Kem C. Gardner POLICY INSTITUTE
THE UNIVERSITY OF UTAH

Policy Brief
March 2016

Migrant Today, Parent Tomorrow:
A Zero Migration Simulation

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Introduction

Recently, the Kem C. Gardner Policy Institute estimated the Utah population was expected to reach three million residents between August 2015 and January 2016, with a midpoint of October 18, 2015 (Perlich, 2015). This information has been of interest to parties in private, public, and academic settings. In discussions of this milestone, it has been noted that approximately two-thirds of this growth since 1995 (when the 2 million point was reached) was due to natural increase (births less deaths), as opposed to migration (Kem C. Gardner Policy Institute, 2015). This seems reasonable since Utah has the highest birth rate in the nation (Hamilton, Martin, Osterman, Curtin, & Mathews, 2015) and a relatively low death rate (Xu, 2014). However, this basic interpretation underestimates the cumulative effects of migration, since many of these births are to children of those who moved to Utah. Today's migrants often become tomorrow's parents (Perlich, 2006a).

We illustrate this idea by considering an alternate past. What would have happened to the Utah population if nobody came or left beginning in 1990? What would happen in the future? This case is not consistent with the emergence of a new Utah. Since 1990, Utah has become increasingly interconnected to the outside world with more people flowing in and out for a wide range of reasons, including economic opportunity. The diversity of motivation and source region has combined to result in the amazing demographic, economic, and cultural transformations that we are experiencing and witnessing. So, we ask you to put yourself in the shoes of a Utahn alive in 1990, wondering about the population growth of the state. What might the future look like, and what can it tell us about the present? A little background is necessary for us to understand how populations grow and decline.

Background

Demographic Rates

Demography is the study of human populations and the forces that affect them. Three demographic forces can affect the size of a population: fertility (births), mortality (deaths), and migration (movement between populations). People join a population through birth or in-migration and leave through death or out-migration. This is the Demographic Balancing Equation, which states that the growth in a population between two time points is equal to the sum of natural increase (births minus deaths) and net migration (in-migration minus out-migration).

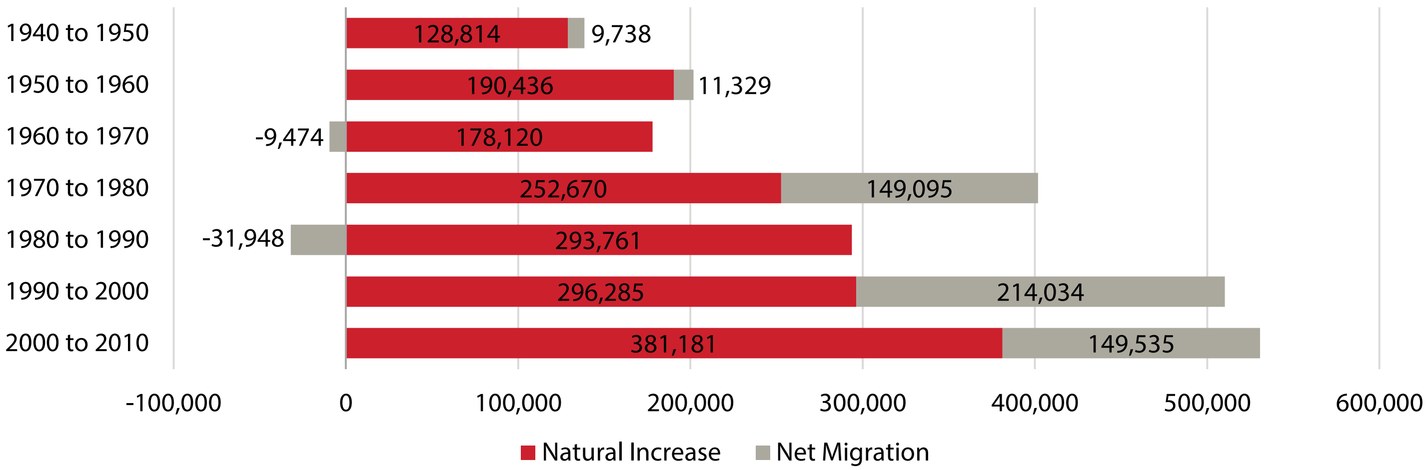
These forces are mathematically represented as rates, where the numerator is the number of events that occur, and the denominator is the population at risk for experiencing the event. For example, if during a certain year, a population has 1,000 people, and eight of them die, then the mortality rate is 8 per 1,000, or 0.008. It follows, then, that if the population consisted of one million people, then we would expect eight thousand deaths to occur. Therefore, if two populations have the same underlying force of mortality, but different sizes, then more people will die in the larger population, simply because there are more people at risk. The forces of migration and fertility can be similarly represented.

Migration in Utah

As recorded in the decennial census counts, Utah has experienced population growth from 1850 to present. Even in periods of out-migration, natural increase has fueled population growth, as births have consistently outnumbered deaths. Additionally flows of sustained out-migration have

Note to reader: The Utah Legislature recently funded the Kem C. Gardner Policy Institute to provide demographic decision support to the state of Utah. The work program includes population estimates by county, long-term population projections by age and sex, long-term employment projections by major industry, topical reports on demographic topics, and a variety of other deliverables. These products will help Utahns make more informed decisions, and ultimately lead to a more prosperous state. This Policy Brief presents an early analysis of how in-migration contributes to natural increase. It demonstrates the newly developed demographic capabilities that reside at the Gardner Policy Institute and serves as a forbearer to more detailed population and employment projections that will be released in Summer 2016.

Figure 1
Utah 10-Year Components of Population Change



Source: Kem C. Gardner Policy Institute computations from U.S. Census Bureau and Utah Population Estimates Committee data.

been comparatively rare. Since the post-WWII period, the Western and Intermountain regions as a whole have generally shared these trends of high population growth due to natural increase and net in-migration. But, the relative contributions of these components have varied between states.[1]

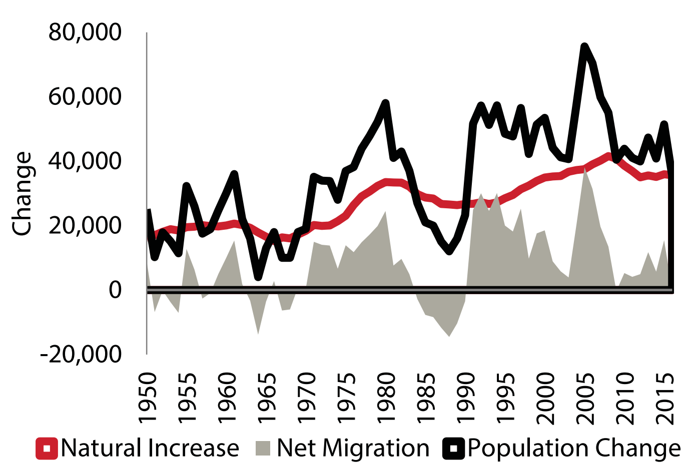
It is known that economic opportunities tend to attract people to new destinations (Partridge & Rickman, 2003). Prior to 1970, migration to and from Utah corresponded to the boom and bust cycles of the Utah economy which, like the economies of many other Intermountain states, was concentrated in volatile industries such as mining, energy, and federal government. Post 1970, a new Utah began to emerge as economic growth was simultaneous with economic diversification. A new pattern of migration developed where, over time, in-migration came to more consistently outpace out-migration. While the 1980s saw a period of economic recession and out-migration, a more stable economic expansion began in the 1990s and continued until the onset of the Great Recession. No periods of significant out-migration from Utah have occurred since 1990. Over the past 25 years, people have come to Utah in increasing numbers and from a wide variety of source regions. They come because of economic and educational opportunities, refugee relocation, family reunification, and growing global connections of the Church of Jesus Christ of Latter-day Saints.

With the onset of the Great Recession of 2008, net in-migration decreased to near standstill, with some experts suggesting there may actually have been greater out-migration—this is particularly true of international migration (Gonzalez-Barrera, 2015; Villarreal, 2014). As the recovery has progressed, it appears that Utah is once again attracting young workers. Of particular note is the recent boom in higher-education tech jobs, leading some to call Utah the "The Next Silicon Valley" (Vara, 2015). Looking into the future, it is unclear how recent changes in economic structure and social patterns associated with the Great Recession might affect the shape of future migration patterns. But, the historical record clearly shows a fairly consistent recent pattern of net in-migration to Utah. Figure 1 gives a graphical overview of these past trends.

The Zero Migration Case

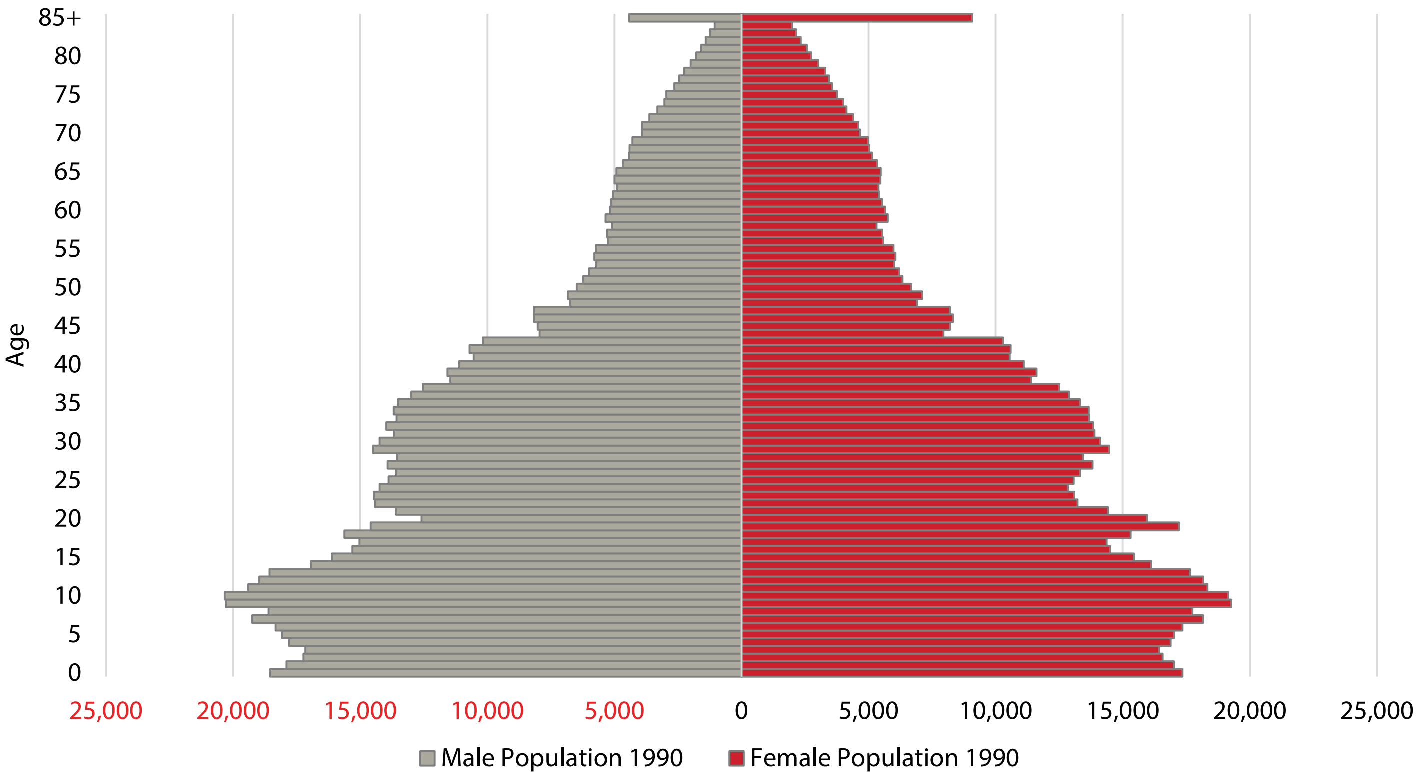
A frequently asked question is: how much of our population growth was due to fertility, mortality, and migration? Or, thinking about this another way, if we eliminated one of the components of change, what would happen to the

Figure 2
Utah Annual Components of Population Change: July 1 Estimates



Source: Utah Population Estimates Committee, U.S. Census Bureau, State of Utah Revenue Assumptions Working Group

Figure 3
Utah Population Estimates by Age and Sex, July 1, 1990



Source: Utah Governor's Office of Planning and Budget, July 1, 1990 Intercensal Revisions from UPED Model System

population? Figure 2 shows the estimated annual components of change. These are the yearly effects of fertility, mortality, and migration upon the size of the population for Utah during the time period. Such decompositions of components are commonly assembled by various agencies performing population estimations and provide useful information. However, if misinterpreted, they may mask the true impacts of these forces over time. In particular, there is a tendency to gloss over the fact that yesterday's migrants are today's parents, and so what appears to be natural increase in a given year may be partially attributable to migration in previous years. As a simple example, if the three forces remained constant over time, positive net migration for women in childbearing ages would increase the future population at risk for giving birth, and that same fertility rate would therefore produce more births. Conversely, if more women of childbearing ages migrated out than in, we would expect fewer births in later years, even with the same fertility rate.

Zero Migration Simulation

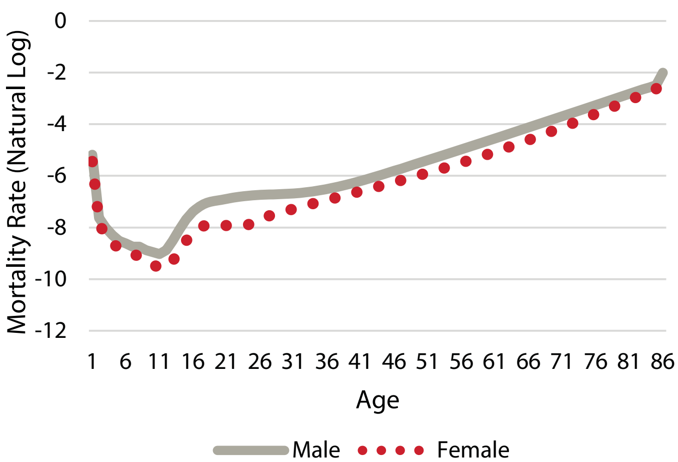
In this exercise, we simulate what would happen if Utah experienced no migration into or out of the state beginning in 1990. This type of population is often termed a closed population. Such a population is theoretical, rarely occurring in reality, but can be instructive if we wish to understand the true impact of migration upon population growth.

Data

This simulation requires estimates of the Utah population by age and sex in 1990, as well as some accurate estimates of fertility and mortality rates. The links between fertility, mortality, and migration complicate this latter requirement. We could use the actual estimated fertility and mortality rates for each year, but vital rates may also be affected by migration, since immigrants might have different fertility and mortality patterns (Hummer, Rogers, & Eberstein, 1998). Therefore, to avoid an overly-complicated analysis, we assume fertility and mortality rates to remain constant over time and use estimates for the year 2000.[2]

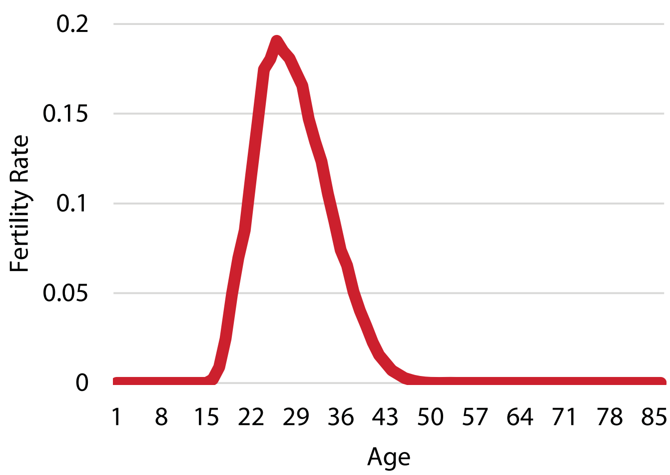
More specifically, we used intercensal population estimates for July 1, 1990, separated by sex and single year of age for ages 0-84[3] and a top-coding of population at 85+. These data were provided by the Governor's Office of Planning and Budget (GOPB; 2001). From that same source, we used age-specific birth rates for women aged 15-49 for July 1, 2000. We used sex- and single-year-of-age specific Utah death rates for 2000 from life tables published by the Centers for Disease Control

Figure 4
Utah Mortality Rates by Age and Sex, 1999-2001



Source: U.S. Decennial Life Tables for 1999-2001: State Life Tables. National Vital Statistics Reports, 60(9)

Figure 5
Utah Age Specific Fertility Rates, 2000



Source: Utah Governor's Office of Planning and Budget, July 1, 1990 Intercensal Revisions from UPED Model System

and Prevention (Wei, Anderson, Curtin, & Arias, 2012). For ages 0-84, we used the rates directly provided. For ages 85 and above, we used an approximation we derived from the lifetable by dividing the number of deaths experienced at ages 85+ by the population at risk (Kintner, 2008). The population and vital rates are shown graphically in Figures 3-5.

Mathematical Model

The simulation model was a cohort component model, which can be used for projecting future populations given the appropriate data. While these alternative estimates are for the past, they are actually projections for a hypothetical future. Our modified cohort component model closely follows that set forth in Smith, Tayman, and Swanson (2013). Normally, migration would also be modeled, but we intentionally do not include the migration component. A simple overview of our method is:

1. To the starting population (or "launch" population), multiply the population in each age and sex category by its corresponding annual death rate, to obtain a number of deaths.
2. Subtract half of the deaths from each age- and sex-specific population.[4]
3. With the remaining still-living (or "survived") population of women, multiply the population in each single-year age group (15-49) by its corresponding age-specific birth rate to obtain the expected total number of births.
4. To obtain the number of expected male births, multiply the total number of births by the proportion of births that are typically male for a human population.[5] The remainder of births are then expected female births.
5. Subtract the remaining half of deaths from the population.
6. Age the population one year, to obtain the next year's target population (this is the projected population for that year).
    a. Survived Populations aged 0-83 will be aged 1-84.
    b. Survived Populations aged 84+ will be aged 85+.
    c. The number of male and female births will be aged 0-1.
7. Make the target population the new launch population, and repeat as many times as desired.

Table 1 shows our estimated populations assuming no migration, along with the absolute change and percent change (growth rate) from the previous year. Notice that under our assumptions of no migration, we would not reach three million until approximately 2030, which is when the current Governor's Office of Management and Budget (GOMB) projections reach four million.

Figure 6 overlays a chart of this theoretical no-migration population with the actual population estimates up to 2015 and GOMB projections from 2016 and beyond. Note that the red region indicates the accumulating difference due to migration over time. We should not interpret this difference as being solely due to more migration in each year, but to the cumulative impacts of migration and subsequent additions to natural increase (births minus deaths).

Table 1
Utah Zero Migration Case

	Total Population	Change From Previous Year: Number	Change From Previous Year: Percent
1990	1,729,100	-	-
1991	1,757,253	28,153	1.6%
1992	1,785,404	28,151	1.6%
1993	1,813,637	28,233	1.6%
1994	1,841,995	28,358	1.6%
1995	1,870,499	28,505	1.5%
1996	1,899,162	28,663	1.5%
1997	1,928,033	28,870	1.5%
1998	1,957,165	29,133	1.5%
1999	1,986,659	29,494	1.5%
2000	2,016,589	29,930	1.5%
2001	2,046,978	30,389	1.5%
2002	2,077,822	30,844	1.5%
2003	2,109,117	31,295	1.5%
2004	2,140,793	31,676	1.5%
2005	2,172,750	31,957	1.5%
2006	2,204,892	32,143	1.5%
2007	2,237,137	32,245	1.5%
2008	2,269,400	32,263	1.4%
2009	2,301,616	32,216	1.4%
2010	2,333,725	32,109	1.4%
2011	2,365,682	31,957	1.4%
2012	2,397,476	31,794	1.3%
2013	2,429,130	31,654	1.3%
2014	2,460,654	31,524	1.3%
2015	2,492,059	31,405	1.3%
2016	2,523,367	31,307	1.3%
2017	2,554,598	31,231	1.2%
2018	2,585,807	31,209	1.2%
2019	2,617,006	31,199	1.2%
2020	2,648,237	31,231	1.2%
2021	2,679,516	31,278	1.2%
2022	2,710,881	31,365	1.2%
2023	2,742,380	31,499	1.2%
2024	2,774,034	31,653	1.2%
2025	2,805,861	31,828	1.1%
2026	2,837,873	32,012	1.1%
2027	2,870,061	32,188	1.1%
2028	2,902,442	32,381	1.1%
2029	2,934,944	32,503	1.1%
2030	2,967,565	32,621	1.1%
2031	3,000,297	32,732	1.1%
2032	3,033,124	32,826	1.1%
2033	3,065,910	32,786	1.1%
2034	3,098,638	32,728	1.1%
2035	3,131,309	32,671	1.1%
2036	3,163,891	32,582	1.0%
2037	3,196,361	32,470	1.0%
2038	3,228,734	32,373	1.0%
2039	3,260,965	32,232	1.0%

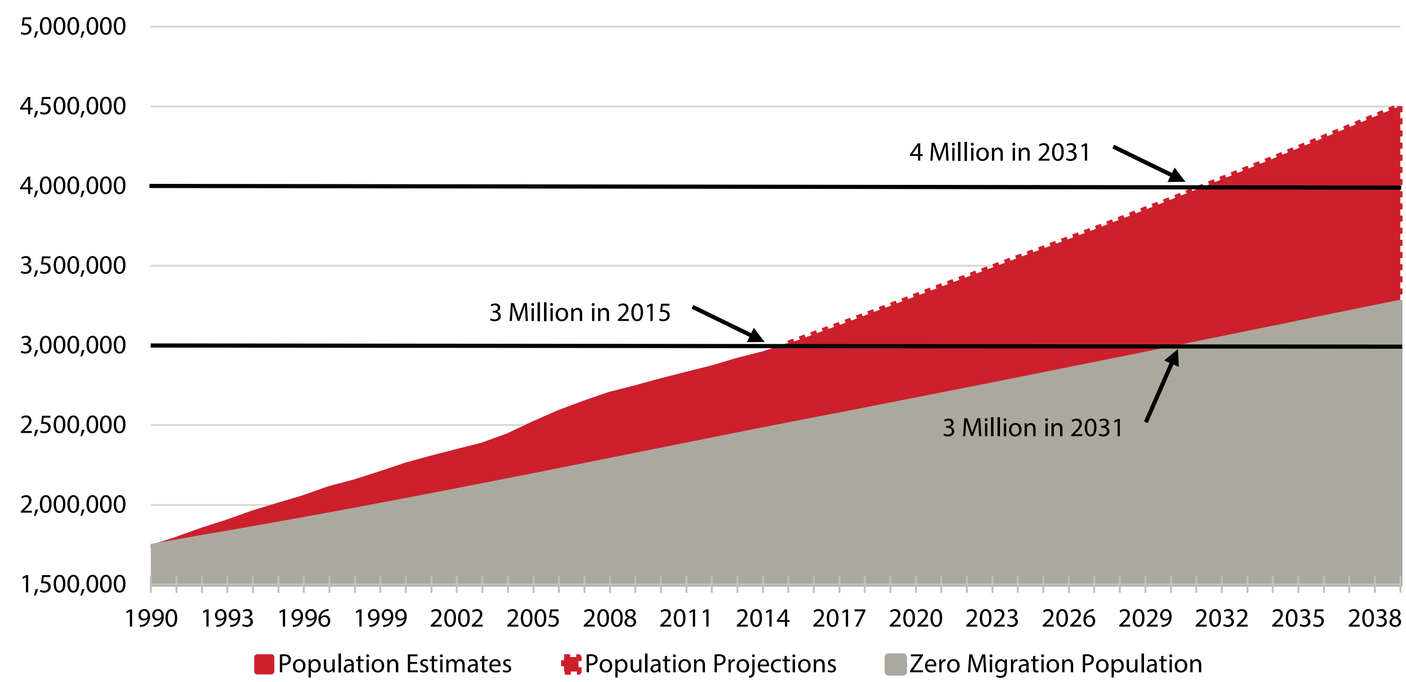
Source: Kem C. Gardner Policy Institute

Conclusion

We have shown that without substantial in-migration since 1990, the Utah population would not have achieved three million people as quickly as it did. Part of this contribution is not simply that in-migrants directly add to the population count, but that they also have children and grandchildren. Many of Utah's births are to in-migrants and therefore without in-migration the number of births would have been much smaller. If we also recognize that migrants tend to be in prime ages for bearing children this contribution becomes even more apparent. An interesting directly related point is that migration has contributed greatly to Utah's young age structure—without large in-migration of young persons and the children they have, the median age of Utah would almost certainly be much higher.

Later in 2016 we will release long term demographic projections for Utah as part of our Demographic Decision Support work for the state. The models and data that we are utilizing for this upcoming work are much more complicated than the purposely simplified approach explained in this paper. The objective of the simulation explored in this paper is limited to an investigation of the contribution of migration to the population growth of Utah since 1990. In addition to producing baseline projections for Utah, we will utilize this more complex model system to investigate other types of scenarios.

Figure 6
Utah Zero Migration Case compared to Population Estimates and Projections



Source: Utah Population Estimates Committee; U.S. Census Bureau, Population Estimates; Governor's Office of Management and Budget, 2012 Baseline Projections; Kem C. Gardner Policy Institute

Since this is a projection of a history that never happened, we might ask: what is the value of this projection? "Population projections reveal something about present conditions …, not about the future behavior of the population" (Keyfitz & Caswell, 2005, p.63). In this case, by projecting an alternative future since 1990, we learn something about the past. The key thing to learn from this exercise is that components of demographic change as traditionally reported (i.e., natural increase vs. migration) should include an understanding of how each component affects the other. A migrant today is often a parent tomorrow. In particular, Utah's high net in-migration from 1990 until the onset of the Great Recession has greatly impacted the natural increase, especially births, in subsequent years.

Suggested Citation

Hollingshaus, M., & Perlich, P. S. (2016). *Migrant Today, Parent Tomorrow: A Zero Migration Simulation*. Salt Lake City, UT: Kem C. Gardner Policy Institute, University of Utah.

Endnotes

1 For a more detailed discussion of Utah's migration history, please see Perlich (2006a, 2006b).

2 We believe this assumption is acceptable, since fertility and mortality have both generally decreased over time, and the year 2000 is the census year—census years usually provide the best estimates—nearest the midpoint of roughly 2002 between 1990 and 2015.

3 It is important to consider the rates separately by age and sex. Applying one simple overall rate for the population would ignore the importance of its "sex and age structure," or the relative number of people in each group of the population. For example, a population that is mostly male, or under age 15 would have fewer births than a population that is mostly women aged 15-49, even if the fertility rate was unchanged.

4 It is important to subtract half the deaths before applying the birth rates. This is because the deaths may occur any time during the year, and will therefore affect the number of women who can give birth. For simplicity, it is traditionally assumed that half the deaths occurred in the first half of the year.

5 Historically, the average secondary sex ratio (the number of males divided by the number of females) for human populations is approximately 1.05. It follows that the average proportion born male might be approximated with 1.05/(1+1.05), or 51.2%.

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