Fairfax County's Cohort Component Population Projection Model

Economic, Demographic, and Statistical Research, Fairfax County, VA

MWCOG, Cooperative Forecasting and Data Subcommittee Meeting,

July 12, 2022

Outline

- Why does Fairfax County need to use Cohort Component Population (CCP) to forecast population?

- Fairfax County CCP model
  - Model input
  - Data sources
  - Update frequency
  - Notes, Limitations, and Caveats

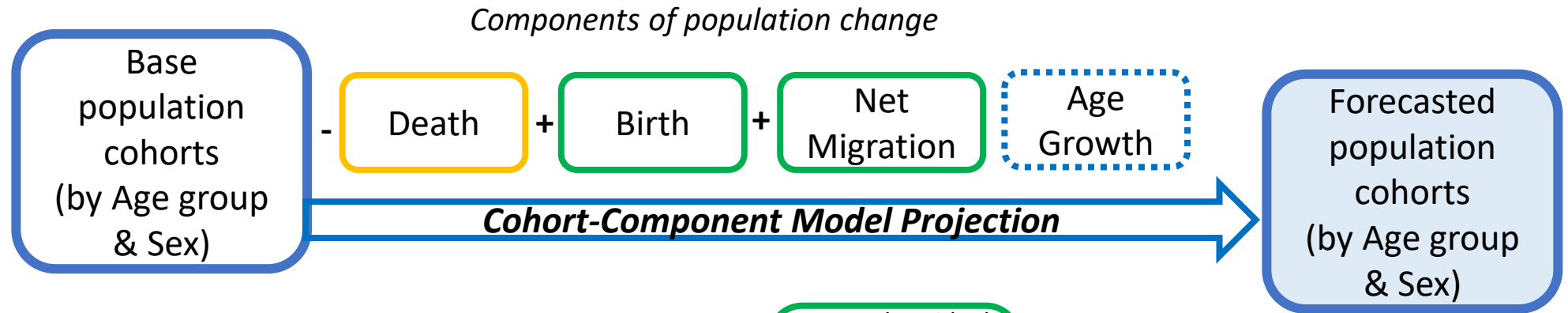- Data products & Observations

- Resources

Why does Fairfax County need CCP to forecast population?

- Fairfax County applies **a Housing Unit-based method**, Integrated Parcel Lifecycle System **(IPLS)** to produce estimates and forecasts for the **total population size** in Fairfax County **with high accuracy, spatial explicit numbers (i.e., parcel-based), and refresh annually.**

- Fairfax County adopts **a Cohort Component population projection model** to **forecast population by age distributions for the entire county (i.e., county-based).** The model has been refreshed annually; however, **some key assumptions are updated every ~ 5 years.**

- Cohort Component population projection helps Fairfax County to understand the **population age structures and its projected change** in the future which provides insight to aid planning and policy-making to deliver **age-relevant services**.

- The research also helps us to understand the underlining **demographic cohort components** of the Fairfax County population, i.e., **Fertility, Mortality, Life expectancy, and Migration patterns.**
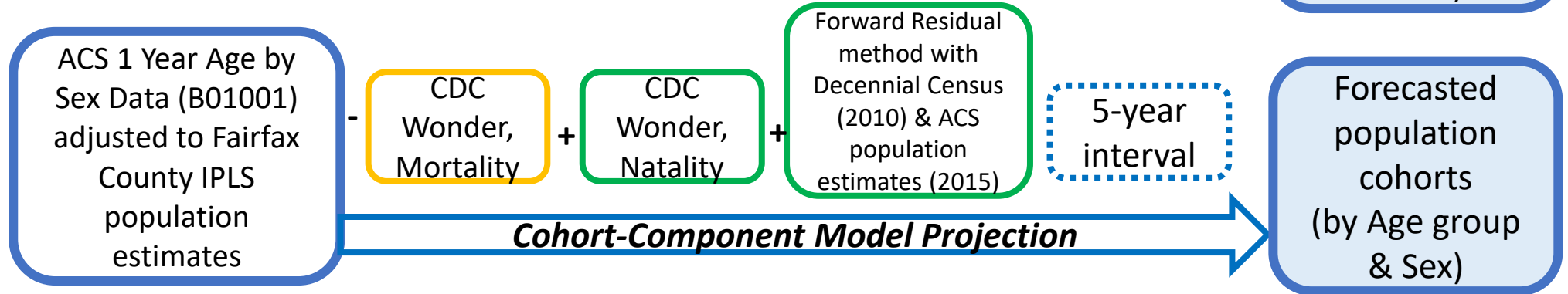
Equation:

$$P_{t+n} = \text{survived population} + \text{births} + \text{net migrants}$$

Components of population change

Model:

| Base population cohorts (by Age group & Sex) | - | Death | + | Birth | + | Net Migration | Age Growth | Forecasted population cohorts (by Age group & Sex) |

Cohort-Component Model Projection

Data Sources:

| ACS 1 Year Age by Sex Data (B01001) adjusted to Fairfax County IPLS population estimates | - | CDC Wonder, Mortality | + | CDC Wonder, Natality | + | Forward Residual method with Decennial Census (2010) & ACS population estimates (2015) | 5-year interval | Forecasted population cohorts (by Age group & Sex) |

Cohort-Component Model Projection

Update Frequency:

| Annual | Annual | Annual | 5-Year | | Annual |

Notes, Limitations & Caveats:

Regroup to 5-year interval

CDC Wonder Data available by Race & Ethnicity
Death Certificate
- Mortality underlying causes of Death (1999 & after)
- Compressed Mortality (1968 & after)
Birth Certificate (mother's place of residence)
- Available 1995 & after

Net Migration
- Migration patterns can be unpredictable with economy and international policies, especially at the County level
- Data on international migration is hard to get
- Another update is due upon the release of the 2020 Decennial Census DHC data

4

Population Change by Component, Fairfax County, VA 2000-2021
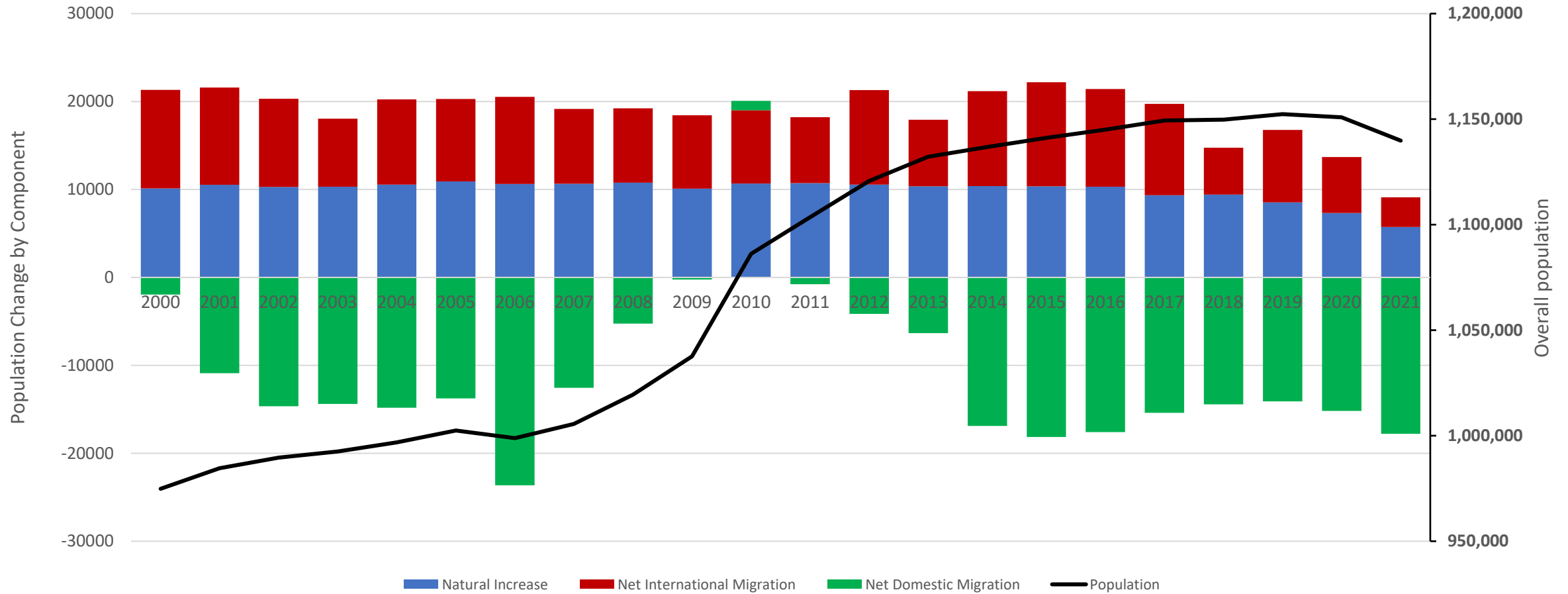
Source: *US Census Bureau, Vintage 2000-2021.*

5

Model products

TABLE 2.3

Projected Population Age Distribution
Fairfax County, 2020 through 2040

Age Group	2020		2025		2030		2035		2040	
	Persons	Percent	Persons	Percent	Persons	Percent	Persons	Percent	Persons	Percent
Under 5	73,357	6.3%	70,895	5.9%	76,244	6.1%	80,635	6.3%	82,870	6.3%
5 to 9	70,758	6.0%	78,874	6.5%	76,699	6.2%	81,999	6.4%	87,015	6.6%
10 to 14	81,789	7.0%	68,281	5.7%	76,548	6.1%	73,999	5.8%	79,381	6.0%
15 to 19	75,682	6.5%	81,045	6.7%	68,104	5.5%	75,884	5.9%	73,606	5.6%
20 to 24	68,494	5.8%	76,205	6.3%	82,275	6.6%	68,492	5.3%	76,717	5.8%
25 to 34	154,978	13.2%	162,114	13.4%	181,014	14.5%	197,764	15.4%	188,533	14.3%
35 to 44	169,277	14.4%	173,918	14.4%	170,437	13.7%	178,560	13.9%	198,990	15.1%
45 to 54	163,776	14.0%	158,242	13.1%	162,828	13.1%	167,078	13.0%	163,358	12.4%
55 to 64	149,703	12.8%	144,251	12.0%	136,789	11.0%	132,209	10.3%	135,744	10.3%
65 and Over	164,033	14.0%	191,511	15.9%	216,106	17.3%	225,991	17.6%	231,007	17.5%
Total	1,171,848	100.0%	1,205,335	100.0%	1,247,045	100.0%	1,282,610	100.0%	1,317,221	100.0%

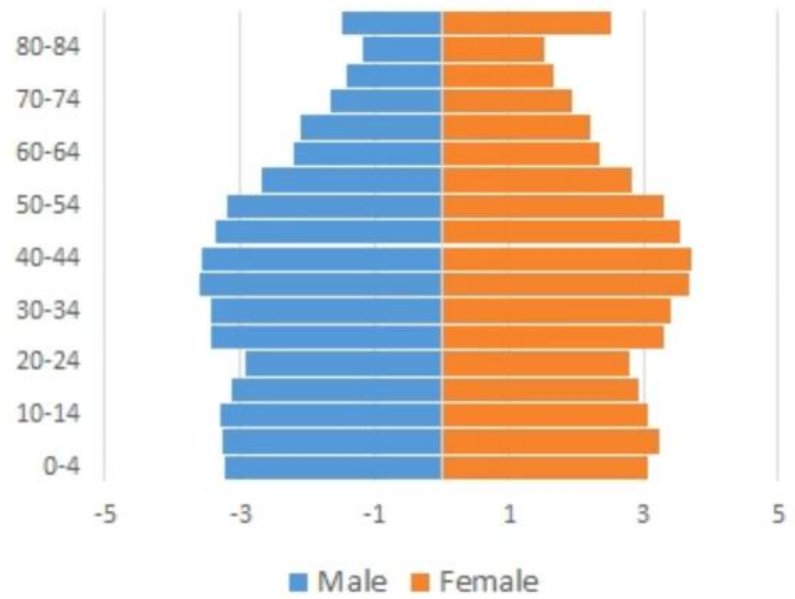Source: Fairfax County Department of Management and Budget, 2021.

Note: Percentages may not sum to total due to rounding.

Demographic Reports 2021

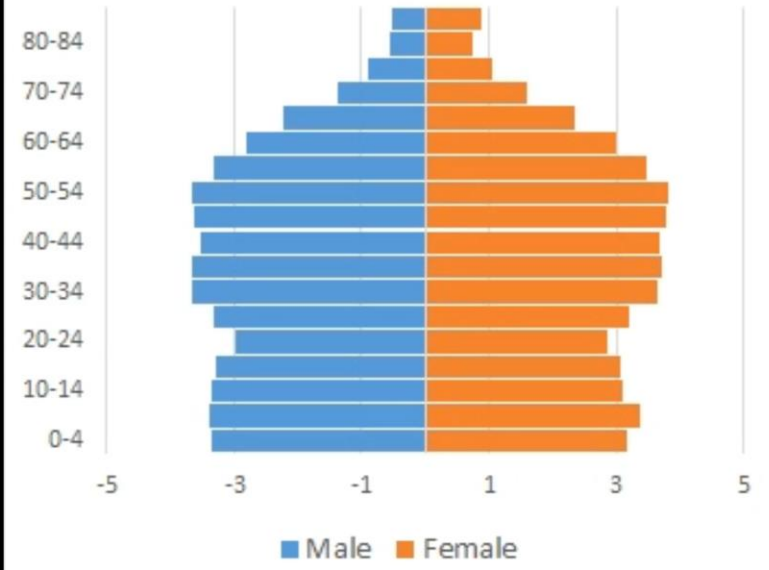# Population Forecast

2015, Fairfax County, VA
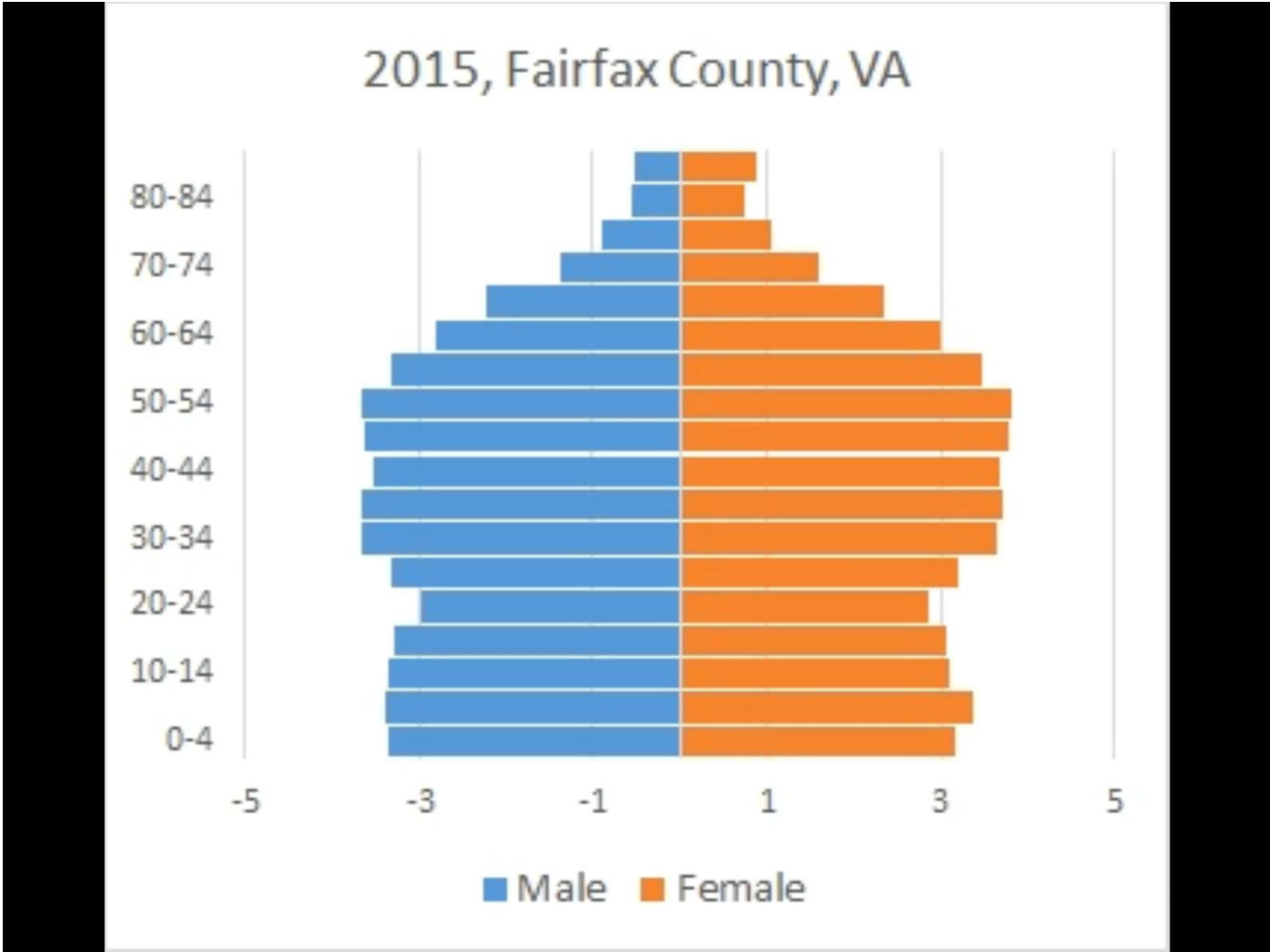
Population Forecast
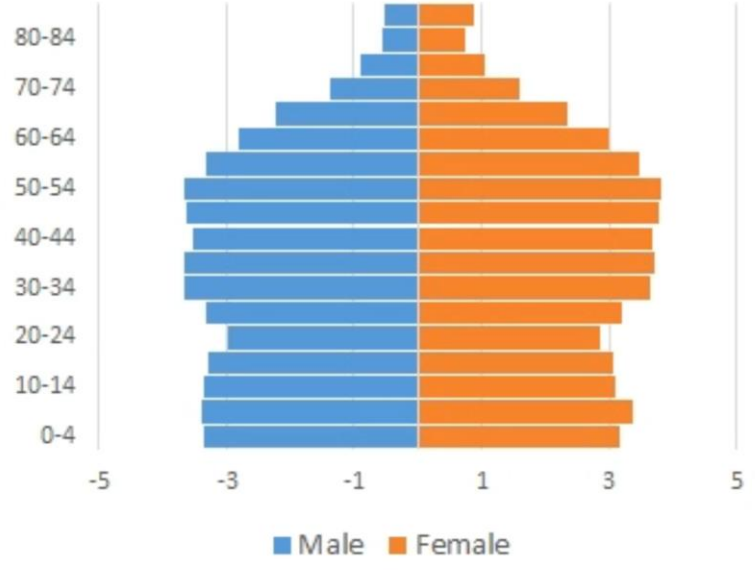

2050, Fairfax County, VA

2015, Fairfax County, VA

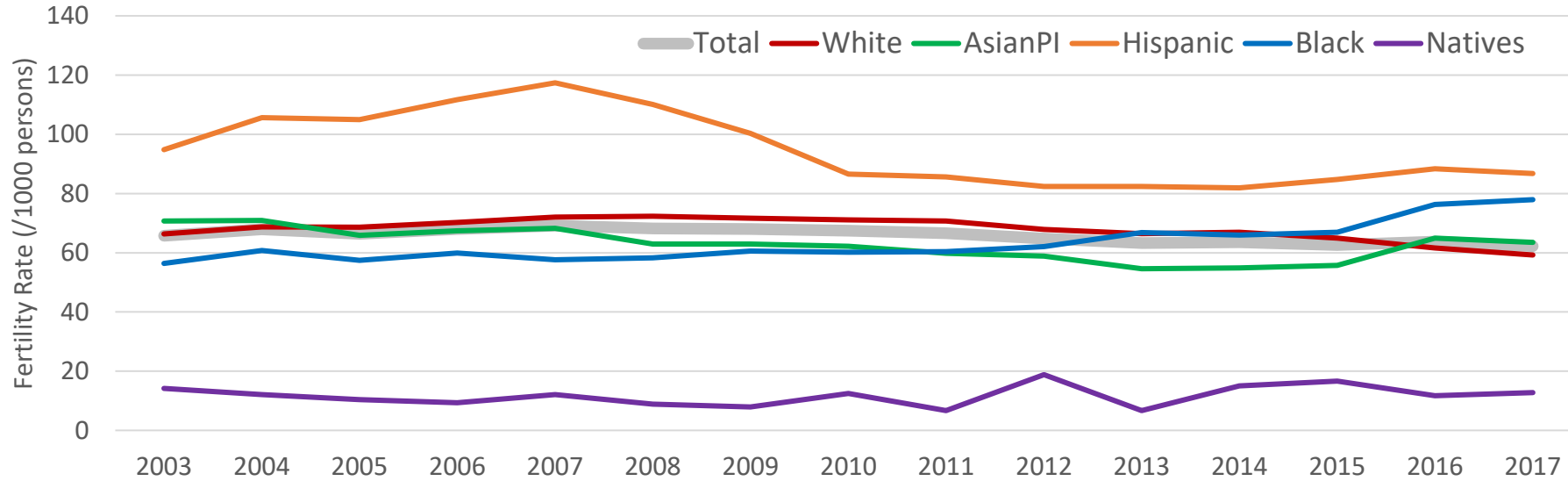No Migration

2015, Fairfax County, VA

2015, Fairfax County, VA

High Birth Rate

Low Birth Rate

Birth

Fertility Rate by Race and Ethnicity in Fairfax County, VA (2003-2017)

Legend: Total, White, AsianPI, Hispanic, Black, Natives

Fertility Rate by Age Group in Fairfax County, VA (2003-2017)

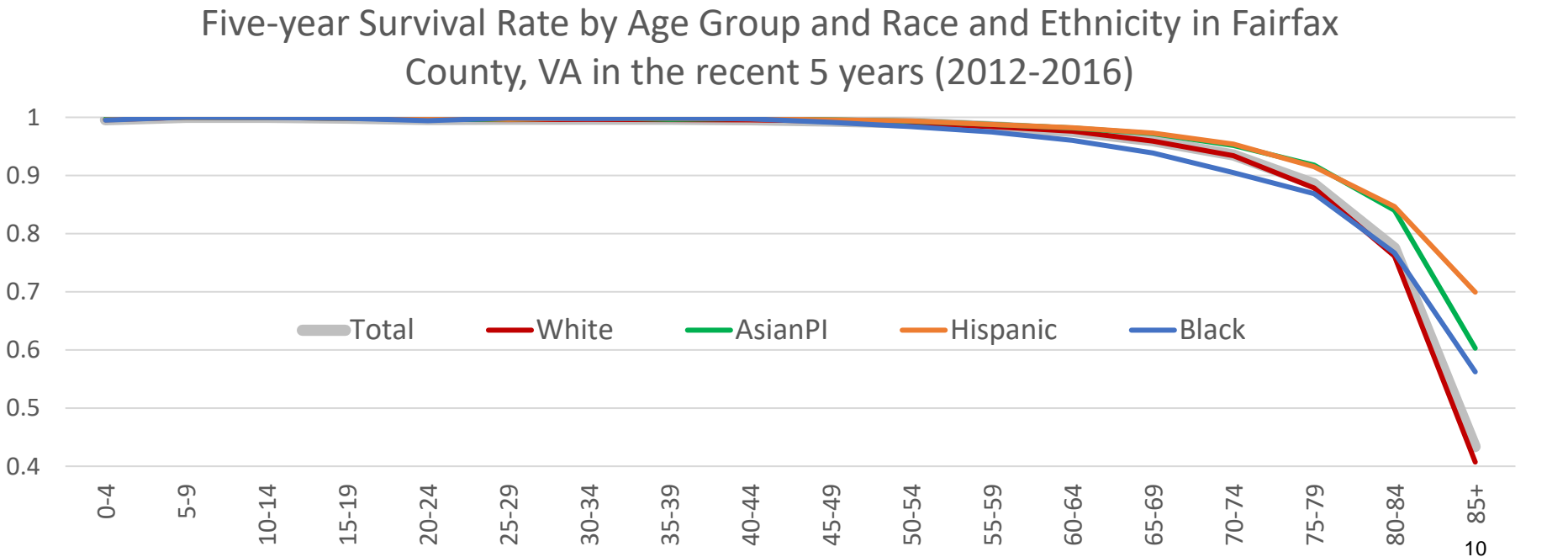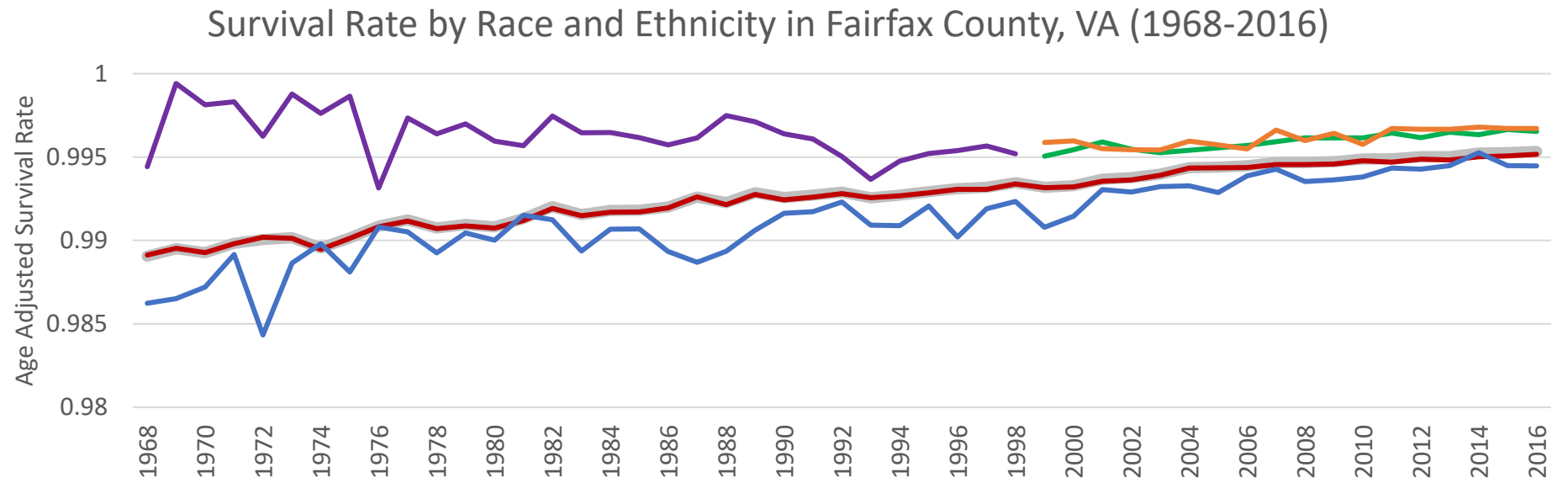Legend: Total, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54

Note: Hispanic include all races.

Source: CDC WONDER Online Database, 2018.

9
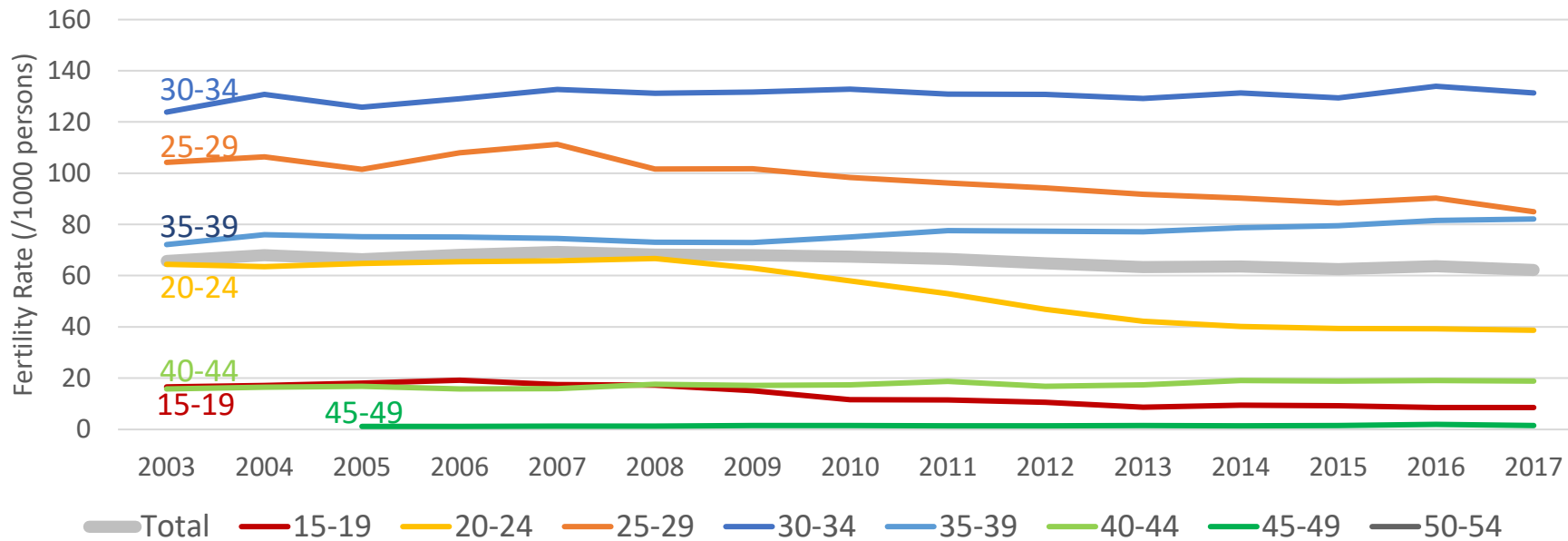
Survival

Hispanic paradox/ Latino paradox

Survival Rate by Race and Ethnicity in Fairfax County, VA (1968-2016)

Five-year Survival Rate by Age Group and Race and Ethnicity in Fairfax County, VA in the recent 5 years (2012-2016)

Note: Hispanic include all races.

Source: CDC WONDER Online Database, 2018.

Conclusions

Population and economy will continue to grow

Migration is an important contribution to sustain population growth and stabilize age structures.

Pattern of birth and death are changing – in the recent decades birth age went up, and death rate went down, but at a very slow changing rate, and with variation among different population groups.

Housing development is planned in line with population growth and economic growth.

➢ Assuming the current rates of birth, death, and migration sustain, Fairfax County will maintain a stable and gradual population growth and balanced age structure. The working-age population will be steadily the majority, the younger age group would have a slight proportional decline, and elders would have a slight proportional increase.

➢ Migration is the major contributing factor to maintaining stable population growth and a balanced age structure.
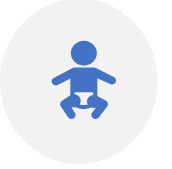
➢ Overall birth rate or fertility rate kept stable in Fairfax County since the 2000s, with birth age of mother slowly increase, and there is a variation of birth rate among different population groups.

➢ Survival rate increased since the 1960s, with Hispanics and Asians having the highest survival rate in their late ages.

➢ Our housing development is forecasted to coordinate with the population growth well in general, with certain areas getting a higher concentration of housing development, which will be mainly in Multi-Family structures. A small shortage of housing could happen, but this should be in the adjustable range, for example by a slightly higher average household size, or reduced vacancy rate.

➢ Employment is projected to steadily grow, with a geographic focus in line with population growth, and mostly in the type of office jobs.
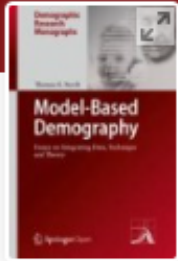
Model-Based Demography pp 135–151 | Cite as

The Cohort-Component Population Projection: A Strange Attractor for Demographers

Thomas K. Burch

Chapter | Open Access | First Online: 14 October 2017

10k Accesses | **2** Citations

Part of the Demographic Research Monographs book series (DEMOGRAPHIC)

Demographic Research Monographs

Thomas K. Burch

Model-Based Demography

Essays on Integrating Data, Technique and Theory

This chapter touches on three questions, although not separately or systematically:

1. Why did the CCP model become the dominant tool for population forecasting?
2. Why has it remained dominant for so long, to the near exclusion of other methods?
3. What will be its future status?

https://link.springer.com/content/pdf/10.1007/978-3-319-65433-1_10.pdf

…"the standard CCP algorithm is limited, linear, and 'open loop,' and assumes continuity in fertility, mortality and migration"….

Advantages

- Accounting for the past
- Contingent but the confident prediction
- Guide to future intervention
- Details of the age-sex composition
- Continuity as a first approximation
- A powerful and flexible abstract model

- **Easy mathematics**

Further questions

- Why did the CCP model become and remain that one technique, despite its many and well-publicized predictive failures, and relatively early criticisms of the continuity assumptions underlying the technique?

- Swanson *et al.* ([1996](#)) have argued that the prime requirement of applied demographic analysis is that it support sound decision making, including decision making that is timely and within cost constraints.

"…A more fruitful view might be to see it first and foremost as a theoretical model of population dynamics, useful for many different purposes. At the same time, other approaches to population forecasting should be given greater attention, approaches with both advantages and disadvantages compared to the cohort-component approach…."

Resources

- Fairfax County Demographics

https://www.fairfaxcounty.gov/demographics/

- Census Bureau
https://www.census.gov/data.html

- CDC Wonder

https://wonder.cdc.gov/

- Model-Based Demography

https://link.springer.com/content/pdf/10.1007/978-3-319-65433-1.pdf

- UNFPA PAPP101, International Union for the Scientific Study of Population

PAPP101 - S10: Population projections: concepts and methods (iussp.org)

- Applied Demography Toolbox

https://applieddemogtoolbox.github.io/

- Census Bureau Demographic Analysis & Population Projection System Software

https://www.census.gov/data/software/dapps.html