Population projections for California climate change scenarios

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February 2008

Population projections are inherently uncertain. The underlying processes which govern population growth are difficult to forecast and include economic, political, environmental, technological, social, and behavioral elements. Social scientists do not fully understand how these elements have shaped fertility, mortality, and migration in the past, let alone how each of these forces might change in the future. Moreover, long-term projections and projections for small areas, including states and particularly counties, are even less certain than short-term projections for large areas. Climate change could affect demographic forces directly, for example by increased mortality associated with high temperatures (or decreased mortality associated with a reduction in cold weather), or indirectly, for example through climate-induced changes in local economies.

In this project, we develop three sets of population projections for California and its counties to 2100: a low series, middle series, and a high series. The projections include breakdowns by age, gender, ethnicity, and nativity (U.S. born and foreign born). A cohort component model is used in which the population is aged over time by applying mortality and migration rates. New cohorts are created by applying fertility rates to women of childbearing ages. Projections have been developed for every five years from 2005 to 2100. Existing national population projections are used to estimate the size of populations that are the source of migrants to California. Past trends in migration, fertility, and mortality rates in California are used to develop future rates.

The three sets of projections developed for California and its counties are designed to provide a subjective assessment of the uncertainty of the state's future population. The projections present three very different demographic futures. In the low series, population growth slows as birth rates decline, migration out of the state accelerates, and mortality rates show little improvement. In the high series, population growth accelerates as birth rates increase, migration increases, and mortality declines. The middle series, consistent with California Department of Finance projections which extend to 2050, assumes future growth in California will be similar to patterns observed over the state's recent history, patterns that include a moderation of previous growth rates but still large absolute changes in the state's population. In the middle series, international migration flows to California remain strong to mid-century and then subside, net domestic migration remains negative but of small magnitude, fertility levels (as measured by total fertility rates) decline slightly,

and age-specific mortality rates continue to improve. Specific assumptions for each of the series are shown in Table 1. A number of storylines could be developed that are consistent with each of these projections series. These storylines do not necessarily involve climate change, but could be consistent with different climate change scenarios.

Table 1. Components of change assumptions for PPIC statewide population projections

		Net international migration (thousands per year)	Net interstate migration (thousands per year)	Total fertility rate /1	Mortality rate /2
Low series	2005-2010	161	-113	2.15	1.00
	2020-2025	26	-63	2.06	0.98
	2045-2050	1	-71	1.93	0.96
	2095-2100	0	-1	1.64	0.94
Middle series	2005-2010	190	-90	2.15	0.98
	2020-2025	225	-30	2.09	0.95
	2045-2050	225	-30	2.09	0.90
	2095-2100	50	-25	2.09	0.85
High series	2005-2010	220	7	2.23	0.98
	2020-2025	240	45	2.30	0.92
	2045-2050	250	50	2.46	0.80
	2095-2100	360	100	2.64	0.67

Source: PPIC climate change population projections
Notes:
/1 The total fertility rate is the average number of children a woman will have over her reproductive years
/2 age specific mortality rates relative to 2005

The key drivers of uncertainty are first migration, and second fertility. For many decades, changes in age-specific mortality rates been relatively stable, and the projections assume that no long-lasting catastrophic events will occur. Migration, in contrast, has been quite volatile, with the state experiencing both large net flows into and out of the state at different times within the past 25 years. Fertility changes have also been notable, with total fertility rates in California reaching 3.5 children per woman during the height of the baby boom and subsequently falling by about half to 1.7 children during the nadir of the baby bust.

The level of uncertainty reflected in these projections is striking. National population projections developed by the U.S. Census Bureau reflect even greater

relative uncertainty for the nation, with the high series four times as great as the low series. To the extent that the U.S. population determines one of the most important pools for potential migrants to California, the widely divergent national projections are necessarily incorporated into the California projections. Table 2 provides comparisons of the new PPIC California projections with national projections developed by the Census Bureau and state projections developed by the California Department of Finance.

Table 2. Population projections for California and the United States

	U.S. Projections			PPIC California Projections			DOF
	Low	Middle/1	High	Low	Middle	High	California
2005	284,000	295,896	292,339	36,982	36,982	36,982	36,982
2010	291,413	308,936	310,910	38,862	39,170	39,896	39,136
2020	303,664	335,805	354,642	41,978	44,184	46,863	44,136
2030	311,656	363,584	409,604	43,653	49,321	54,054	49,241
2040	314,673	391,946	475,949	44,103	54,214	61,237	54,226
2050	313,546	419,854	552,757	44,204	59,283	69,376	59,508
2060	310,533	449,312	642,752	44,554	63,968	79,677	
2070	306,589	482,207	749,257	44,683	68,818	91,466	
2080	300,747	517,767	873,794	44,377	74,018	106,192	
2090	292,584	554,975	1,017,344	43,924	79,476	124,982	
2100	282,706	593,820	1,182,390	43,835	85,264	147,698	

Notes:
/1 The middle series to 2050 is based on the Census Bureau's 2004 interim projection series; From 2050 to 2100, the Census Bureau's 2000 series was used but modified in light of the 2004 series. Contact author for details.

Three data files accompany these projections:

1. popproj_low_series.xls
2. popproj_middle_series.xls
3. popproj_high_series.xls

In each file, the sheet labled 'projections output' provides detailed projections by demographic characteristics, and the sheet 'county summary' provides county totals.