

## **Evaluating the Role of Immigration in U.S. Population Projections**

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### *Abstract*

We first replicate the official 2008 Census Bureau projections by race/ethnicity and then develop separate routines and assumptions for immigrants and natives. The most important finding so far is that immigration accounts for the overwhelming majority of future U.S. population growth. Future immigration by itself will add about 100 million new residents to the U.S. population by 2050, accounting for about three-fourths of population growth. Moreover, if immigration continues at the level the Census Bureau expects, it would not be possible to stabilize the U.S. population even if native fertility were dramatically lower. We can also say that immigration has a positive, but small impact on the share of the population that is of working age. The arrival of nearly 70 million immigrants (the Census Bureau level of immigration) over the next four decades can only offset about 14 percent of the decline in the share of the population that is of working age (16 to 65). We find that immigration is no fix for an aging society, a finding that is consistent with prior research.

### *Introduction*

The goal of this project is to evaluate the role of immigration in the official U.S. population projections. The Census Bureau produces population projections every few years. While these projections have significant value, they are by their nature somewhat limited in their ability to address academic and policy questions that might arise, particularly those related to immigration issues, the single most important component in past and future population growth of the United States. By taking the Bureau's most recent projections as a base line and building a model with separate projections pathways for the immigrant and native population, the impact of varying immigration scenarios can be tested and understood.

We will discuss how our starting model was developed from Census Bureau projection assumptions and how separate native and immigrant pathways are incorporated into our cohort-component model. Finally, we present some of the initial findings by incorporating various immigration assumptions to the Census baseline projection model.

### *Replicating Census Bureau Projections*

We started with the 2008 Census Bureau population projections (Census, 2008), the official projections for the U.S. and the standard against which other projections are judged. Census generously shared the underlying data and assumptions they had available. Unfortunately, by 2011 this did not include all of the data they had in 2007, when the projections were being developed. In order to create a model with alternative scenarios we first had to write a program that would replicate the Census outcomes. To accomplish this, we reverse-engineered Census projections based on published and unpublished data that they supplied.

The roots of the 2008 Census projections are in the 2000 Census; while the published data begin with 2010, Census shared unpublished details of the model's annual increments since 2000. We found the assumptions used in the Bureau's model fluctuated over the first years of the decade likely helping the

model conform to current estimates. Therefore, our projection model used the 2007 projected population as the starting year, after which assumptions stabilized.

Since neither the Center for Immigration Studies (CIS) nor Decision Demographics is a federal agency, we had the luxury of being able to ignore OMB 15, so all of our work was done with five race/ethnic groups: Hispanic of any race and four non-Hispanic groups—white, Black, Asian and Pacific Islanders (shortened to “Asians” for simplicity), and American Indians and Alaskan Natives (AIAN). This step allowed us to do projections and create all of our model’s data inputs with sizable populations not subject to the volatility that some of the smaller race groups display, and avoided the complications of creating and perpetuating multiple-race groups for whom little supporting data exist.

The Census projections provide data for all years in several racial/ethnic combinations. The seven Census groups were collapsed to five race/ethnic groups, which we termed CIS race groups, as shown in Table 1 below.

Table 1

Census Projection Race Groups	CIS Race Groups
1. Hispanic	1. Hispanic
2. White non-Hispanic	2. White non-Hispanic
3. Black non-Hispanic	3. Black non-Hispanic
4. AIAN non-Hispanic	4. AIAN non-Hispanic
5. Asian non-Hispanic	5. API non-Hispanic
6. NHOPI non-Hispanic	
7. 2+ race non-Hispanic	

To create the five CIS race groups, the Asian non-Hispanic and Native Hawaiian and Other Pacific Islander (NHOPI) non-Hispanic groups were combined to create an Asian and Pacific Islander (API) non-Hispanic group; the 2+ race non-Hispanic group was distributed across the four non-Hispanic race group using allocation factors developed from the 2002 Current Population Survey (CPS) (Polivka, 2003). These factors distribute and assign persons back to single race categories, as shown in Table 2.

Table 2

Allocation of 2+ Race to Single Race

Race	Allocation
White	64.7%
Black	15.6%
AIAN	7.8%
API	12.0%

*Replication Accuracy*

After converting the Census projection model data inputs to the five CIS race groups, the cohort-projection model exactly projected the population to 2050, using Census annual births. In preparing to add the native and foreign components to the model, we tested the model with calculated total fertility rates (TFRs). With TFRs, the 2040 projection was within 0.8 million persons or 0.2 percent of the Census results. The error rate rose very gradually; at 2050, the

calculation was off by 3.5 million or 0.6 percent from Census results. Slight error was introduced by the sex ratios of births, which did not perfectly follow the Census Bureau sex ratios. Since we lacked the exact ratios used by Census, Decision Demographics calculated an average sex ratio by CIS race, averaging by race the sex ratios implicit in the Census Bureau's projections over all projection years.

After matching the Bureau's outcomes for the five race groups, we created parallel programming paths for natives and immigrants. We then repeated the testing, using identical rates for both groups, and again were able to replicate the Bureau's outcomes. Next, we developed separate fertility rates for natives and immigrants and repeated the duplication of outcomes. Having successfully developed and tested the tool, we were now able to decompose the native and immigrant portions of the projections, employ distinct rates for natives and immigrants, and explore alternative projection outcomes. The discussion that follows offers more details in terms of separating immigrants and natives; the fertility, mortality, and immigration components of the project; and our plans for further developing this project.

#### *Separating Immigrants and Natives in the Projections*

The first task was to separate natives and immigrants by race in the population base for the projections. As mentioned, the Bureau projections start with the 2000 population and move forward from there, but we used their 2007 "projection" as our base year. After allocating Census race groups into our five races by using a crosswalk of single race and multiple races from the 2002 CPS, we employed data from the 2006-2008 American Community Survey Public Use Microdata Sample (ACS PUMS) to separate natives from immigrants by age and race.

#### *Development of CIS Race Groups from the ACS Public Use Data*

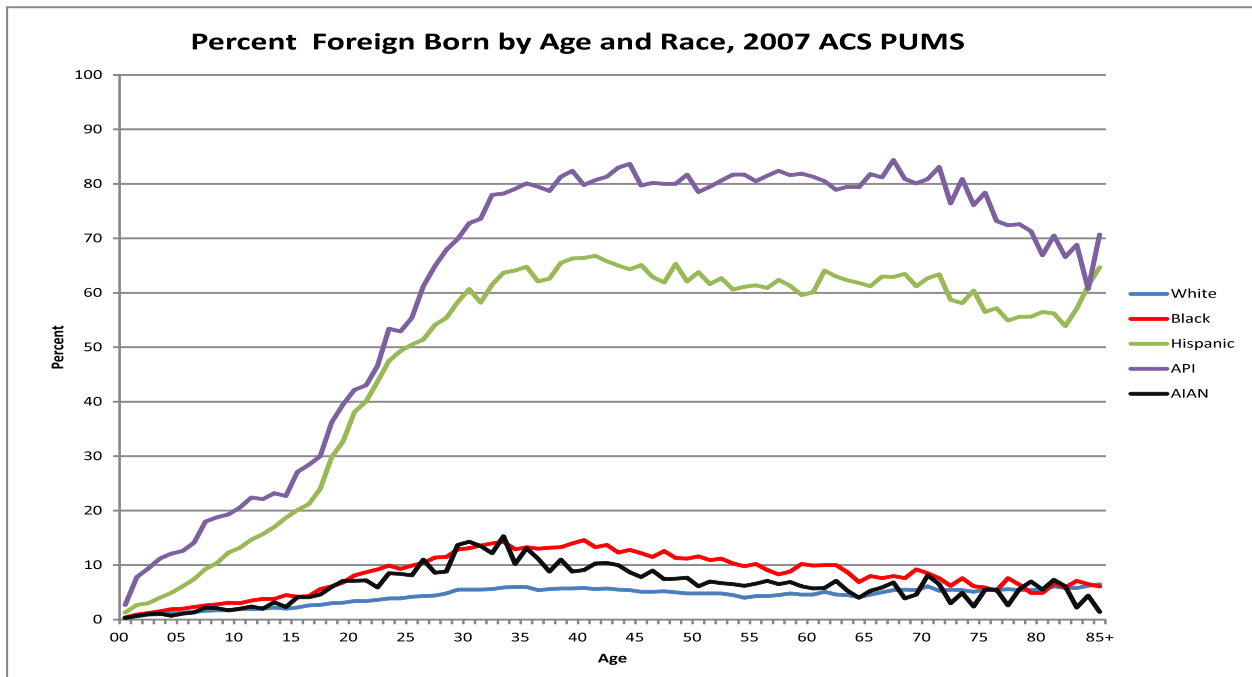
For the ACS-based tabulation of the native and foreign born shares by CIS race groups described above, as well as the TFR tabulations described below, the ACS PUMS data were adjusted to conform to the CIS race groups. Since the ACS PUMS are individual-level data, the allocation of persons of 2+ races in Census data to CIS race categories is somewhat different than when working with aggregate data. For each person who indicated belonging to more than one race group, the data record was replicated once for each race group named. These new records were weighted by dividing the original weight by the number of races the respondent indicated. For example, if a person responded that he or she was white, black, and Asian, three copies of the data record were made, each with a person level weight one-third of the original value.

The ACS PUMS data required two additional steps to allocate non-Hispanic persons of an "Other" race. First, multiple race persons who indicated one of their races as "Other" were allocated. If, for example, a person responded white and Other, then the undefined Other response was dropped. A small number of persons indicated they were of only one race which was "Other." These records were treated similarly to persons of multiple races except their weight was assigned proportionately to the existing race distribution. The proportions for this distribution were quite similar to the allocation factors used to distribute 2+ race persons in the aggregate data from the Census Bureau 2008 projection model. The exact allocation factors used were calculated from the ACS file independently for each ACS year.

*Applying Native and Foreign Born Share Results from the ACS*

Figure 1 shows the percent of each race group that is foreign born by single years of age. The percent foreign born rises rapidly from age 0 through age 34 for Hispanics and Asians especially. Even among whites and blacks, with small foreign groups, there is a strong pattern—supported by very large samples—of increasing proportions of foreign born through age 34. The AIAN group is so small as to have fairly volatile percentages.

Figure 1



Therefore, as summarized in Table 3, for Hispanics, whites, blacks, and API, single year native and foreign born shares by sex were used up to age 34. For ages 35 to 85+, the native-foreign ratios for five year age groups were used. For the smaller AIAN group, all ratios were based on five year age groups by sex up to ages 70-74, beyond which the ratio for AIAN groups ages 75-84 and 85+ were used. Application of these ratios successfully distributed the starting population into two groups, native born and foreign born.

Table 3  
**Age Group Aggregation of the ACS  
for Native-Foreign Born Proportions**

Age	Race-Group				
	White Non-Hisp	Black Non-Hisp	API Non-Hisp	Hispanic	AIAN Non-Hisp
0	single	single	single	single	5-year
↓	year	year	year	year	
34	<hr/>				
35	5-year	5-year	5-year	5-year	5-year
↓					
74	<hr/>				
75	5-year	5-year	5-year	5-year	10-year
↓					
84	<hr/>				
85+	All	All	All	All	All

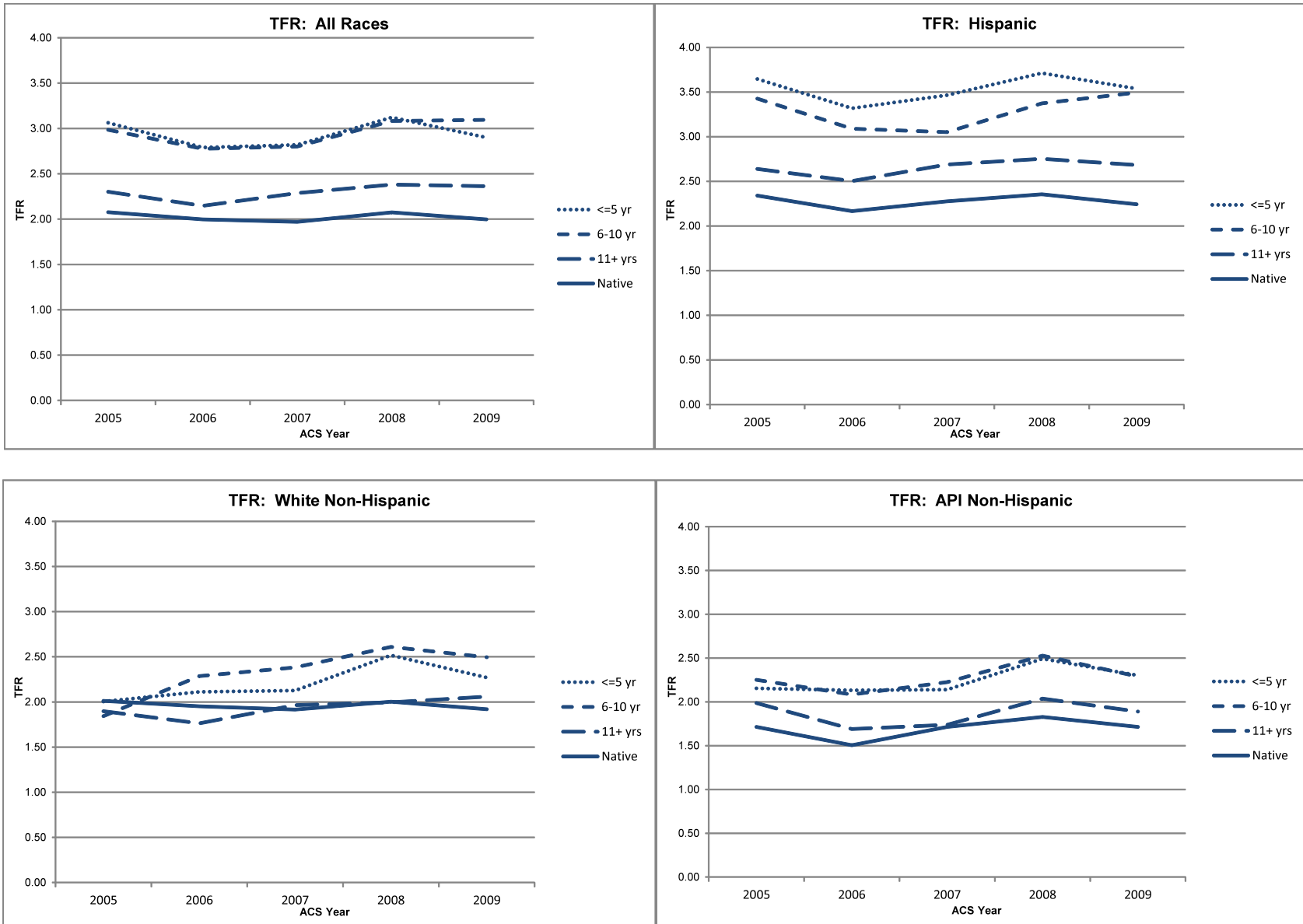
*Fertility*

We also employed ACS-PUMS data to develop separate fertility rates for immigrants and natives by race. The Census Bureau uses age-specific fertility rates (ASFRs) in its model, with special routines to deal with the model’s addition of infants with multiple races; it went to some lengths to create assumptions about future fertility. Again, we chose to avoid the additional complications of projecting two-or-more race people. Total annual projected births by race are available, but because the Bureau could not provide ASFRs by race, we calculated Total Fertility Rates (TFRs). Although we did most of our analysis with ASFRs, and our projection model is written for ASFRs, our current work is based on using TFRs.

In developing our projection model and matching the Bureau projections, we first used the numbers of births and then created TFRs. When we employed the precise numbers, our projections matched exactly. When we used the TFRs, our projections drifted ever so slightly, something we attribute to the sex ratios employed, since differences did not appear until our initial group of female births went on to have children.

Having duplicated the Bureau’s projections with TFRs for total race groups, we proceeded to analyze native and foreign fertility in the ACS in terms of ASFRs and TFRs; we also studied fertility by the number of years immigrants had been in the U.S., as shown in Figure 2.

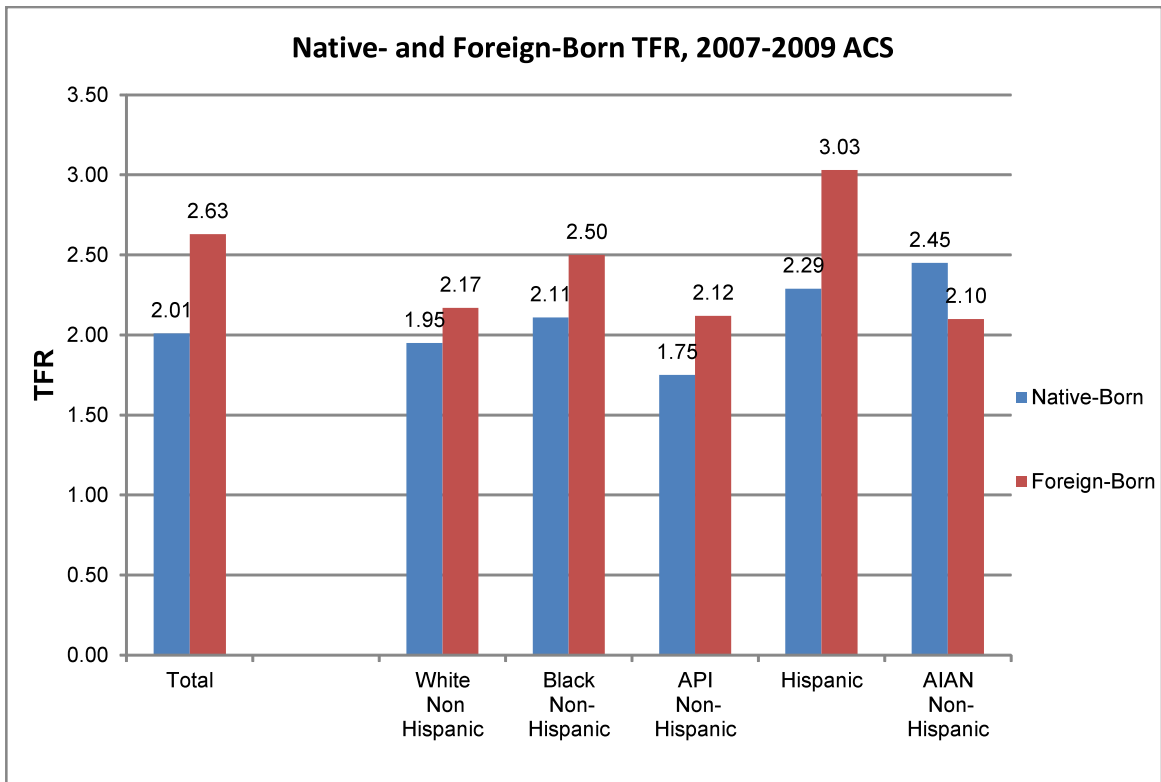
Figure 2



Our projection model is set up to apply separate fertility to natives and immigrants, but all births go into the native population. Figure 2 appears to support that assumption generally, because the TFRs for immigrant groups tend to converge with those of natives over time. Although it is theoretically possible to vary fertility according to the number of years in the U.S., we opted for a simpler distinction between immigrants and natives only.

To develop the specific TFRs for our models, we used the time series of TFRs implicit in the Census Bureau’s projections and applied native and foreign differentials from the total TFRs that we found in the 2006-2008 ACS by race. These differentials are shown in Figure 3.

Figure 3



Next, the ratio of native ACS TFR to overall ACS TFR was calculated for each race. Likewise, the ratio of immigrant TFR to overall TFR as reported in the ACS was calculated for each race. These resulting ratios, shown in Table 4, were then applied to the 2008 to 2050 projected TFR levels from the Census projections. For example for each year and race:

$$\text{Immigrant TFR} = \text{Census Projection TFR} * (\text{ACS Immigrant TFR} / \text{ACS Total TFR})$$

Table 4

	2007-2009 ACS Total Fertility Rates			Adjustment Applied to Census Projected TFR	
	Nativity		Total	Native Born	Foreign Born
	Native Born	Foreign Born			
Total	2.01	2.63	2.12	--	--
White Non Hispanic	1.95	2.17	1.96	-1%	11%
Black Non-Hispanic	2.11	2.50	2.17	-3%	15%
API Non-Hispanic	1.75	2.12	2.01	-13%	5%
Hispanic	2.29	3.03	2.63	-13%	15%
AIAN Non-Hispanic	2.45	2.10	2.44	0%	-14%

As a result, two TFR schedules were developed for the 2008 to 2050 projection period: one for native born women and one for foreign born women. Note that births to foreign born women are actually native births. Thus when female offspring of foreign born women reach their childbearing years themselves, the model employs native TFRs to estimate births to these women.

Once these distinct rates were established and employed in the projection model, only very small, iterative adjustments to the rates were needed to continue to conform to the original projections. Before adjustment, the projected population in 2050 was low by only 0.6 percent in 2050. The TFRs for natives and immigrants within each race were adjusted by the same factors in order to create the same number of births by race contained in the original projections. The Hispanic and Asian TFRs were adjusted up by a maximum of 4.5 percent in 2050, while white and black required less than 0.01 percent adjustments. Thus, we have taken advantage of the Census Bureau's work in forecasting fertility rates, but differentiated the immigrant and native components thereof. When we develop scenarios that vary the numbers of immigrants, this work ensures we will have the appropriate TFRs to apply to immigrants and natives.

### *Mortality*

Although it was possible for our projection model to apply distinct mortality rates to natives and immigrants, we had no basis on which to calculate differential rates, so we applied the same rates to both groups. As a result, we likely underestimated mortality of immigrants, thus overestimated the immigrant forecasts somewhat. In order to calculate age-sex-race mortality rates from the data supplied by the Census Bureau, we collapsed their base populations and deaths by race-ethnicity into our five groups and calculated new rates for every year.

### *Immigration*

Immigration is the primary component that we seek to change and model in our scenarios. The projection model is built so that immigration assumptions can be easily adjusted to allow the model to quickly and easily assess the impact of legislation and other actions or events. In our current model, all net immigration is assumed to accrue to the immigrant side of the equation. We understand that this is by definition wrong, because the Census Bureau projections apply to the resident population, and there are native residents who enter and leave the country. The



largest of these groups are in the armed services, but there are also Puerto Ricans, students, people who move abroad to work, and retirees to other countries. Future work will address this issue.

Future work will also create more realistic scenarios for varying the immigration assumptions, including zero net migration. Like the 2008 Census Bureau projections, most zero migration assumptions simply zero out the net migration counts across the board. This pattern is very unlikely to occur. Among the more likely scenarios are that immigration policies or relative economic opportunity change, affecting selected groups of immigrants.

Another way to achieve zero net immigration is if the whole immigration distribution moves downward, leaving some groups with positive migration, while others cross into negative. The current immigration assumptions by single years of age, sex and race, show virtually all net immigration to the U.S. as positive with the exception of a few elderly groups who have virtually insignificant net out-migration. Future work will focus on creating the ability to adjust immigration in so the net across all ages is zero within a sex-race/ethnic group yet positive and negative flows will still be present. This is a more realistic representation of how a zero net immigration situation would occur.

### *Results*

Figure 4 shows the projected size of the U.S. population in millions, from 2008 to 2050 under different immigration scenarios. The Census Bureau assumes in its projections net immigration of 1.3 million in 2008. This number rises steadily to 1.5 million by 2020, 1.7 million by 2030, and about 2 million by 2050. Between 2008 and 2050, cumulative net immigration (legal and illegal) is expected to be almost 71 million. The top line in the figure shows the size of the U.S. population assuming this level of immigration over the next 4 decades. The second line shows the effect if immigration were reduced by half of what the Bureau expects. Thus, the second line still assumes a steady increase in the number of new immigrants over the next 4 decades, but at only 50 percent of what is assumed in the top line. The bottom line assumes no immigration. The 103-million difference between the top and bottom lines represents the impact of immigration on population size.

These projections demonstrate that immigration makes for a much larger overall U.S. population and, of course, a more densely settled country. Another interesting finding is the continuing growth in the foreign-born population over the next half century (figures for the foreign born are shown in italics); our work represents one of the very few efforts to project the size of the foreign born. It may be worth noting that in about a decade the foreign born share of the U.S. population could surpass the all-time high of about 15 percent reached in 1890, if these projections prove to be correct.

Figure 4

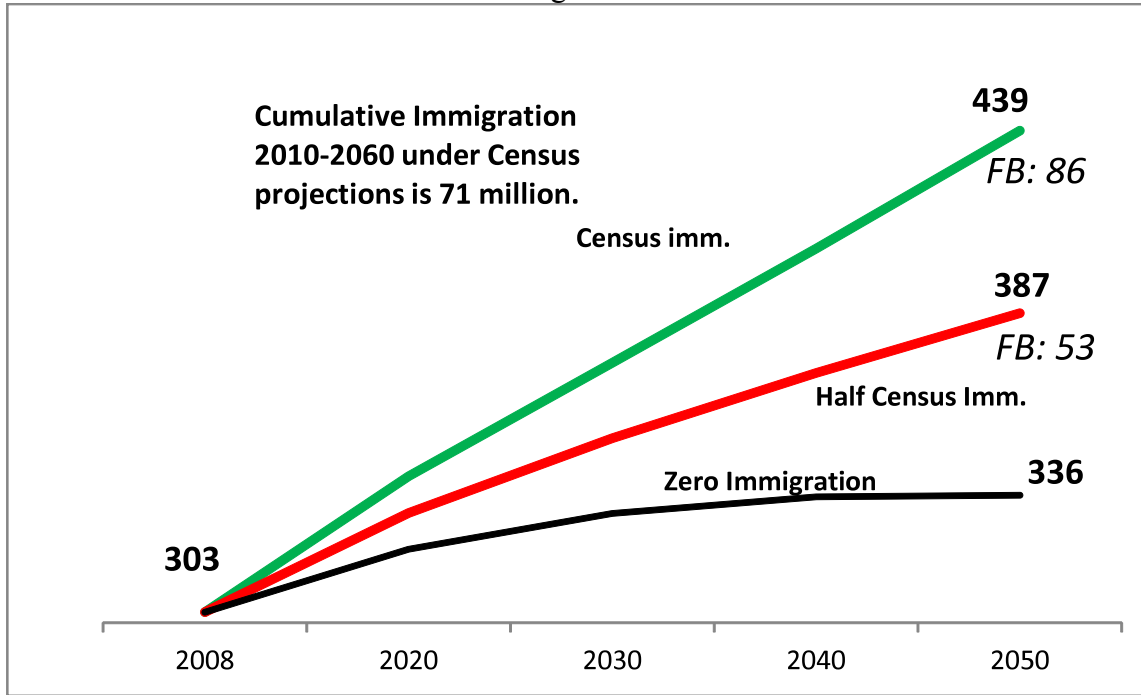
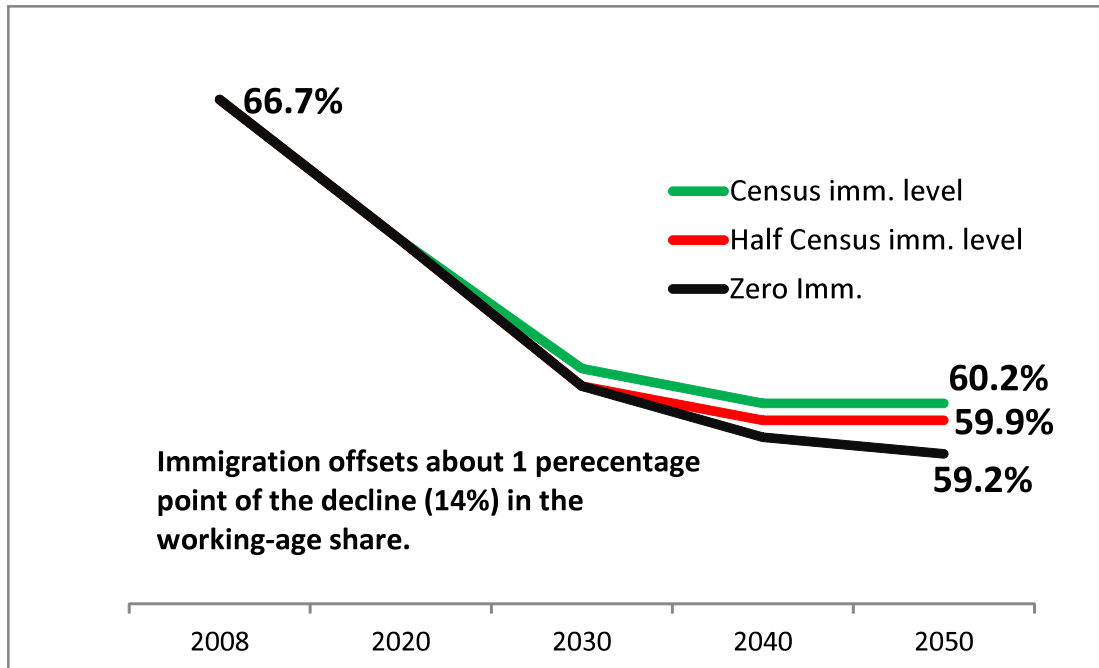


Figure 5 shows that the level of immigration makes relatively little difference to the share of the U.S. population that is of working age (16 to 65). Most demographers think in terms of dependence ratios. In the figure, we have converted the dependence ratio to the percentage that are of working age, as it is an easier concept for many audiences.

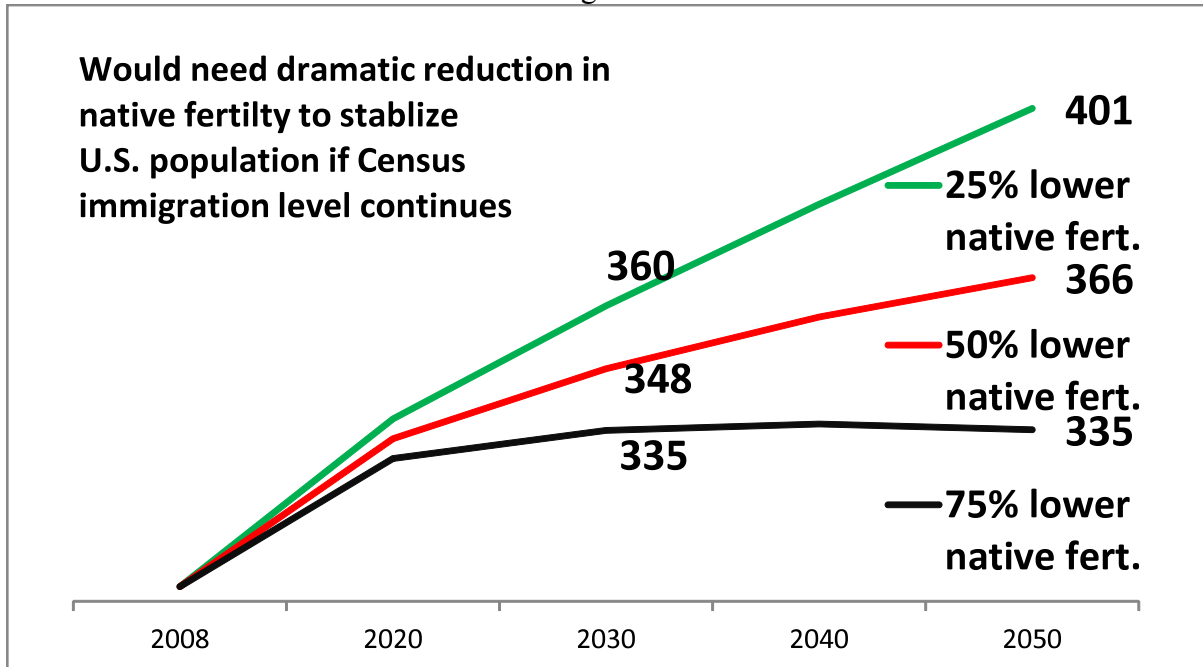
Figure 5



Two conclusions can be drawn from these two figures: first, as is well known, the working-age share of the population will decline steeply, especially through 2030; second, the level of immigration makes very little difference to that decline. Net immigration of 71 million people over 42 years offsets only 14 percent of the decline in the working age share. In short, the impact of immigration on the share of the population that is comprised of potential workers is positive, but quite small. If we are concerned about the decline in workers, the figure indicates that we will have to look at policy solutions other than immigration to deal with the challenges associated with an aging society.

In Figure 6 we examine the issue of U.S. population stabilization, using net immigration and immigrant fertility from the Bureau's base line assumptions. This figure is of interest to those environmentalists who wish to stabilize the size of the U.S. population. It shows what happens under Census Bureau immigration levels, but with different native fertilities—e.g. sustained reductions of 25 percent, 50 percent, and 75 percent by 2025. A drop of 50% would result in possibly the world's lowest fertility; a 75% drop would be unprecedented.

Figure 6



The figure shows that even if native fertility were cut by 50 percent, creating a TFR of less than 1, the U.S. population would still grow under the current Census Bureau immigration level. A TFR of less than one child per woman by 2025 for the native born population seems unlikely in the extreme, and yet even this very low fertility cannot stabilize the U.S. population. What we can conclude from this figure is that if population stabilization is an important environmental goal, then the level of immigration would have to be addressed.

### *Conclusion and Future Work*

Our examination of the Census Bureau projections allows for many possible avenues of analysis. One of the interesting things we have already found is that immigration accounts for most future U.S. population growth. Moreover, if immigration continues at the level the Census Bureau expects, it would not be possible to stabilize the U.S. population even if native fertility were dramatically lower. We can also say that immigration has a positive, but small impact on the share of the population that is of working age.

There are many other issues that can be explored with our model. For example, we can project the size of the school-age population as well the racial and ethnic composition of the population. Since social measures like poverty or educational attainment are correlated with variables such as age, gender, race, and ethnicity we might be able to use our projections to speculate about the impact of immigration on educational composition of the U.S. labor force or the poverty rate. In our view there are an almost unlimited number of academic and policy questions for which our model can provide insight.

In term of future model technical development, aside from working to create more realistic assumptions for the zero net migration scenario, plans include adapting the model with published 2010 Census population as the starting point, the incorporation of the forthcoming Census Bureau projections based on 2010, conducting regular updates, and possibly performing state projections with immigrant-native distinctions.

### **References**

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