Population and Economic Projections for the State of Hawaii to 2050

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Research and Economic Analysis Division
Department of Business, Economic Development and Tourism
STATE of HAWAII

This report was produced by the Research and Economic Analysis Division of the Hawaii Department of Business, Economic Development & Tourism, under the direction of Eugene Tian, Division Administrator. The projections were developed by a team of researchers; Yang-Seon Kim, Research and Statistics Officer, Carlie Liddell, Research Statistician, Rene Kamita, Economist, and Naomi Akamine, Economist. DBEDT would like to thank many agencies and individuals who provided comments and suggestions on the projections.

Table of Contents

List of Tables

List of Figures

This report presents the results and methodology of the 2050 Series of the DBEDT Population and Economic Projections for the State of Hawaii and its four counties. This is the tenth in a series of long-range projections dating back to the first report published in 1978. The 2050 Series uses the detailed population characteristics from the 2020 Decennial Census, vintage 2022 population estimates by the U.S. Census Bureau, 2022 estimates of economic variables, and input-output (I-O) tables based on the 2017 Economic Census as baseline data for the projections.

It should be noted that these projections are neither targets nor goals. They are DBEDT's best estimates of likely trends in important population and economic variables based on currently available information. The accuracy of these projections depends on the degree to which historical trends provide guides to the future, changing external conditions, infrastructure capacity, and other supply constraints which have not been incorporated into the model.

Section 1 of this report summarizes the population and economic projections for the state and counties. Section 2 describes the methodology and assumptions that were used to produce the projections. The appendix tables contain detailed projections.

SUMMARY OF PROJECTIONS

1. Population projections

The resident population of Hawaii, which includes active-duty military personnel and their dependents as well as the other civilian population, is projected to increase from 1.45 million in 2020 to 1.56 million in 2050, an average growth rate of 0.24 percent per year over the projection period.

The size and age structure of an area's population are determined by three components: births, deaths, and migration. DBEDT's long-rage projections are revised every 5 years using updated data and revised assumptions about these three components. The population growth presented in the current series is about 0.2 percentage point lower than the growth previously projected for the State of Hawaii. This is mainly due to revised assumptions about fertility rates and migration. In this version of projections, assumptions on fertility rates are revised downward to incorporate the substantial decrease in fertility rates that Hawaii has experienced since the last projections. Reflecting the considerable size of net domestic out-migration observed in recent years, total net migration, which includes both domestic and international migration, is assumed to be at about 2,500 per year in the first decade, but 4,000 and 4,500 per year in the next two decades. This projection assumes that over time the domestic out-migration observed in recent years will ease while international migration will increase back to the pre-pandemic long-term averages. The result is about 3,700 net migration per year on average during the projection period, which is about 1,100 lower than previously projected. The methodology and detailed discussion on the assumptions made about fertility, mortality, and migration are included in the methodology section at the end of this report.

Table 1 presents the projection of total resident population by county. There has been much faster population growth in the neighbor island counties in the past decades, and the combined share of the three neighbor islands' populations increased from 21.1 percent of the total population in 1980 to 30.2 percent in 2020. With more room to grow, these counties are projected to continue to have higher population growth than Honolulu County. This is consistent with the previous projections. The resident population of Honolulu County is projected to grow at an annual rate of 0.2 percent during the 2020 to 2050 period, Hawaii County and Kauai County are projected to grow at 0.5 percent, and Maui County is projected to have 0.4 percent average annual growth, increasing the combined population share of the three neighbor island counties to 32.3 percent by 2050.

Table 1. Resident population by county: history and projections

Year	State Total	Hawaii County	Honolulu County	Kauai County	Maui County
1980[1]	968,500	92,900	764,600	39,400	71,600
1990[1]	1,113,491	121,572	838,534	51,676	101,709
2000[1]	1,213,519	149,244	876,629	58,568	129,078
2010[1]	1,365,065	185,285	957,511	67,234	155,035
2020[1]	1,451,043	200,712	1,012,305	73,186	164,840
2030[2]	1,501,150	215,570	1,033,600	78,360	173,520
2040[2]	1,542,570	224,460	1,054,670	82,440	181,000
2050[2]	1,560,890	230,730	1,060,110	85,180	184,870
Average annual growth rate (%)					
1980-1990	1.40	2.73	0.93	2.75	3.57
1990-2000	0.86	2.07	0.45	1.26	2.41
2000-2010	1.18	2.19	0.89	1.39	1.85
2010-2020	0.61	0.80	0.56	0.85	0.62
2020-2030	0.34	0.72	0.21	0.69	0.52
2030-2040	0.27	0.40	0.20	0.51	0.42
2040-2050	0.12	0.28	0.05	0.33	0.21

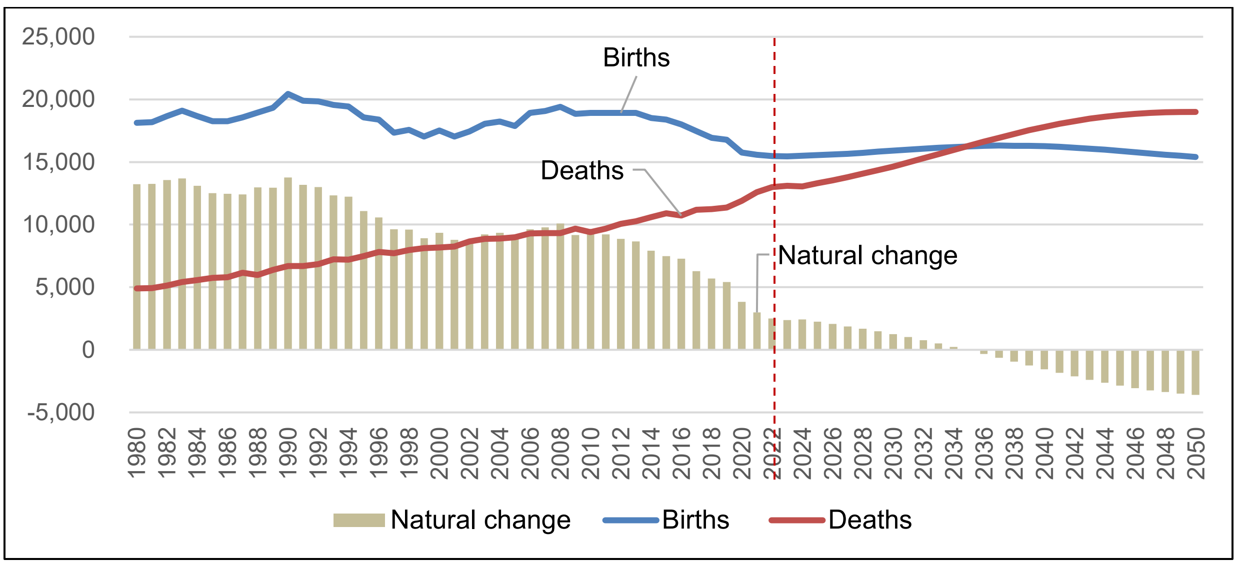
[1] Estimates by the U.S. Census Bureau for July 1st population (vintage 2022 population estimates)
[2] Projections by DBEDT for July 1st population

Migration as the main driver of future growth

Since the previous long-range projection in 2018, we have observed an accelerated decrease in fertility rates. For many decades, Hawaii had relatively stable fertility rates, with total fertility rates in the range of 2.1-2.3, slightly higher than U.S. averages.[1] However, a declining trend started in 2008. It was not clear at the time of previous projections if the declining trend would continue or rebound to previous highs. With more data, we have observed the total fertility rate declined from 2.34 in 2008 to 1.77 in 2020, with an especially sharp decline in recent years. As a result, the natural increase, the number of excess births over deaths, in Hawaii decreased from about 10,000 in 2010 to under 4,000 in 2020.

Hawaii was not alone here. A similar trend has been observed nationwide, with a decrease in the nationwide total fertility rate from 2.12 in 2007 to 1.64 in 2020. The key question to be answered is whether the decline is a permanent trend or a temporary phenomenon due to delays in marriages and births. If it is the latter, the decline may be recovered at least partially in the future. This projection adopted the growth patterns presented in the projected future age-specific fertility rates developed by the U.S. Census Bureau for the latest national population projection. This methodology resulted in a very modest decline of total fertility rate in Hawaii from 1.77 in 2020 to 1.74 in 2050, and a relatively stable level of total births throughout the projection period, as shown in Figure 1.

Figure 1. Birth, deaths, and natural changes: history and projections



Alongside tepid birth rates, deaths are projected to rise with the aging population throughout the projection period, although the rise in deaths will flatten near the end of the projection period. With the rising number of deaths, natural change is projected to change directions, from an

[1] Total fertility rate measures the hypothetical number of children who would be born to a woman in her lifetime when the current age-specific fertility rates are applied.

increase to a decrease, in the mid-2030s, even earlier in late-2020s if we exclude births from military families who do not stay in Hawaii long enough to grow and age. This diminishing natural growth explains why population is projected to grow more in the first decade than in the second despite a lower level of net migration assumed for the first decade. With diminishing natural growth, migration is expected to become the main driver of future population growth in Hawaii, especially for the second half of the projection period when natural decreases are projected.

Table 2. Births, deaths, and natural changes: history and projections

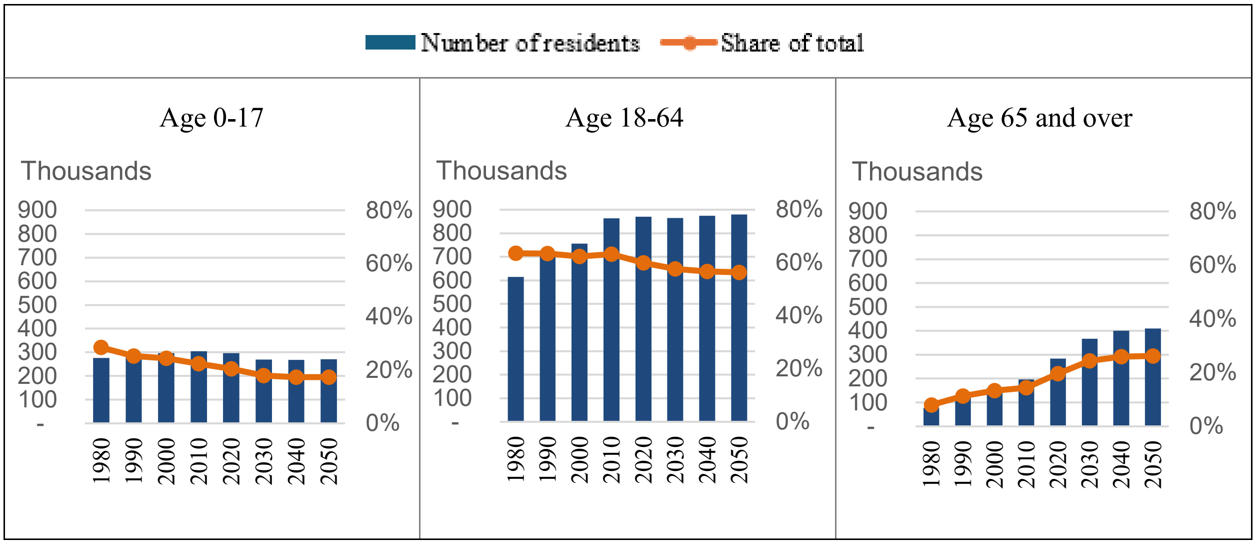
Period	Average number per year during the period		
	Births	Deaths	Natural change (birth-death)
1980-1990	18,720	5,690	13,040
1990-2000	18,660	7,450	11,210
2000-2010	18,320	9,000	9,320
2010-2020	18,020	10,670	7,350
2020-2030	15,600	13,370	2,230
2030-2040	16,170	16,110	60
2040-2050	15,910	18,570	-2,660

Aging population

Population aging is one of the most prominent features of Hawaii's population trend. The state's 65 and older population has been growing rapidly but especially since 2010 when the first baby boomers reached the age of 65 years old. While the total population increased by 6.3 percent from 2010 to 2020, the 65 and older population grew by 44.4 percent, making up 19.6 percent of total population in 2020. Population aging is a common trend observed in the U.S. and many other countries in the world alike, but Hawaii has a much older population than the U.S. average. While the U.S. population was projected to have one-in-five people aged 65 and over by 2030, Hawaii had nearly this ratio already in 2020. The elder population will continue to increase fast for a while, increasing its size by 29.2 percent between 2020 and 2030, but the growth of this population will start to slow down significantly from around 2030 when all baby boomers will reach the age group. The share of older population is projected to increase to 24.4 percent in 2030, 25.9 percent in 2040, and then slowly to 26.2 percent by 2050.

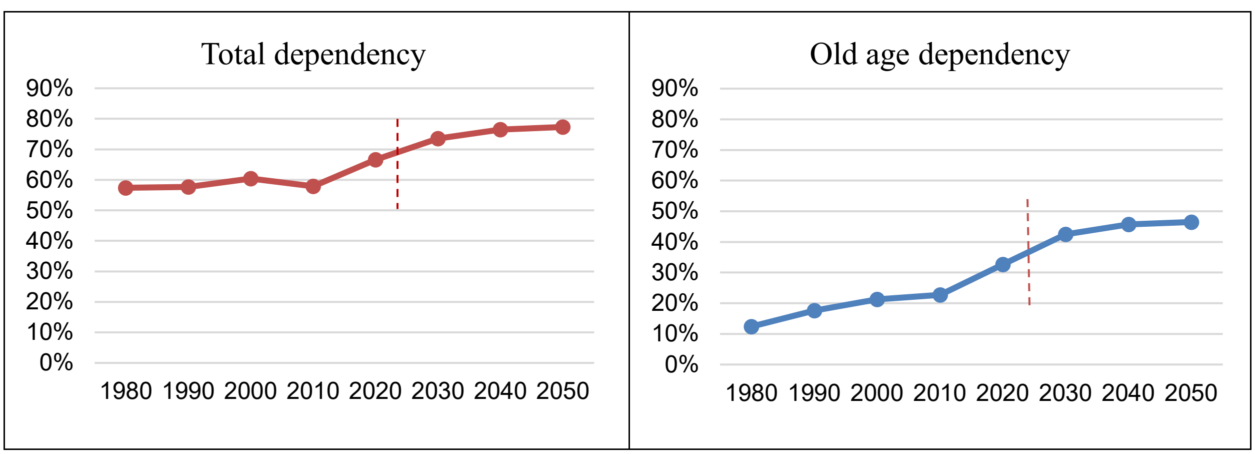
Reflecting the rapid drops in total births in Hawaii from mid-2010s and low numbers of total births projected for the future, population in age 0 to 17 will shrink by 27,000 people between 2020 and 2030. The population in the active working age, 18-64, will not shrink, but its share of total population will decrease from 60.0 percent in 2020 to 56.4 percent in 2050. The size of this group will be flat in the first two decades and will see a small increase in the last decade of the projection period.

Figure 2. Resident population by major age groups: history and projections



The total dependency ratio provides a rough indicator of the burden on the working population in the economy. It can be calculated by comparing the size of the dependent population (children aged between 0 and 17 and the elder population aged 65 and over) to the size of the active working-age population (people aged 18-64). Another useful measure of dependency is the old age dependency ratio, which is calculated by dividing the elderly population (65 and over) by the working age population (aged 18-64). Figure 3 presents the projected values of these two widely used dependency ratios. Compared to the U.S. average, Hawaii's total dependency ratio in 2020 was 3.0 percentage points higher and the old-age dependency ratio was 5.1 percentage points higher. As presented in Figure 3, both dependency ratios are projected to increase rapidly in Hawaii until the early 2030s before they slow down and level off.

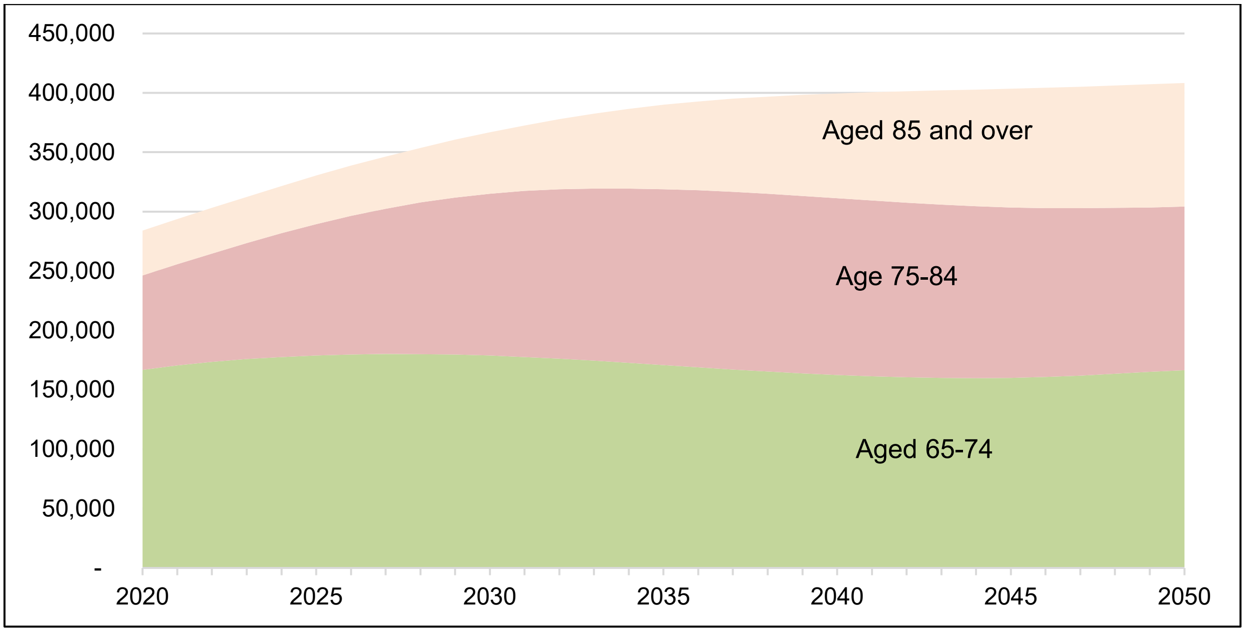
Figure 3. Dependency ratios: history and projections



Aging within the elder population

Aging within the older population is another phenomenon that will be observed in future years. In 2020, 58.7 percent of this population were ages 65-74, 28.0 percent were ages 75-84, and 13.3 percent were aged 85 and over. The first decade of the projection period will see a rapid increase in the 75-84 group, and a rapid expansion of the population aged 85 and over will characterize the following two decades. In 2050, it is projected that about a quarter of the elder population in Hawaii will be aged 85 and over. The share of the population aged 65-74 is projected to be at 40.8 percent, much lower than its shares in 2020. The 75-84 age group is projected to be 33.7 percent of the elder population in 2050.

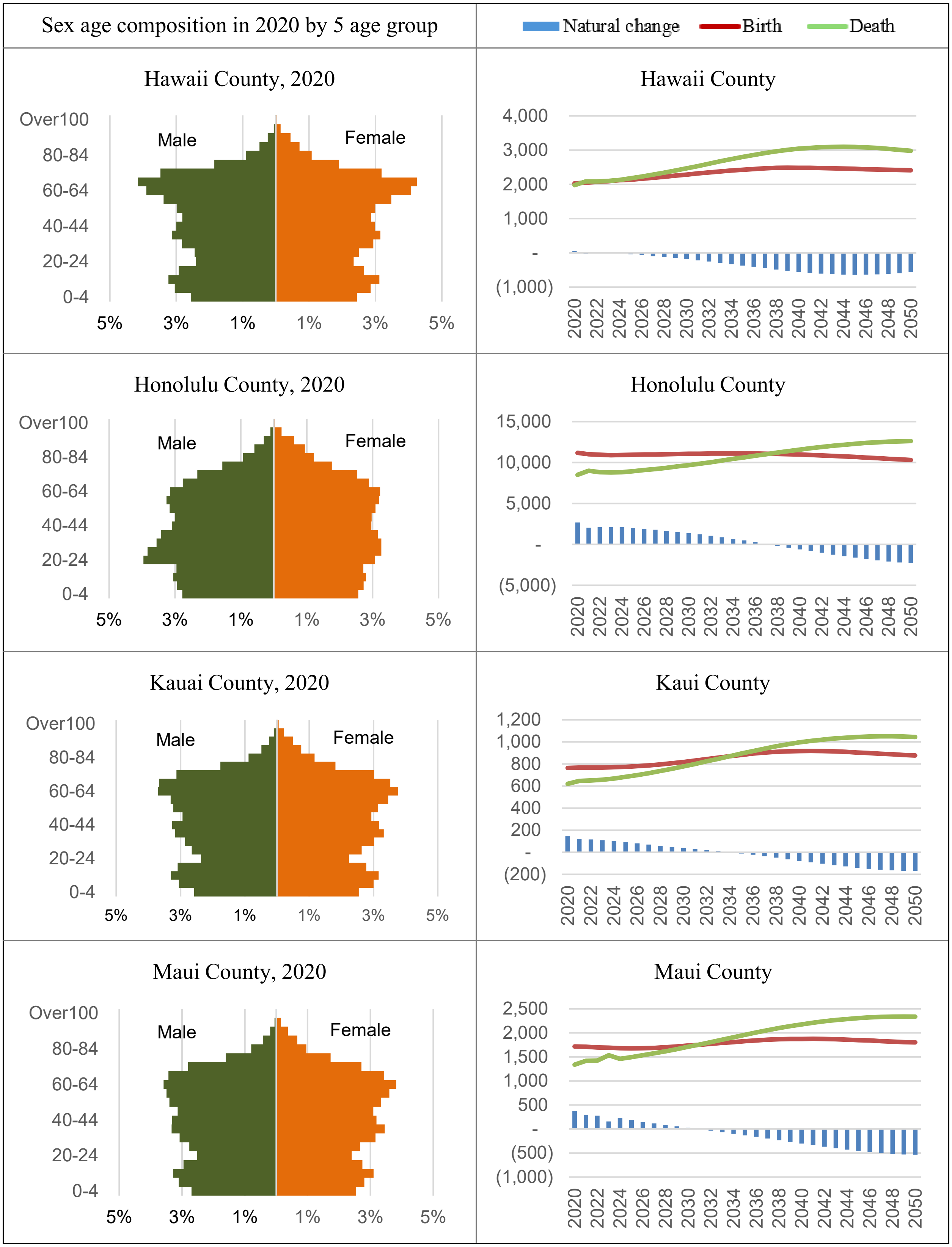
Figure 4. Projected age composition of the elder population in Hawaii



County-specific growth paths

Some of the statewide trends or characteristics presented in this report are shared by all counties in Hawaii, but since each county has a different age structures and characteristics, the growth path projected for each county is not the same. As shown in Figure 5, Hawaii County had a much older age structure in 2020 with almost no natural increase. Thus, Hawaii County is projected to go through more substantial aging and population loss due to natural decrease in the early part of the projection period. This means that the county will need to rely on migration for its population growth. Compared to other counties, Honolulu County had a much younger age structure in 2020. The large military population in the county was a big contributor to the younger age structure, but the county had a much wider prime working age group than the other counties even after military personnels and their dependents were excluded.

Figure 5. Population pyramids in 2020 and projected natural changes by county



Significant differences were also observed among the four counties in Hawaii in historical fertility and mortality patterns. When combined with the different base year age structures, those differences resulted in varying growth paths by county. For example, there are differences found among counties in the projected turning points of natural change (Figure 5) and the projected future population shares of the elder population (Table 3). More county-specific characteristics can be found in the methodology section at the end of this report, and detailed population projections by county are provided in Appendix Tables A-2 through A-21.

Table 3. Projected shares of the elder population by county for 2020-2050 (% of total population)

Area	2020	2030	2040	2050
Statewide	19.6	24.4	25.9	26.2
Hawaii County	22.9	27.2	26.1	24.8
Honolulu County	18.8	23.6	25.7	26.4
Kauai County	21.3	26.2	26.6	26.4
Maui County	19.4	25.1	26.6	27.0

<u>De facto population</u>

Due to the important role of tourism in the State of Hawaii, the de facto population, which estimates those who are physically present in a given area at a given time, often serves as a more useful measure for planning purposes. De facto population can be calculated from the resident population by adding visitors who stayed in the area and subtracting residents who were temporarily away from home on a typical day of the year. In 2019, the de facto population was estimated to be 12.1 percent higher than the resident population statewide, but it was only 2.2 percent higher in 2020 due to pandemic-related travel restrictions. The difference between the de facto population and the resident population varied significantly by county. In 2019, a pre-pandemic normal year, the de facto population was about 35 percent higher than the resident population in Maui and Kauai Counties while it was 6.4 percent and 13.4 percent higher in Honolulu and Hawaii Counties. The de facto population is projected to grow faster than the resident population in all counties mainly because tourism is projected to grow faster than the population. By 2050, de facto population is projected to be 13.7 percent higher than resident population statewide.

Table 4. De facto population by county: history and projections

Year	State Total	Hawaii County	Honolulu County	Kauai County	Maui County
1980	1,054,220	99,180	822,410	46,340	86,290
1990	1,257,320	137,100	913,270	68,560	138,390
2000	1,336,010	166,430	926,190	74,730	168,650
2010	1,468,740	202,410	988,400	83,190	194,740
2020 [1]	1,482,790	207,870	1,015,490	78,950	180,480
2030	1,679,640	247,210	1,097,160	105,850	229,420
2040	1,738,450	259,990	1,121,250	113,240	243,970
2050	1,774,820	269,890	1,130,740	119,460	254,730
Average annual growth rate (%)					
1980-1990	1.8	3.3	1.1	4.0	4.8
1990-2000	0.6	2.0	0.1	0.9	2.0
2000-2010	1.0	2.0	0.7	1.1	1.4
2010-2020 [1]	0.1	0.3	0.3	-0.5	-0.8
2020-2030 [1]	1.3	1.7	0.8	3.0	2.4
2030-2040	0.3	0.5	0.2	0.7	0.6
2040-2050	0.2	0.4	0.1	0.5	0.4

[1] Visitor arrivals to Hawaii were limited in 2020 due to pandemic-related travel restrictions.

2. Economic projections

The growth of Hawaii's economy is expected to slow gradually over the projection period mostly due to the slowdown or levelling off of population growth in Hawaii. The long-term growth of an economy is determined by the productive capacity on the supply side although short-term economic growth is dominantly determined by demand components. Since the slowdown on the demographic side will constrain the growth of the available worker pool, the growth of jobs is projected to grow modestly. However, the productive capacity of an economy is determined not only by the size of the worker pool but also by productivity and available capital in the economy. Factoring in ongoing and expected future growth in productivity, personal income and GDP are projected to surpass the population and job growth.

The current projection series used 2022 as the base year for the projection. This is the latest year for which most main economic data are available. In 2022, Hawaii's economy was still falling behind what was achieved in pre-pandemic normal years. The coronavirus pandemic caused worldwide contractions of the economy and losses of jobs. The impact was especially painful in Hawaii where the economy has heavily relied on tourism. In 2020, the real GDP of Hawaii decreased by 10.5 percent from the previous year while the real GDP of the U.S. decreased by only 2.2 percent. Mainly due to the pandemic stimulus moneys from the federal government to ease the adverse impacts of the pandemic, Hawaii's economy has shown a smooth recovery from the pandemic since 2021. However, as of 2022, the real GDP in Hawaii was still 4.2 percent lower than what it achieved in 2019, and there were 1.1 million (10.8 percent) fewer visitors than 2019.

This projection assumed that Hawaii's economy will fully recover to its pre-pandemic levels in a few years and will return to pre-pandemic growth paths. It is also assumed that there were no significant shifts in the main demand components of Hawaii's economy between pre- and post-pandemic periods even though the pandemic caused businesses and individuals to make changes to the way they did economic activities. With high unmet housing demands statewide and construction demands for recovery from the Maui fires, investment demand is projected to remain high for several years before its growth gradually slows down. Tourism demand is also projected to be high until it recovers to the pre-pandemic level and then slows down, with visitors arriving 0.9-1.0 percent more per year during the projection period. See the methodology section of this report and Appendix table A-59 and A-60 for more details on tourism projections.

Personal income

Real personal income is projected to grow at 1.4 percent per year on average during the 2022-2030 period but grow at slower rates of 1.3 percent and 1.1 percent per year in the following two decades.

Growth of personal income is projected to slow down over the projection period mainly because labor income, which makes up about 70 percent of personal income, is projected to grow at diminishing rates due to job growth slowing down over the projection period. However, the adverse effects of limited job growth on the economy are expected to be mitigated by the increases in real wages. Average per-job-wage and salary income has increased over time during the past decades in real terms. It is assumed that the productivity growth will allow real wages to continue to increase in the future.

Transfer income has been growing much faster than other components of personal income. With the rapid expansion of the elder population in the past three decades, its share of personal income increased from 8.4 percent in 1990 to 16.2 percent in 2019. Transfer income in 2020 and 2021 was more than 50 percent higher than its 2019 level due to the multiple rounds of the COVID-19 stimulus payments. This additional portion will be removed when the remaining temporary assistance programs end. However, the original portion of transfer income is projected to continue a fast growth while the 65 and over population will be growing fast, until about 2030. After that, it is projected to grow similarly with other components of personal income.

Historical series and projections of personal income, total and by component, are reported in Appendix Tables A-48 through A-53.

Table 5. Projection of real personal income

Real personal income (State total, millions of 2017 dollars)			
2022	2030	2040	2050
69,270	77,170	87,550	97,220

Average annual growth rates		
2022-2030	2030-2040	2040-2050
1.4%	1.3%	1.1%

Table 6. Components of personal income as percentage of total income (%)

Component	1990	2000	2010	2019	2022	2030	2040	2050
Labor income [1]	70.5	67.0	64.0	64.1	61.1	59.8	58.2	57.5
Dividend, interest & rent	21.1	21.4	19.6	19.6	20.0	20.3	20.5	21.0
Transfer income	8.4	11.7	16.4	16.2	19.0	20.0	21.3	21.5

[1] Earnings (wage and salary, supplements to wages and salaries, and proprietor's income) minus contributions for government social insurance

GDP

Real GDP is projected to grow at 1.4 percent per year on average during the 2022-2050 projection period. Like personal income, the growth of real GDP is projected to slow down from

1.5 percent during the 2022-2030 period to 1.3 percent in the last decade of the projection period. But the expected deceleration is not as much as expected for personal income for a few reasons. Personal consumption, the largest component of an area's GDP, may increase faster than personal income in the future. Since personal income in the data from the U.S. Bureau of Economic Analysis includes the income that people earned during the year, it will be constrained by jobs and labor income earned in that year. Conversely, with the expansion of the elder population and the increasing popularity of private pension programs over time, future consumption is likely to be funded more by personal savings. The other factor is productivity growth. Ongoing and future technological growth paired with the slowing population growth implies that productivity-driven growth will play a more important role in future economic growth. This growth will allow real wages to rise, leading to an increase in labor income. However, the full amount of growth will not be reflected in personal income while GDP is likely to capture it fully.

Table 7. Projection of real GDP

Real GDP (State total, millions of 2017 dollars)			
2022	2030	2040	2050
85,211	96,060	110,730	126,150

Average annual growth rates		
2022-2030	2030-2040	2040-2050
1.5%	1.4%	1.3%

Jobs

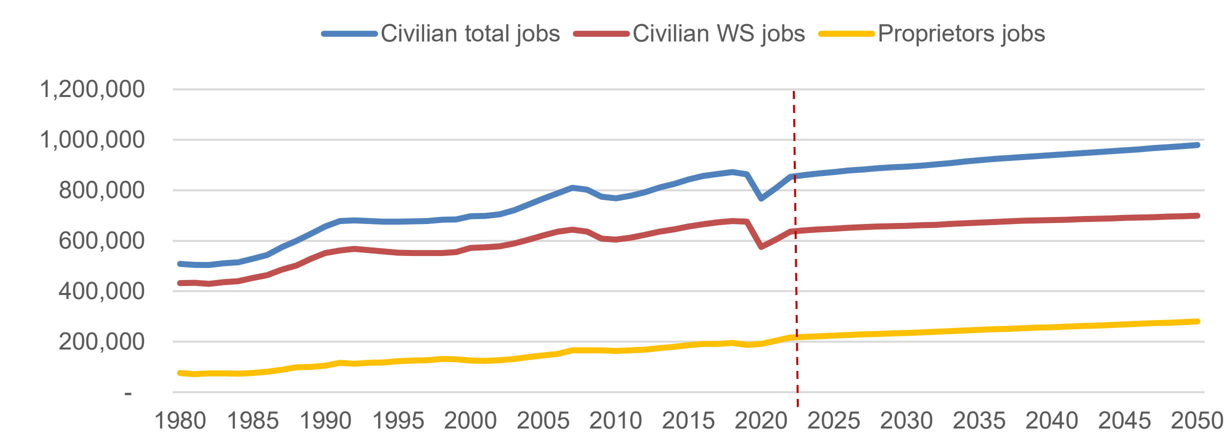
The jobs data used as the base for this projection are total jobs and wage and salary jobs for 2022 by county from the U.S. Bureau of Economic Analysis (BEA).[2] The number of total jobs is different from the number of people employed because a person can hold multiple jobs and proprietors' jobs, that comprises total jobs together with wage and salary jobs, in BEA's data are estimated based on IRS tax data.[3] Since jobs are occupied by people, however, slow or no population growth constrains job growth if the economy is already at full employment. One way of accommodating job growth higher than population growth would be by increasing labor force participation rates. This is very challenging or unfeasible, however, with an aging population. With the population growing slower than previously projected, the current series also projects lower overall job growth than previously projected.

[2] Wage and salary jobs from the U.S. Bureau of Economic Analysis (BEA) are slightly different from alternative data from the U.S. Bureau of Labor Statistics (BLS) in its coverage and methodology.
[3] BEA gives equal weight to full-time and part-time jobs in its estimates of employment.

Total civilian wage and salary jobs in Hawaii are expected to increase by 62,900, from 636,240 in 2022 to 699,140 in 2050. This represents an average annual growth of 0.3 percent throughout the projection period. Total civilian jobs including proprietors' jobs are projected to grow faster than wage and salary jobs, at an average annual growth of 0.5 percent over the period, increasing its size from 853,100 in 2022 to 979,350 in 2050.

The higher growth rate of total jobs is due to a higher growth projected for proprietors' jobs than wage and salary jobs. From 1980 to 2019, proprietors' jobs saw 2.3 percent annual growth on average, while the average annual growth of civilian wage and salary jobs for the period was 1.2 percent. As a result, the statewide share of proprietors' jobs increased from 14.9 percent in 1980 to 18.0 percent in 2000, and then to 25.4 percent in 2022. The growth of proprietors' jobs has been especially high since the pandemic. This trend is expected to continue in the future, but at a more moderate rate than observed in the past.

Figure 6. Civilian job growth by type: history and projections



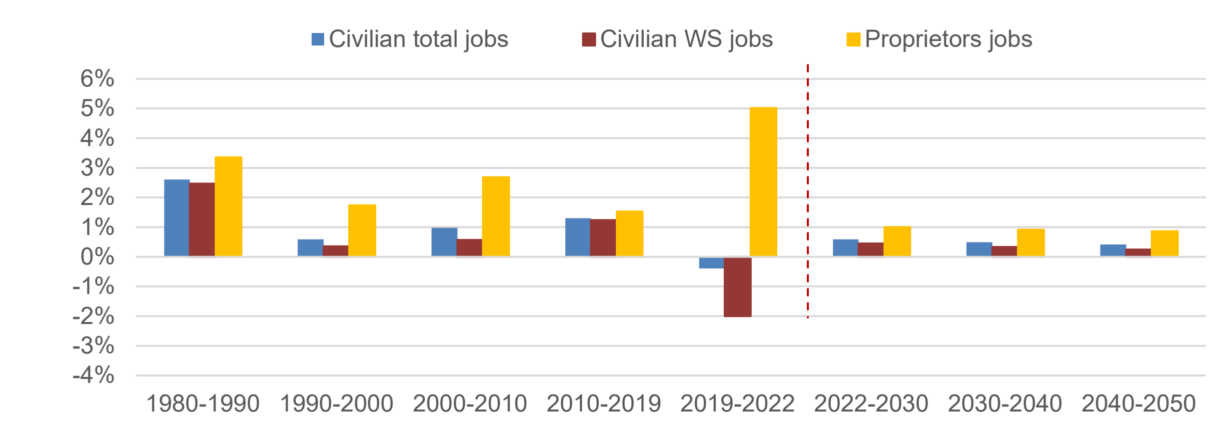


Table 8. Projection of civilian jobs, 2022-2050

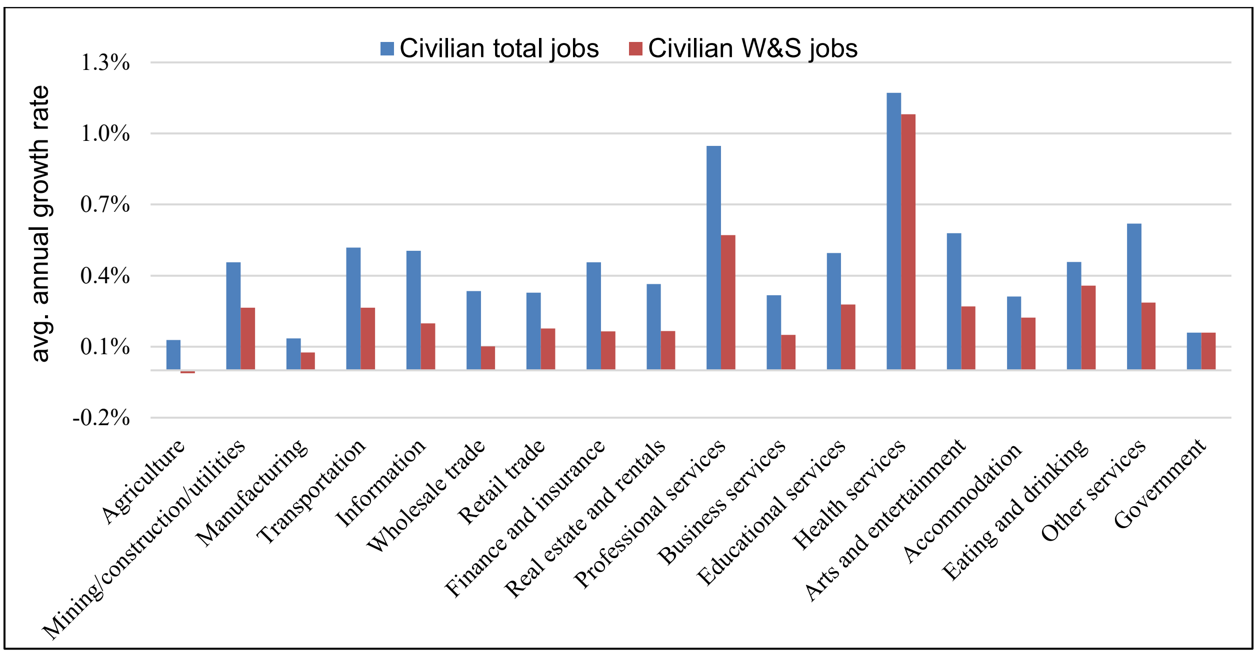
	2022 [1]	2030	2040	2050
State Total				
Civilian total jobs	853,100	894,370	939,270	979,350
Civilian W&S jobs	636,238	659,510	682,010	699,140
Proprietor jobs	216,862	234,860	257,260	280,210
Hawaii County				
Civilian total jobs	109,988	117,910	126,130	133,520
Civilian W&S jobs	73,712	78,020	82,010	85,160
Proprietor jobs	36,276	39,890	44,120	48,360
Honolulu County				
Civilian total jobs	588,028	612,690	638,000	661,150
Civilian W&S jobs	453,665	467,970	480,720	490,590
Proprietor jobs	134,363	144,730	157,280	170,560
Kauai County				
Civilian total jobs	45,976	48,950	51,950	54,700
Civilian W&S jobs	32,164	33,820	35,240	36,390
Proprietor jobs	13,812	15,130	16,700	18,310
Maui County				
Civilian total jobs	109,108	114,820	123,200	129,980
Civilian W&S jobs	76,697	79,700	84,040	87,000
Proprietor jobs	32,411	35,110	39,160	42,980
	Average annual growth rate			
	2022-2050	2022-2030	2030-2040	2040-2050
State Total				
Civilian total jobs	0.5%	0.6%	0.5%	0.4%
Civilian W&S jobs	0.3%	0.5%	0.3%	0.2%
Proprietor jobs	0.9%	1.0%	0.9%	0.9%
Hawaii County				
Civilian total jobs	0.7%	0.9%	0.7%	0.6%
Civilian W&S	0.5%	0.7%	0.5%	0.4%
Proprietor jobs	1.0%	1.2%	1.0%	0.9%
Honolulu County				
Civilian total jobs	0.4%	0.5%	0.4%	0.4%
Civilian W&S jobs	0.3%	0.4%	0.3%	0.2%
Proprietor jobs	0.9%	0.9%	0.8%	0.8%
Kauai County				
Civilian total jobs	0.6%	0.8%	0.6%	0.5%
Civilian W&S jobs	0.4%	0.6%	0.4%	0.3%
Proprietor jobs	1.0%	1.1%	1.0%	0.9%
Maui County				
Civilian total jobs	0.6%	0.6%	0.7%	0.5%
Civilian W&S jobs	0.5%	0.5%	0.5%	0.3%
Proprietor jobs	1.0%	1.0%	1.1%	0.9%

[1] Actual figure, source: U.S. Bureau of Economic Analysis (BEA)

Figure 7 presents the average annual job growth projected for each sector during the 2022-2050 period given final demand components projected for the period and taking into consideration ongoing and future developments in the demand- or supply-side of the sectors which are not reflected in our projection model. Facing the rapidly increasing demand expected for the future as well as the current shortage of various healthcare occupations, the health care sector will have the largest job growth during the projection period. The professional service sector is also expected to grow much faster than other sectors. As technology-based innovation is expected to be an important driver of future economic growth, this sector is likely to have stronger opportunities for growth. Growth in the agriculture and manufacturing sectors, though, is projected to be negative or very low.

Sectors may follow different growth paths even though similar average growths are projected for the sectors. A sector may grow faster in the near future to recover to their pre-pandemic levels while others may grow more evenly over the projection period. Some sectors may experience more ups and downs along future business cycles while others may show more resilience to short-term business cycles. Detailed projections of civilian total and civilian wage and salary jobs are provided for each county in Appendix Tables A-38 through A-47.

Figure 7. Projected civilian job growth by sector during the 2022-2050 period



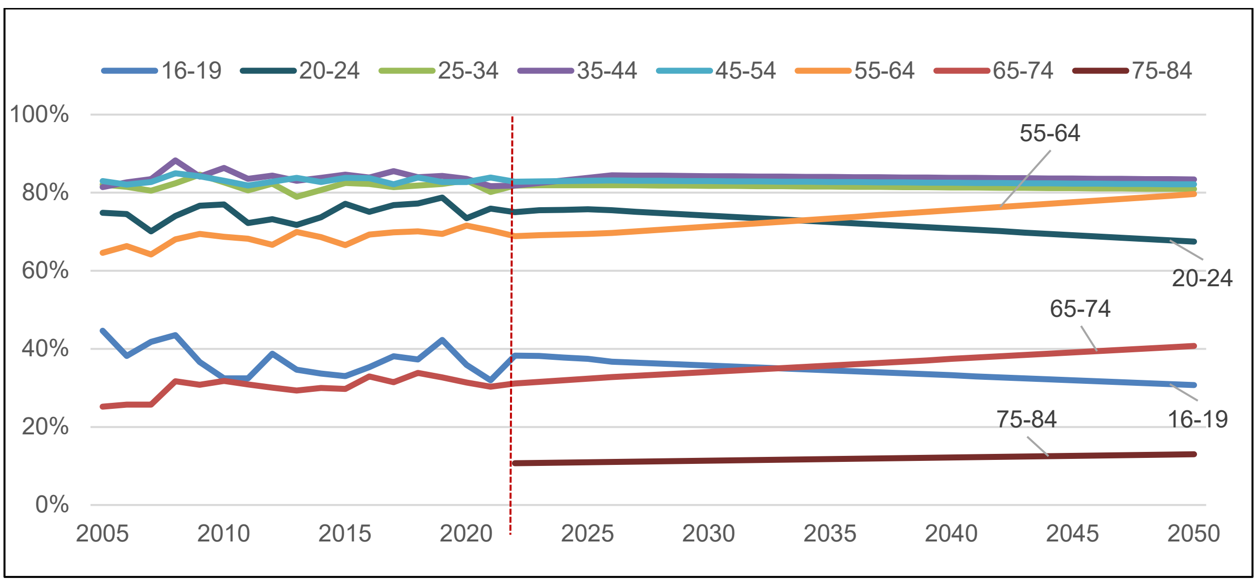
Labor force

The labor force is determined by the size of the working-age population and the labor force participation rate. Labor force participation rates are affected by labor market conditions in the short term, while the long-term trend is determined by the composition of the working-age population. Since the population aged 65 and over does not work as much as people in prime working ages do, the rapid expansion of the elder population has raised a big concern over the future labor supply.

The labor force participation rate in the U.S. peaked at 67.1 percent in the late 1990s and has gradually declined since 2000. The steady increase in the labor force participation rate until 2000 was mainly caused by the increasing share of women in the labor force, and the decline observed since 2000 was caused by the aging population becoming bigger. With an age structure older than that of the nation's, Hawaii's labor force participation rate peaked earlier, in 1992, at 68.7 percent and has declined since.

Given the fact that we are in the middle of a rapid change in age structure and that the future direction of labor force participation will vary by age group, we projected future participation rates for each age group to fully incorporate the impacts of the expected changes in participation rates on our future labor force. There is widespread consensus that the older population will work more in the future than they do now. For other age groups, the projections were done using the projections by the U.S. Bureau of Labor Statistics and the literature on the topics as references. In the projections, it was assumed that the negative shock on the labor force participation rates caused by the pandemic will be removed by 2026 for all groups, and from there the age groups will follow their own long-term trends, with some groups increasing their participation rates while others decrease or remain flat. Compared to the pre-pandemic 3-year averages, the participation rates of the 55-64 and the 65-74 age group are assumed to be 10 and 8 percentage points higher by 2050. Participation rates are assumed to decline for the 16-24 age group by 6-8 percentage points and the 25-54 age group by 1 percentage point by 2050.

Figure 8. Labor force participation rates by age group: history and projections[1]



[1] Historical rates were estimated using the Public Use Microdata Sample of the American Community Survey for each year. Because of its small sample size, historical rates for the 75-84 age group are not presented here.

The total labor force, calculated as the sum of the projected labor force for each age group, is presented in Table 9. Hawaii's future labor force will be constrained by population growth; however, as shown in Figure 2 on page 5, the prime working-age population is projected to remain relatively stable over the projection period, and the elder population is expected to work more over time. Thus, the labor force in Hawaii is projected to grow similar to or a little higher than population growth over the projection period.

Table 9. Projection of civilian labor force, 2022-2050

2022 [1]	2030	2040	2050
697,500	721,250	734,350	747,460
Average annual growth rate			
2022-2050	2022-2030	2030-2040	2040-2050
0.2%	0.4%	0.2%	0.2%

[1] 2022 figure was estimated by DBEDT based on population estimates by age group and labor force participation rates estimated using the Public Use Microsample data of the 2022 American Community Survey.

PROJECTION METHODOLOGY

The DBEDT 2050 projection series was produced using the Hawaii Economic Projection and Simulation Model, which was developed by the Department in 1978 and refined over the years. It is an inter-industry econometric model that generates economic forecasts for the state and its four counties on an annual basis.

The population projection is done separately using the cohort component method. However, the demographic module interacts closely with the economic module, as the population size and characteristics are key factors in determining many economic variables.

The 2050 Series used the detailed population data from the 2020 Decennial Census and the vintage 2022 population estimates by the U.S. Census Bureau, 2022 job and income data from the U.S. Bureau of Economic Analysis, and the 2017 Hawaii inter-county input-output (I-O) tables as baseline data for the projection.

The following sections describe the demographic and economic modules of the model.

Demographic Module

Projections of Hawaii's population in this DBEDT 2050 long-range series were projected using the cohort-component method with 2020 as the base year. Population in year t is estimated as the population from the previous year plus births minus deaths plus net migration.

$POPULATION_{t,k} = POPULATION_{t-1,k-1} + BIRTHS_t - DEATHS_{t,k} + NETMIG_{t,k}$

where $POPULATION_{t,k}$: number of residents at age k in year t

$BIRTHS_t$: number of newborn babies in year t

$DEATHS_{t,k}$: number of people deceased at age k in year t

$NETMIG_{t,k}$: number of net migrants at age k in year t

The foundational datasets used for the population projections include the 2020 decennial census, vintage 2022 population estimates by the U.S. Census Bureau, and birth and death data collected by the Hawaii Department of Health.

Military population

The resident population is divided into three components: military personnel, military dependents, and other civilians. The number of military personnel and their dependents stationed in Hawaii is mainly the result of national defense considerations, and the state's economic situation has little impact. Therefore, the population of active-duty military personnel and their dependents is assumed to be exogenous and is projected using information available at the time of the projection. Without foreknowledge of any changes to the future size of the military population in Hawaii, the current projections assume that the total number of active-duty military personnel will increase gradually from 41,762 in 2020 to 43,086, the average number of Armed Forces in Hawaii during the 2010-2022 period, by 2025 and remain unchanged through the end of the projection period. The projected totals were then allocated to each age and sex category using the age and sex composition of military personnel and their dependents. This composition for military personnel was derived from annual population estimates by the U.S. Census Bureau. For military dependents, the age and sex composition was derived from the 2017-2021 Public Use Microdata Sample of the American Community Survey and military dependent data from the U.S. Department of Defense's Defense Manpower Data Center. Unlike the other civilian population, military personnel and their dependents do not stay in Hawaii long enough to be aged forward in the population projections. They are similar to temporary migrants or other special populations in this respect. In applying the cohort-component method, the military-affiliated population assumed for the previous year is removed and replaced with a new military-affiliated population assumed for the current year.

Projections of the population are based on a complex set of assumptions about fertility and mortality. These assumptions play a key role in determining the size of the natural population change and the age structure of the population in the future. The methodologies used to estimate current levels of fertility and mortality rates and the assumptions about their future levels are explained in detail below.

Fertility rates

Age-specific fertility rates are calculated by dividing the number of births by the female population in each age category. Age-specific fertility rates indicate the probability that a woman of childbearing age will give birth in a year. Multiplied by the number of women of childbearing age, fertility rates estimate the number of births that will take place in the year.

Historical trends

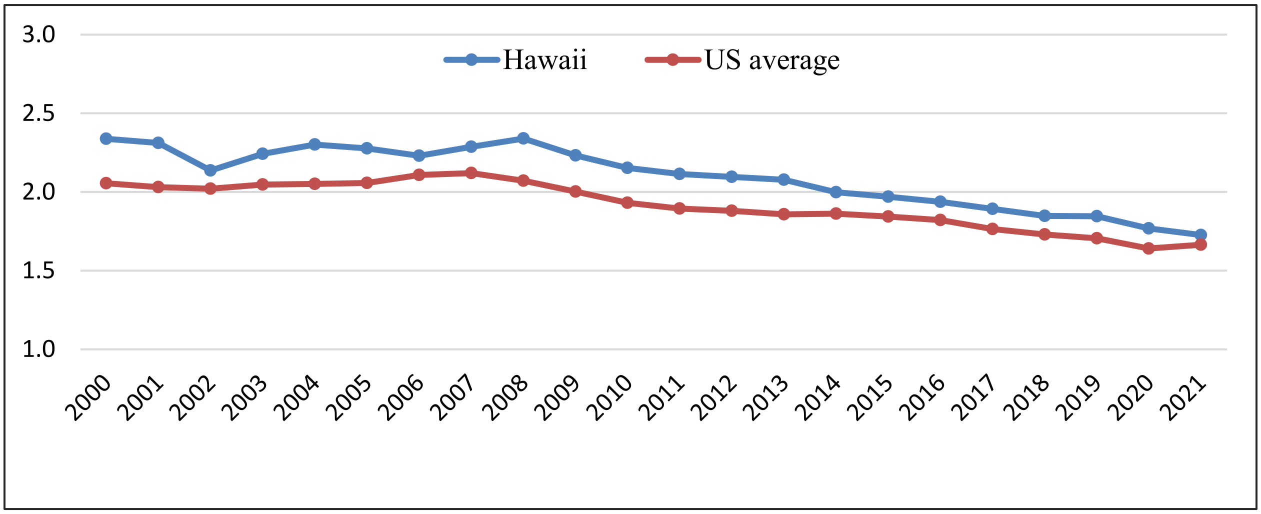
Fertility rates in most developed countries have declined sharply for many decades since the end of the baby boom years. Although fertility rates in the U.S. recovered some in the 1990s and 2000s, they have been falling since the Great Recession, with fertility rates at an all-time low in 2020. National-level fertility rates in 2021, however, slightly rebounded from this low. Researchers have identified this as the COVID-19 "baby bust and rebound," in which the lower conceptions of early 2020 were succeeded by an increase in births in from March 2021 to September 2021.[4]

Fertility rates in Hawaii have followed a similar trend but have been higher than the U.S. average and experienced more fluctuations. As shown in Figure 9, total fertility rate, which measures the hypothetical number of children who would be born to a woman in her lifetime when the current age-specific fertility rates are applied, fluctuated between 2.1 and 2.4 in 2000s. However, as

[4] Kearney, M. and Levine, P. "The US COVID-19 Baby Bust and Rebound." *Journal of Population Economics* 26, 2145-2168 (2023).

observed in the nationwide trend, fertility rate in Hawaii declined during the recession starting from 2008. The decline in fertility rates continued even after the economy recovered from the recession, implying that the economic hardship was not the only cause of the decline. Hawaii's total fertility rate was estimated at 1.727 for 2021.[5] This was higher than the U.S. fertility rate of 1.664, but where the U.S. saw a slight rebound from the 2020 low, Hawaii did not. It is possible that Hawaii's COVID-19 "baby recovery" was delayed due to differences in public health responses and economic circumstances and would not yet be observed in 2021.

Figure 9. Trend of total fertility rates in Hawaii and the U.S.



Source: National Vital Statistics Reports, Births: Final Data (annual), National Center for Health Statistics, Centers for Disease Control and Prevention

A key question in projecting future fertility rates is whether the decline in fertility rates represents a permanent decrease or is an artifact of delayed marriages and first births. Figure 10 below provides some insight on that question by comparing the number of births in Hawaii per 1,000 women in each 5-year childbearing age group over time. Decline in fertility rates have been broadly observed for women under the age of 35, and the decline is especially large for teenagers and women in their early 20s. This has been accompanied by an increase in birth rates for women in ages 35 to 39 and a modest increase in birth rates for women aged 40 to 44. Thus, recent trends in age-specific fertility suggest that the decrease in fertility rates for the younger age groups will be partially corrected by increased fertility rates in the older age groups. However, the decline in fertility rates is not fully explained by delays in marriages and births, and fertility rates are assumed to remain relatively flat over the projection period.

[5] National Vital Statistics Report, Births: Final Data for 2021 (January 2023), National Center for Health Statistics, Centers for Disease Control and Prevention.

Figure 10. Number of births per 1000 women by age group in Hawaii

Source: National Vital Statistics Reports, Births: Final Data (multiple years), National Center for Health Statistics, Centers for Disease Control and Prevention

Projections of future fertility rates

For the estimation of fertility rates in the base year, detailed data on historical births in Hawaii were obtained from the Hawaii State Department of Health. The data contain information on individual births compiled by the sex of the baby, the age of the mother, and the county of residence. To mitigate random fluctuation in estimates due to small sample sizes, data for the three years from 2019 to 2021 were averaged and adjusted to generate the total observed in 2020 and produce estimates of age-specific fertility rates for each county. These estimates were used as the base year for the fertility rate projections.

The next step was to adjust the calculated 2020 fertility rates for the likely change in the future fertility rates. Fertility rates change over time because of changes in age and race/ethnicity composition, maternity patterns, socio-economic factors, and changes in policies that affect the cost of having children. However, as previously discussed, Hawaii's fertility rates follow a similar trend to U.S rates, thus fertility rates in this projection were created by adopting the pattern of age-specific fertility rates in the U.S. Census Bureau's 2023 national-level projections and then applying those patterns to the 2020 base year estimates for each county to create Hawaii-specific projections.

The U.S. Census Bureau projected declines in fertility rates for foreign-born population groups while increases for native-born Asians and Pacific Islanders (non-Hispanic). National birth rates are projected to have no change for native-born non-Hispanic whites. The total fertility rate for the full U.S. population is projected to be 1.60 in 2050, a small decline from 1.64 in 2023.[6] Table 10 presents future total fertility rates calculated for Hawaii using the age-specific fertility rates projected for future years as described above. The statewide total fertility rates are projected to decline slightly over the period from 1.77 in 2020 to 1.74 in 2050.

Table 10. Hawaii's total fertility rate: history and projections

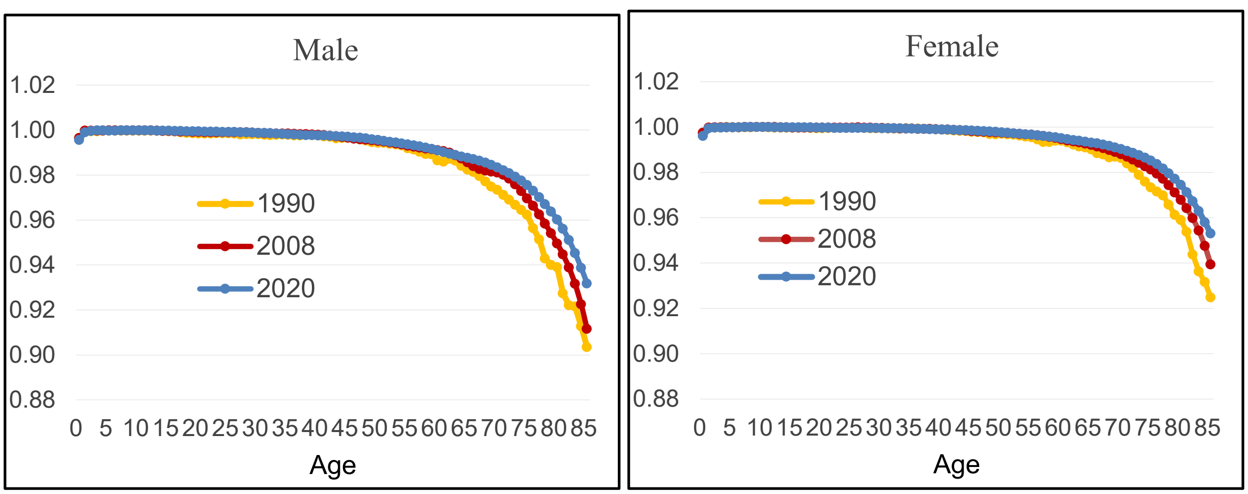
2000[1]	2010[1]	2020[1]	2030	2040	2050
2.34	2.14	1.77	1.76	1.75	1.74

[1] Source for 2000 -2020 figures, National Vital Statistics Reports, Births: Final Data (multiple years), National Center for Health Statistics, Centers for Disease Control and Prevention

Life tables and survival rates

Compared to fertility rates, the future direction of mortality rates is better understood. With better health services and increased affluence, mortality rates have generally decreased over time and will continue to decrease (Figure 11). However, the projection period includes the advanced aging of the baby boom generation, and with this, there will be a rise in deaths due to aging.

Figure 11. Survival rates in Hawaii by sex: 1990, 2008, 2020



In this projection, age- and sex-specific mortality rates were adjusted in a similar manner to fertility rates. Using historical microdata provided by the Department of Health, deaths for the three years from 2019 to 2021 were averaged and adjusted to generate the total observed in 2020 to produce estimates of sex-age mortality rates for each county. The data were also adjusted to account for coronavirus deaths. These estimates were used as the base year for the mortality rate projections. Then, we adopted the pattern of sex-age specific mortality rates from the Census

[6] U.S. Census Bureau, *2023 National Population Projections*, Table 6. Projected Age-Specific Fertility Rates for Women Aged 14 to 54 Years by Nativity, Race, and Hispanic Origin for the Unites States: 2023 to 2100 and Table 10. Projected Total Fertility Rates by Nativity, Race, and Hispanic Origin for the United States: 2023 to 2100.

Bureau's 2023 Population Projections and applied them to the 2020 base year estimates. Life expectancy was calculated as a result.

The latest national population projection by the U.S. Census Bureau projected that life expectancy at birth will increase gradually from 77.3 years for the male population and 82.2 years for the female population in 2023 to 81.3 years for the male population and 85.2 years for the female population in 2050.[7] Hawaii has historically had higher life expectancies than the United States average. As shown in Table 11, Hawaii's total life expectancy was about 5 years longer than the U.S. average in 2020. Hawaii's life expectancies are projected to remain higher than the U.S. average through 2050, but the gap between the U.S. and Hawaii life expectancies is projected to narrow because the life expectancy is already quite advanced in Hawaii.

Table 11. Life expectancy at birth for the U.S. and Hawaii, 2020

United States			Hawaii[1]		
Both Sexes	Male	Female	Both Sexes	Male	Female
77.0	74.2	79.9	82.0	79.3	84.8

[1] Life expectancies for Hawaii are DBEDT estimates.

Table 12. Life expectancy at birth for Hawaii and its counties, 2020 and 2050

Area	Life Expectancy in 2020[1]		Projected Life Expectancy in 2050[2]	
	Male	Female	Male	Female
State of Hawaii	79.3	84.8	83.0	87.6
Hawaii County	76.5	83.1	80.9	86.1
Honolulu County	79.9	85.2	83.5	88.0
Kauai County	79.7	84.4	83.5	87.3
Maui County	78.5	84.2	82.4	87.0

[1] DBEDT Estimates.
[2] DBEDT Projections.

Net migration

Migration plays an important role in population growth. Both the initial number of people who migrated to the area and their descendants contribute to population growth. Migration also impacts the age structure of the population. Compared to the total population, migrants have a younger age structure, with a high concentration of migrants in the 20 to 35 age range.[8] With a younger age structure, migrants help to augment the working-age population in the economy and slow down the aging of population.

[7] U.S. Census Bureau, *2023 National Population Projections*, Table 8. Projected Life Expectancy by Nativity, Race, and Hispanic Origin for the Unites States: 2023 to 2100.
[8] State of Hawaii Department of Business, Economic Development & Tourism, Migration Dashboard.

Net migration, the calculation used in the cohort-component method of this population projection, subtracts out-migration from in-migration. One way of estimating the size of migration is to subtract total natural change from total population change in the ten-year periods between two decennial censuses. Table 13 presents the average annual net migration to Hawaii from 2000 to 2020 estimated using this residual method. On average, about 3,900 migrants were added every year in Hawaii during the twenty-year period.

Table 13. Estimation of average net migration per year, 2000-2020

Period	Population change per year	Natural increase per year	Estimated migration per year
2000-2010	14,880	9,200	5,680
2010-2020	9,500	7,340	2,160

Net migration can be divided into two groups—domestic and international migrants—with different migratory behaviors. Net international migration in Hawaii has been relatively stable in the past decades, with recent dips during the coronavirus pandemic. Prior to the pandemic, net international migration averaged about 6,000 per year. In this set of projections, we assume that net international migration will return to the long-term average by 2025 and will remain at that level throughout the projection period.

Net domestic migration has shown significant fluctuation over the past decades, with sizable domestic out-migration observed in recent years. This projection assumes an easing to the domestic out-migration in the first decade of the projections but project a continuation of negative net domestic migration, about -1,500 to -2,000 per year, for the remainder of the projection period.

Net domestic and international migration are allocated to each county using historical patterns and recent trends as a guide. In line with recent trends, these projections assume that the neighbor island counties will absorb a larger share of migrants than they have in previous decades, as they have more room for population growth and relatively lower costs of living. This is particularly notable for Hawaii County, which is projected to have negative natural change early in the projection series. The sex-age distribution of migrants was estimated using the 2015-2019 PUMS data from the American Community Survey, which was used to represent a normal survey period not impacted by the COVID-19 pandemic.

Economic Module

The economic portion of the model contains four blocks: final demand, income, output, and employment. The final demand components are either projected by a set of econometric equations or exogenously given. The projected final demands are allocated to each county and sector using the relevant final demand vectors in the 2017 inter-county Input-Output (I-O) table. Sectoral outputs are then derived by multiplying the projected final demands by the total requirements matrix of the 2017 I-O table. Jobs are derived by dividing each sector's projected output by job-to-output ratios, adjusting for the projected productivity changes for the year. Once jobs are projected, labor income is estimated as a function of jobs.

For endogenous variables, regression-based analyses were conducted to capture economic relationships among the variables. In most regressions, variables were estimated in logarithmic forms so that the estimated coefficients represent elasticities of dependent variables with respect to the change in explanatory variables. With a few exceptions, the regressions were conducted using data for the period of 1980-2022 with dummy variables to filter out exceptional periods such as the period affected by the 2008 global recession and the COVID-19 pandemic. A shorter period excluding the earlier years was used if data were not available for the entire period or the performance that we experienced in the earlier years was not expected to provide a good guide for the future.

To capture county-specific behavior, the variables were estimated at the county-level when the data were available at that level. However, since there was often more randomness in county-level data, the coefficients estimated based on statewide data were used for all counties unless there was strong evidence of different behaviors among counties. In all estimation equations presented in this section, the subscript 't' indicates year, 's' indicates sector, 'j' indicates area, and "k" indicates age group.

<u>Projection of final demand</u>

Personal consumption expenditures

Per capita consumption (pcPCE) was projected as a function of per capita personal income (pcPI) and the population structure represented by the proportion of population 65 and over in total population (sharePOP65). The projected per capita consumption was then combined with the projected population to project total personal consumption for the year.

$$\ln(\text{pcPCE})_{t,j} = \beta_0 + \beta_1 \bullet \ln(\text{pcPI})_{t,j} + \beta_2 \bullet \text{sharePOP65}_{t,j}$$

Private investment

Private investment estimated in the I-O table consists of three components; private sector spending on construction, producers' durable equipment, and changes in inventories.[9] Despite

[9] DBEDT, The Hawaii state input-output study: 2017 benchmark report

its critical role in economic growth, it is very challenging to project future trends of investment demand based on its historical trends because it fluctuates severely over business cycles. Also, there is no good time series data to be used for efficient analysis of historical trends of all components of private investment demand. In this projection, the private investment component was projected exogenously. Producers' durable equipment and changes in inventories were projected based on the trends observed in the historical I-O tables. For projection of private sector spending on construction, historical building permit data was analyzed, but the projection was done mostly based on the prospects for future demand for new housing, which would be determined by future population growth, average household size, and the existing unmet or pent-up housing demand.

State and local government spending

Assuming that the needs and funding for state and local government spending is determined by the size of economy, the state and local government spending (SLGS) was projected as a function of GDP as follows.

$$\ln(SLGS)_{t,\,state} = \beta_0 + \beta_1 \bullet \ln(GDP)_{t,\,state}$$

Federal government spending

According to the 2017 I-O table, 73.5 percent of total spending by the federal government was employee compensation. Future compensation of federal employees was projected based on past trends of per capita growth in compensation of federal employees, reflected in annual income and employment data from BEA, and the projected total number of federal employees for the future.

For the remaining portion of federal spending, historical federal procurement data were analyzed. Total federal prime contract award spending has shown a steadily increasing trend in recent years, but the spending fluctuated significantly over a longer time period. In this projection, federal spending other than employee compensation is assumed to grow at about 1 percent annually in real terms over the projection period.

Exports

Exports consist of the commodities and services that are sold to people and businesses outside the State of Hawaii. If constraints in local production capacity are not considered, the level of exports would depend solely on factors outside the economy. For this reason, future levels of exports were either exogenously given or projected using a separate model.

Exports consist of tourism exports and non-tourism exports. With little information on factors affecting non-tourism exports, those exports were modeled to be determined by the size of output. That is, exports for each sector were calculated assuming that the proportions of output to be exported in total output would remain constant at the levels in the 2017 I-O table. A detailed methodology used for the projection of tourism is presented in the tourism section.

Projections of output

Annual outputs for each sector were projected by applying the final demand-output relationships in the 2017 Hawaii I-O tables to the annually projected final demands. To estimate final demand for a sector, each component of projected final demands was distributed among sectors using the final demand coefficients derived from the 2017 I-O table. The sector outputs were estimated using the sector's projected final demands and the total requirement matrix from the 2017 I-O table. These projected outputs, in turn, formed the basis for projecting job counts by sector.

Projection of GDP

GDP was projected using the projected output by sector and the proportion of the value added in total output of each sector presented in the Hawaii I-O tables. Comparison of the I-O table for different years in the past shows that the proportions of value added have increased over time. To project GDP in the future years, the proportions of value added calculated from the 2017 I-O table were adjusted using the annual changing factors estimated by comparing historical I-O tables.

Projections of jobs

Jobs data reported in this projection series are consistent with the BEA job data in definition and coverage with one exception: military jobs were subtracted from the BEA jobs data to calculate civilian jobs.

Jobs projections involved two types of jobs: wage and salary jobs and proprietors' jobs. Wage and salary jobs were projected based on the projected outputs, and proprietors' jobs were then projected based on the projected wage and salary jobs.

Total Job (TJOB) =Wage and Salary Job (WSJOB) + Proprietor Job (PJOB)

Wage and salary jobs for each sector in a county were projected by multiplying outputs projected for the sector and county with corresponding wage and salary job-to-output ratios. These ratios were derived from the 2017 I-O tables and adjusted for productivity change. As a result of the productivity increase, there is more output per job and thus, fewer new jobs are required to increase output by a given amount. Job-to-output ratios were adjusted from their 2017 levels to reflect this advancement in production technology. The annual rate of productivity change for each sector was estimated using historical data on jobs by sector. Because annual output data are unavailable, estimates of labor productivity growth were developed using historical ratios of output and jobs presented in the I-O tables and the historical ratios of wage and salary jobs and real GDP.

$$\text{WSJOB}_{\text{t, s, j}} = \text{OUTPUT}_{\text{t, s, j}} * (\frac{\text{WSJOB}}{\text{OUTPUT}})_{\text{t, s, j}}$$

$$(\frac{\text{WSJOB}}{\text{OUTPUT}})_{\text{t, s, j}} = (\frac{\text{WSJOB}}{\text{OUTPUT}})_{\text{t-1, s, j}} * \text{ Productivity Factor}_{\text{s,j}}$$

Proprietors' jobs were projected using the projected wage and salary jobs and the sector specific ratios of proprietors' jobs to wage and salary jobs. These ratios were also derived from the 2017 inter-county I-O tables and adjusted to account for the observed trend in the increasing share of proprietors' jobs.

$$PJOB_{t,s,j} = WSJOB_{t,s,j} * \left(\frac{PJOB}{WSJOB}\right)_{t,s,j}$$

$$\left(\frac{PJOB}{WSJOB}\right)_{t,s,j} = \left(\frac{PJOB}{WSJOB}\right)_{t-1,s,j} * \text{ Annual Changing Factor}_s$$

<u>Projections of labor force</u>

The labor force consists of all members of the civilian non-institutionalized population aged 16 and over who have a job or are actively seeking one. Since the labor force participation rate (LFPRT) varies significantly by age, future labor force participation rates were projected by age groups as explained in pages 15-16 and the total labor force was calculated as the sum of the projected labor force for each age group.

$$\text{Labor force}_{t,j,k} = \text{Population}_{t,j,k} \bullet LFPRT_{t,j,k}$$

<u>Projections of personal income</u>

Personal income (PI) was projected in terms of four components: earnings, contributions for government insurance, property income (dividends, interests, and rent), and transfer income. Each of these components was projected as described below, and the following formula produced the projections of personal income.

Personal income = Earnings – Contributions for government social insurance +Property income + Transfer income

Earnings

Earnings include wages and salaries (WSINC), supplements to wages and salaries (SWSINC), and proprietors' income (PRINC).

EARNINGS=WSINC + SWSINC + PRINC

The earnings from wage and salary jobs (WSINC + SWSINC) and the earnings from proprietors' jobs (PRINC) were estimated and projected separately, as they had shown different trends in the past. For incomes from wages and salaries jobs, the annual growth rate of the average per-job-incomes was estimated as described below to project the average per-job-income for the future for each county. Then, total earnings from wage and salary jobs were projected by multiplying the projected WSJOBs with the projected average per-job-income projected for the county.

$$\ln\left(\frac{WSINC+SWINC}{WSJOB}\right)_{t,j} = \beta_0 + \beta_1 \bullet \text{Year}_t$$

Proprietors' income was estimated as a function of proprietors' jobs in the county.

$$\ln (PRINC)_{t,j} = \beta_0 + \beta_1 \bullet \ln (PJOB)_{t,j}$$

Transfer income

Transfer income (TRANS) represents transfer receipts of individuals from the governments, that includes retirement and disability insurance benefits, Medicare and other medical benefits, unemployment insurance, and other federal assistance payments. Since this income category will increase with the number of retired workers, the number of people unemployed, and the increase in real wage and cost, it was modeled to depend on the size of population aged 65 year and over (POP65), unemployment rate (UNEMPRT), and the real wage.

$$\ln (TRANS)_{t,j} = \beta_0 + \beta_1 \bullet \ln (POP65)_{t,j} + \beta_2 \bullet UNEMPRT_{t,j} + \beta_3 \bullet \ln \left(\frac{WSINC+SWINC}{WSJOB}\right)_{t,j}$$

Property Income

Property income (DIR) includes dividend income, personal interest income, and rental income. Many factors, such as interest rates, stock prices, and housing prices, will affect the future size of property income. Due to the large uncertainty involved with these variables, property income of each county was estimated based on its historical relations to earnings.

$$\ln (DIR)_{t,j} = \beta_0 + \beta_1 \bullet \ln (EARNINGS)_{t,j}$$

Contributions for government social insurance

Contributions for government social insurance (CGI) consist of employer contributions for government social insurance and employee and self-employed contributions for government social insurance. It was estimated as a function of earnings.

$$\ln (CGI)_{t,j} = \beta_0 + \beta_1 \bullet \ln (EARNINGS)_{t,j}$$

Projection of tourism

Tourism projections underlying the DBEDT 2050 series were developed using both econometric modeling and relationship analysis. Visitor arrivals, days, and expenditures, statewide and by county, were projected in the following sequences using the assumption presented in Tables 14 through 18 on the following pages.

Daily visitor census and visitor days

For the near future until 2025, the projections in the latest DBEDT quarterly forecasts were adopted. The long-term growth rate of daily visitor census (DVC) was projected using the regression model presented in the next page.

$DVC_{t,\ state} = \beta_0 + \beta_1 \bullet Year + \beta_2 \bullet D01\_03 + \beta_3 \bullet D08\_11 + \beta_4 \bullet D17\_19 + \beta_5 \bullet D20$

D01_03 = dummy variable representing years 2001 to 2003, a recession period
D08_11 = dummy variable representing years 2008 to 2011, a recession period
D17_19 = dummy variable representing years 2017 to 2019, a booming period
D20 = dummy variable representing year 2020, a recession year caused by COVID-19

The regression of the daily visitor census using 1990-2023 data filtering out the economic recession and booming period resulted in an increase of about 2,320 per year, on average 0.87 percent annual growth when applied to project the statewide daily visitor census during the 2025-2050 period (Table 14).

Table 14. Projection of statewide daily visitor census, 2025-2050[1]

2025	2030	2035	2040	2045	2050
239,145	250,732	262,319	273,906	285,493	297,081

Average annual growth rate				
2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
0.95%	0.91%	0.87%	0.83%	0.80%

[1] Include visitors who arrive by air only

The statewide daily visitor census was then allocated to each county based on historical trend as presented in Table 15 below. Visitor days are calculated by multiplying the daily visitor census with the number of days in the year.

Table 15. Assumption on county shares of daily visitor census (%)[1]

County	2025	2030	2035	2040	2045	2050
Hawaii	15.9	16.2	16.4	16.5	16.6	16.7
Honolulu	46.3	45.8	44.9	44.4	43.9	43.4
Kauai	12.3	12.5	12.6	12.8	12.9	13.1
Maui	25.5	25.5	26.0	26.3	26.5	26.8

[1] Include visitors who arrive by air only

Visitor arrivals

Visitor's average length of stay showed a declining trend statewide but an increasing trend at the county-level during the past two decades before the COVID-19 pandemic. It was a result of visitors staying in one county (or one island) longer and a reduction of multiple island visitations during the 20-year period. For the projection into the next 25 years, the same trends at the state- and county-levels were assumed as presented in Table 16.

Table 16. Assumption on the average length of stay by county (days), 2025-2050[1]

Area	2025	2030	2035	2040	2045	2050
Statewide	8.75	8.72	8.68	8.65	8.62	8.59
Hawaii	7.47	7.75	8.03	8.31	8.59	8.87
Honolulu	6.82	6.88	6.93	6.99	7.04	7.10
Kauai	7.51	7.84	8.16	8.49	8.82	9.14
Maui	8.07	8.33	8.59	8.85	9.12	9.38

[1] Include visitors who arrive by air only

Future visitor arrivals were then projected by dividing the projected visitor days by the projected average length of stay as follows.

Visitor arrivals = Visitor days / Average length of stay

Visitor expenditures

Nominal visitor expenditures by visitors who arrived by air and total expenditures were projected by the following sequence and assumptions:

1. Per person per day personal spending (PPPD) were projected for each county: PPPD increased 2.2 percent, 1.3 percent, 2.6 percent, and 2.7 percent annually on average from 2009 to 2019 for Hawaii County, Honolulu County, Kauai County, and Maui County, respectively. This growth reflects not only the increase in price level, but also the change in spending pattern, such as the increase in spending on accommodation. For the future, we assume similar annual growth rates for PPPD (Table 17).
2. Visitor expenditures of each county were derived by multiplying PPPD with the corresponding visitor days of the county. Statewide visitor expenditures by visitors who arrived by air were projected as the sum of the four counties.

Table 17. Per person per day visitor personal expenditures[1] (in current dollar), 2025-2050

County	2025	2030	2035	2040	2045	2050
Hawaii	228.3	254.5	283.7	316.4	352.7	393.3
Honolulu	228.5	258.5	285.4	315.2	339.5	365.7
Kauai	272.4	308.2	348.7	385.0	425.1	469.4
Maui	297.8	336.9	381.2	420.9	464.7	513.1

[1] Include visitors who arrive by air only

Real visitor personal expenditures were derived by deflating the nominal visitor expenditures using the tourism price index. Tourism price inflation was assumed to be 3.0 percent between

2025-2030, and reduce to 2.5 percent between 2030-2040, and further decrease to 2.0 percent between 2040-2050. The same tourism price index was applied to all counties.

Total real visitor expenditures were projected by adding supplemental business expenditures and the expenditures by visitors who arrived by cruise ships.

Total Real Visitor Expenditures = Real air visitor personal expenditures + Real supplemental business expenditures + Real cruise visitor expenditures

Supplemental business expenditures were derived by applying their ratio to air visitor personal expenditures observed in the past 20 years. Cruise visitor expenditures were derived by assuming a growth rate of 3.0 percent per year for the 2025-2050 period. Supplemental business expenditures and cruise visitor expenditures were then deflated using the same tourism price index.