigration Statistics* published annually by DHS.\(^\text{16}\) Refugees and asylees were a smaller fraction of entries than new LPRs. The number of people entering the United States as temporary residents has increased over time (see Figure 2).

**Figure 2: Estimated Number of Legal Inflows by Type of Status and Year of Entry**

![Graph showing legal inflows by type of status and year of entry.](image)

Data source: Congressional Budget Office, using data from the Department of Homeland Security.

**3.1.1 Newly Arrived Lawful Permanent Residents.** Some individuals enter the United States with an immigrant visa. They are granted lawful permanent residence (also known as a green card) after arrival. Most of the new LPRs are granted admission because of their relationship to family already residing in the United States, but other programs not related to family relationships, such as the Diversity Immigrant Visa Program (sometimes called the diversity lottery), also allow for entry as an LPR.

DHS tracks entry into the United States and collects the data on new arrivals (although the State Department issues immigrant visas). DHS provided CBO with data on all new LPRs by year, country of birth, and whether they were living abroad when they were granted lawful permanent

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\(^{16}\) CBO converted DHS arrival data from fiscal years to calendar years. CBO compiled all data back to 1982 except for nonimmigrant entries, which CBO compiled back to 1981. See DHS (2019).
residence (new arrivals) or were already in the United States (adjustments of status). This section describes new arrivals by their country of birth.\textsuperscript{17}

3.1.2 Refugees. Refugees apply to immigrate to the United States from a foreign country because of persecution or a well-founded fear of persecution. DHS reports the number of refugee arrivals by country of birth in the \textit{Yearbook of Immigration Statistics}, using data from the Department of State.\textsuperscript{18}

In some years, DHS aggregated refugees’ countries rather than identifying them individually. The level of aggregation varied annually. For some years, the data only reported refugees by country for the countries that sent the greatest number of refugees, and all other countries were aggregated by region. In those years, CBO imputed the number of refugees from each country on the basis of the distribution of refugees from that country in previous and later years. Although such imputations are by nature uncertain, they should have had minimal impact on CBO’s estimates of the total foreign-born population without legal status because the numbers of refugees from the countries in question were relatively low and because CBO also aggregated countries by region in its model.

3.1.3 Affirmative Asylees. Asylees are similar to refugees in that they are unwilling or unable to return to their country of nationality because of persecution or fear of persecution. They differ from refugees in that they are applying for asylum from within the United States, not from abroad. Consequently, the year they arrive in the United States is not necessarily the same as the year in which they are granted asylum. Nonetheless, CBO treated the year asylum was granted as the year of arrival because data on the year of arrival were not available. That treatment was a simplification for modeling purposes, and it is possible that asylees spent some years in the United States without legal status before being granted asylum. Unless there were sizable fluctuations from year to year in the number of asylees or in the span between their arrival and receipt of affirmative asylum, CBO’s treatment should have introduced only negligible errors. Because the number of affirmative asylees was relatively small, any errors did not significantly affect CBO’s total counts of the foreign-born population by legal status.

Whereas affirmative asylees apply for asylum within 12 months of entering the United States, defensive asylees apply for asylum after proceedings for their deportation have started. Before 2002, the data in the \textit{Yearbook of Immigration Statistics} did not distinguish between the two types of asylees. Therefore, CBO calculated the fraction of the total that were defensive asylees

\textsuperscript{17} As discussed in Sections 3.2.2 and 3.3.2, new LPRs were recorded in the year that their legal status changed. For people who were already living in the United States when they were granted status as LPRs, CBO estimated the years those people would have arrived.

\textsuperscript{18} See DHS (2019).
in 2002 and used that fraction to estimate the number of people in the two groups in previous years. Section 3.2.2 discusses defensive asylees.

As in the case of the data for refugees, data for asylees’ countries of birth are sometimes aggregated. CBO imputed the number of asylees by country on the basis of the distribution in previous and later years.

3.1.4 Temporary Residents. CBO estimated arrivals of new temporary residents using data on visa entries (which DHS calls admissions). Visas are travel documents needed for noncitizens to legally enter the United States for an extended period.\(^\text{19}\) There are two broad categories of visas: immigrant and nonimmigrant. Immigrant visas are for people who intend to work and live permanently in the United States, such as new LPRs, discussed above. Nonimmigrant visas are for people who intend to stay in the United States temporarily for a specific purpose such as business, tourism, or education.

CBO considered foreign-born residents with certain nonimmigrant visas to be temporary residents, including temporary workers, students, exchange visitors, and their spouses and dependents. Entries of people with visas to visit for business or pleasure and transit aliens (people in continuous transit through the United States) were excluded from the analysis. Those visas are not associated with setting up residence in the United States, and therefore people admitted with those visas were not counted in the residential population.\(^\text{20}\)

DHS reports the number of entries into the United States by temporary residents on an annual basis, but it does not report the number of new temporary residents. Those measures differ because some temporary residents may visit other countries and therefore may enter the United States multiple times in a year.

CBO estimated the number of new temporary residents in two steps: first, it estimated the number of temporary residents who are present in a year; second, it estimated the inflow each year.

3.1.4.1 Number of Temporary Residents. CBO estimated the total number of temporary residents present in a year as the number of entries from a given country for a given year divided by the estimates of average entries per person from that country in that year. The next section describes how to estimate inflow in the year that temporary residents arrived.

\(^\text{19}\) Temporary visitors who arrive for a purpose associated with setting up a residence must apply for a visa. Temporary visitors who enter the United States on business or pleasure for a short period might be from a country for which the United States does not require a visa or may participate in the Visa Waiver Program.

\(^\text{20}\) Someone entering the United States on a visa for business or pleasure might stay on illegally beyond the authorized period of stay. In CBO’s model, that person would be treated in the same way as someone who entered without legal status.
CBO first estimated the average number of times a particular type of temporary resident was likely to enter the country in a year. For example, a student pursuing a four-year degree within the United States might have entered multiple times on a student visa, returning to his or her home country for school breaks. CBO then calculated the implied number of entries per person each year by using estimates of the population of temporary residents from the Census Bureau and from DHS, for the years in which such estimates were available. The estimated entries per person from 1982 to 2018 were smoothed over time to interpolate the relationship for years in which the estimates were not available. The estimates for Canada and Mexico were significantly larger in 2010 and later years because DHS began releasing complete counts of land entries in 2010 (see Figure 3).

Figure 3: Estimated Entries per Temporary Resident, by Year


Beginning in 2010, DHS published more complete counts of entries via land borders with Canada and Mexico, which led to many more entries from those countries compared with previous years.

3.1.4.2 Inflow of Temporary Residents. CBO applied the inflow rates for each year to the estimated total number of temporary residents to yield an annual estimate of the inflow of temporary residents. CBO calculated total annual inflow because that enabled comparison with
the year of entry reported in the census or ACS. That calculation was not always simple. Specifically, CBO estimated the fraction of that population that was new each year (inflow rate) on the basis of the type of admission—for example, student or agricultural worker (see Figure 4).

**Figure 4: Estimating Inflows of Temporary Residents**

![Diagram of inflows and outflows](Image)

Data source: Congressional Budget Office.

The estimated inflow rates varied both over time and among visa categories for people from a given country or region of origin. CBO used three broad visa categories: seasonal workers (holders of H-2 visas); highly skilled or specialized workers (holders of H-1B visas); and other (mostly students, but also people in the United States for other purposes such as diplomats and intracompany transfers). CBO estimated inflow rates for each of those visa categories as described below. The overall inflow rate was then the weighted average of those rates, where the weights were the percentage of each visa admission category for a given year of entry and country or region of origin.

CBO estimated a 50 percent inflow rate for seasonal workers using information from the U.S. Citizenship and Immigration Services (USCIS). Seasonal work visas are generally up to a year in duration. Therefore, if many seasonal visas are less than a year in duration but some are renewed for additional years, it is reasonable to estimate that about half of the people entering the United States with seasonal visas in a given year came to live in the country in that year, whereas the other half arrived in a previous calendar year.

CBO estimated that the inflow rate for H-1B visa holders declined over time on the basis of data from the USCIS (see Figure 5). The USCIS data report the number of visa petitions approved for

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new employment and for continuing employment. CBO’s estimated inflow rate was 35 percent from 1982 to 1999, declining linearly to 15 percent in 2018.

CBO estimated a 30 percent inflow rate for students using data from the Institute of International Education, which conducts an annual survey of colleges and universities in the United States. The Institute’s Open Doors project estimates the total number of international students and new international students each school year.²²

**Figure 5: Inflow Rate of H-1B Visa Holders by Year of Entry**

![Graph showing inflow rate of H-1B visa holders by year of entry from 1982 to 2018.]

Data source: Congressional Budget Office, using data from U.S. Citizenship and Immigration Services.

Under the H-1B program, foreign-born workers can be temporarily employed in occupations that require highly specialized knowledge and the equivalent of at least a bachelor’s degree—occupations in fields such as mathematics, engineering, information technology, and postsecondary teaching.

Temporary resident inflow rates vary by country and over time. Over the 1998–2018 period, the average inflow rate by country ranged from 0.281 to 0.347. An alternative inflow rate is considered in Section 7.1.2.

If using the inflow rate yielded a smaller estimate than the change in the number of temporary residents from one year to the next, CBO instead used the net inflow of temporary residents to count the number of new arrivals. The net inflow in temporary residents was the difference between the number of temporary residents in year $t$ and the number in year $t-1$. However, that

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difference was the result of both inflow and outflow. The implications of alternative inflow rates on CBO’s estimate of the number of people without legal status are discussed in the sensitivity analysis section of this paper.

3.2 People With Legal Status Who Arrived Before the Major Survey Year
After summing the estimated legal arrivals by year and country of birth, CBO estimated how many people in each of those cohorts were still in the country with legal status at the time of the major survey. In other words, the agency estimated how many of the people with legal status who flowed into the country left before being counted in a major survey. LPRs, refugees, and asylees were all treated as permanent arrivals. CBO posited that LPRs expected to remain in the United States permanently. Refugees were required to request adjustment to LPR status after a year in the United States and asylees were eligible to request adjustment to LPR status as well. CBO’s expectations for temporary residents were different: It judged that some became LPRs, some left the United States, and some overstayed their temporary legal status. CBO therefore treated the rates at which people left differently depending on whether they had permanent or temporary status when they arrived.

3.2.1 Outflows of People Who Arrived With Permanent Status. In CBO’s model, people exited the population with permanent legal status through death or emigration.23 The population of new arrivals with permanent status is younger, on average, than the general population of the United States. Accordingly, CBO used a death rate of 5.7 deaths per 1,000 people in that population’s year of arrival, compared with 8.6 deaths per 1,000 people for the general population in 2017, for example.24 As the cohort aged, death rates increased by 1 percent per year.25 Alternate specifications are explored in Section 7.1.

Although CBO assumed that people who arrived with permanent status intended to settle in the United States, foreign-born people have a higher rate of emigration than native-born people. However, the tendency of the foreign-born to emigrate declines the longer they live in the United States. CBO assumed that the emigration rate was 3 percent in the first year of arrival, and that the rate fell to 1.9 percent after people had been in the country for 10 years.26

3.2.2 Outflows of People Who Arrived With Temporary Status. CBO calculates the outflow of temporary residents in a given year using its calculations of the inflow and net inflow of those...
residents and estimates the change in the total number of temporary residents from one year to the next: \( \text{outflow} = \text{inflow} - \text{net inflow} \) (see Figure 6).

**Figure 6: Estimating Outflows of Temporary Residents**

![Diagram of outflows](image)

Data source: Congressional Budget Office.

In the model, there were three ways that people could exit the population of those with temporary legal status. First, they could adjust to LPR status. In that case, they remained part of the population of all residents with legal status, but they exited the temporary resident population and moved to the permanent resident population. Second, they could remain in the United States after overstaying their temporary legal status. At that point, they exited the population of those with legal status and became part of the population of people without legal status. Third, they could die or emigrate before their temporary legal status expires. In that case, they exited the U.S. population entirely. On the basis of data from the SIPP about adjustments to LPR status, CBO posited that almost all temporary residents who exited the legal population did so within five years of entering the country.\(^{27}\)

\[3.2.2.1 \text{Temporary Residents Who Adjusted to LPR Status.} \] CBO modeled two groups of people who adjust to LPR status: people who entered the country as temporary residents on a nonimmigrant visa and complied with the terms of that visa, and people who did not have legal status (because they either entered the country without legal status or stayed after their temporary legal status expired).\(^{28}\)

CBO inferred that most people who adjusted their status to LPRs entered the country on a nonimmigrant visa and adjusted status before their temporary legal status expired. As mentioned previously, data on year of entry were not available for people who made the adjustment to LPR status while residing in the United States. Using data from the SIPP, CBO estimated that people

\[^{27}\text{See Census Bureau (2018) for more information.}\]

\[^{28}\text{Temporary residents who became lawful permanent residents also include refugees, asylees, and people acting under IRCA. However, CBO used DHS data specific to those populations to count them as having arrived with permanent legal status.}\]
who became LPRs in year $t$ arrived 5 years before, in year $t-5$. (Section 7.3 discusses the sensitivity of the results to different estimates.) To estimate the number of people who arrived with temporary status but had not become LPRs by 2018 (that is, the number who arrived from 2014 to 2018), a linear model projected how many people would adjust to LPR status in future years. The projection equation was based solely on each person’s year of arrival and was estimated separately by country. If those projections resulted in an adjustment value that was either too high (greater than 150 percent of the previous year’s value) or too low (less than 50 percent of the previous year’s value), CBO instead used a value equal to the previous year’s value. To avoid inadvertently double-counting people who arrived in the United States before 1982, CBO scaled adjustments of status for people who were estimated to have arrived in the early 1980s.

CBO used a longer adjustment timeline for people from China and India (see Table 1). That was because their wait for employment-based adjustment to LPR status had grown over time. CBO estimated that, by 2018, people from India and China were waiting 14 years to adjust to LPR status. In keeping with CBO’s projections for people with nonimmigrant visas from other countries, projections for the size of the population from India and China adjusting to LPR status in future years were calculated using linear extrapolation.
Table 1: Timeline for Temporary Residents from China or India to Become Lawful Permanent Residents, by Year of Entry

<table>
<thead>
<tr>
<th>Year of Entry (t)</th>
<th>Year of Adjustment to Lawful Permanent Resident Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982 through 1991</td>
<td>t + 5</td>
</tr>
<tr>
<td>1992</td>
<td>t + 5 and t + 6</td>
</tr>
<tr>
<td>1993 through 1997</td>
<td>t + 6</td>
</tr>
<tr>
<td>1998</td>
<td>t + 6 and t + 7</td>
</tr>
<tr>
<td>1999 through 2005</td>
<td>t + 7</td>
</tr>
<tr>
<td>2006</td>
<td>t + 7 and t + 8</td>
</tr>
<tr>
<td>2007</td>
<td>t + 8</td>
</tr>
<tr>
<td>2008</td>
<td>t + 8 and t + 9</td>
</tr>
<tr>
<td>2009</td>
<td>t + 9</td>
</tr>
<tr>
<td>2010 through 2013</td>
<td>t + 10</td>
</tr>
<tr>
<td>2014</td>
<td>t + 10 and t + 11</td>
</tr>
<tr>
<td>2015</td>
<td>t + 11 and t + 12</td>
</tr>
<tr>
<td>2016</td>
<td>t + 12 and t + 13</td>
</tr>
<tr>
<td>2017</td>
<td>t + 13 and t + 14</td>
</tr>
<tr>
<td>2018</td>
<td>t + 14</td>
</tr>
</tbody>
</table>


3.2.2.2 Temporary Residents Who Overstayed Temporary Legal Status. To calculate the population of temporary residents who remained in the United States after their legal status expired, CBO multiplied the total outflow by an overstay rate. The final overstay rate was DHS’s estimated average overstay rates by visa type, weighted by categories of visa entries. CBO used different overstay rates for students than for all other visa types. The agency also used different student overstay rates for each of 10 countries that accounted for either a large number of visa entries or a large fraction of the population without legal status: China, India, Japan, Germany, the United Kingdom, Canada, Mexico, El Salvador, Guatemala, and Honduras. Additionally, CBO only included 53 percent of student overstays in its analysis because information from DHS showed that many students who stayed after their temporary legal status expired left the United States within the calendar year.29

When temporary residents exited the population of nonimmigrant visa holders by overstaying their legal status, they entered the population without legal status. Therefore, their year of exit

29 See DHS (2020).
from the population of those with legal status was the same as their year of entry to the population of those without legal status.

3.2.2.3 Temporary Residents Who Emigrated or Died. To estimate the number of residents who emigrated or died before their temporary legal status expired, CBO estimated the number of temporary residents who neither overstayed their status nor adjusted to LPR status and assumed that the balance left the United States. The agency then applied an emigration rate to that balance over the five years that their temporary legal status allowed them to stay in the United States. For each country of birth, that emigration rate was weighted by the estimated percentage of student visas from that country because students typically follow a definitive timeline for entering and exiting the United States. For example, data from the Student and Exchange Visitor Program showed that about 30 percent of international students were enrolled in bachelor’s degree programs, so CBO assumed that 30 percent of the students who left the United States did so after four years.30

3.2.3 Estimating the Total Foreign-Born Population. To estimate the total number of foreign-born people without legal status in a given year, CBO first calculated the total number of foreign-born people using major survey data, then subtracted the number who had legal status. CBO produced those estimates by country of birth and year of arrival to harmonize them with the estimates of the number of legal arrivals in a given year and the number of people who remained in the major survey year.

3.2.3.1 Data. CBO used the decennial census long form for 1990 and 2000 and used ACS data for 2010 and 2018. (The ACS replaced the decennial census long form.) The ACS, which was fully implemented in 2005, is the largest household survey in the United States.31 The Census Bureau collects data for the survey on a rolling basis throughout each year. The ACS provides statistics about the social, economic, and housing characteristics of the population as a whole and also provides statistics for many different geographic divisions and subpopulations—including the year of entry and place of birth for foreign-born people residing in the United States.

3.2.3.2 Reweighting. CBO reweighted the census and ACS data to match the Census Bureau’s official population estimates.32 The Census Bureau releases updated estimates of the population by selected characteristics every year, using the most recent decennial census as the primary input and adding later data on births, deaths, and net immigration. Those updated estimates are referred to as postcensal estimates. After the next decennial census, the previous decade’s

30 See National Center for Education Statistics.
31 The ACS household sample was fully implemented in 2005 and the group quarters sample was fully implemented in 2006.
32 See Census Bureau, “Population and Housing Unit Estimates.”
postcensal estimates are again updated using those data and new data about births, deaths, and migration. Those are referred to as intercensal estimates.

Because official population estimates use the decennial census as a primary input, the reweighting procedure only slightly affected CBO’s estimates of the total population in 1990 and 2000, primarily because reweighting shifted the reference date from April to July of the reference year. Reweighting the data to align the population totals to the intercensal estimate for 2010 and the postcensal estimate for 2018 (the years when CBO used ACS data) had a larger impact.

3.2.3.3 Adjustment for Undercounting. Undercounting of the foreign-born population in censuses and surveys is well documented in prior research, although it is less of an issue in censuses because they have more resources for outreach and follow-up than surveys. The problem of undercounting is greater for more recent arrivals to the United States and is a bigger issue for people without legal status than for people with legal status. CBO applied averages of estimated undercount rates from the long form of the decennial census and the ACS, weighted by estimates of the number of people with and without legal status. Using counts of the number of people by year of entry, CBO applied an undercount rate of 6.3 percent to census data and a rate of 8.3 percent to ACS data in the year after new residents’ arrival, and decreased both rates by 10 percent for each additional year of residency. Section 7.2.2 shows the sensitivity of the model’s results to the undercount rate.

3.2.4 Total Population by Year of Arrival and Country. For each of the major surveys, CBO summed the number of people present in the survey year who had arrived in the previous decade, by year of arrival and country of birth. The estimates for 1990 and 2018 required additional steps. In the 1990 census long form, the year of arrival was only available as part of a range. That survey was the first major survey available after Immigration Reform and Control Act of 1986 (IRCA) took effect, so the relevant ranges for CBO’s analysis were 1982 to 1984, 1985 to 1986, and 1987 to 1990. (CBO did not include years before 1982 because IRCA allowed people who had arrived before 1982 to become LPRs.) To estimate the number of people surveyed in 1990 by year of arrival, within each range CBO adopted the same distribution of people by specific year of arrival that the agency observed in the 2000 census. CBO applied those estimated distributions by country to the 1990 census to arrive at the number of people present in 1990 who had arrived between 1982 and 1989.

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33 CBO’s average undercount rates were based on those recorded by other researchers. For the census, Warren and Warren (2013) estimated an undercount rate of 10 percent for the population without legal status and 3 percent for the population with legal status. For the ACS, they estimated an undercount rate of 12.1 percent for the population without legal status and 5.3 percent for the population with legal status. CBO used the weighted average of those rates, weighted by the Warrens’ estimates for the size of the foreign-born population by legal status in 2000 and 2010.
Estimating the number of people who arrived in 2018 also required an adjustment. The 2018 ACS was fielded throughout the year, but foreign-born people were only noted in the sample once they arrived. If, for example, arrivals were uniformly distributed throughout the year, the ACS would capture only about half of all arrivals. To estimate total 2018 arrivals, CBO calculated the ratio of people recorded as arriving in year $t$ for the survey fielded in year $t + 1$ to the number of people recorded as arriving in year $t$ for the survey fielded in year $t$, for $t = 2014, 2015, 2016$, and $2017$. The average was 1.75. Therefore, CBO multiplied the estimate of arrivals in the 2018 ACS by 1.75 to estimate the total number of 2018 arrivals.

After those adjustments, the summation was straightforward; CBO counted people by country or region of birth and year of arrival. Significant historical and political events—the reunification of Germany, the dissolution of the Soviet Union, civil wars, and other political developments—changed the borders of countries and the collection and classification of data relating to country of birth. To ensure a complete time series and to account for small sample sizes from some countries, CBO combined data from some countries to form regions, and, matching the countries and regions in the DHS data, estimated the total population of immigrants for 72 countries or regions by year of arrival.  

3.2.5 Adjustment for Heaping. Heaping refers to people’s tendency to report retrospective dates in round numbers. Because CBO combined survey data, which reflect such heaping behavior, with administrative data on inflows, which do not, CBO adjusted the survey data for that bias.

In the model, CBO used a three-year central moving average (the average of the current year, $t$, one year earlier, $t−1$, and one year later, $t + 1$) to estimate arrival by country and year. For the most recently arrived cohort, that method could not be used for the last year in the period because it required data from the year before and after arrival, and data for the year following the last year in the period were not available. Therefore, CBO used a standard three-year moving average (current year $t$, one year prior $t−1$, and two years prior $t−2$) to estimate the year of arrival for 2010 through 2018. Section 7.2.1 presents alternative adjustments for heaping.

3.3 People Without Legal Status

From the completed estimates of the total number of foreign-born people in the four major survey years by year of arrival and country of birth, CBO subtracted its estimates of the number of people who had arrived with legal status in the years before the major survey and remained in the country to be counted in the survey year. That resulted in estimates of the number of people without legal status who were present in the major survey year by year of arrival and country of birth. The subtraction was the crucial point of the residual method; it allowed for estimates of the

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34 In this paper, “country” and “country or region” are used interchangeably when referring to those 72 locations; most of them are individual countries.
total number of people without legal status by year of entry in each of the four major survey years.

CBO then accounted for people who were no longer part of the population of people without legal status, either because they had left the country or because they had achieved legal status. They might have been part of that population before—but not during—the major survey year, or they might have been part of that population in the major survey year but not afterward.

3.3.1 Inflows and Outflows of People Without Legal Status, by Year

People flow in and out of the population of residents without legal status in a number of ways (see Figure 7).

Figure 7: Modeled Inflows and Outflows of Residents Without Legal Status

Data source: Congressional Budget Office.

CBO estimated inflows (by country of birth and year of entry) to the population of residents without legal status by combining its estimates of that population in a major survey year with its estimates of the number of people without legal status who had arrived before that survey year but were no longer part of the population without legal status by the survey year. CBO estimated outflows from the population of those without legal status by following entry cohorts over time and estimating how many people exited the population without legal status each year, while also
taking into account people who entered that population by overstaying their temporary legal status.\textsuperscript{35}

In accordance with prior literature, CBO estimated that the population of those without legal status was zero in 1982. As noted previously, IRCA allowed foreign-born people who had been living in the United States since 1982 to become permanent residents even if they entered the country without legal status. Nearly 3 million people were granted LPR status under IRCA, a number that was estimated to represent most of the people without legal status who were in the United States in 1982.\textsuperscript{36} Therefore, CBO estimated that everyone who entered the United States before 1982 would have legal status as of that year.

To estimate the total number of people without legal status for every year after 1982, CBO added the estimated annual inflows and subtracted the estimated annual outflows. For example, the agency acknowledged that people who arrived in 1988 and emigrated in 1989 were present for a year even though they were not present in the major survey year. If some of those who arrived in 1988 emigrated in 1994, they would be included in the total population of those without legal status as of 1990, 1991, 1992, and 1993. CBO would then subtract their numbers from the total population without legal status in 1994 and later years.

\textbf{3.3.2 Outflows From the Population Without Legal Status.} People exited the population of U.S. residents without legal status in various ways: They died, emigrated, were removed through legal proceedings, were granted asylum, or became LPRs. CBO modeled outflows from the population by estimating each possibility separately. Because foreign-born people without legal status tend to be even younger than foreign-born people with legal status—who are already younger, on average, than the general population—CBO used a lower death rate for that group (3.9 deaths per 1,000 people) than it had used for foreign-born people with legal status (5.7 deaths per 1,000 people).\textsuperscript{37} As the cohort aged, CBO increased that estimated death rate by 1 percent per year, as it had for the foreign-born population with legal status. Section 7.1.1 describes alternate specifications for death rates.

The emigration rate for the foreign-born population without legal status tends to be higher than the rate for the foreign-born population with legal status, but both rates fall as people stay longer in the United States. For foreign-born people without legal status, CBO used an emigration rate

\textsuperscript{35} Outflow from the population without legal status can be negative if, in a given year, more people overstay their temporary legal status than exit the population.

\textsuperscript{36} See Rytina (2002).

\textsuperscript{37} See Warren and Warren (2013).
of 3.2 percent in the first year after arrival, falling steadily to 2 percent by those people’s 10th year of residence and remaining constant thereafter.38

DHS reports the number of people deported from the United States each year and the number of people granted asylum each year. Asylum is referred to as defensive asylum when it is granted after the government has initiated deportation proceedings. CBO modeled both the number of people who were deported and the number who were granted asylum as having exited the population of those without legal status. Once people were deported, they were no longer counted in the population of foreign-born residents without legal status. CBO moved the people granted defensive asylum into the population of foreign-born residents with legal status. CBO’s model treated people removed or granted defensive asylum in year $t$ as though they had arrived in year $t-1$.39 As with other modeling assumptions, CBO expected that the arrival year it assigned would not be true for all members of the group. However, it judged that unless there were large spikes in the number of removals or defensive asylum applications granted from one year to the next, its assumption would not introduce bias in the aggregate.

For some countries and years of entry, CBO observed that far more people became LPRs than the number of people it estimated were in the country with temporary legal status. That was because some residents without legal status became permanent residents (for example, if they overstayed their temporary legal status and an immediate relative had legal status). CBO modeled that change in status for people from five countries (Colombia, El Salvador, Guatemala, Honduras, and Mexico) in the relevant years of entry. Those countries were selected because the number of people from them who became LPRs was particularly large compared with the estimated number of temporary residents from those countries. Several of the countries had long waitlists to become LPRs, particularly for people who sought LPR status on the basis of family preference.40 The table below shows CBO’s estimates for the length of time it took people from those countries who lacked legal status to become LPRs by year of entry and year that their legal status changed.

CBO generally estimated the amount of time it took people with family-preference petitions to become LPRs using data from the USCIS.41 Although those data provided multiple family preference categories, for simplicity CBO estimated a single time span from entry year to year of adjustment to LPR status. The length of time it took family-preference petitioners to adjust to LPR status increased over the 1982–2008 entry period (see Table 2).

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38 Ibid.
39 According to DHS (1986), the majority of removals take place within one year of arrival.
40 For information about family preference, see USCIS, “Green Card for Family Preference Immigrants” (2020).
41 For information about priority dates, see USCIS, “Adjustment of Status Filing Charts” (2020).
Table 2: Timeline for People Without Legal Status from Select Countries to Become Lawful Permanent Residents, by Year of Entry

<table>
<thead>
<tr>
<th>Year of Entry (t)</th>
<th>Year of Adjustment to Lawful Permanent Resident Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982 through 1989</td>
<td>t + 10</td>
</tr>
<tr>
<td>1990</td>
<td>t + 10 and t + 11</td>
</tr>
<tr>
<td>1991 and 1992</td>
<td>t + 11</td>
</tr>
<tr>
<td>1993</td>
<td>t + 11 and t + 12</td>
</tr>
<tr>
<td>1994</td>
<td>t + 12</td>
</tr>
<tr>
<td>1995</td>
<td>t + 12 and t + 13</td>
</tr>
<tr>
<td>1996 and 1997</td>
<td>t + 13</td>
</tr>
<tr>
<td>1998</td>
<td>t + 13 and t + 14</td>
</tr>
<tr>
<td>1999 and 2000</td>
<td>t + 14</td>
</tr>
<tr>
<td>2001</td>
<td>t + 14 and t + 15</td>
</tr>
<tr>
<td>2002 through 2008</td>
<td>t + 15</td>
</tr>
</tbody>
</table>

Data source: Congressional Budget Office, using data from the U.S. Citizenship and Immigration Services.

CBO selected Colombia, El Salvador, Guatemala, Honduras, and Mexico because the number of people who were illegally present and became LPRs was particularly large compared with the number of temporary residents from those countries. The year in which their status changed is based on U.S. Citizenship and Immigration Services, “When to File Your Adjustment of Status Application for Family-Sponsored or Employment-Based Preference Visas: July 2019,” https://go.usa.gov/xf9w4.

CBO separated the population that adjusted to LPR status by year of entry and country of origin, then into people who had temporary legal status and people who did not and estimated the years in which members of those two groups became LPRs. For example, of the population that entered in 1988 and later became LPRs, CBO estimated that half entered the United States on a nonimmigrant visa and became LPRs five years later, in 1993 (see Section 3.2.2.1). CBO estimated that the other half entered the country without legal status in 1988 and became LPRs as detailed in Table 2 (in this example, members of that group would have become LPRs in 1998). Section 7.3 shows that how CBO estimates which people without legal status become LPRs has an important influence on its final estimates.

3.3.3 Inflows and Outflows of People Without Legal Status, by Cohort. For each major survey year, CBO identified cohorts by country of birth and year of entry in the population of those without legal status. CBO estimated inflows by adding the number of people from each cohort whom CBO estimated to have exited that population between the year of entry and the major survey year. That calculation implied the annual outflow for each entry cohort until the major survey year. Following the major survey year, CBO used the same estimation strategy
(estimating death, emigration, removals, and adjustments to LPR status) to provide annual estimates of the outflow of people by cohort through the end of the estimation period in 2018.

Because CBO calculated outflows each year by entry cohort, the total outflow in a given year was the sum of the outflow from each cohort that entered before the year in question. For example, in 1988, the outflow was the sum of people who left the population without legal status for each cohort that arrived between 1982 and 1987.

In short, CBO started its measurement period in 1982 under the premise that people who had arrived without legal status before that year obtained legal status under IRCA. Next, the agency added inflows and subtracted outflows each year. That final step yields the estimates of the total number of people without legal status by year of arrival and country of birth from 1982 to 2018.

4 Use of Survey Data to Determine Legal Status

The demographic residual method enabled CBO to estimate the number of people without legal status by year. However, to understand how the characteristics of the foreign-born population differ depending on their legal status, CBO needed to distinguish between those who had legal status and those who lacked it in demographic survey data. CBO used the CPS ASEC to impute legal status to foreign-born residents who were very likely to have it based on their responses to certain questions.

4.1 Current Population Survey

The CPS ASEC has information about the demographics and economic circumstances of households. As described in this section and the next, CBO used that information to identify foreign-born people who were likely to have legal status and inferred that the remainder were potentially without legal status. The survey contained no direct indicators that would have enabled CBO to estimate which respondents did not have legal status. CBO imputed the legal status of all foreign-born individuals from 1998 through 2018.42

Given the length of the time series in the CPS ASEC and the benefits of the information it contains on the people in the sample, CBO judged it to be the best available dataset for the agency’s purposes, even with certain time inconsistencies.43 Other major demographic surveys CBO considered for its analysis were the ACS and the SIPP. The ACS was not in full production until 2005 and did not collect all the information used for identifying legal status until 2008, so its time series is shorter. The SIPP has a smaller sample size and underwent a major redesign in

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42 See Ruggles and others (2019).

43 Because the time series for this project was 20 years, CBO used the production files for all results, not the bridge file or research files that the Census Bureau released for 2017 and 2016 data, respectively. Once the source of the discrepancy in the counts of the foreign-born population is better understood, CBO might make further adjustments to the most recent data.
2014, making it less suitable for CBO’s analysis than the CPS ASEC. Further, the CPS ASEC is the base dataset CBO uses for several other models.

CBO made two adjustments to data in the CPS ASEC. First, the agency reweighted population totals to match intercensal population estimates (through 2010) and postcensal population estimates (2011 and later). That adjustment harmonized population counts in the CPS with the totals in census and ACS surveys. Reweighting CPS data to conform to estimated population totals also produced a more consistent time series because CPS does not revise its weighting after new information about the population becomes available.44

Second, CBO addressed the problem of surveys undercounting the foreign-born population. As mentioned, several studies have shown that foreign-born people are less likely to be counted in censuses and surveys. Those without legal status are more likely to be undercounted than those with legal status, who are in turn more likely to be undercounted than native-born people. Undercounting was a substantial problem before 2000 but has been less of a problem since then.45

To compensate for undercounting, CBO modified the population-adjusted CPS ASEC weights for foreign-born people with and without legal status. It treated people without legal status who came from Mexico differently than those who came from other countries. CBO derived a series of undercount rates from estimates that were drawn from the literature for a number of years between the late 1990s and 2014.46 It held the undercount rates constant after 2014 because no estimates for recent years were available from the literature. The agency interpolated values for the intervening years and then linearized the series (see Figure 8).

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44 CBO acknowledges that there was a mismatch in the populations of interest in the two sources. The intercensal and postcensal estimates are for the total population of the United States, whereas the CPS ASEC covers the civilian, noninstitutionalized population as well as members of the armed forces living in civilian housing on a military base or in a household not on a military base. Nonetheless, CBO judged that the advantages of a consistent time series and consistency across datasets outweighed the disadvantages of the mismatch in the measured populations.


46 See Baker (2018); Passel and Cohn (2016); Van Hook and others (2014); and Passel (2001).
A shortcoming of the CPS ASEC was the lack of time series comparability between the data before and after the survey was redesigned in 2014. If the redesign elicited more precise responses about household relationships and health insurance coverage, for example, CBO’s imputation of legal status would be more precise after 2014. CBO’s estimation of income by legal status would also be more precise.

Another shortcoming was the significant difference between the counts of the foreign-born population in 2018 in the CPS and the counts in the ACS. That difference indicated that changes in the CPS ASEC survey or processing system may have affected estimates of the

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47 See Berchick and Jackson (2019).
48 See Jackson and Berchick (2020).
49 See Camarota (2019).
foreign-born population. CBO’s first adjustment to the CPS ASEC data, reweighting the population totals, mitigated that concern.

4.2 Criteria for Assigning Likely Legal Status
After estimating the total population without legal status, CBO imputed likely legal status on the basis of certain survey responses to the CPS ASEC. CBO assigned likely legal status to foreign-born CPS ASEC respondents if they met any of 12 different criteria, including information about their country of birth, date of entry into the United States, employment, and receipt of certain types of government services. The table below describes the assignment criteria, and, of those assigned likely legal status, reports the percentage of foreign-born people assigned legal status based on each criterion (see Table 3). CBO’s imputation procedure applied criteria sequentially; thus, the number of people estimated to be likely to have legal status on the basis of any one criterion was influenced by the order of the sequence.
Table 3: Criteria Used to Assign Likely Legal Status to CPS ASEC Respondents\textsuperscript{a}

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturalized Citizens</td>
<td>59</td>
</tr>
<tr>
<td>Arrivals Before 1982</td>
<td>9</td>
</tr>
<tr>
<td>Veterans, Members of the Armed Forces, or Federal, State, or Local Government Workers</td>
<td>2</td>
</tr>
<tr>
<td>Cubans Arrivals Before 2017</td>
<td>1</td>
</tr>
<tr>
<td>People Who Received Certain Benefits or Were Covered by Certain Government Insurance\textsuperscript{b}</td>
<td>4</td>
</tr>
<tr>
<td>Heads of Household Living in Public Housing or Receiving Subsidized Rent</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Workers in Occupations Requiring Some Form of Licensing, With Certain Exceptions</td>
<td>2</td>
</tr>
<tr>
<td>Arrivals at Age 60 or Older</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Workers Identified by Certain Occupations, Levels of Education, and Lengths of Stay</td>
<td>1</td>
</tr>
<tr>
<td>People Who Were Enrolled in Medicaid, With Certain Exceptions</td>
<td>7</td>
</tr>
<tr>
<td>Spouses, Children, or Grandchildren of Native-Born or Foreign-born Heads of Household With Legal Status</td>
<td>12</td>
</tr>
<tr>
<td>People Whose Country of Birth Was a Significant Source of Refugees</td>
<td>Negligible</td>
</tr>
</tbody>
</table>


\textsuperscript{a} Estimates reflect only the distribution of people assigned likely legal status on the basis of the sequential criteria and do not include the people assigned probabilistic legal status. Probabilistic assignment of legal status is described in Section 5.1. For more details on the assignment criteria, see Congressional Budget Office, \textit{The Employment of Foreign-Born People} (June 2020), p. 22-24, [www.cbo.gov/publication/56357](http://www.cbo.gov/publication/56357).

\textsuperscript{b} Includes Social Security, Supplemental Security Income, Temporary Assistance for Needy Families, Medicare, and military health insurance.

CBO’s list of criteria was similar but not identical to the list of criteria employed by Borjas.\textsuperscript{50} To reflect government policies, CBO modified four of the criteria Borjas used and added other criteria. First, under the Cuban Adjustment Act of 1966, any Cuban national could apply to become a permanent resident after a year in the United States; however, from 2017 on, U.S.

\textsuperscript{50} See Borjas (2017).
policy no longer allowed Cubans who arrived on U.S. soil to be admitted or paroled into the country on a temporary basis. Because CBO examined data through 2018, its criterion took that policy change into account. Second, heads of households must be citizens or foreign-born people with legal status to benefit from federal rental assistance; however, that requirement does not apply to all members of a household. CBO’s criterion only assigned likely legal status to heads of households if they lived in public housing or received subsidized rent, not to all household members. Third, for certain states and certain occupations, CBO did not assign likely legal status on the basis of occupational licensing because those states allowed for such licensing regardless of legal status. Fourth, CBO did not assign likely legal status on the basis of Medicaid enrollment to people who had given birth in the past year or to a child living in a state with state-funded Medicaid for children without legal status.

CBO also added three criteria. One assigned legal status to workers who were likely to have been admitted to the United States under the H-1B program. CBO identified those people on the basis of certain occupations, levels of education, and lengths of stay. Foreign-born workers can be temporarily employed in occupations that require highly specialized knowledge as long as they have the relevant knowledge and the equivalent of at least a bachelor’s degree—occupations such as mathematics, engineering, information technology, and postsecondary teaching. In general, those workers can stay in the United States for six years, but CBO’s criterion also reflected circumstances under which stays could be extended beyond six years. On the basis of other research, CBO also added a criterion for people who arrived in the United States at age 60 or older because evidence indicated that very few unauthorized residents arrived at those ages. Finally, CBO added a criterion to identify people who probably would have had legal status as refugees if, in the year that they arrived, the number of refugees admitted from their country of origin was at least double the number of arrivals from that country who were not refugees.

CBO also considered whether to assign likely legal status to spouses, children, and grandchildren of household heads with legal status. Other researchers do not impute legal status to household members of people from Mexico and Central America. That is because people from those countries who lack legal status must leave the United States to apply for it, and that departure prompts a prohibition on their return to the United States for multiple years. However, that approach means that legal status is not imputed to many children from Mexico and Central America.
America even though they arrived in the United States with household heads who were imputed to have legal status. For that reason, CBO imputed legal status to spouses, children, and grandchildren of household heads with legal status.

5 Probabilistic Assignment and Reweighting

After imputing likely legal status using the assignment criteria, CBO found that it had identified fewer people with legal status than the number it derived from the demographic residual method. That discrepancy varied among countries and years: The number of foreign-born people assigned likely legal status was less than the total from the residual method for some countries and years and greater than the total from the residual method for other countries and years. Therefore, CBO used probabilistic assignment and reweighting to adjust CPS ASEC data to match the total number of people assigned legal status with the total it had calculated through the demographic residual method.

With probabilistic assignment, CBO randomly assigned legal status to a fraction of people who were not identified from the assignment criteria as being likely to have legal status. With reweighting, CBO matched the counts for those with and without legal status to the output from the demographic residual method. In other words, probabilistic reassignment addressed the fact that the imputation procedure underassigned legal status for certain cohorts, and reweighting addressed the fact that the procedure overassigned legal status for other cohorts. Underassignment probably occurred because people with legal status could not always be identified from CBO’s assignment criteria. For example, people who came to live in the United States on a family-sponsored petition but who were not naturalized citizens and did not live with the sponsoring family member at the time of the survey would not be identified by CBO’s criteria. Overassignment was likely to occur if the assignment criteria were too broad for reasons that could not be determined from the available data. Though both types of error, along with sampling errors, were likely to be present in all countries and all years, CBO used probabilistic assignment to make an adjustment if the first error dominated. The magnitude of the second error was smaller overall; because CBO wanted to treat the assignment criteria consistently across countries, it used reweighting to adjust the total if the second error dominated.

CBO used probabilistic assignment for people from India, China, and the Philippines in every year from 1998 to 2018. It used reweighting for Mexico and Central America in every year from 1998 to 2018. Essentially, the assignment criteria were more likely to identify people with legal status from Mexico and Central America than they were to identify people with legal status from India, China, and the Philippines.

5.1 Probabilistic Assignment

CBO assigned probabilistic legal status to some residents whom the assignment criteria did not identify. CBO considered the demographic residual method to result in the total population without legal status and the imputation procedure to result in the total population that was
potentially without legal status. The agency used the ratio of the number of people from a particular geographic region who were found through the demographic residual method to the number who were imputed to be potentially without legal status. The agency estimated the ratio of the two populations by region for every year from 1998 to 2018. Those regions were Central America; Mexico; India, China, and the Philippines; Asia (excluding India, China, and the Philippines); Europe; Africa; Oceania; North America; and South America. CBO then assigned a random number between zero and one to all survey respondents. (Household members that arrived in the United States as a group were given the same random number to ensure that they would be kept together during probabilistic assignment.) If a respondent who was not assigned legal status during the imputation procedure received a random number greater than the calculated ratio described above, CBO assigned legal status to that respondent.

5.2 Reweighting Data
After probabilistic assignment, CBO recalculated the regional ratios between the total population without legal status that it found using the demographic residual method and the population that was potentially without legal status (which CBO found through the CPS ASEC after probabilistic assignment). Ideally, all of those ratios would be within a rounding distance of one. However, overassignment meant that the recalculated ratio was greater than one for some cohorts; that is, the total population without legal status was greater than the total population that was potentially without legal status. For those cohorts, CBO reweighted the populations with and without legal status so that they matched the totals produced by the demographic residual method for each place of birth.56

6 Results
CBO estimated that the number of foreign-born people without legal status rose from 8.1 million in 1998 to 11.0 million in 2018.57 The time series showed that the number of foreign-born without legal status increased from 1998 through 2007. After 2007, estimates were generally unchanged, indicating that the number of people joining the population of those without legal status over the 2008–2018 period was similar to the number of people leaving that population.

CBO’s estimates of the number of foreign-born people without legal status changed at each step of the estimation procedure (see Figure 9). The first line shows the size of the population that was potentially without legal status because that group’s responses to the CPS ASEC did not lead CBO to assign them likely legal status. As explained previously, that assignment was based

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56 For Ireland, Jamaica, and the Dominican Republic, the legal inflow CBO calculated using DHS data was larger than the total foreign-born population calculated from the CPS ASEC data in recent years. CBO could do little to remedy the problem, which reflects sampling error, errors in adjusting the survey data, and other sources of uncertainty. The agency aggregated those countries as part of larger regions in part to address the issue; it did not observe such discrepancies once the data was aggregated.

57 There are small changes in the final results reported here relative to those in CBO (2020) because replicating the estimation led to slight differences in the random numbers generated.
solely on the criteria CBO applied to the CPS ASEC. The second line shows the size of the population without legal status after CBO adjusted the CPS ASEC data to make up for undercounting of the foreign-born population. The third line shows the size of the population without legal status after assignment of probabilistic legal status, and the fourth line shows the size of the population without legal status after reweighting. At that point, the count of people without legal status from the CPS ASEC matched the aggregate total from the residual method.

**Figure 9: Estimates of the Population Without Legal Status at Different Points in CBO’s Methodology**


The probabilistic assignment and reweighting procedures had more impact in some years than others. In recent years, the population totals from the imputation procedure were similar to the population totals from the demographic residual method. Probabilistic assignment and reweighting had more effect (and shifted more people from one status to the other) in the earlier years.

Probabilistic assignment and reweighting had more effect on the estimated number of people without legal status than on the estimates of population characteristics by legal status. Even in cases where population characteristics are the main interest, however, it is important to include
probabilistic assignment and reweighting in analyzing data over time. For example, those procedures mattered in looking at the growth of the labor force by legal status because the difference between the annual population totals from the imputation procedure and those from the demographic residual method varied over time. Consequently, employing probabilistic assignment and reweighting led to more accurate estimates of changes in growth rates over time.

In general, CBO’s estimates of the population without legal status were comparable to those produced by other research institutions (see Figure 10).

**Figure 10: Estimates of the Population Without Legal Status by Source**


The portion of the figure that is shaded in light blue represents the 90 percent confidence interval introduced through sampling variation present in surveys. It reflects uncertainty in the total number of foreign-born people and does not reflect other sources of uncertainty in estimating the number of people without legal status.

CBO’s estimates of the population without legal status by place of birth were also similar to the estimates of other researchers (see Figure 11). However, the smaller the population associated with a given country and year of entry, the more uncertain was CBO’s estimate of that foreign-
born population and therefore the more uncertain was CBO’s estimate of the corresponding number of people without legal status.

**Figure 11: Estimates of the Population Without Legal Status, by Region or Country of Birth and Source**


The shaded portion of each panel represents the 90 percent confidence interval introduced through sampling variation present in surveys; it does not reflect the other sources of uncertainty in estimating the number of people without legal status. The shading only represents uncertainty in the total number of foreign-born people from a particular country or region.

CMS = Center for Migration Studies; DHS = Department of Homeland Security; Northern Triangle = El Salvador, Guatemala, and Honduras.

It is difficult to pinpoint the exact source of the differences between CBO’s estimates and those of the other institutions, but they probably come from variations in demographers’ techniques and data sources. Other researchers, for example, may have used different data sources to measure the population of temporary residents, different techniques to estimate the temporary resident population, different techniques to estimate the number of residents without legal status who became LPRs, and different adjustments for undercounting. Further, the data researchers used to estimate the total size of the foreign-born population varied from the data CBO used, as did their methodologies for producing the estimates.
CBO’s aggregate estimates of the foreign-born population by legal status and birth region are reliable, but its estimates for particular countries might be less reliable. The population of temporary residents from the Philippines was particularly difficult to model because, in 2005, DHS changed the way it reported selected classes of admission. Most importantly for CBO’s estimates, DHS stopped reporting the number of transit aliens separately. Those changes caused the modeled estimate to more than quadruple from 2004 to 2008. As noted earlier, CBO omitted from its analysis people who were likely to leave the United States within one year of arrival—temporary visitors who came for business or pleasure and transit aliens. That did not affect CBO’s estimates of the number of temporary residents from most countries, but it had significant implications for countries with large numbers of transit aliens, particularly Bolivia, Brazil, Nicaragua, Peru, and the Philippines.

The characteristics of the population of foreign-born residents by legal status were presented in an earlier CBO publication. The characteristics of the foreign-born labor force in that report followed patterns similar to those found by Borjas and Passel.

7 Sensitivity Analysis

As discussed in Section 3, CBO made a number of decisions regarding the inflows and outflows of the populations with and without legal status. CBO’s final estimates are robust if some of those decisions, such as its estimate of the death rate, are varied and more sensitive if other decisions are varied, such as the number of foreign-born people who become LPRs.

7.1 Changes in Rates of Outflow and Inflow

One set of decisions related to the estimated inflows and outflows of foreign-born people. CBO varied the estimates it used for rates of death, emigration, and inflow of temporary residents to determine how sensitive its model was to those variations.

7.1.1 Death and Emigration Rates. CBO’s estimates of the total population without legal status were robust when assumptions about average death and emigration rates changed. A 25 percent increase or a 50 percent decrease in the death rates for populations with legal status and without legal status would result in a change small enough to be attributable to rounding error for the population without legal status (see Figure 12). In the context of CBO’s methodology, a 25 percent increase in the emigration rates for the populations with and without legal status would result in slightly more people without legal status, a 1.8 percent increase, in 2018. (The population without legal status had the higher emigration rate of the two groups.)

58 See CBO (2020).

59 See Borjas (2017) or Passel (2005).
7.1.2 Inflow Rate for Temporary Residents. Few data were available on the number of temporary residents in the United States and the ways they entered and left the country. The data that were available enumerated the entrances of temporary residents (who may leave and enter the country multiple times during their period of legal residence). Estimating the inflow of new residents from the available data presented many challenges. CBO estimated the inflow rate of temporary residents from a given country as a weighted average that was based on the type of visa admission—for seasonal employment, highly skilled employment, and other types of admission. The average inflow rate for all observations by country and year was about 31 percent.

To test the sensitivity of that result, CBO set the inflow rate for a given year at a flat 25 percent of the total population of temporary residents in that year. Relative to CBO’s weighted-average approach, the flat rate of inflow for temporary residents resulted in fewer people without legal status in 2018, a 1.8 percent decrease (see Figure 13). However, the estimates that resulted from the two methods were close in all but the most recent years. That might have been because there was a large increase in the number of temporary residents in later years, as well as a substantial increase in the wait before people (particularly those from China and India) could become LPRs.
### 7.2 Changes in Corrections for Heaping and Undercounting

CBO implemented a smoothing method to correct for the tendency of CPS ASEC respondents to report their years of entry in round numbers (heaping), and also made adjustments for undercounts of foreign-born people. CBO’s estimates of the total number of foreign-born people by year of entry were sensitive to those corrections; therefore, so were CBO’s estimates of the number of people without legal status.

#### 7.2.1 Heaping

Without a correction for heaping behavior, CBO’s estimates of the size of the total population, and therefore of the population without legal status, would have been larger. The correction for heaping was most salient in 2000. Some people in the 2010 ACS who reported arriving in 2000 may actually have arrived in the late 1990s. If so, they would have been counted twice in the census data—the first time in the 2000 census, when they would have reported their arrival, and a second time in the 2010 census, when they reported arriving in 2000. Without a correction for heaping behavior, CBO saw a sharp uptick in its estimate of the population without legal status in 2000, and its estimates of that population remained bigger through 2018 (see Figure 14).
To correct for heaping, CBO implemented a combination of two moving averages in its final specification: a central moving average for entry years 1982 to 2009 and a three-year moving average for entry years 2010 to 2018. That combination produced an inflow time series that probably best reflected true arrival trends. However, CBO also considered the effects of using each of the averages on its own for the entire study period.\textsuperscript{60}

Implementing a three-year moving average for the entire study period smoothed many of the spikes and dips in the inflow data, but it also shifted the trends CBO observed in the data by one year. That shift in inflow trends was especially noticeable for earlier entry years because inflows of foreign-born people consistently increased in later years.

Implementing a central moving average for the entire study period resulted in the same trends CBO had observed in the data. However, because the foreign-born population increased steadily after 2010, a central moving average led to a larger estimate of the foreign-born population in later years. Further, a central moving average could not be used to estimate the most recent year of data because it required data from the years before and after the survey year. CBO therefore

\textsuperscript{60} DHS uses a three-year moving average to account for heaping. See Baker (2018).
used a central moving average to calculate estimates of the foreign-born population without legal status through 2017; those estimates were slightly bigger in later years because its estimates of the total foreign-born population were slightly bigger.

**7.2.2 Undercounting.** Foreign-born people are less likely to be counted in censuses and surveys. CBO corrected for that tendency in census and ACS data by multiplying survey weights to increase the representation of foreign-born people.

In the final model, CBO used an undercount rate of 8.3 percent for the ACS and 6.3 percent for the census, with those rates falling by 10 percent for each year of residence in the United States (see Section 3.2.3.3). Estimates of the population that was without legal status were somewhat sensitive to the undercount rate. Using a rate that was 20 percent higher or lower had a modest effect on CBO’s estimate (see Figure 15).

CBO also estimated the size of the population without legal status if undercount rates were 8.3 percent for the ACS and 6.3 percent for the census in all years, regardless of the amount of time foreign-born people spent in the United States. That variation had more effect on CBO’s estimate of the population without legal status, especially over the past 10 years. The estimated number of people without legal status increased from 11.0 million to 11.9 million in 2018.

Finally, CBO estimated the size of the population without legal status if the undercount rates were much higher: 20 percent in the ACS and 10 percent in the census. Those changes substantially affected CBO’s estimate, increasing it by 20 percent to 13.2 million in 2018.
Data source: Congressional Budget Office, using census and American Community Survey data from IPUMS-USA and data from the Department of Homeland Security.

7.3 Changes in Suppositions Regarding Adjustment to Lawful Permanent Status
CBO estimated both the entry year and previous legal status of people who became LPRs. It was particularly challenging to estimate the number of people who became LPRs by entry year because the data only show the year in which LPR status was granted. The agency examined the effect of varying its modeling decisions about people’s length of residence in the United States before becoming LPRs and about the birthplaces of people without legal status who became LPRs.

7.3.1 Adjustment to Lawful Permanent Resident Status for Temporary Residents. In CBO’s model, most people with temporary legal status who became LPRs had arrived five years earlier, based on data from the SIPP. As explained in Section 3, CBO’s model estimated that it would take longer for temporary residents from China and India to become permanent residents.

CBO considered the effects of varying those modeling decisions. Because the number of temporary residents increased over time, if the timeline for adjustment was longer it would decrease CBO’s estimate of the number of temporary residents who became LPRs and would increase the agency’s estimate of the number of residents without legal status who became LPRs. Therefore, increasing the timeline increased the estimated number of people who lived in the United States without legal status before becoming LPRs. Shortening the period from entry to
LPR status to four years or extending that period to six years did not have a sizable impact on either the total estimates of the population without legal status or the estimates of that population by country of origin (see Figure 16). Extending the period from entry to LPR status to 10 years substantially affected the estimates. However, given data from other sources, 10 years was not a reasonable estimate for countries other than China and India.

Figure 16: Estimates of the Population Without Legal Status, Varying How Long Temporary Residents are Present Before Becoming Lawful Permanent Residents

7.3.2 Adjustment to Lawful Permanent Resident Status for Residents Without Legal Status. For some countries, the number of people who became LPRs in a particular year greatly exceeded the inflows of new temporary residents in preceding years. In those cases, CBO inferred that some of those who became LPRs had been in the United States without legal status. CBO suspected that people without legal status who arrived in later years were not eligible to become LPRs because Congress did not pass legislation that would have allowed for such adjustments in those years. CBO examined the effect of changing the arrival year of people without legal status who became LPRs to 5 years, 10 years, or 16 years before legal status was
granted (in other words, the cohorts that arrived before 2013, before 2008, or before 2002). Estimates of the population without legal status varied depending on those timelines (see Figure 17).  

**Figure 17: Estimates of the Population Without Legal Status, Varying Entry Years for Foreign-Born People Who Become Lawful Permanent Residents**

Data source: Congressional Budget Office, using census and American Community Survey data from IPUMS-USA and data from the Department of Homeland Security.

### 7.3.3 Countries of Birth

As described in Section 3, CBO judged that people who became LPRs from particular countries of origin probably had lacked legal status if the inflow of temporary residents from such countries in multiple years was not high enough to explain the number of people who became LPRs five years later. CBO also explored limiting or expanding its list of countries of origin for people without legal status who became LPRs.

In CBO’s model, some people from Colombia, El Salvador, Guatemala, Honduras, and Mexico who did not have legal status acquired that status by becoming LPRs. CBO also explored the

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61 CBO chose 2002 to correspond with requirements in the Legal Immigration and Family Equity (LIFE) Act, which allowed people to become permanent residents if they had fulfilled certain requirements before April 30, 2001. See USCIS, “Green Card Through LIFE Act,” (2020).

62 CBO hopes to obtain administrative data from the Department of Homeland Security on the length of time immigrants without legal status reside in the United States before becoming LPRs. That data would allow CBO to improve its estimates.
effect of modeling people without legal status from China, India, Nicaragua, and the Philippines to become LPRs.

CBO’s estimates of the population without legal status (both total population and population by country of birth) were sensitive to revisions in the countries of origin for people without legal status whom CBO modeled would become LPRs (see Figure 18). They were also sensitive to revisions in the length of time that people without legal status lived in the United States before adjusting their status. That was primarily because modeling the number of people without legal status from a given country who became LPRs involved simultaneously increasing the population of people without legal status and decreasing the estimated population of people with nonimmigrant visas who became LPRs. CBO’s aggregate estimates of the population without legal status were affected by two factors—the increase in the estimated number of people who lived in the United States without legal status and the decrease in the estimated number of people with temporary status who become permanent residents.
8 Conclusion

As described in this paper, CBO imputed legal status to foreign-born people in the CPS ASEC using a three-step process. First, CBO estimated the total number of people without legal status by using the demographic residual method. Second, CBO imputed likely legal status according to specific criteria after making some adjustments in the CPS ASEC data. Third, CBO assigned probabilistic legal status and reweighted the CPS ASEC data so that their totals matched the total foreign-born population that was implied by the demographic residual method.

CBO conducted a sensitivity analysis to determine how using alternative estimates of specific factors in the demographic residual method would affect its analysis. Most of that sensitivity analysis centered on the population of temporary residents. CBO estimated the effects of variations in the inflow rate of temporary residents, the smoothing method that the agency
implemented to adjust for the heaping of responses to year-of-entry questions in survey data, and the time it took temporary residents and residents without legal status to become LPRs. Those decisions had a moderate effect on CBO’s estimates of the number of people without legal status. The agency also explored the effect of changing its suppositions about the birthplaces of foreign people, which altered previous legal status and the length of time before people became LPRs. That last set of suppositions was one of the most influential: It greatly changed the estimated size of the population without legal status.

Further improvements to CBO’s demographic residual method depend on the availability of more data. More detailed data from DHS would help CBO define the length of time it takes foreign-born individuals with temporary status or without legal status to become LPRs after they enter the United States. That information could improve the precision of CBO’s estimates of the number of people without legal status. Because those estimates were created by country, improving them would in turn improve the precision of probabilistic assignment.

Additional information could also help CBO improve its estimates for individual countries. For example, the population of temporary residents from the Philippines was difficult to model because DHS in 2005 reduced the number of classes of nonimmigrants and countries of origin it reported. If more information became available, those estimates could be improved.
References


