The Demographic Forecast in the REMI Model

State-by-State Factors and Analysis, 2019-2030

Friday, June 21, 2019

Presented To: REMI

The "population equation" in the REMI model

$$N_t^k = N_{t-1}^k + Births_t^k - Deaths_t^k + RTMIG_t^k + ECMIG_t^k + IntMIG_t^k \quad (3\text{-}1)$$

Where;

N_t^k = The population in region *k* at time *t*.

$Births_t^k$ = The number of births during the time period *t-1* to *t* in region *k*.

$Deaths_t^k$ = The number of deaths during the time period *t-1* to *t* in region *k*.

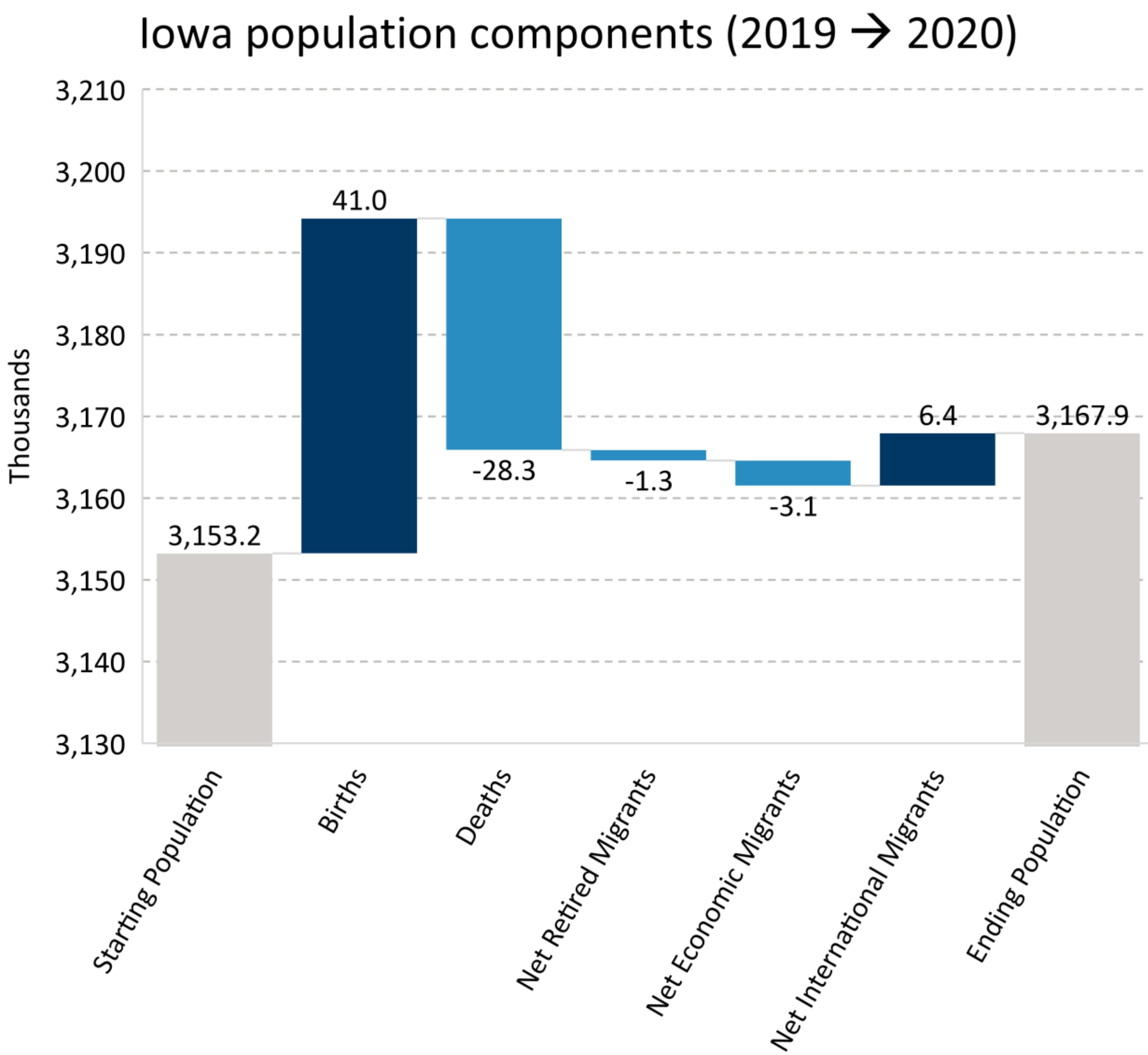
$RTMIG_t^k$ = The net inflow of interregional retired migrants to region *k* during the time period *t-1* to *t*.

$ECMIG_t^k$ = The net inflow of interregional economic migrants to region *k* during the time period *t-1* to *t*.

$IntMIG_t^k$ = The net inflow of international migrants to region *k* during the time period *t-1* to *t*.

Final Population = Starting Population + Births – Deaths + Net Retired Migration + Net Economic Migration + Net International Migration

“Starting Population” to “Final Population”



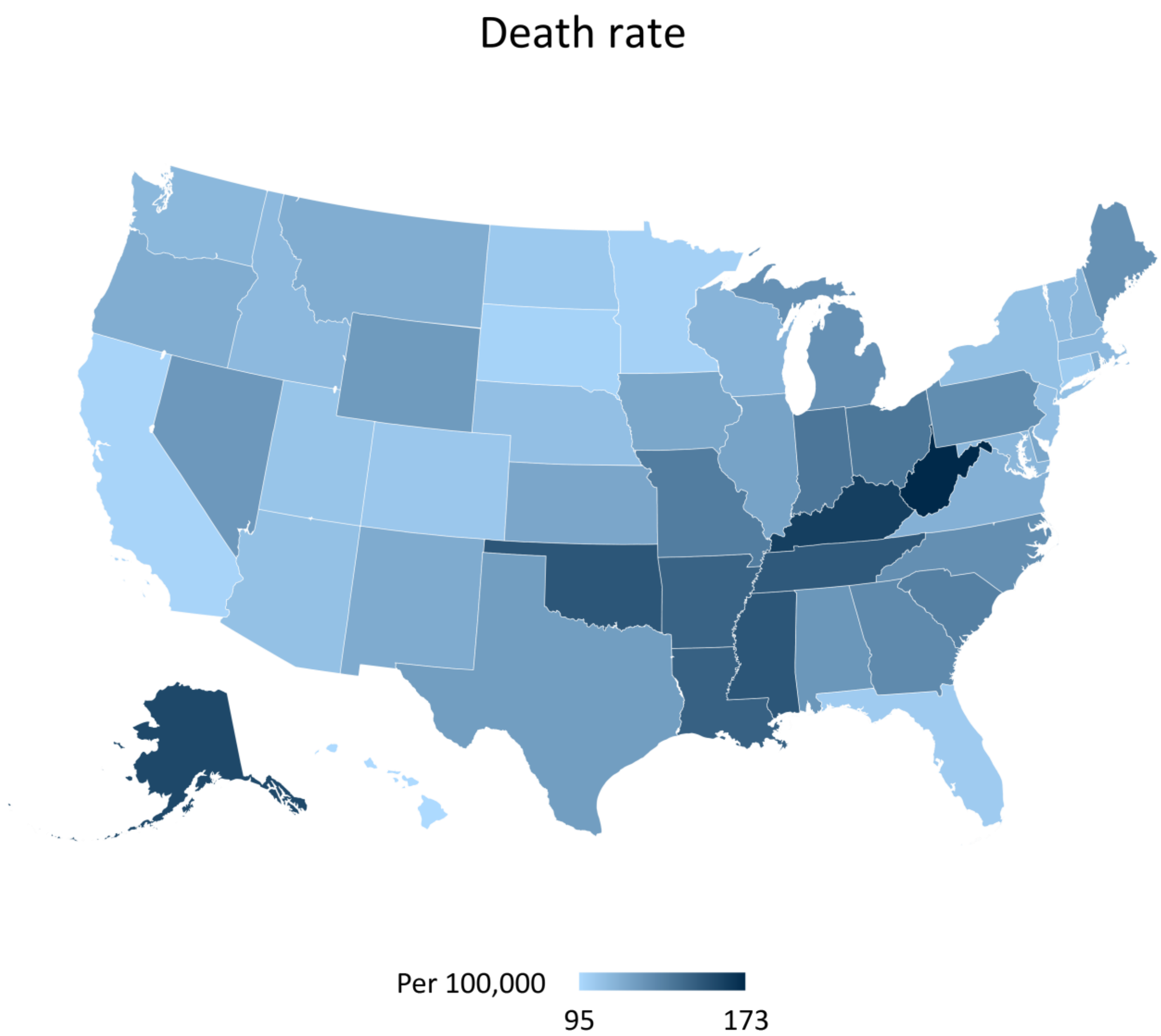
- Iowa ends 2019 and begins 2020 with a population of 3.1532 million (the furthest to the left)
- Natural change
  - +41,000 births
  - -28,300 deaths
  - = +12,700 natural change
- Migration
  - -1,300 retired migrants
  - -3,100 economic migrants
  - +6,400 international migrants
  - = +2,000 migration
- At the end of 2010 and the start of 2021, Iowa has a population of 3.1679 million (to the right)
  - Net change of +14,700
  - 12,700 of births net of deaths and 2,000 from migration
- The REMI model does these calculations for each region of the model and each year of the modeling in the same way

Natural change

- The REMI model has three demographic characteristics
  - 4 races
    - White Non-Hispanic
    - Black Non-Hispanic
    - Other Non-Hispanic
    - Hispanic
  - 2 sexes
  - 101 age cohorts (age 0 through age 100+ with every age in the middle)
  - 4 * 2 * 101 = 808 cohorts

- These individual cohorts have individual “survival rates” (i.e., the chance of not dying in a given year) and the female population has an associated birth rate
  - These rates are on a state-by-state basis, which means the model requires 808 * 51 (including the District of Columbia) data points, = 41,208
  - The same demographic cohort has different characteristics across different states even if the same race, sex, and age, as shown in the example slide

“Survival rate” for White Non-Hispanic men, ages 30-34



- One minus the survival rate (the chance of making it through a given year) yields the death rate (not making it that year)
- The map shows the death rates contained in the model for White Non-Hispanic men between the age of 30 and of 34
  - The rate is higher than the rest of the country in the triangular region bordered by Oklahoma, West Virginia, and Louisiana
  - The lowest death rate for these cohorts include those within California, Florida, the “prairie” states of the Midwest, and along the East Coast megapolis from Washington, DC to Boston
- Could be several reasons for this, including public health crises the Appalachian region with opioid abuse and/or the decline in the socioeconomic prospects of young men in these regions

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Birth rates by state and age of mother

RANK	CHANGE	15-19	RATE
1	-	NM	3.8%
2	-	AK	3.7%
3	-	AR	3.6%
4	-	OK	3.5%
5	-	TX	3.5%
6	-	MS	3.4%
7	-	WV	3.3%
8	-	LA	3.2%
9	-	KY	3.2%
10	-	TN	2.9%

RANK	CHANGE	20-24	RATE
1	+3	OK	11.3%
2	+23	ID	11.2%
3	-1	AK	11.0%
4	-1	AR	11.0%
5	+1	MS	10.9%
6	+8	WY	10.7%
7	0	WV	10.5%
8	0	LA	10.4%
9	0	KY	10.2%
10	-9	NM	10.1%

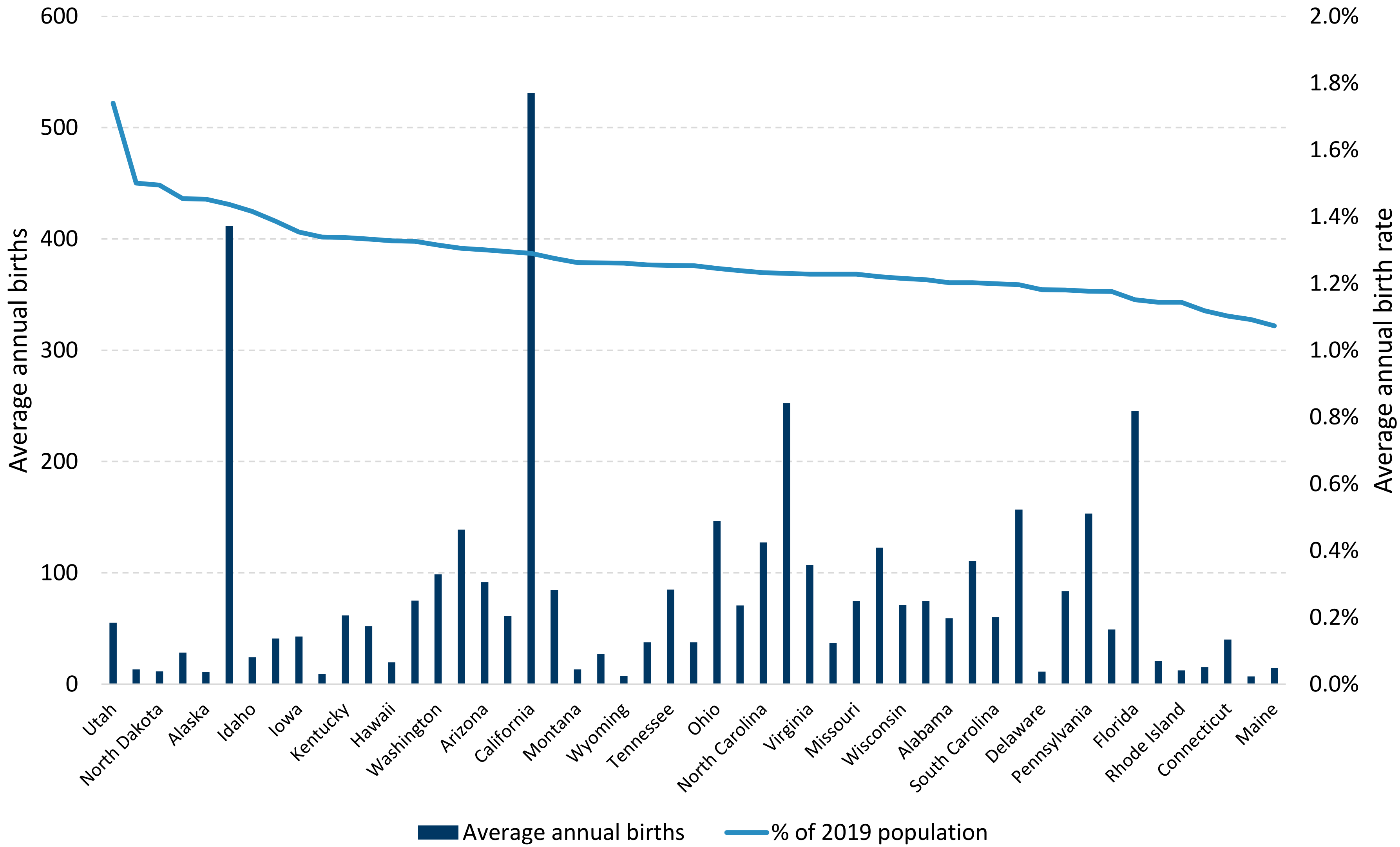
RANK	CHANGE	25-29	RATE
1	+15	UT	16.5%
2	+10	SD	15.8%
3	+25	ND	15.6%
4	+23	NE	14.4%
5	+24	IA	14.4%
6	-4	ID	13.5%
7	+11	KS	13.4%
8	-7	OK	12.8%
9	-6	AK	12.7%
10	+9	IN	12.6%

RANK	CHANGE	30-34	RATE
1	0	UT	12.6%
2	+13	MN	12.3%
3	0	ND	12.2%
4	-2	SD	12.1%
5	+41	NJ	11.7%
6	-2	NE	11.7%
7	+43	MA	11.3%
8	-3	IA	11.2%
9	+38	CT	10.9%
10	+4	WI	10.9%

RANK	CHANGE	35-39	RATE
1	+50	DC	7.4%
2	+19	HI	6.8%
3	+4	MA	6.6%
4	+1	NJ	6.4%
5	+22	NY	6.4%
6	+14	CA	6.3%
7	+4	MD	6.0%
8	+1	CT	5.8%
9	+8	WA	5.6%
10	+6	VA	5.6%

RANK	CHANGE	40-44	RATE
1	0	DC	2.4%
2	0	HI	1.8%
3	+2	NY	1.6%
4	+2	CA	1.5%
5	-1	NJ	1.5%
6	-3	MA	1.4%
7	0	MD	1.4%
8	+2	VA	1.3%
9	0	WA	1.3%
10	-2	CT	1.2%

Births and birth rate (2019 to 2030) by state



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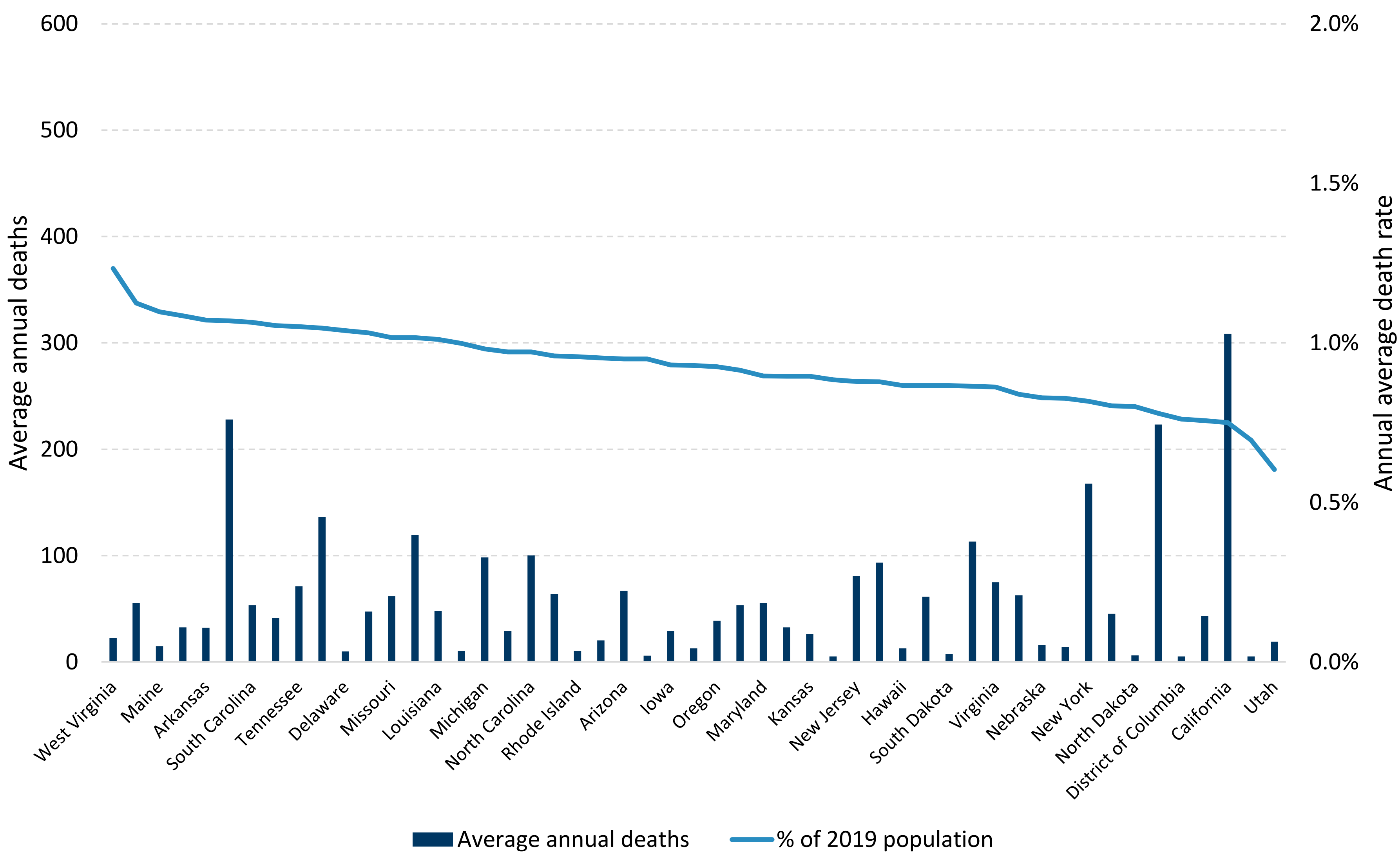
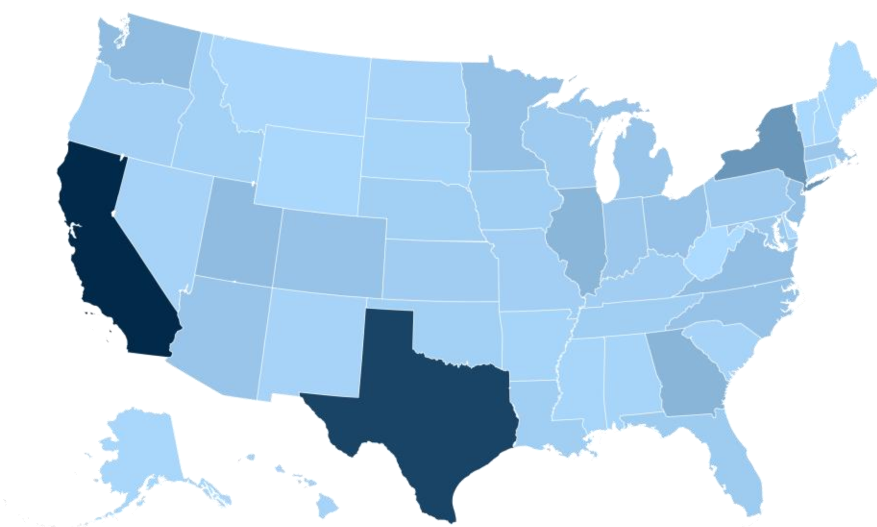
Deaths and death rate (2019 to 2030) by state



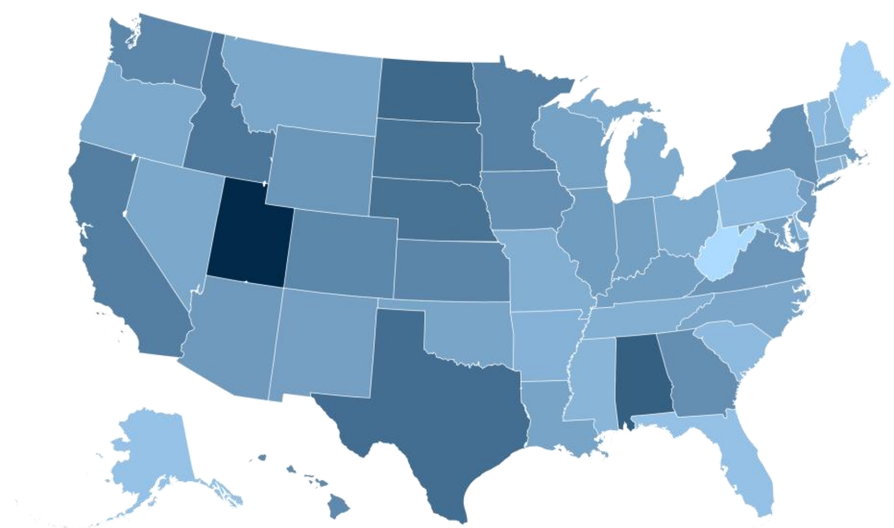
Natural change (2019 to 2030) by state

Average annual natural change



Natural change (thousands) -2 222

% of 2019 population



% of 2019 population -0.1% 1.1%

Retired migration

$$RTMG_i^l = rm_i^l\left(\left(1 - RTDUM_i\right) * N_i^l + RTDUM_i * N_i^u\right) \quad (3\text{-}1)$$

Where;

$RTMG_i^l$ = The net inflow or outflow of migrants of age i (i=65,66, …100+) to region l

rm_i^l = The net proportion of the relevant population that has historically migrated into or out of area l.

N_i^l = The 65 and above population in area l.

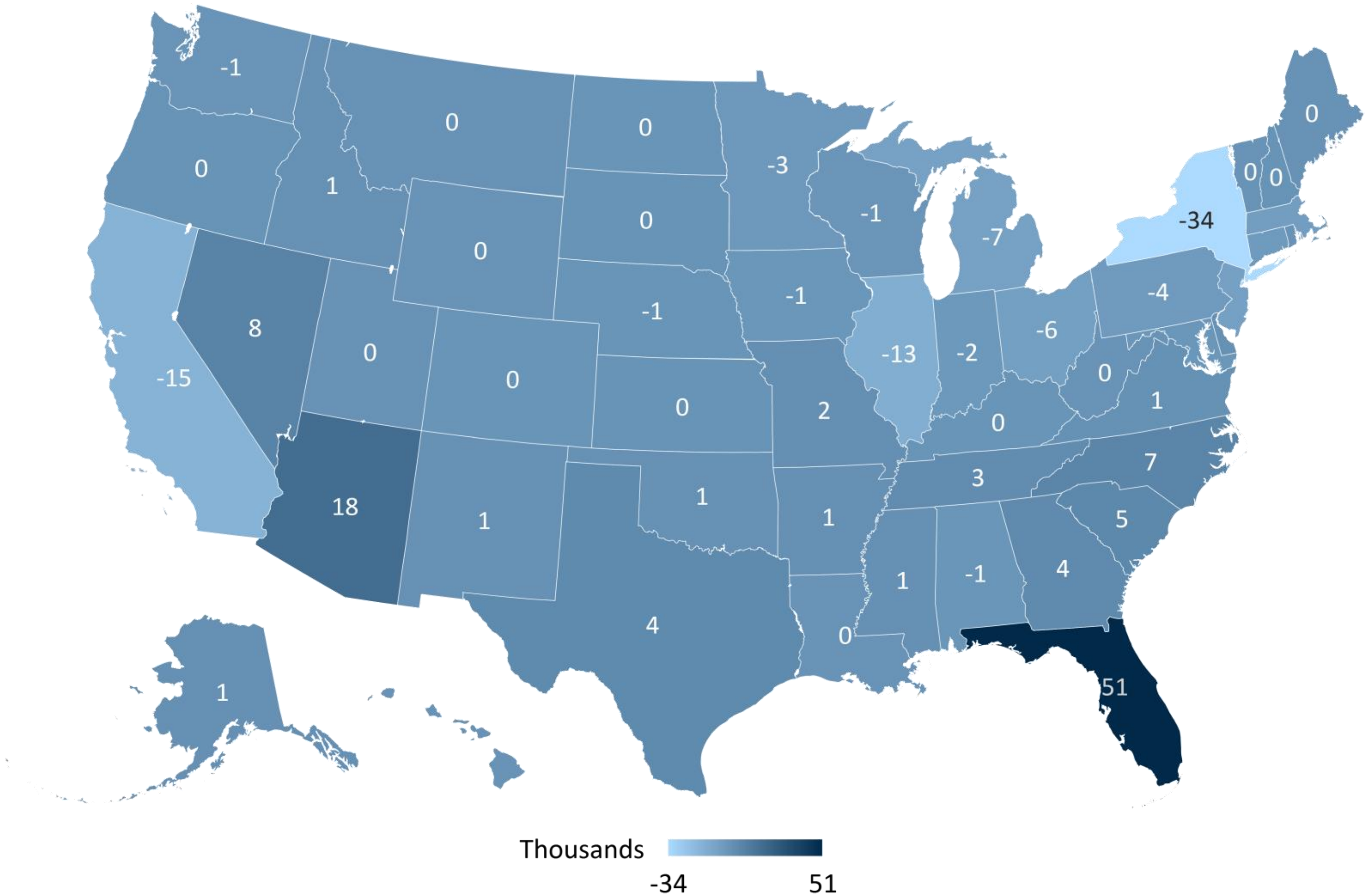
N_i^u = The 65 and above population in area u.

$$RTDUM_i = \begin{cases} 1 \text{ if } rm_i^l > 0 \\ 0 \text{ if } rm_i^l < 0 \end{cases}$$

Retired migration is based on a "risk-probability" model where people over 65 have a probability associated with them leaving or entering a particular state based on historical patterns. For instance, if people have historically left Illinois and moved to Florida during the years for retirement, then the model keeps these probabilities. People over age 65 keep flowing "downhill" in the model's logic based on these long-running patterns. The map on the next slide shows net retired migration (the annual averages from 2019 to 2030).

“Wildebeest” model

Annual average retired migration (2019 to 2030)



Economic migration

$$ECMG_t^l = \left[\lambda^l + \beta \ln\left(REO_t^l\right) + \beta \ln\left(RWR_t^l\right) + \beta \ln\left(MIGPROD_t^l\right)\right] * LF_{t-1}^l$$

ECMG = Net Economic Migration

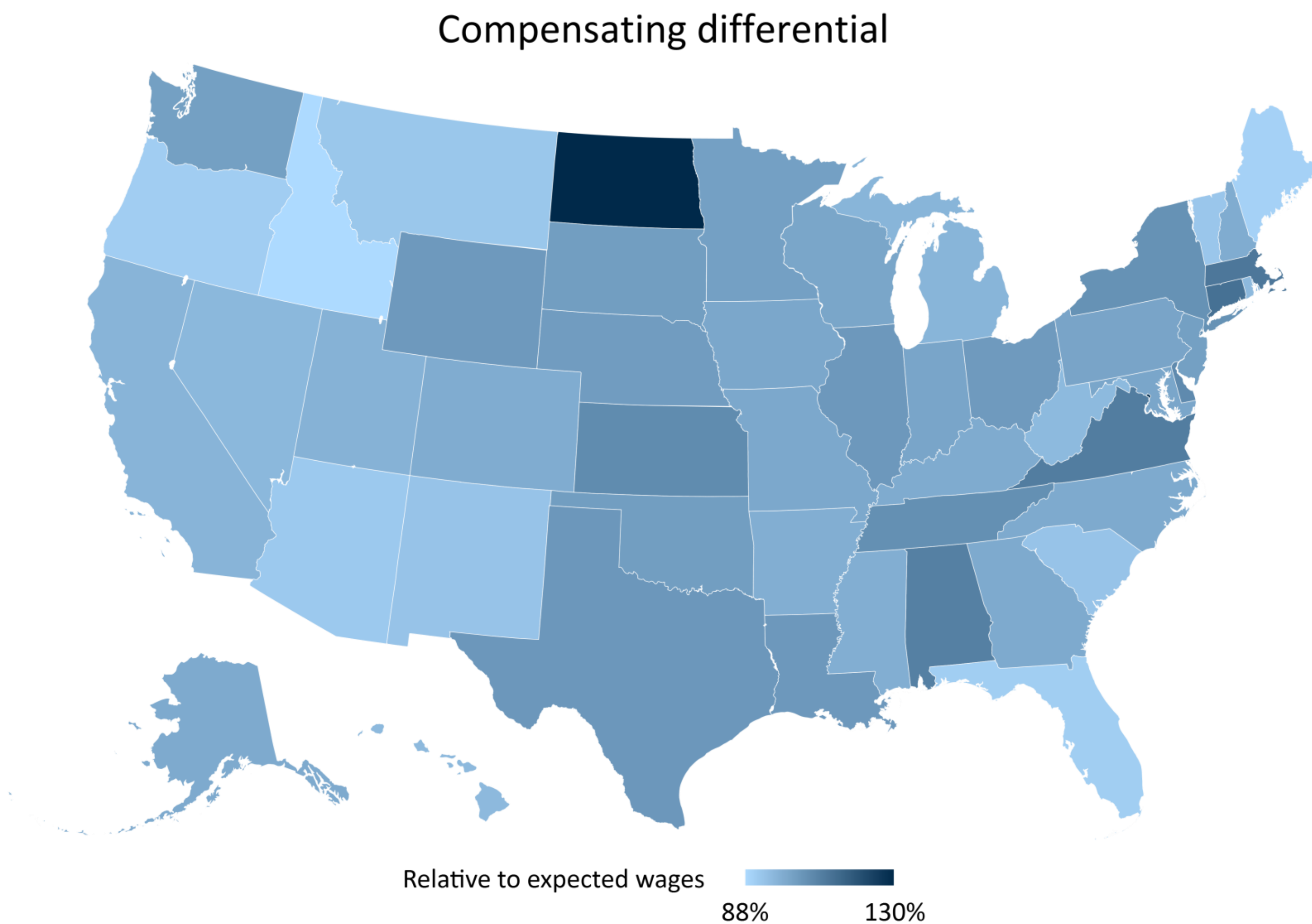
REO = Relative Employment Opportunity

RWR = Relative (Real) Wage Rate

MIGPROD = Commodity Access

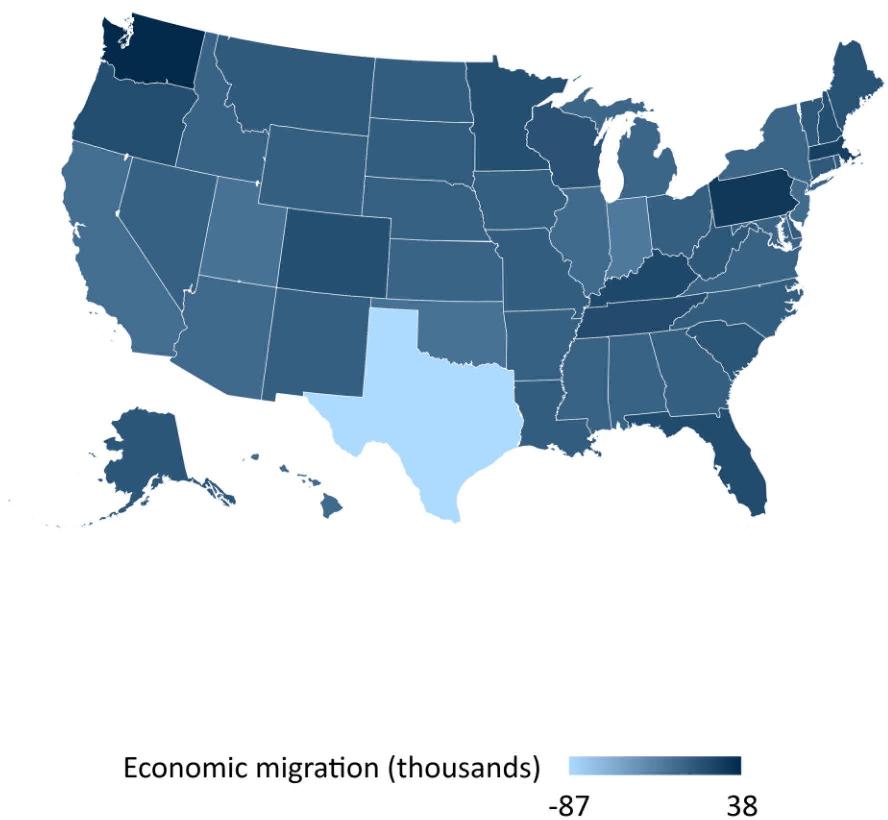
Lambda = Fixed Amenity Factor

Lambda as the "compensating differential"

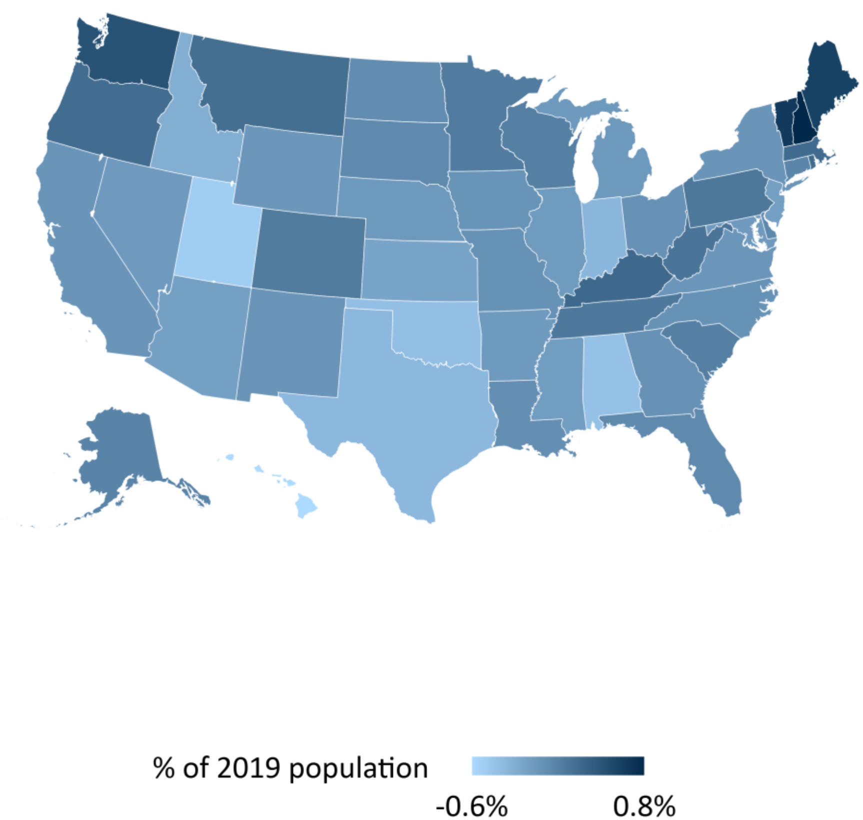


Economic migration (2019 to 2030) by state

Average annual economic migration



% of 2019 population



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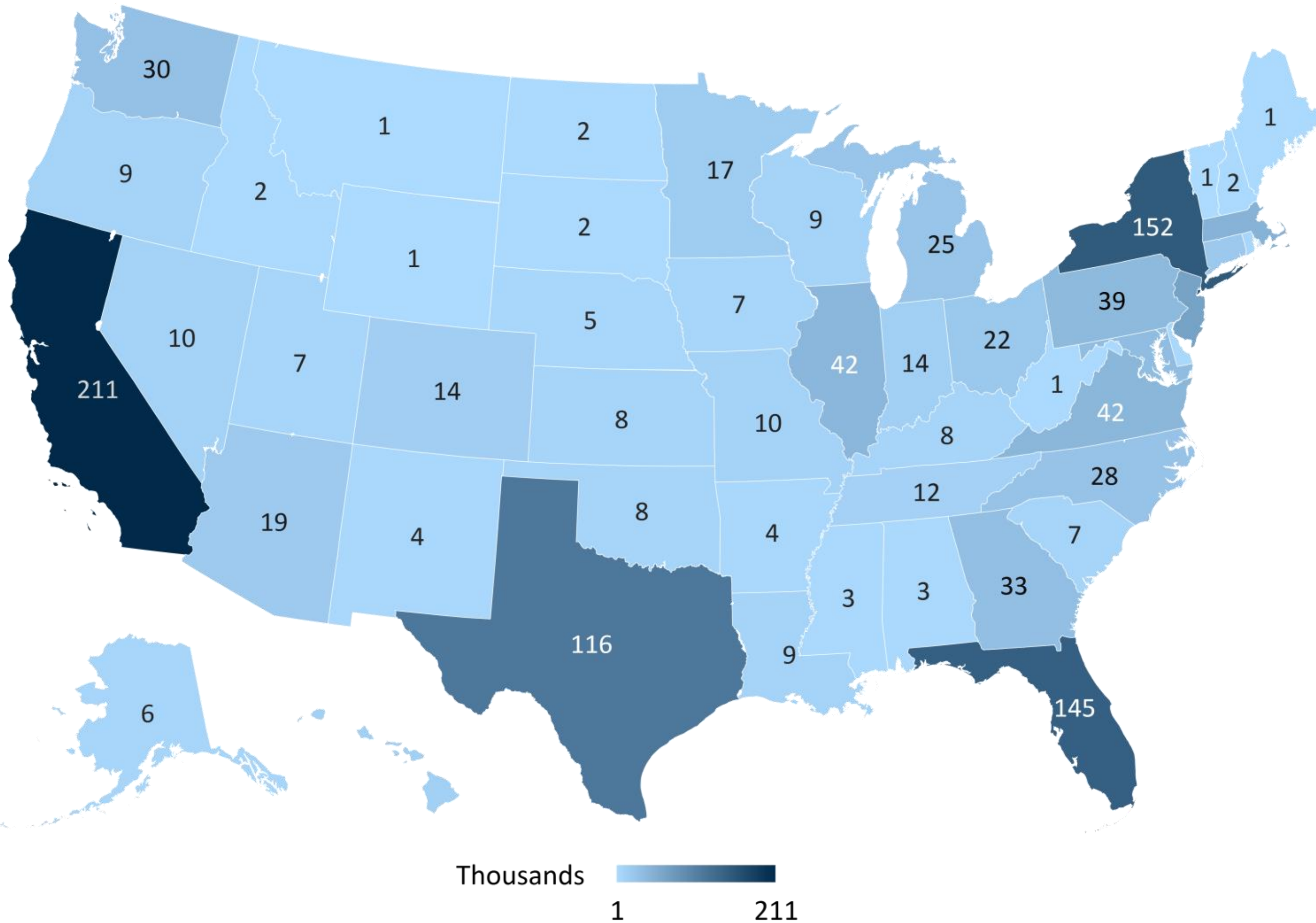
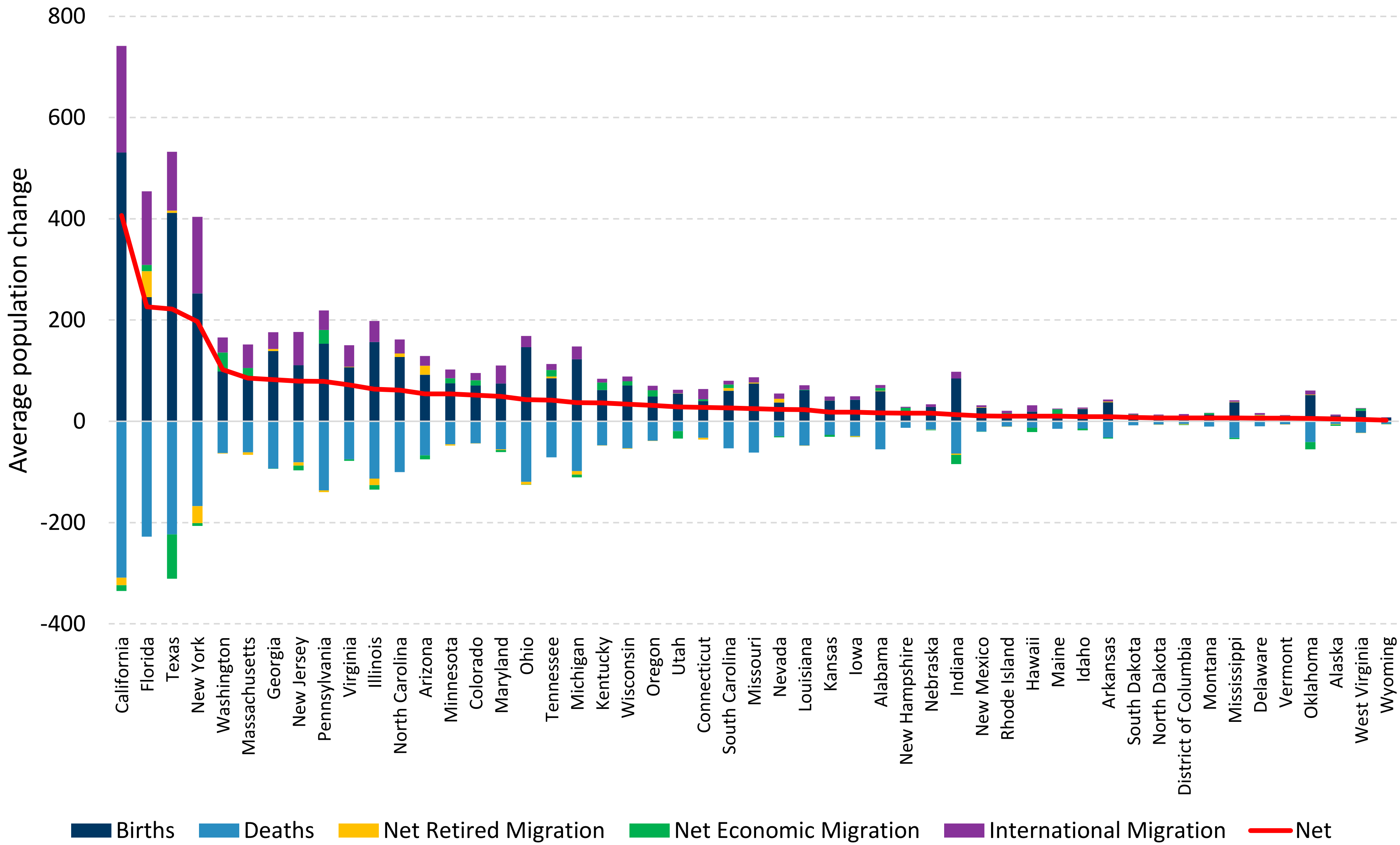
International migration

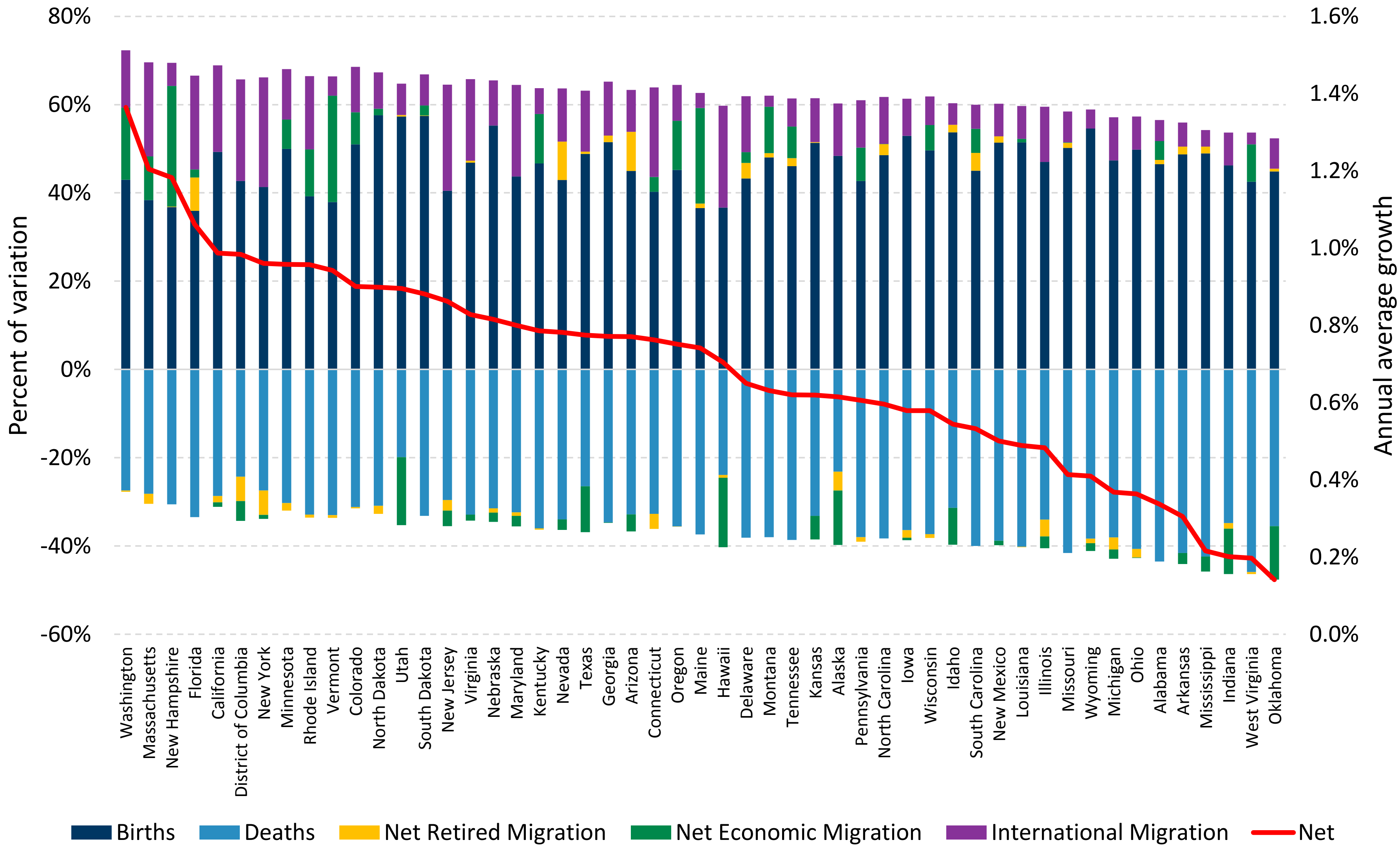
Annual average international migration (2019 to 2030)



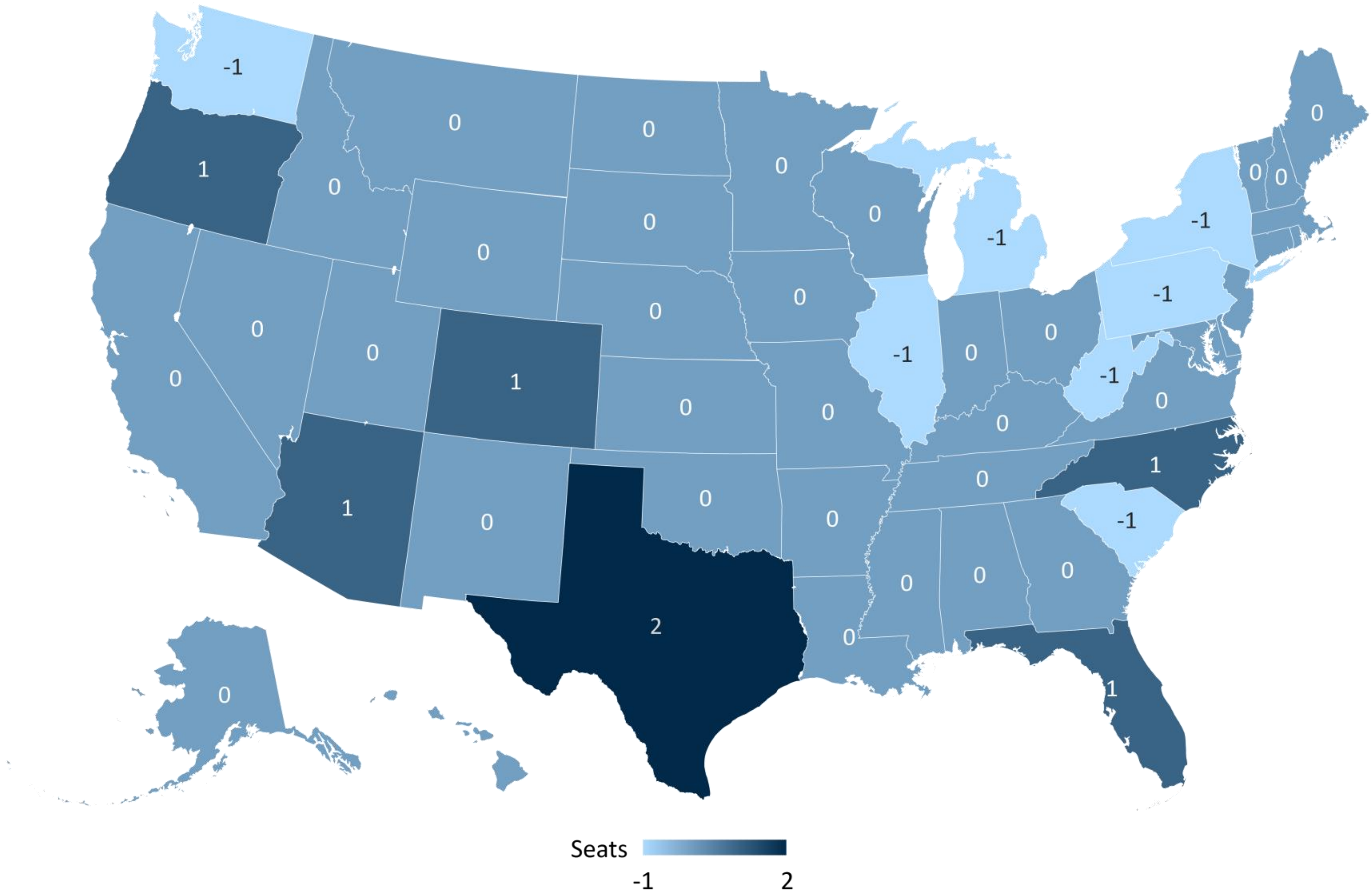
Annual average population change (2019 to 2030)



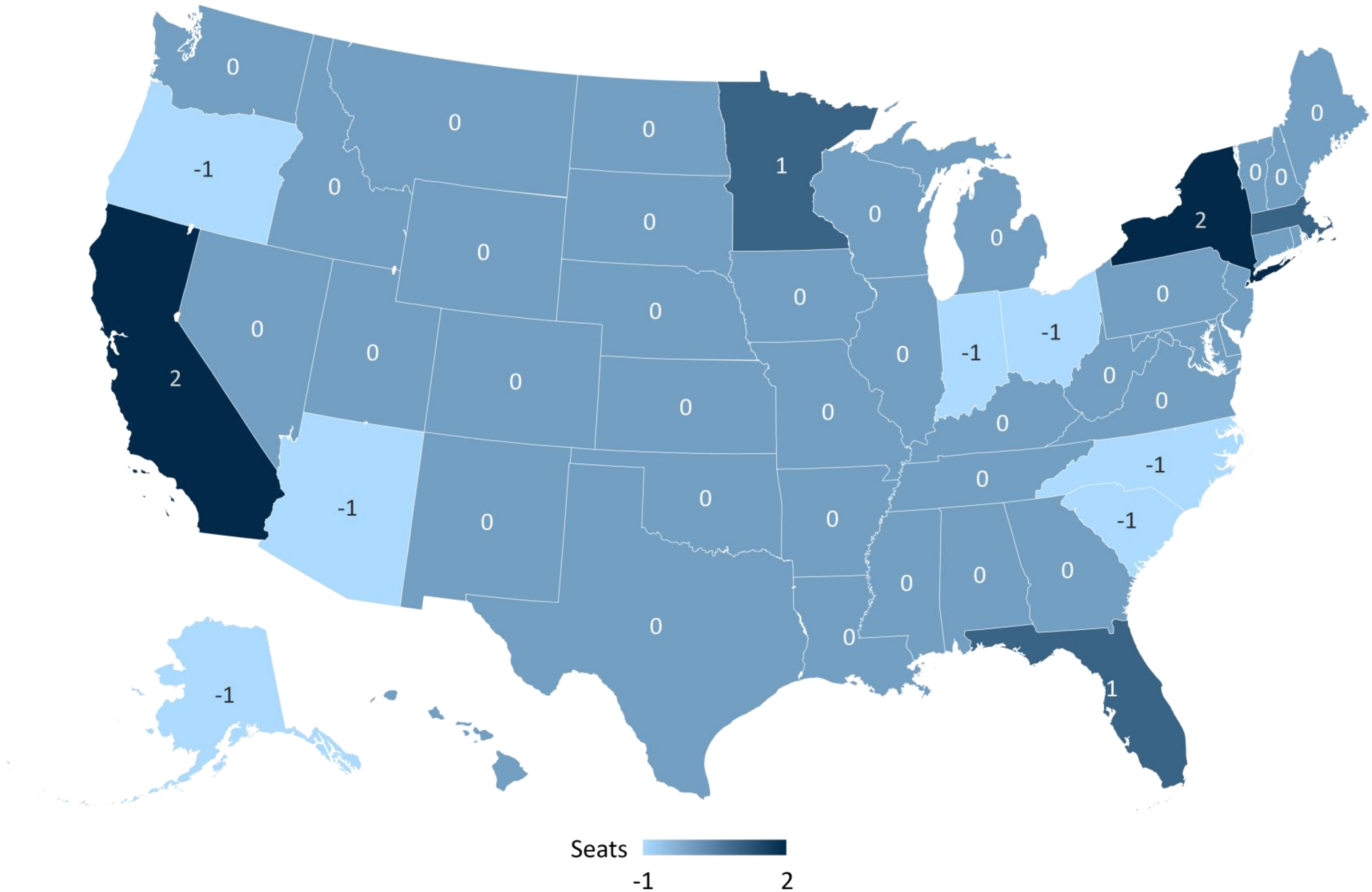
Relative factor strengths in each state



2020 reapportionment (using 2018 data)



2030 reapportionment (using REMI data)



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