PI$^+$ v1.5

Demographic Component of the REMI Model

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Overview

The demographic component of the REMI model uses a "cohort-component" method to forecast the population for a region. The components of demographic change are calculated every year for each of the age cohorts by sex and race. The population at the end of the year is equal to the population at the beginning of the year (starting population) plus births and net migration, minus deaths. The rate of change for each of the components depends on both observed historical trends in the region and on forecasted national trends. There are also several types of special populations that have different characteristics than the rest of the population and need to be treated differently. They are military, military dependents, prisoners, and college students.

Historical Data

Population

The model contains historical demographic data starting from the year 1990. Some of this data comes from official sources and some of it is estimated.

The Bureau of Economic Analysis (BEA) provides the total population for each county from its personal income and population summary tables. The BEA uses the population estimates from the U.S. Bureau of the Census. It is important that the population estimates are consistent with the personal income estimates, so the total population data is taken from the BEA instead of directly from the Census in case one bureau revises its estimates and the other does not.

The Census provides population estimates annually in 5-year age groups by sex, race, and Hispanic origin. There are 4 races in the REMI model, White, Black, Other, and Hispanic. The Census treats race and Hispanic origin as two different concepts in accordance with the guidelines from the Office of Management and Budget (OMB). Each person has a race and a separate Hispanic origin attribute, so a Hispanic person may be of any race. From the year 1990 to 1999, the Census asked people whether they were Hispanic or Non-Hispanic and asked them to pick a single race to identify themselves. Starting in 2000, people were asked to select all of the races that apply to them, instead of the race that best describes them. This means that the estimates of population by race are not completely compatible for the years before and after 2000.

Before 2000, the category White in the REMI model includes non-Hispanics who primarily identify themselves as White. Black includes non-Hispanics who primarily identified themselves as Black, and all other non-Hispanics are grouped into Other. Hispanic contains all people who are of Hispanic Origin regardless of their race. Afterwards, the White category includes non-Hispanic people who are White *alone*, the Black category includes non-Hispanic people who are Black *alone*, and non-Hispanics of all other races *and combinations of races* are grouped into Other. Hispanic still contains all people who are of Hispanic Origin, regardless of their race.

As a result of the racial definition changes, the population of some of the races may have made some sudden jumps or drops in the year 2000. The population shifts will show up in the model as economic migration. Although there may be a large jump in the number of economic migrants by

race, there will not be a large change in the number of economic migrants for the sum of all races, so this population shift will not affect the economic calculations.

Historical population estimates for single years of age are estimated by taking the starting population in the year 1990, applying the components of change by age, and adjusting the ages within each 5-year age group so the total matches the Census estimates.

Components of Change

The Census provides annual estimates of the total number of births, deaths, and net international migrants into each county, which are used to calibrate the county's birth rates, survival rates, and migration rates.

Birth rates can vary greatly by region and are difficult to calculate for each county because of small sample sizes. State birth rates are calculated by race and age group using data from the Center for Disease Control, National Center for Health Statistics. Regional birth rates are created by adjusting the state rates to fit the total number of births that are estimated by the Census.

The Census publishes its own population projection and the assumptions that are used to generate it, including a natality rate and survival rate forecast. The assumed national survival rates are specific to each age, sex, race, and Hispanic origin. Regional survival rates in the model are estimated by adjusting the national survival rates to fit the total number of deaths estimated in the area.

Net international migration is the net number of people who enter the region from outside the fifty states and District of Columbia. This includes net migration from Puerto Rico and U.S. territories, Armed Forces, permanent migrants, temporary migrants (such as students), refugees, and illegal migrants. Net international migrants in each county are divided up by race according to the data from the state population projections from the Census. Each county in the state has the same racial breakdown of net international migrants as the whole state.

Interregional migration is the difference between the in- and out-migration of an area within a year, and only consist moves where the origin and destination are within the United States. The Census published its annual estimates for Net Domestic Migration at county level since 2000. In the REMI model, interregional migration is divided into two categories: retired migrants and economic migrants.

People aged 65 and older who move from one area to another are called retired migrants. They do not respond to economic conditions. Data from the Census 2000 Migration DVD is used to calculate a migration rate by age for each of the counties.

The interregional migrants under the age of 65 are called economic migrants. Economic migrants are calculated as the difference between the net domestic migrants and the net retired migrants. The labor force, relative employment opportunity, relative wage rate, and the commodity access index are used, along with the historical economic migration data, to calculate an amenity term for the area which is used in the migration equation to predict future migration.

Unexplained growth is calculated as the residual of population growth of the region during the year minus all of the other components of change.

Population Forecast

The U.S Census periodically produces national population projections based on assumptions about demographic components of change, including future births, deaths, and net international migration. The changes in birth and survival rates from the Census population projection assumptions file are applied to the last history year regional birth and survival rates to form the forecasted rates. In the latest 2012 national population projections, the Census combines the non-Hispanic race groups with similar mortality patterns and produces survival rates for three race and Hispanic origin groups. The survival rates are re-estimated based on the Census projected population to match the race groups in the REMI model. The birth and survival rates are multiplied by the population by sex, race, and age to predict the number of births and deaths.

The net international migration forecast for the nation by race is also from the Census assumptions files. Each area gets the same percentage of the nation's net international migrants by race as it had in the last history year. The international migrants acquire the birth rates and survival rates of the area that they move into. Births and deaths are calculated for the migrant population by applying the birth and survival rates to half of the migrants, because the migrants arrive during the whole year and will only be in the region for half of the year, on average.

Economic migration is an endogenous calculation in the model. It depends on the economic conditions, the current labor force, and the amenity of the area. Births and deaths are added and subtracted from the economic migrants in the same manner that they are for the international migrants.

Retired migration for the area is calculated using the retired migration rates by age group. If the rate is a positive number, then the net retired migration into the area is based on the size of the 65 and older population in the rest of the nation. Otherwise, the net migration leaving the area is related to the migration rate and size of the over-65 population in the area.

Special Populations

Special populations are also estimated by age, sex, race, and Hispanic origin. The special populations are important because they are pockets of the general population that do not appear to age over time and have other special characteristics.

Active Military

The active military consists of people in the full-time duty in the active service of the Army, Navy, Marine Corps, or Air Force. It includes uniformed personnel on the active list, in training, or in military schools. Total active military population data by base is available from the Department of Defense, Statistical Information Analysis Division. National sex and race totals for the active military are from the DoD, Office of Personnel and Readiness publication "Population Representation in the Military Services". Federal Military employment data from BEA differs from active military strength because federal military includes all active military, Coast Guard, and military reserve members who

meet regularly for training. Active military personnel are not part of the labor force, and only active military members have military dependents. The ratio of active military to Federal Military employment is calculated in the last history year, and number of active military personnel in the forecast is calculated by applying that ratio to the forecasted Federal Military employment total.

Active Military Dependents

Active military dependents are the family members that live with active military personnel and move when the person in the military is reassigned to a different base. They are the spouses, children, and other adult family members that depend on an active member of the military. Dependent totals by branch of the military are available from the DoD publication "Selected Manpower Statistics". The national ratio of active military to dependents is recalculated by branch every year based on new data. This ratio is applied to the active military at each of the bases to estimate the number of dependents.

College Students

College population estimates are very important, because there are more than 15 million people in the United States enrolled in college, and they mostly fall within a very narrow age range. Students that live in places other than their hometowns during the school year are counted by the Census as residents of their new towns. It is difficult to estimate college population, because not all of the college students necessarily live in the same county as the college where they are enrolled. Census enrollment data by county, race, and sex are used in combination with data from the Department of Education, National Center for Educational Statistics to estimate the college population of an area by year. College students are assumed to have labor force participation rates lower than the general college-aged population.

Prisoners

Prisoners are estimated using data from the Census and annual data from the Department of Justice Statistics. The Census data provides a distribution of prisoners by race, sex, and type of facility for each county. The change in prisoners by year is based on state and national level data about local jails and state, federal, and military prisons from the Bureau of Justice Statistics. Prisoners are not included in the labor force.

What Makes Special Populations Special?

For the population estimates to be reasonable, it is important to recognize the special populations because they can comprise a very large portion of the population in an area that does not appear to age over time. In a college town, for example, there may be thousands of people between the ages of 18 and 22 years. Ten years later, there will not be an abundance of 28-to-32-year-olds; instead, the same 18-to-22-year-old bulge in the population will still exist. If special populations were simply not allowed to age, this would create problems in large models that have a large total special population but a small net special population. To model this situation, before the population in an area is aged, all of the special populations are returned to their "home areas". The special populations estimated in

the area are taken out and the estimated special populations from the area that currently exist in other areas are brought back in. The population is then aged one year. New special populations are added to and taken out of the population in the same age distribution as the previous year. In this way, the special population appears not to age and the total population of the nation is allowed to grow normally.

Special populations are also treated differently in the labor force calculations. Labor force participation rates are only applied to the civilian, non-institutional population.

Labor Force

Historical labor force totals by county are taken from the Bureau of Labor Statistics. Participation rates by race and age are calculated using the relative compensation rate, employment opportunity, demographic characteristics, and national participation rates. They are calibrated in the history so the labor force will be consistent with the data reported by the BLS. The participation rates are multiplied by the civilian non-institutional population to generate the labor force. Forecasted national rates from BLS are used in the participation rate equation to help shape the participation rates in the model forecast.