

**Evaluating Components of International Migration: Foreign-Born Emigrants**

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**Demographic Analysis-Population Estimates Research Project  
Statement of Findings**

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**Tammany J. Mulder  
Betsy Guzmán  
and Angela Brittingham**

**Population Division, U.S. Census Bureau  
Department of Commerce**

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\* This paper reports the results of research and analysis undertaken by Census Bureau staff. It has undergone a more limited review than official Census Bureau publications. This report is released to inform interested parties of research and to encourage discussion. Please direct questions to Tammany Mulder at (301) 763-6137 ([tammany.mulder@census.gov](mailto:tammany.mulder@census.gov)).

## **SYNOPSIS**

On March 1, 2001, the U.S. Census Bureau issued the recommendation of the Executive Steering Committee for A.C.E. Policy (ESCAP) that the Census 2000 Redistricting Data not be adjusted based on the Accuracy and Coverage Evaluation (A.C.E.). By mid-October 2001, the Census Bureau had to recommend whether Census 2000 data should be adjusted for future uses, such as the census long form data products, post-censal population estimates, and demographic survey controls. In order to inform that decision, the ESCAP requested that further research be conducted.

Between March and September 2001, the Demographic Analysis-Population Estimates (DAPE) research project addressed the discrepancy between the demographic analysis data and the A.C.E. adjusted estimates of the population. Specifically, the research examined the historical levels of the components of population change to address the possibility that the 1990 Demographic Analysis understated the national population and assessed whether demographic analysis had not captured the full population growth between 1990 and 2000. Assumptions regarding the components of international migration (specifically, emigration, temporary migration, legal migration, and unauthorized migration) contain the largest uncertainty in the demographic analysis estimates. Therefore, evaluating the components of international migration was a critical activity in the DAPE project.

This report focuses on the evaluation of the U.S. Census Bureau's estimate of foreign-born emigration from the United States between 1980 and 1990. Estimates produced by Ahmed and Robinson (1994) and Oosse (1998) were recreated and evaluated by age, sex, race, and Hispanic origin to determine if the estimated flows were realistic. In addition, an attempt was made to create new foreign-born emigration estimates for the 1990 and 2000 decade using the preliminary results from Census 2000. Based on recreation and evaluation efforts, Ahmed and Robinson and Oosse estimates appear sound and represent the most recent and most reliable data on foreign-born emigration available. Future research is needed to evaluate the application of a residual method to estimate foreign-born emigration. In addition, efforts will focus on creating new estimates using alternative methodologies and data sources.

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## **B. INTRODUCTION AND BACKGROUND**

### **What is emigration?**

International migration consists of flows both to and from a host country. Emigration, the departure from a country of residence, is a component of net international migration. As a component of change in population estimates for the United States, emigration is defined as the number of U.S. residents departing permanently from the U.S. to reside abroad. This movement is one of the most problematic components of international migration to estimate and is estimated separately for the native and foreign-born portions of the resident population. Theoretically, estimates of the emigrant population should not include unauthorized or temporary migrants leaving the United States because these populations are estimated as a separate component of net international migration.

### **Emigration Estimates of the U.S. Legal Resident Foreign-Born Population**

The Immigration and Naturalization Service (INS) began collecting data on the emigration of the United States population in 1901. Attempts to collect data on emigrants were terminated in 1957 due to the questionable reliability (Warren and Peck 1980). After INS discontinued this data series, the Census Bureau began producing estimates of emigration as a component of estimated net international migration used in the production of the demographic analysis estimates of the census population adjusted for estimated net census undercount and of intercensal and postcensal national population estimates. The following discussion provides an overview of the major emigration estimates produced since the direct method of data collection was discontinued.

Warren and Peck (1980) produced foreign-born emigration estimates for the 1960 to 1970 decade using a residual methodology. The method used data for the foreign-born population from two consecutive decennial censuses and the number of immigrants admitted between the respective censuses. In summary, the expected foreign-born population as of the 1970 census date was calculated from the enumerated foreign born in the 1960 census and the number of immigrants admitted during the intercensal period, using a cohort-survival methodology to account for mortality during the ten year period between censuses. The expected foreign-born population in 1970 was subtracted from the 1970 enumerated foreign-born population, resulting in an estimate of the number of foreign-born emigrants for the decade. According to Warren and Peck, approximately 1.14 million foreign-born residents left the United States from 1960 to 1970 when controlling for nonimmigrant students. Inclusion of non-immigrant students increased the estimate from 1.14 million to 1.18 million people.

New estimates for the 1960 to 1970 and 1970 to 1980 period were produced by Warren and Passel as an input to estimate the undocumented migrant population (Warren and Kraly 1985). Estimates were derived by applying a cohort-component method using INS annual registration data and the components of population change to estimate the emigration of the “non-U.S. citizen” (p. 16). The non-U.S. citizen population excludes the naturalized foreign-born population. Table 1 presents Warren and Passel’s results for both decades. For the 1960 to 1970 decade, Warren and Passel estimated 900,000 *non-citizen* foreign-born emigrants, which is smaller than Warren and Peck’s estimate of 1.14 million total foreign-born emigrants. For the 1970 to 1980 decade, the number of non-citizen emigrants increased from 900,000 to 1.18 million.

Borjas and Bratsberg (1996) also produced foreign-born emigration estimates for the 1970 to 1980 decade, concentrating only on the legal immigrant population. INS microdata pertaining to aliens granted legal permanent residence were compared to the 1980 census results for those who entered between 1970 and 1980 after adjusting for mortality. The authors isolated the legal immigrant population by adjusting the 1980 census, removing illegal immigrants and nonimmigrants. According to Borjas and Bratsberg, among legal immigrants that entered between 1970 and 1974 and 1975 and 1980, approximately 21.5 percent and 17.5 percent respectively emigrated by 1980. The total number of legal foreign-born emigrants for the decade was estimated to reach 882,483 people. This estimate is smaller than the non-citizen estimate of 1.18 million by approximately 298,000 people.

Emigration estimates for 1980 to 1990 were produced by Ahmed and Robinson (1994). Similar to Warren and Peck, Ahmed and Robinson applied a residual methodology to estimate the number of emigrants and the emigration rates for the foreign-born population that entered before 1980. These estimated rates were then applied to the 1990 enumerated population to estimate emigration from 1980 to 1990. This methodology produced an estimate of 195,000 annual foreign-born emigrants for the April 1, 1980 to April 1, 1990 period. In other words, approximately 1.95 million foreign-born people emigrated in the ten-year period. The number of estimated emigrants represents approximately 25 percent of the immigrants who were granted legal permanent residence by the INS between 1980 and 1990 (Table 1). Compared with estimates for previous decades, Ahmed and Robinson's estimates indicate a sizable increase in estimated emigration; however, as shown in Table 1, the ratio of emigrants to the number of immigrants declined from .27 to .25 from 1970-1979 to 1980-1989.

According to data presented by Warren and Kraly (1985) in Table 1, the number of emigrants historically remained a consistent proportion of the legal immigrant population for particular decades. The number of emigrants from 1900 to 1979 represented approximately one-third of the number of legal immigrants. With exception to the 1950-1959 decade, the ratio of the number of emigrants to the number of immigrants for decades in the 1940-1989 period ranged from .25 to .33. For the 1900 to 1989 period, the ratio of foreign-born emigrants to legal immigrants was .32. As the number of immigrants increased or decreased, so too did the number of emigrants. According to Duleep (1994),

.... emigration is highly concentrated in the initial years of U.S. residence. A majority of the immigrants who emigrate do so within 5 years of U.S. residence, and about 80 percent or more emigrate within the first 10 years. Only 13 to 20 percent of the immigrants who emigrate appear to do so after 10 years (p. 45).

In summary, emigration usually takes place within a few years after the year of immigration. Therefore, in all likelihood, trends in emigration will reflect trends in immigration with a time lag.

In order to improve estimates of emigration trends for the foreign-born population in the national population estimates, Oosse (1998) revised the foreign-born emigration estimates by creating emigration rates to be applied to the U.S. legal resident foreign-born population. The rates represent new emigration estimates based on the emigration estimates produced by Ahmed and Robinson. Application of annual emigration rates to the foreign-born population theoretically reflects annual emigration trends as the foreign-born population changes each year, compared to

applying a constant annual assumption of a number of emigrants each year. Table 2 presents the foreign-born emigration estimates for April 1, 1990 to April 1, 2000, based on the application of Oosse's emigration rate estimates. The number of foreign-born emigrants totaled 2.17 million for 1990 to 2000, or 26 percent of the estimated legal immigrant and refugee population for the same period (not shown).<sup>1</sup> The average annual number of emigrants for the decade was approximately 217,000.

Woodrow-Lafield (1996) produced an alternate estimate of the emigrant population as of 1990 using a multiplicity survey methodology. Estimates were created for Americans Living Abroad (ALA's) and emigrants and emigration estimates do not differentiate between native and foreign-born status. According to Woodrow-Lafield,

For the period 1980-1989 (or 1980-1988), the implied number of emigrants would be 1.2 million. Prorating to annual average figures, emigration during the 1980s may have ranged between 110,000 and 200,000, considering likely sampling errors. Lower coverage levels of the emigrant population would imply a higher emigrant population, perhaps exceeding three million, and higher levels of annual emigration (p. 191-192).

In comparison to the multiplicity survey results after considering nativity status and coverage levels, the Ahmed and Robinson estimate of 195,000 annual foreign-born emigrants falls within the 110,000 to 200,000 range. The Oosse estimate of 217,000 is slightly above the stated range.

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<sup>1</sup> The legal immigrant and refugee estimates are published in Population Division Working Paper #51 (2001).



The multiplicity estimates are based on survey results and the emigrant population is generally small in size. Hence, the estimates are prone to sampling error (p. 175), preventing the estimation of general demographic characteristics, such as the age and sex of emigrants. Therefore, multiplicity survey results contribute to the knowledge of the aggregate number of emigrants, but do not represent a viable estimate to apply to the national estimates and demographic analysis estimates products.

In summary, only a small amount of research exists on estimating the U.S. foreign-born emigrant population. In general, when creating estimates, the use of direct techniques are preferred over indirect techniques and theoretically produce estimates that are more reliable. However, estimates produced using direct methods, more specifically using data collected by the INS, for the first half of the century (1901-1957) are questionable as noted by Warren and Peck. As of 1957, emigration estimates used for national estimates were produced using an indirect methodology. For the most part, foreign-born emigration estimates were produced using a derivative of a residual methodology. In conclusion, little is known about the actual level of U.S. emigration, making it one of the most difficult components of net international migration to estimate. However, estimates produced by Ahmed and Robinson and by Oosse represent the most recent detailed emigration estimates available. In addition, the estimates appear to follow historical emigration trends and approximate estimates produced using different data sources and methodology.

### **Evaluation of Census Bureau Foreign-born Emigration Estimates**

To help evaluate the Demographic Analysis and the national population estimates, Task Team 6 was directed to answer the following research question: “*Is the assumed flow of foreign-born emigration realistic?*” The team was asked to, “*Replicate/create tabulations of the foreign born in 1990 to evaluate current assumptions by age, sex, race, and Hispanic origin (US Census Bureau P. 5).*” In addition to 1980-1990 estimates, Team 6 was directed to create new foreign-born emigration estimates for the 1990 and 2000 decade using the preliminary results for census 2000.

This statement of findings presents 1) the methodology used to answer the above stated research question and the replication efforts, 2) the limitations discovered throughout the replication process, 3) the results of the replication efforts compared to the original estimates produced by Ahmed and Robinson and by Oosse, and 4) a discussion of new 1990-2000 foreign-born emigration estimates.

### **C. METHODOLOGY AND REPLICATION**

#### **Evaluation and Replication of Ahmed and Robinson Estimates**

As discussed above, Ahmed and Robinson applied a residual technique to create emigration estimates based on the 1980 and 1990 censuses. The residual technique is a general tool developed to compare an expected population at a specific point in time to an enumerated population at the same point in time in order to isolate a population of interest. In the case of emigration, this translates as applying a cohort-survival method to the foreign-born population enumerated in an earlier census and comparing that expected population to the corresponding

population enumerated in a latter census. Theoretically, the difference should be the population that emigrated between the two censuses.

In order to produce the 1990 emigration estimates, Ahmed and Robinson (p. 2) summarized the methodology with the following equations:

$$\begin{aligned} E_{1980-1990} &= (P_{1980} - D_{1980-1990}) - P_{1990} \\ \text{or, } E_{1980-1990} &= S_{1990} - P_{1990} \end{aligned}$$

where

$E_{1980-1990}$  is the estimated number of foreign born who emigrated between 1980 and 1990

$P_{1980}$  is the foreign-born population enumerated in the 1980 census

$D_{1980-1990}$  is the number of deaths experienced from 1980 to 1990 by the foreign-born population enumerated in 1980

$P_{1990}$  is the foreign-born population that entered before 1980 and was enumerated in 1990

$S_{1990}$  is the 1980 foreign-born population survived to 1990

The above methodology produces a stock number of emigrants and the emigration rates for the 10-year period (1980 to 1990) for the foreign-born population that entered *before 1980*. This method does not apply to the foreign-born population that entered between 1980 and 1990.

Therefore, the emigration rates calculated for the *before 1980* entrants, adjusted for the average length of stay and mortality, were applied to the foreign-born population enumerated in the 1990 census that entered between 1980 and 1990. A detailed discussion of the methodology is included below in the discussion of the replication efforts of Ahmed and Robinson's estimates.

To replicate the estimates produced by Ahmed and Robinson, we began by locating all existing papers, programs, and results found internally at the Census Bureau. This included obtaining original SAS programs written by Ahmed, input and output data, spreadsheets created by

Ahmed, life tables tabulated by the Projections Branch, internal Census Bureau memorandums and notes, and working papers published in the Population Division working paper series. Once all the available information was gathered, we began replication of the estimates by following Ahmed and Robinson's methodology, piecing together programs and data sets. A majority of the replication efforts resulted in creating new programs.

Appendix A presents a detailed outline of the steps used to replicate the estimates based on SAS programs, those existing prior to replication efforts and those developed during the process. The main steps are listed below in order with a reference to the detailed step number from Appendix A in parenthesis. These steps do not represent the actual order of steps taken by Ahmed and Robinson.

- 1) Preliminary emigration estimates for the population that entered before 1980. (Step 3)
- 2) Emigration estimates for the population that entered before 1980 for selected countries. (Step 4)
- 3) Emigration estimates for the population that entered between 1980 and 1990 for selected countries. (Step 6)
- 4) Emigration estimates for the population that entered between 1980 and 1990 for non-selected countries. (Step 8)
- 5) Emigration estimates for the population that entered before 1980 for non-selected countries. (Step 10)
- 6) Final estimates of emigration for the 1980-1990 decade. (Step 11)

1) *Preliminary emigration estimates for population that entered before 1980*

To begin, preliminary estimates of the emigrant population were created for the foreign-born population that entered *before 1980*. Data used to create the estimates were the 1980 census of the resident foreign-born population as of April 1, the 1990 census of the resident foreign-born population as of April 1, and 10 year survival rates calculated from 1990 life tables generated by the Population Projections Branch of the US Census Bureau. The 1980 census data were used to calculate the 1990 expected population, and the 1990 census was used as the enumerated population to compare the expected population. Survival rates were used to age the 1980 population 10 years to create the expected 1990 population.

The 1980 census results were available from a summary file previously adjusted for unknown country of birth. Characteristics include sex, age collapsed to 14 categories (see Appendix B), country of birth by 40 country groups (see Appendix C), citizenship status, and period of entry collapsed to 1975-1980, 1970-1974, 1960-1969, and before 1960. The methodology used to impute unknown country of birth for this file was not determined. During the estimates procedure it was discovered that the 1980 file contained people placed in incorrect age groups with respect to their period of entry. In all likelihood, this error occurred in the census editing procedure when imputing unknown characteristics of respondents. These cases were removed from the data set.

Data for 1990 were generated from the 1990 census (Summary Tape File 3 – Sample Data) and recoded for estimates purposes. Characteristics of the foreign-born population include sex, age collapsed to five-year age groups, race and Hispanic origin, country of birth by 111 country groups (see Appendix C), citizenship status, and period of entry collapsed to 1987-1990, 1985-

1986, 1982-1984, 1980-1981, 1975-1979, 1970-1974, 1960-1969, and before 1960. Originally, the 1990 country of birth coding contained an additional code for those enumerated as being born abroad, at sea, and not specified, but this population was proportionally distributed prior to the emigration processing.

In order to produce reliable estimates using a large enough data set to provide “stability of the rates” (p. 4), Ahmed re-classified both the 1980 and 1990 census country of birth codes from 40 country groups into categories of four country groups, each theorized to represent the following race and ethnic groups: Hispanic, non-Hispanic White, Black, and Asian and Pacific Islander. Table 3 presents the list of countries used to create each mutually exclusive race and Hispanic origin group. The classification for each country was based on the reporting of race and Hispanic origin and country of birth of the foreign-born population in the 1990 census. We were unable to replicate this task due to time constraints. Although the race and origin groups are actually country groups and are not the census reported race and origin values, they are referred to hereafter as race groups to prevent confusion.

Survival rates were needed to obtain the 1990 expected population. National resident population life tables for 1990, generated by the Population Projections Branch, were used to calculate the ten-year survival rates needed to survive the 1980 foreign-born population of before 1980 entrants. Life tables were available for four race groups (White, Black, American Indian, Eskimo and Aleut, and Asian and Pacific Islander) by Hispanic and non-Hispanic origin, and for Hispanic origin only. To calculate survival rates by sex, age groups, and the four race groups based on country groups, Ahmed and Robinson used the non-Hispanic White, Hispanic only, Black, and Asian and Pacific Islander life tables. The Black and Asian and Pacific Islander life

tables were generated for both the Hispanic and non-Hispanic population. See Ahmed and Robinson for survival rates (1994, p. 30).

Once the data sets were acquired and recoded, Ahmed and Robinson calculated a preliminary residual estimate of 1980-1990 emigrants for the population that entered before 1980. The *expected foreign-born population for 1990* was calculated by surviving the 1980 enumerated foreign-born population by sex, age, race group, and period of entry. The difference between the expected 1990 population that entered before 1980 and the enumerated 1990 population for those entering before 1980 is the estimated number of emigrants who left between 1980 and 1990. Estimates were created by age, sex, country of birth groups (40), and period of entry. Emigrants for each of the 40 countries were maintained in the estimate process, irrespective of race group designation. See Ahmed and Robinson for the preliminary residual results (1994, p. 17).

Ideally, the residual would provide the total number of emigrants for each country as a positive number. The preliminary residual, however, resulted in negative differences for the aggregate value for particular countries. After conducting background research into why particular countries obtained negative values, Ahmed and Robinson separated the countries into selected and non-selected countries. The non-selected countries were those countries that showed a statistically significant negative difference. We were unable to locate or replicate the statistical tests conducted for the negative differences. Non-selected countries were Mexico, El Salvador, Guatemala, Peru, Haiti, Jamaica, Trinidad and Tobago, and Other South and East Asia. In addition, the selected and non-selected countries were then separated into the corresponding race groups previously assigned.

In summary, the data set was divided into two separate groups, the non-selected and selected countries. Both country groups are available by the four race groups, age groups, sex, country of birth, and period of entry. None of the non-selected countries fell into the non-Hispanic White race group.

2) *Emigration estimates for the population that entered **before 1980** for selected countries*

After categorizing the data into the selected and non-selected countries, estimates were derived of the number of emigrants and the emigration rate for *selected countries* only by age, sex, race group, country of birth, and period of entry. Emigration estimates were derived for 1970-1979, 1960-1969, and before 1960. The 1990 expected population for before 1980 entrants was compared to the observed population enumerated in 1990 that entered before 1980. Negative differences were still obtained for countries within the age, sex, and race group distributions, but not for the aggregate number of emigrants. The negative cases were removed from the data set. Based on the steps listed above, we replicated Ahmed's results of the 1980-1990 number of emigrants and the emigration rate for before 1980 entrants for selected countries by age, sex, and race.

3) *Emigration estimates for the population that entered **between 1980 and 1990** for selected countries*

Next, the number of emigrants and the emigration rate for selected countries were calculated for the population that entered between 1980 and 1990. Estimates for the 1980-1990 period of entry were not estimated using the residual methodology as was done for before 1980 entrants. In comparison, an emigration rate for 1980-1990 entrants was estimated and applied to the 1990 enumerated population that entered within the same period.



To begin, the foreign-born population enumerated in the 1990 census that entered between 1980 and 1990 by age, sex, and country of birth was isolated. The race groups were coded and the non-selected countries were removed. The period of entry for the 1990 census was collected in four categories (1987-1990, 1985-1986, 1982-1984, and 1980-1981). The following steps were taken to produce the 1980-1990 selected country emigration estimates:

- a. The proportion of 1980-1990 foreign-born entrant population enumerated in the 1990 census were calculated by age, sex, period of entry, and race.
- b. The *average length of stay* for 1980-1990 was determined for each age group. The proportions of foreign born in each period of entry and age group by sex and race were multiplied by the average potential number of years an immigrant could reside in the U.S. based on period of entry. The proportions for 1987-1990 entrants were multiplied by 1.63 years, 1985-1986 by 4.25 years, 1982-1984 by 6.75 years, and 1980-1981 by 9.25 years. Ahmed and Robinson define the average length of stay as, "... the weighted average of the duration to April 1, 1990 from the middle points of the years 1980-1981, 1982-1984, 1985-1986, and 1987-1990 (p. 8)."
- c. The *mid-point of age in 1990* was determined by calculating the middle age value within an age group. For example, the middle age value for the 0-4 year age group (i.e., 0 to exact age 5) is 2.5 years.

- d. Average age at time of entry was then calculated by subtracting the average length of stay from the mid-point of age in 1990.
- e. To calculate 1980-1990 entrant emigration rates, the 1970-1979 entrant emigration rates were used as a base. Taken from Step 2 for selected countries, the 1970-1979 rate's age distribution was expanded from 13 to 15 categories to match the 1990 age groups and the ten-year rates were annualized.
- f. The 1970-1979 entrant emigration rates were multiplied by the average length of stay to weight the rates for the number of years migrants are able to emigrate.
- g. Survival rates were subtracted from the adjusted 1970-1979 entrant emigration rates to account for mortality. Rates were estimated by sex, age, and race using the 1990 life tables referenced above, based on the age at the time of entry and the length of stay.
- h. Estimates of the theoretical number of 1980-1990 entrants were derived by dividing the enumerated 1990 foreign-born population that entered between 1980 and 1990 by the adjusted 1970-1979 emigration rates to include the population subject to mortality by age, sex, and race.
- i. The theoretical number of 1980-1990 entrants was multiplied by the adjusted 1970-1979 emigration rate. This step produced estimates of the number of

emigrants for selected country 1980-1990 entrants by age, sex, race group, and country of birth.

4) *Emigration estimates for the population that entered between 1980 and 1990 for non-selected countries*

Emigration estimates for the selected countries for before 1980 and 1980-1990 entrants were produced in Step 2 and Step 3. In the next two steps, non-selected country emigrants and the emigration rates were calculated separately for both the before-1980 and 1980-1990 entrants.

As described above, non-selected countries were coded as the countries with statistically significant negative number of emigrants calculated in Step 1. Based on research presented in their paper, Ahmed and Robinson assumed that these countries were likely to have lower rates of emigration than the selected countries. Various percentages were tested before arriving at the conclusion that halving the emigration rate from the selected countries would be the most reasonable assumption. Non-selected 1980-1990 entrant emigration rates were calculated by multiplying the adjusted 1970-1979 emigration rates, calculated in Step 3, by .5.

Once the 1980-1990 non-selected emigration rates were calculated, the steps taken in Step 3 were duplicated for the non-selected countries. The 1990 ten-year survival rates by sex, age, and race were subtracted from the non-selected 1980-1990 emigration rates to account for mortality. The theoretical number of 1980-1990 entrants were estimated by dividing the enumerated 1990 foreign-born population by the 1980-1990 non-selected emigration rates adjusted for mortality.

5) *Emigration estimates for the population that entered before 1980 for non-selected countries*

To estimate the number of emigrants for those who entered before 1980 for non-selected countries, the same steps were taken as in Step 2 with exception to differing emigration rates. The emigration rates produced in Step 2 for selected countries were halved and applied to the non-selected countries by age, sex, race groups, and period of entry (1970-1979, 1960-1969, before 1960).

6) *Final estimates of emigration for the 1980-1990 decade*

Estimates for the before 1980 and 1980-1990 entrants for selected and non-selected countries were aggregated, maintaining the age, sex, race, period of entry, and selected/non-selected country characteristics.

**Evaluation of Oosse Estimates**

Time limitations permitted only a detailed analysis of the estimates produced by Oosse, as opposed to a complete validation effort. Therefore, only the methodology used to create the estimates will be discussed. Oosse used Quattro Pro spreadsheets to create the final 1980-1990 emigration rates.

As mentioned above, Oosse's estimates were created to update the emigration assumption for the processing of the national estimates and the demographic analysis estimates. Historically, a constant number of emigrants was used as input into the estimated net international migration component. Emigration rates for the foreign-born population allowed demographers to vary emigration estimates as the size and composition of the foreign-born population changed from

year to year. In addition, the new estimates were expanded to single year of age from 0 to 115 years of age and 14 country groups. The following are the general steps taken to produce the revised set of estimates.

1) *Produced new emigration estimates for 1980 to 1990 based on Ahmed and Robinson's estimates.*

In order to produce updated estimates based on the Ahmed and Robinson estimates, we collected the 1980 and 1990 census foreign-born results, survival rates calculated by Ahmed and Robinson, and emigration data supplied by Ahmed.

- a. To begin, Oosse calculated the expected 1990 foreign-born population by applying 10-year survival rates to the 1980 foreign-born population by age, sex, country of birth (40), and period of entry. The population was aggregated by country of birth and sex for analysis purposes.
- b. Oosse then calculated an average 1980 foreign-born population by age, sex, period of entry, and country of birth by calculating the average of the 1980 census of the foreign born and the expected 1990 foreign-born population calculated in Step (a) above.
- c. Emigration rates estimated by Ahmed and Robinson for the pre-1980 periods of entry are applied to the average 1980 foreign-born population, resulting in estimates of the average annual number of emigrants for the before 1980 entrants

by age, sex, country of birth (40), period of entry, and selected/non-selected county status.

- d. After calculating the average annual before 1980 entrant emigration estimates, Oosse calculated the annual number of emigrants for the 1980-1990 period of entry. The 1990 census file was recoded for unknown country of birth for 1980-1990 entrants using a proportional distribution based on the country of birth distribution reported by Ahmed and Robinson. The adjusted 1980-1990 entrant emigration rate estimates produced by Ahmed and Robinson were applied to the 1980-1990 enumerated foreign-born population. These calculations resulted in the 1980-1990 annual number of emigrants by age, sex, and country of birth (40) for 1980-1990 entrants.
- e. New estimated 1980-1990 annual number of emigrants was calculated by summing across each period of entry by age, sex, country of birth, and selected/non-selected country status.
- f. Oosse compared the new annual emigration estimates to Ahmed and Robinson's final estimates. Based on this comparison, Oosse calculated sex and country of birth-specific rake factors that were applied to the new annual emigrant estimates to replicate the distribution of the 40 countries of birth distribution originally estimated by Ahmed and Robinson. These calculations produced an estimate of the annual number of emigrants for 1980 to 1990 by age, sex, and country of birth.

- g. The average 1985 foreign-born population was calculated by averaging the 1980 and 1990 enumerated foreign-born population by age, sex, and country of birth. The theoretical number of unauthorized migrants in the base population was removed by applying a proportion of the unauthorized population to each country. Adjustments were made to 13 countries. Table 5 presents a list of the 13 countries.
- h. 1980 to 1990 annual emigration rates were calculated by dividing the estimated annual number of emigrants for 1980 to 1990 calculated in Step (f) by the average 1985 foreign-born population calculated in Step (g). The rates were calculated by sex, age groups, and country of birth (40). Rates for Cuba were assumed to be zero.
- 2) *Created estimates of the annual number of emigrants for 1980 to 1990 and the respective rates in greater demographic detail.*

Application of emigration estimates to the net international migration component required the adjustment of the 1980-1990 emigration estimates. The age distributions for the estimated number of emigrants and the average 1985 population were expanded to single year of age from 0 to 115 years and the country of birth groups collapsed from 40 to 14 groups. The age distribution was disaggregated by proportionally distributing the total number within each age group for both the five-year and ten-year groups. For emigrants and the 1985 average population in the 75 years and older category, the number is expanded to single year of age based on proportions in a 1989-1991 stable population life table published by NCHS.

For Demographic Analysis-Population Estimates (DAPE) research project replication purposes, we maintained the original 40 countries of birth distribution to allocate race and Hispanic origin characteristics. The imputations were created based on the results of the 1990 census. In conclusion, the estimated number of annual emigrants for 1980-1990, the respective emigration rates, and the average 1985 population by sex, single year of age (0-115), race, Hispanic origin, and country of birth were distributed internally to be used in the production of estimates by other DAPE task teams.

#### *Creation of New 1990-2000 Foreign-born Emigration Estimates*

In addition to replicating and analyzing the existing foreign-born emigration estimates, Task Team 6 endeavored to create new estimates for the 1990 to 2000 decade. Following the guidelines set forth by the DAPE Core Team and recognizing the existing time limitations, we adopted the methodology used by Ahmed and Robinson and attempted to produce 1990-2000 foreign-born emigration estimates by single year of age, sex, race, Hispanic origin, country of birth, and period of entry.



The methodology used previously was altered because additional data and research to support alternative methodological assumptions were available. Similar to Ahmed and Robinson, we began with the 1990 and 2000 enumerated foreign-born population from the census sample files. Survival rates were generated using 1999 life tables generated by the Population Projections Branch of the US Census Bureau.

The census population universe is the total resident population, which includes both the unauthorized and temporary migrant populations. Because we are estimating the emigration of the legal permanent resident foreign-born population only, the presence of these populations in the universe creates biases in the estimates. In comparison to the 1980-1990 methodology, we were able to isolate the temporary migrant population present in the population universe using the temporary migrant estimates produced by Task Team 8 for 1990 and 2000. Unauthorized migration estimates for 1990 and 2000, however, were created as part of the emigration estimates production process based on existing research (Passel 1999).

Estimates produced by Ahmed and Robinson used four race groups and applied race-Hispanic origin-based survival rates. For the 1990-2000 estimates, a race variable based on country of birth was not created. The 1990 Census race and Hispanic origin variables were used, which were proportionally distributed for Census 2000 based on reported age, sex, and country of birth in both the 1990 and 2000 census. Survival rates were calculated from life tables of the total population by sex and single year of age.

Once the unauthorized and temporary migrant populations were removed from the 1990 and 2000 foreign-born populations, we generated a preliminary estimate of the before 1990 entrant emigrants as was estimated by Ahmed and Robinson in *Step 1* (above) for the before-1980 entrants. New estimates were generated by single year of age with no race detail.

Preliminary residual estimates produced several countries with negative results. The negative results may originate from overestimating mortality, erroneous assumptions about the unauthorized or temporary migrant population, and changes in census coverage of the foreign-born population between censuses. In all likelihood, the enumeration of the foreign-born population in 2000 improved over the 1990 census. Therefore, the foreign-born population for those who entered before 1990 could be larger in 2000 than is theoretically possible based on the results of the 1990 census. In addition, respondents may provide erroneous responses to the period of entry on the census.

Time limitations prevented the completion of 1990-2000 based estimates. Based on the presence of large negative values for several countries, it is necessary to revisit the original methodology and assumptions used to create the estimates.

#### **D. LIMITATIONS**

Limitations arose from the lack of research in the field of emigration. There is little knowledge about the characteristics and flow of foreign-born emigrants. Without a better understanding of the population of interest, it is difficult to evaluate the adequacies of the methodology. For example, the residual methodology does not account for the changes in the foreign-born

population due to changes in the unauthorized population or in the temporary migrant population. In addition, the assumption of complete coverage of the foreign-born population in the 1980 and 1990 census, inherent to Ahmed and Robinson's and to Oosse's estimates, is in all likelihood incorrect.

The most severe constraint for the DAPE project was the time frame within which we were expected to undertake the project. After each estimate was validated, there was insufficient time to check the quality or to examine the reasonableness of the estimates. Because there were many problems fitting the data and the methodology, the 1990-2000 estimates were not finished and the 1980-1990 estimates had to be used for the 1990-2000 period. The emphasis was placed on replicating the existing estimates and creating new estimates within the allotted time frame.

### **Ahmed and Robinson Estimates**

#### **Limitations to Methodology**

Replication efforts did not include an evaluation of the methodology, therefore the appropriateness of the residual methodology is taken as a given. However, there are still limitations to the methodology that can be divided into two general areas: problems with the assumptions and inconsistencies between the theory underlying the calculations, and the actual trends.

The residual method assumes there is no difference in coverage rates between the censuses. However, evidence suggests that Census 2000 had better coverage than the 1990 Census. The change in coverage would contribute to the fact that many more foreign-born were enumerated in

2000 than would have been expected given the population in 1990. Therefore, coverage error may bias the 1980 to 1990 emigration estimates. However, we were unable to research this possibility in depth.

In addition to assuming that the coverage is the same between the two data points, we assume that there is no significant difference between population universes of the two sources. Two populations that challenge this assumption are the unauthorized population and the temporary migrant population. Although one could argue that the effects could cancel each other out if the numbers were incorrect in both time points, the presence of negative results indicates that it is a problem. In particular, the negative results are prevalent in countries that are most likely to be sending countries for unauthorized migrants. The methodology, as described by Ahmed and Robinson, makes allowances for this discrepancy by halving the emigration rate of those country groups that do not have negative effects. Additional research needs to be done to investigate whether or not there is a better way to account for the negative results.

In order to calculate the expected population to compare to the enumerated population, we need to make assumptions about the mortality trends of the foreign-born. Research in the field of mortality indicates that the foreign-born population has better life expectancies, or higher survival rates than the native population, which is not reflected in the mortality assumption used to create the expected 1990 population (Crouch 2000). For the purposes of the methodology, the life table schedules for the native populations used to create the mortality rates were applied to the foreign-born population. This assumption is more accurate than using the life tables for the sending countries because the foreign born who migrate also exhibit higher survival rates than those who do not migrate. It is possible that the U.S.-based tables overestimate deaths to the

foreign-born population. If deaths were overestimated, the expected population would be too small and could then be smaller than the enumerated population, leading to the negative results.

Because the methodology relies on the trends for the previous decade, the estimates for 1990 are actually based on the rates for the foreign-born population that entered between 1970 and 1979.

We know that the international migration trends have been quite different from one decade to the next so there is no reason to believe that emigration trends are static. Even if the emigration trends were not as dynamic as immigration trends, there is not sufficient evidence to support emigration estimates based on 1970 to 1979 trends for the 1980 to 1990 period.

The methodology also incorporates the underlying theoretical trend that ten-year trends are representative of the actual annual trends. Because the method uses census data, the data are collected ten years apart. We know from existing research that migration fluctuates throughout the decade. If emigration closely follows immigration, then annualized ten-year trends do not accurately reflect changes from year to year.

### **Limitations to Replication Effort**

The ability to replicate the emigration estimates was hampered by time constraints and lack of detailed documentation. Overall, there was insufficient time to evaluate each step of the methodology and to check the reasonableness of assumptions. However, these limits were accepted as part of the project's limitations.

## *Oosse Estimates*

### **Limitations to Methodology**

The focus of Oosse's work was to create emigration rates. By using rates, the emigration component would vary in correspondence to changes in the base population. However, in order to create the greater detail, Oosse had to use several data sources and make additional assumptions about the foreign-born population.

Although using multiple data sources allowed Oosse to create the detail necessary, there needs to be more research to understand whether the data sources sufficiently reflect the characteristics of the foreign-born population. Oosse used NCHS life tables to proportionally redistribute estimates of emigrants from an age category to single years of age. Oosse also incorporated an estimate of the percentage of the foreign born that were unauthorized without any further information about the characteristics of the unauthorized. Therefore, to remove the unauthorized population from the base population, we used the same percentages across different age-sex combinations. However, we know from existing research, that the unauthorized population is most likely to be men in the working ages. There was no documentation of how the proportions were calculated, only who provided the information. In order to replicate the results it would be best to know who provided the data and how they were manipulated.

### **Limitations to Replication Effort**

Oosse produced memos explaining the methodology in a systematic list, and centralized all the spreadsheets and data in one workbook. However, at times, the documentation was difficult to follow and a further description of data sources was needed. For example, as mentioned

previously, Oosse incorporates an assumption about the unauthorized population in order to remove them from the base population but there is no source data for the assumption. The exact source of these assumptions and data were undetermined. In addition, Cuba is assumed to have a zero emigration rate. Although return migration to Cuba is likely to be difficult, there is no documentation or justification why the assumption was made. Further research would be necessary to determine if this was a reasonable assumption.

## **E. RESULTS**

### **Replication of Ahmed and Robinson Estimates**

Table 4 presents the results obtained by the DAPE replication efforts compared to the Ahmed and Robinson results by sex, race, and selected/non-selected countries. Although we were unable to duplicate Ahmed and Robinson's results, we arrived at a similar estimate when applying the methodology and assumptions used by Ahmed and Robinson. According to the DAPE validation results, the estimated number of emigrants is 1,940,355 for the ten-year period from 1980-1990. This result is 8,813 emigrants smaller than Ahmed and Robinson's ten-year total emigration estimate of 1,949,168 emigrants.

As an input to the net international migration component for the national estimates and the demographic analysis estimates for 1990, Ahmed and Robinson calculated a rounded annual emigration estimate of 195,000. If we followed the same logic, the DAPE replication annual emigration estimate would be approximately 194,000.

The differences between the DAPE replication estimates and the Ahmed and Robinson estimates exist throughout the age, sex, race, period of entry, and selected/non-selected country of birth distribution. We were able to closely replicate the estimates produced for the before 1980 entrants for both the selected and non-selected countries. Differences occurred when attempting to replicate the 1980 to 1990 entrant emigration estimates. Validation efforts for the before 1980 entrant estimates were aided by the existence of a few SAS programs created by Ahmed. The remainder of the DAPE validation estimates, however, were produced based on piecing together information published in Ahmed and Robinson's working paper. In all likelihood, a large proportion of the differences occurs as a result of differences in race classification by country of birth for the 1980 to 1990 period of entry. After reviewing the results, however, we were unable to isolate the origin of the differences.

Analysis efforts were terminated prematurely, as the time allotted to complete replication efforts for both sets of estimates was extremely brief.

### *Evaluation of Oosse Estimates*

Table 5 presents the results obtained by the DAPE analysis efforts compared to the Oosse results by sex, race, and selected/non-selected countries. DAPE estimates produced and compared to Oosse's estimates were generated as input for other DAPE teams. We were able to replicate Oosse's results to the exact total number of foreign-born emigrants for 1980-1990. Differences in the total from Ahmed and Robinson, Oosse, and the DAPE estimates originate from Oosse's assumption that Cubans do not return to reside in their country of birth. Time constraints prevented a thorough comparison between the Oosse and Ahmed results and the imposed 1990 race and Hispanic origin distribution.



### **Creation of New 1990-2000 Estimates**

As noted above, due to time constraints and possible weaknesses in the current methodology (especially the assumption of equal census coverage in using a residual approach) and/or data sources, we were unable to produce 1990-2000 foreign-born emigration estimates.

### **Is the assumed flow of foreign-born emigration realistic?**

DAPE validation and analysis efforts were severely limited by time constraints and the lack of knowledge and research existing on emigration of the foreign-born population. When compared to historical emigration trends at the aggregate level, the estimates produced by Ahmed and Robinson and Oosse appear to be in alignment with past trends. However, the foreign-born emigration statistics and estimates that exist are of questionable quality. The DAPE validation efforts for Ahmed and Robinson's estimate produced a similar estimate. Evaluation of the Oosse estimates determined that the estimates are methodologically sound and accurate. However, a more thorough analysis of the methodology used to create the Ahmed and Robinson estimates and the estimated characteristics of the estimates from Oosse and from Ahmed and Robinson are needed.

Based on the research DAPE Task Team 6 was able to complete in the time allotted, we were unable to determine if the assumed flow of foreign-born emigration is realistic. However, the Ahmed and Robinson estimates and the Oosse estimates represent the most recent and reliable data on emigration available. In order to answer the above stated research question, the U.S. Census Bureau should devote additional resources to further analyze existing data and to develop new estimation methodology.

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## Appendix A: Description of SAS Programs Used to Replicate Ahmed and Robinson's 1980-1990 Emigration Estimates.

Step #	Description	SAS Programs	Data	
			Input	Output
<i>Pre-1980 Selected</i>				
1	Acquire 1980 base population adjusted for cases with unknown country of birth.	FB80CEN	fb80cen.dat *	fb80t.dat * fb80m.dat * fb80f.dat *
2	Create a file containing the foreign-born population enumerated in the 1990 census. Recode the country of birth from 111 categories to 40.	d_fb90_c40	fb111_ad.dat *	d_fb90_c40.dat
3	Calculate the preliminary number of emigrants for the total population that entered before 1980 by age, sex, country of birth, and period of entry.	d_FB_EMIG	d_fb90_c40.dat d_fb80f.dat	d_fbemig_t.dat d_fbemig_m.dat d_fbemig_f.dat
4	Recreate the number of emigrants and the emigration rate for SELECTED countries by age, sex, and race group, and period of entry.	d_Fb_1980_select	d_fbemig_m.dat d_fbemig_f.dat	d_Fb_1980_sel.dat d_Fb_1980_sel_race.dat d_Fb_1980_sel_rate.dat d_Fb_70_79_sel.dat
<i>1980-1990 Selected</i>				
5	Calculate the proportional distribution of the 1980-1990 entrant foreign born population enumerated in 1990, the average length of stay, the mid-point of age in 1990, and the average age at entry.	d_Fb_8090_midpt	d_fb90_c40.dat	d_Fb_8090_midpt.dat
6	Estimate the 1980-1990 number of emigrants (and rates) for SELECTED countries that entered 1980-1990 by age, sex, and race group.	d_Fb_emig_8090	d_fb90_c40.dat d_Fb_8090_midpt.dat d_Fb_70_79_sel.dat d_SR_1990_15.prn *	d_emig_8090_age.dat d_ERSR_8090_age.dat
<i>1980-1990 Non-Selected</i>				
7	Create data sets for the 1980-1990 entrants enumerated in 1990 by age, sex, country of birth, and period of entry NON-selected countries.	d_fb_8090_nonsel	d_fb90_c40.dat	d_fb_8090_nonsel.dat
8	Estimate the number of 1980-1990 entrant emigrants for NON-selected countries by age, sex, and race.	d_Fb_emig_8090_nonsel	d_ERSR_8090_age.dat d_Fb_8090_nonsel.dat	d_Fb_emig_8090_nonsel.dat

(continued on next page)

**SAS Programs Used to Replicate Ahmed and Robinson's 1980-1990 Emigration Estimates (continued).**

Step #	Description	SAS Programs	Data	
			Input	Output
<i>Pre-1980 Non-Selected</i>				
9	Create data set that contains the 1980 enumerated foreign born that entered before 1980 for NON-selected countries by age, sex, race, and period of entry.	d_Fb_1980_nonsel.sas	d_fbemig_m.dat d_fbemig_f.dat	d_Fb_1980_nonsel.dat
10	Estimate the number of before 1980 entrant emigrants for NON-selected by age and race.	d_Fb_emig_1980_nonsel	d_Fb_1980_nonsel.dat d_Fb_1980_sel_rate.dat	d_Fb_emig_1980_nonsel.dat
<i>Final Estimates</i>				
11	Merge four files with the estimated number of emigrants for the before 1980 and 1980-1990 entrants and selected/non-selected countries to estimate the 1980-1990 emigrants by age, sex, and race.	d_Fb_emig_final	d_Fb_1980_sel.dat d_emig_8090_age.dat d_Fb_emig_8090_nonsel.dat d_Fb_emig_1980_nonsel.dat	d_Fb_emig_final.dat d_Fb_emig_94.dat

(\*)existing data

**Appendix B: Categorical Age Variables Used to Replicate Ahmed and Robinson's 1980-1990 Emigration Estimates.**

13 categories (and total)		15 categories	
1	Total		
2	0-4	1	0-4
3	5-9	2	5-9
4	10-14	3	10-14
5	15-19	4	15-19
6	20-24	5	20-24
7	25-29	6	25-29
8	30-34	7	30-34
9	35-39	8	35-39
10	40-44	9	40-44
11	45-54	10	45-49
		11	50-54
12	55-64	12	55-59
		13	60-64
13	65-74	14	65-74
14	75+	15	75+

Source: DAPE Team 6, Population Division, U.S. Census Bureau.

## Appendix C: Country of Birth Variables Used to Replicate Ahmed and Robinson's 1980-1990 Emigration Estimates.

Country classification for the 1980-1990 estimate period (40 categories with 8 regional and total categories that were not used in programming):

### All Countries, Total

#### *North & Central America, Total*

- 3 Mexico
- 4 Cuba
- 5 Dominican Republic
- 6 El Salvador
- 7 Guatemala
- 8 Canada
- 9 Haiti
- 10 Jamaica
- 11 Trinidad & Tobago
- 12 Other N. & C. American Countries

#### 13 *South America, Total*

- 14 Argentina
- 15 Colombia
- 16 Ecuador
- 17 Peru
- 18 Other South American Countries

#### 19 *Europe, Total*

- 20 France
- 21 Germany (East & West)
- 22 Greece
- 23 Ireland
- 24 Italy
- 25 Netherlands
- 26 Poland
- 27 Portugal
- 28 Spain
- 29 U.S.S.R
- 30 United Kingdom
- 31 Yugoslavia
- 32 Other European Countries

#### 33 *Asia, Total*

#### 34 *Middle East, Total*

- 35 Iran
- 36 Israel
- 37 Other Middle Eastern Countries

#### 38 *South & East Asia, Total*

- 39 China & Taiwan
- 40 India
- 41 Japan
- 42 Korea
- 43 Philippines
- 44 Other S. & E. Asian Countries

#### 45 *Africa, Total*

#### 46 *Oceania, Total*

- 47 Australia
- 48 Other Oceania

## Country classification for the 1990 Census (111 categories):

1	Mexico
2	Cuba
3	Dominican Republic
4	Costa Rica
5	El Salvador
6	Guatemala
7	Honduras
8	Nicaragua
9	Panama
10	Other Latin N & C America
11	Canada
12	Belize
13	Bahamas
14	Barbados
15	Haiti
16	Jamaica
17	Trinidad and Tobago
18	Other West Indies
19	Other N and C America
20	Argentina
21	Bolivia
22	Brazil
23	Chile
24	Colombia
25	Ecuador
26	French Guyana, Suriname
27	Guyana
28	Paraguay
29	Peru
30	Uruguay
31	Venezuela
32	Other South America
33	Albania
34	Austria
35	Belgium
36	Bulgaria
37	Czechoslovakia
38	Denmark
39	Finland
40	France
41	Germany (East, West, Berlin)
42	Greece
43	Hungary
44	Ireland
45	Italy & the Vatican
46	Netherlands
47	Norway
48	Poland
49	Portugal
50	Romania



51	Spain
52	Sweden
53	Switzerland
54	United Kingdom
55	Yugoslavia
56	U.S.S.R. (as reported)
57	Baltics (Est.-Lat.-Lith.)
58	Other Northern Europe
59	Other Eastern Europe
60	Other Southern Europe
61	Other Western Europe
62	Europe, not specified
63	Iran
64	Iraq
65	Israel
66	Jordan
67	Lebanon
68	Saudi Arabia
69	Syria
70	Turkey
71	Other Middle East
72	Afghanistan
73	Bangladesh
74	Burma
75	China
76	Hong Kong
77	India
78	Indonesia
79	Japan
80	Cambodia
81	Korea
82	Laos
83	Malaysia
84	Pakistan
85	Philippines
86	Sri Lanka
87	Taiwan
88	Thailand
89	Vietnam
90	Other South and East Asia
91	Algeria
92	Cape Verde
93	Egypt
94	Ethiopia
95	Ghana
96	Kenya
97	Liberia
98	Libya
99	Morocco
100	Nigeria
101	South Africa
102	Sudan

103	Tanzania
104	Uganda
105	Zimbabwe
106	Other northern Africa
107	Other Africa
108	Australia
109	New Zealand
110	Other Oceania
111	Antarctica

Source: Population Division, U.S. Census Bureau.

**Appendix D. Demographic Analysis–Population Estimates (DAPE) Research Project Related to Evaluating Components of International Migration (in order of Working Paper Series Number).**

- Deardorff, K. and L. Blumerman. 2001. *Evaluating Components of International Migration: Estimates of the Foreign-Born Population by Migrant Status: 2000*. Population Division Working Paper No. 58, U.S. Census Bureau.
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- Costanzo, J., C. Davis, C. Irazi, D. Goodkind, R. Ramirez. 2001. *Evaluating Components of International Migration: The Residual Foreign Born*. Population Division Working Paper No. 61, U.S. Census Bureau.
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Malone, N. 2001. *Evaluating Components of International Migration: Consistency of 2000 Nativity Data*. Population Division Working Paper No. 66, U.S. Census Bureau.

Table 1. The number of immigrants and foreign-born emigrants by decade: 1900-1989.  
[In thousands]

<b>Period</b>	<b>Immigrants to the US</b>	<b>Foreign-born emigrants from the US</b>	<b>Ratio of emigrants to legal immigrants</b>
Total, 1900-1989	38,319	12,231	0.32
1980-1989	7,869 <sup>1</sup>	1,950 <sup>2</sup>	0.25
1970-1979 <sup>3</sup>	4,334	1,176	0.27
1960-1969 <sup>3</sup>	3,213	900	0.28
1950-1959 <sup>3</sup>	2,500	425	0.17
1940-1949 <sup>3</sup>	858	281	0.33
1930-1939 <sup>3</sup>	699	649	0.93
1920-1929 <sup>3</sup>	4,295	1,685	0.39
1910-1919 <sup>3</sup>	6,348	2,157	0.34
1900-1909 <sup>3</sup>	8,203	3,008	0.37

<sup>1</sup> From U.S. Immigration and Naturalization Service, 1998 Statistical Yearbook, Table 1.

<sup>2</sup> Assumption of 195,000 annual emigrants estimated by Ahmed and Robinson, 1994. "Estimates of Emigration of the Foreign-born Population: 1980-1990.", U.S. Census Bureau Technical Working Paper no. 9

<sup>3</sup> From Warren and Kraly, 1985. "The Elusive Exodus: Emigration from the United States." PRB Population Trends and Public Policy paper no. 8, Table 1.

Table 2. Foreign-born emigrants for the national estimates: 1990 to 2000.

[July 1 to June 30]

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<b>Year</b>	<b>Foreign-born emigrants</b>
1990 (4/1-6/30)	50,915
1990-1991	203,709
1991-1992	205,798
1992-1993	209,172
1993-1994	212,351
1994-1995	214,401
1995-1996	218,295
1996-1997	222,533
1997-1998	228,048
1998-1999	231,204
1999-2000 (7/1/-4/1)	176,138
Total (1990-2000)	2,172,564

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Source: Mulder, T. et. al. 2000. "U.S. Census Bureau Measurement of Net International Migration to the United States: 1990 to 2000." Population Division Working Paper No. 51, U.S. Census Bureau.

Table 3. Ahmed and Robinson categorization of selected and non-selected countries and race and Hispanic origin by country of birth.

<b>Race/Origin</b>	<b>Selected Countries</b>	<b>Non-Selected Countries</b>
Hispanic	Cuba Dominican Republic Other North and Central America Argentina Colombia Ecuador Other South America Spain	Mexico El Salvador Guatemala  Peru
Non-Hispanic White	All countries in Europe (except Spain) Middle Eastern countries Canada Australia	
Black	Africa (as a whole)	Haiti Jamaica Trinidad and Tobago
Asian and Pacific Islander	China India Japan Korea Philippines Other Oceania	Other South and East Asia

Source: Ahmed, B. and G. Robinson. 1994. "Estimates of Emigration of the Foreign-born Population: 1980-1990." Population Division Working Paper No. 9, U.S. Census Bureau.

Table 4. 1980-1990 foreign-born emigrants as estimated by Ahmed & Robinson and DAPE, and the difference between the two, by selected and non-selected countries, race groups, and sex.

Race/Origin	Ahmed and Robinson (1994) <sup>1</sup>			DAPE Replication (2001) <sup>4</sup>			Difference		
	Number of FB emigrants 1980-1990			Number of FB emigrants 1980-1990			Number of FB emigrants 1980-1990		
	Total	Selected <sup>2</sup>	Non-Selected <sup>3</sup>	Total	Selected	Non-Selected	Total	Selected	Non-Selected
Total	<b>1,949,168</b>	1,582,203	366,965	<b>1,940,355</b>	1,572,771	367,584	-8,813	-9,432	619
Male	1,009,882	799,124	210,758	1,002,344	794,315	208,029	-7,538	-4,809	-2,729
Female	939,286	783,079	156,207	938,011	778,456	159,555	-1,275	-4,623	3,348
Hispanic	438,755	207,959	230,796	451,274	220,657	230,617	12,519	12,698	-179
Male	248,129	110,839	137,290	255,098	117,923	137,175	6,969	7,084	-115
Female	190,626	97,120	93,506	196,176	102,734	93,442	5,550	5,614	-64
Non-Hispanic White	878,463	878,463	0	868,675	868,675	0	-9,788	-9,788	0
Male	427,565	427,565	0	422,070	422,070	0	-5,495	-5,495	0
Female	450,899	450,899	0	446,605	446,605	0	-4,294	-4,294	0
Black	130,707	81,580	49,127	118,676	68,728	49,948	-12,031	-12,852	821
Male	67,101	43,851	23,250	57,797	37,143	20,654	-9,304	-6,708	-2,596
Female	63,606	37,729	25,877	60,879	31,585	29,294	-2,727	-6,144	3,417
API	501,242	414,201	87,041	501,730	414,711	87,019	488	510	-22
Male	267,088	216,871	50,217	267,379	217,179	50,200	291	308	-17
Female	234,155	197,331	36,824	234,351	197,532	36,819	196	201	-5

<sup>1</sup> Ahmed, B. and J.G. Robinson. 1994. "Estimates of Emigration of the Foreign-born Population: 1980-1990." Population Estimates and Projections Technical Working Paper no. 9, U.S. Census Bureau.

<sup>2</sup> API and Non-Hispanic White male and female do not add to total due to rounding errors.

<sup>3</sup> Using middle assumption (50%).

<sup>4</sup> DAPE Team 6, Population Division, U.S. Census Bureau.



Table 5. 1980-1990 annual average foreign-born emigrants as estimated by Oosse and DAPE, by country of birth and sex.

Country of Birth	Oosse (1998) <sup>1</sup>			DAPE Results (2001) <sup>2</sup>		
	Number of FB emigrants 1980-1990			Number of FB emigrants 1980-1990		
	Total	Male	Female	Total	Male	Female
Total	190,415	98,556	91,859	190,414	<b>98,556</b>	<b>91,858</b>
<i>Mexico</i>	20,068	11,948	8,120	20,068	11,948	8,120
<i>Cuba</i>	-	-	-	-	-	-
<i>Canada</i>	11,282	5,135	6,147	11,282	5,135	6,147
<i>Yugoslavia</i>	1,983	1,013	970	1,983	1,013	970
<i>India</i>	5,275	3,103	2,172	5,275	3,103	2,172
<i>Philippines</i>	11,242	5,796	5,446	11,242	5,796	5,446
<i>Africa</i>	6,796	3,980	2,816	6,796	3,980	2,816
<i>China &amp; Taiwan</i>	10,149	5,642	4,507	10,149	5,642	4,507
<i>N, C, and S America</i>	25,235	13,192	12,043	25,235	13,192	12,043
Dominican Republic	-	-	-	2,860	1,514	1,346
El Salvador	-	-	-	1,641	969	672
Guatemala	-	-	-	846	493	353
Haiti	-	-	-	1,534	762	772
Jamaica	-	-	-	2,539	1,173	1,366
Trinidad & Tobago	-	-	-	842	385	457
Other N. and C. America	-	-	-	5,938	3,026	2,912
Argentina	-	-	-	835	461	374
Colombia	-	-	-	2,337	1,256	1,081
Ecuador	-	-	-	1,193	658	535
Peru	-	-	-	526	293	233
Other South America	-	-	-	4,144	2,202	1,942

(continued on next page)

Table 5 (continued). Annual average foreign born emigration as estimated by Oosse and DAPE, by country of birth and sex.

Country of Birth	Oosse (1998)			DAPE Results (2001)		
	Number of FB emigrants 1980-1990			Number of FB emigrants 1980-1990		
	Total	Male	Female	Total	Male	Female
<i>W. &amp; C. Europe, Australia &amp; New Zealand</i>	52,288	24,469	27,819	52,288	24,469	27,819
France	-	-	-	2,069	954	1,115
Germany (East & West)	-	-	-	11,908	5,058	6,850
Greece	-	-	-	3,093	1,690	1,403
Ireland	-	-	-	1,903	825	1,078
Italy	-	-	-	7,979	3,959	4,020
Netherlands	-	-	-	1,301	654	647
Portugal	-	-	-	3,548	1,810	1,738
Spain	-	-	-	743	414	329
UK	-	-	-	9,608	4,351	5,257
Other European Countries	-	-	-	9,371	4,382	4,989
Australia	-	-	-	765	371	394
<i>USSR and Poland</i>	10,510	4,883	5,628	10,510	4,883	5,628
USSR	-	-	-	6,017	2,791	3,226
Poland	-	-	-	4,493	2,091	2,402
<i>Middle East</i>	12,033	7,234	4,798	12,032	7,234	4,798
Iran	-	-	-	3,998	2,437	1,561
Israel	-	-	-	1,839	1,036	803
Other Middle East	-	-	-	6,195	3,761	2,434
<i>Japan and Korea</i>	13,759	6,565	7,194	13,759	6,565	7,194
Japan	-	-	-	5,334	2,679	2,655
Korea	-	-	-	8,425	3,886	4,539
<i>Other Southeast Asia and Oceania</i>	9,794	5,596	4,198	9,794	5,596	4,198
Other S. & E. Asia	-	-	-	8,705	5,012	3,693
Other Oceania	-	-	-	1,089	584	505

<sup>1</sup> Oosse, M. 1998. "Calculation of Annual Emigration Rates for the Foreign Born, 1980-1990." Unpublished Spreadsheets, U.S. Census Bureau.

<sup>2</sup> DAPE Team 6, Population Division, U.S. Census Bureau.