GAO

Session G-1: Insights from the Congressional Watchdog on Equity in Evaluation Design

Assessing Disparities in FEMA Flood Map Investments using Multivariate Analysis

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Presentation Overview

- Background/Issues/Challenges
- Data
- Geospatial Analysis
- Methodology/Analysis
- Findings
- Impact of Work

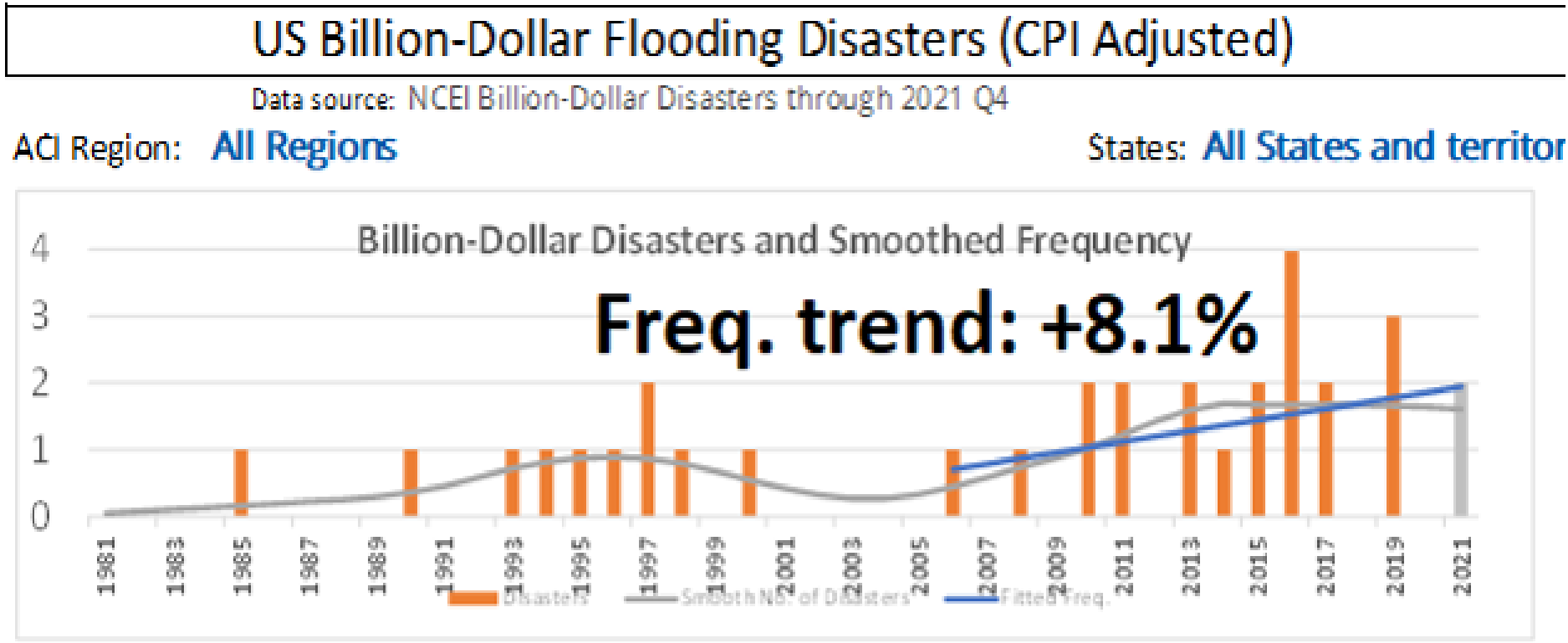
Flood

- Flood is the number one (frequently, costly, deadly) nature disaster in the US
- National Flood Insurance Program (NFIP) – Federal Program established in 1968

Estimated Loss* from Hurricane Ian

- NFIP:
  - $10-$13 billion
- Private Market
  - $7 billion (BL)
  - $46-$67 BL

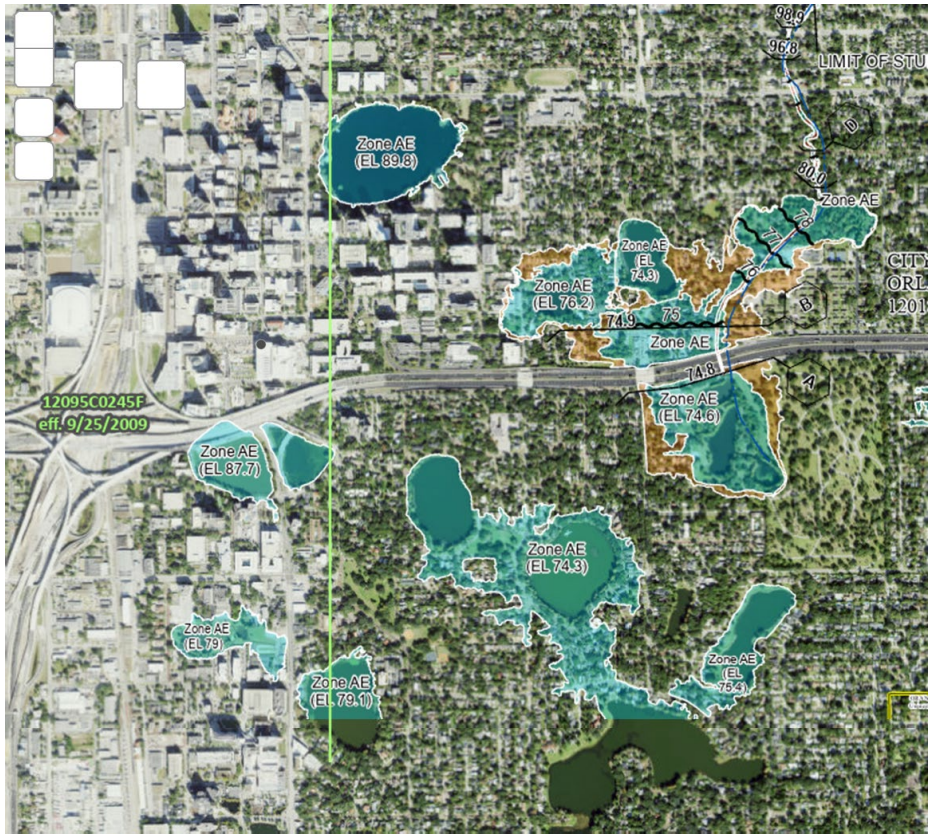
*Projected estimate made by CoreLogic



What are Flood Maps?

- FEMA Flood Maps are created and updated to identify the extent of flood risks and set
  - Mandatory purchase requirement for NFIP
  - Special community building standards.

- Spending/Investment
  - $2.3 billion on flood hazard mapping from 2014-2020 ($414 million annually since 2019)
  - 1.2 million miles of Flood Maps, over 22,500 maps cover “NFIP communities”, with differing levels of “details”



FEMA Mapping Process

- Started at the FEMA community level
- FEMA's 10 Regional offices collaborates with State and Local Governments to prioritize where to create or update new flood maps
- Only a third of the US territory currently falls under US flood maps

Has FEMA's map investments been aligned with its strategic priorities: areas with higher risk for flooding and vulnerable/underserved populations over the years?

Definitions and Challenges

Risk: Function of 3 factors: Threats / Vulnerabilities / Consequences

Equity:

- GAO Yellow Book: GAO-21-368G: *"…program provides equitable access to or distribution of public resources within the context of statutory parameters;"*
- *Executive Order 13985: "… Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*
- FEMA Strategic Plan: "… Achieve Equitable Outcomes for Those We Serve"

GAO's objectives:

1. To what extent has FEMA developed flood maps (FIRMs) products that reflect current and future flood hazards?
2. 2. To what extent has FEMA assessed its mapping program's efforts to enhance flood resilience, …?

3. How has FEMA prioritized its mapping resources in determining where to create and update its maps and flood risk products over the years?

FEMA Data

FEMA's Administrative data for Flood Map:

- Coordinated Needs Management Strategy (CNMS) - geospatially-enabled platform
- New, Validated, or Updated Engineering (NVUE) - standard and performance metric
- Project Planning And Purchase Portal (P4) - multi-year cost and budget estimation tool
- Map Information Platform (MIP) - +500 mapping standards, guidance, technical reference

FEMA's Open-Source, Risk Assessment Tools

- National Risk Index (NRI) - risk assessment for 18 natural disasters
- Resilience Analysis and Planning Tool (RAPT) – hazard and infrastructure information, as well as 20 community resilience indicators (including ACS data)
- Community Engagement Prioritization Tool (CEPT) - floodplain management, monitor and promote program compliance

FEMA has not made use of a variety of additional quantitative data that could inform its decision-making process

Methodology/Analysis

- Research Question: have FEMA's Flood Insurance Rate Maps investments for FY12-20 aligned with its goals:

prioritizing areas with the highest risks and areas with the most vulnerable populations

Measuring Flood Risks

- Flood zones (CNMS)
- Frequency, probability of flooding
- Exposure, expected annual loss
- Historical loss ratio
- Flood risk scores (NRI)

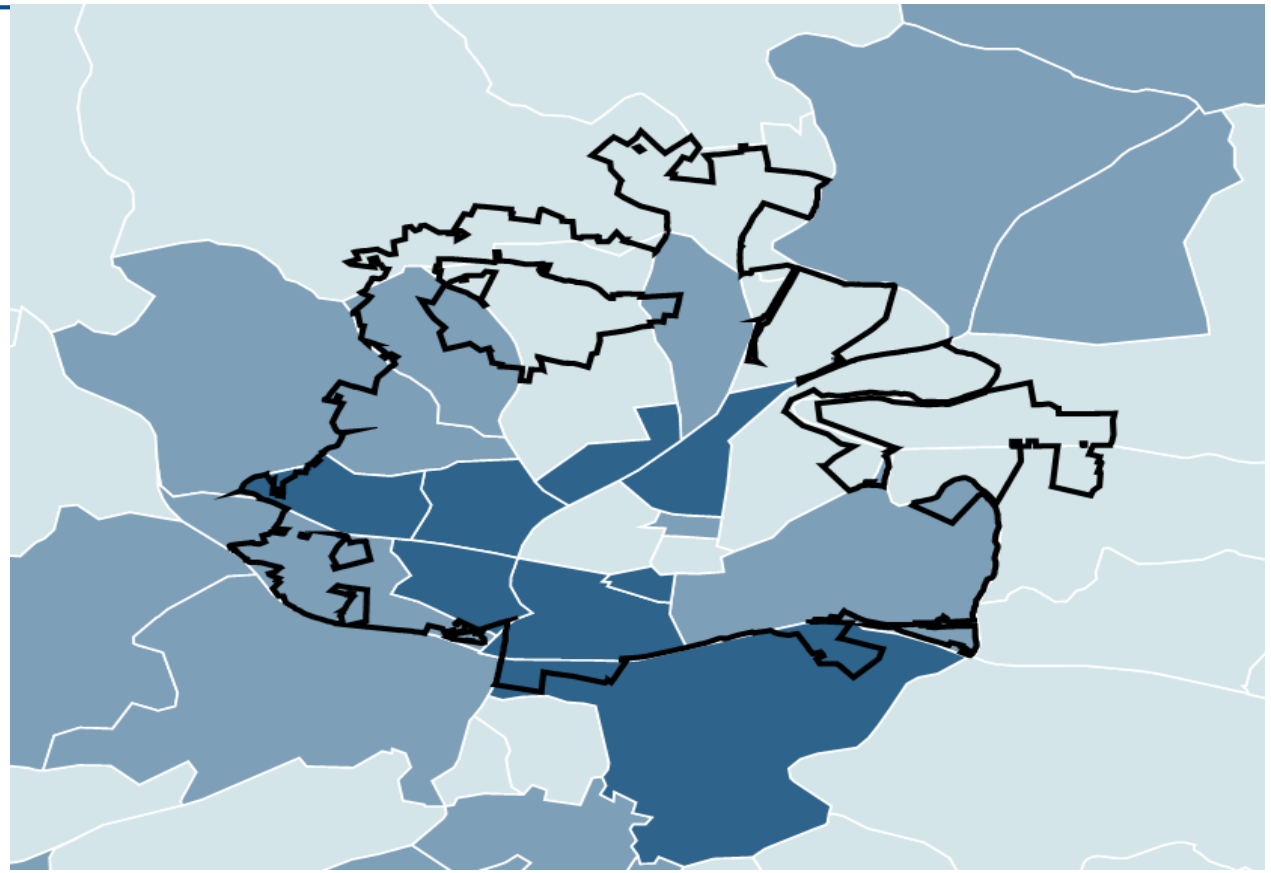
Measuring community vulnerability and resilience

- Social vulnerability score and rating (NRI)
- CDC Social Vulnerability Index (SVI) (CEPT)
- FEMA community resilience ratings (RAPT)

Data Challenges

- FEMA makes mapping decisions about whether to target investments at the individual project level, by FEMA communities
  - Over 22,000 communities

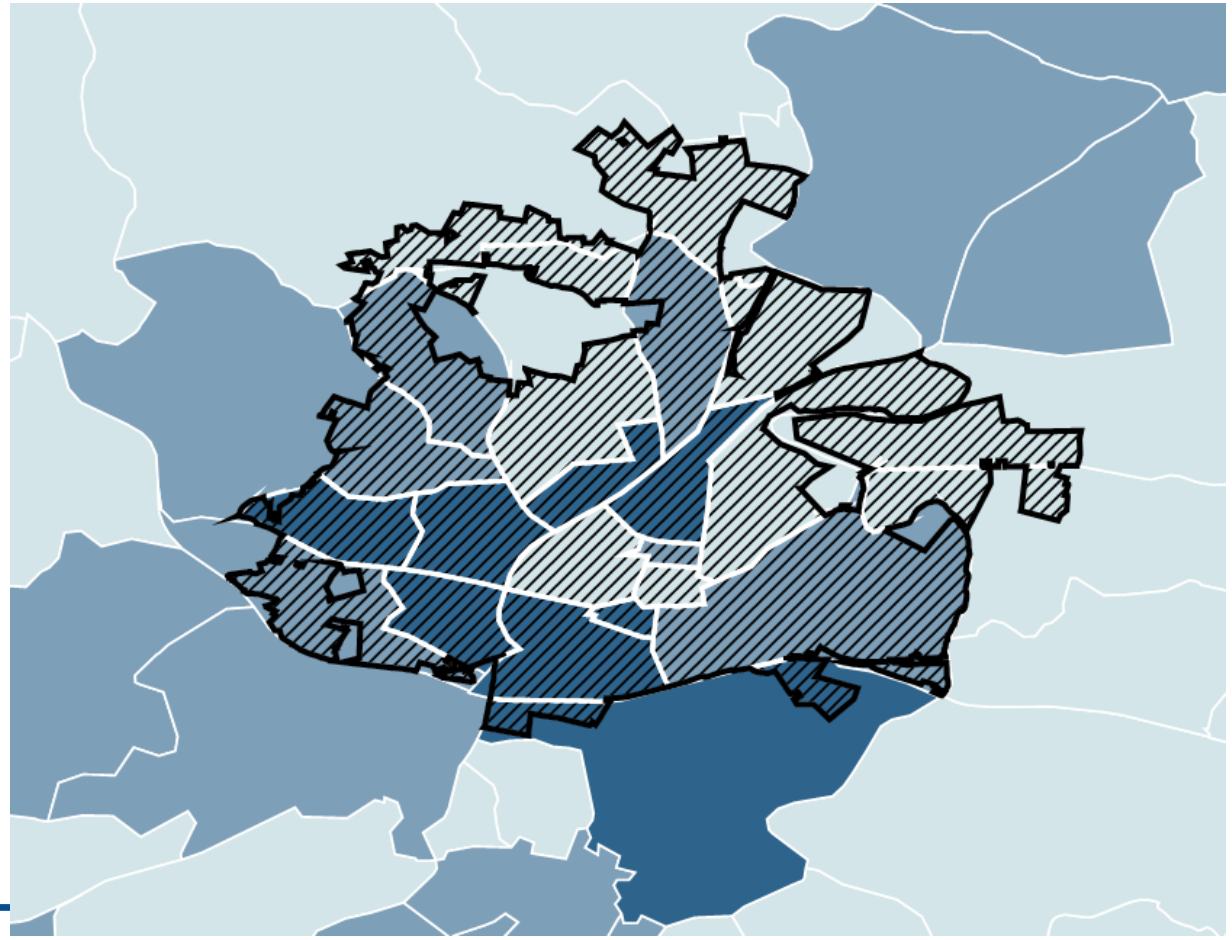
- FEMA measures of risk, vulnerability, and demographics are reported at the level of Census tract.



FEMA Community 240030: Frederick City, MD

Geospatial Analysis

- We conducted geospatial analysis to identify the Census tracts that were located inside of each FEMA community, either fully or partially
  - Overlaying the boundaries of Census tracts onto the boundaries of communities.
  - Community 240030 intersects with 24 censes tracts



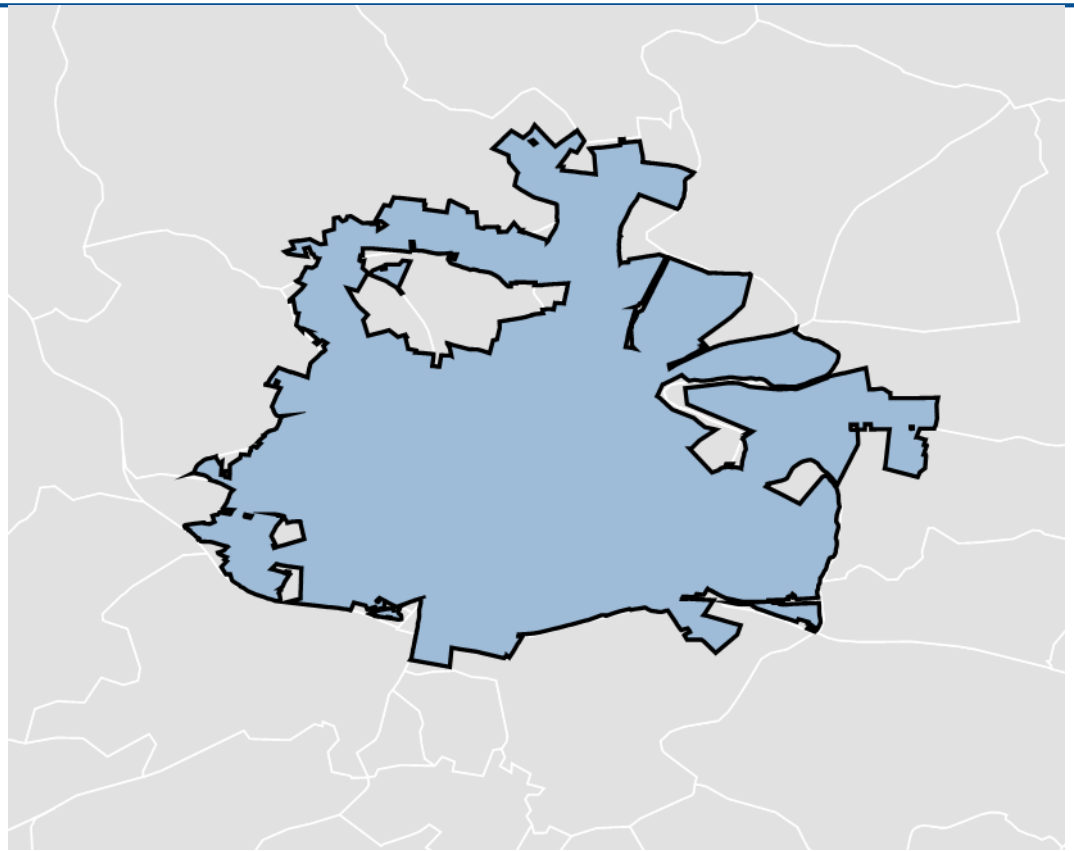
Social Vulnerability Index for Census Tracts, Frederick, MD

Geospatial Analysis

- Created the Crosswalk: calculating the area of each Census tract that was contained within each community and weights:

$$w_{ij} = \frac{Area\ of\ GEOID_j\ within\ CID_i}{Area\ of\ CID_i}$$

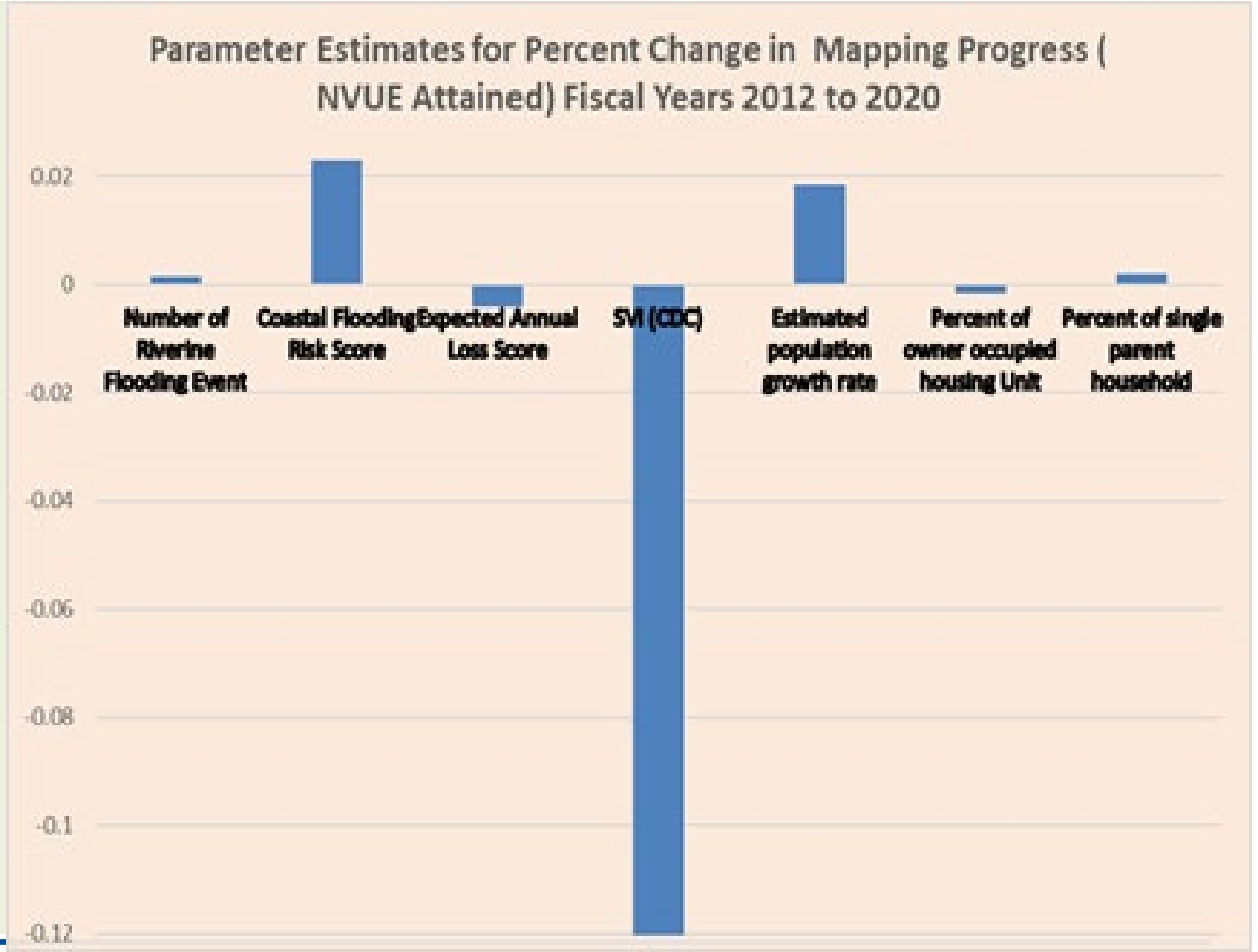
- Estimated the measures of risk, vulnerability, and demographics at the FEMA community level



FEMA Community 240030: Frederick City, MD

Evaluating FEMA Mapping Progress

- Measures of Program Outcomes
  - Product delivered (miles mapped)
  - Quality of the product (tiers, NVUE complaint)
  - How long it take to get the map updated
  - Cost/ ($) invested (FEMA P4)
- Multivariate analysis/modeling
  - Program outcomes linked to flood risks, vulnerability, resilience, and other characteristics
  - Variable selection using multivariate analysis
  - Choose the most **efficient** models
  - Sensitivity tests



Key Findings

- FEMA's mapping investments from fiscal years 2012 to 2020 were
  - greater where flood risks were higher, while controlling all other factors
  - lower for communities with higher levels of social vulnerability and underserved populations, other identified factors being equal

Communities with higher flood risks had

- more miles of digital maps
- greater increases in the percentage of mapped miles that met the NVUE standard
- shorter cycle times between the stages of FEMA's mapping process

Communities with higher levels of social vulnerability had

- more unmapped miles or paper FIRMs in FY12
- smaller increase in the percentage of mapped miles that met the NVUE standard
- longer cycle times between the stages of FEMA's mapping process

Modeling Summary/Takeaways

- Assessing program effectiveness and equitable services simultaneously
- Identified opportunity for making data-informed decision
- Addressing equity Issues
  - Data linking considerations (Unit of analysis, data credibility)
  - Using predictive analytics tools that fits your needs
  - Be flexible & asking the right questions
- Statistical Considerations
  - Sampling Error
  - Collinearity of inputs

GAO Report(GAO-22-104079)
FEMA Flood Maps: Better Planning and Analysis Needed to Address Current and Future Flood Hazards

Impact of work

GAO Recommendation: FEMA should consider ways to leverage and integrate available flood risk data, such as through statistical analyses, into its annual process for prioritizing flood mapping investments.

FEMA's response/progress:

- FEMA stated it has developed a new data tool that consolidates multiple datasets into its annual process for prioritizing flood mapping investments.
- FEMA will assess the incorporation of additional criteria into project selection, as is their continuation of the evolution for a more comprehensive, data-driven approach to project selection.

Other Connections:

- Current GAO works
- National Flood Conference
- National medias (*CNN, Business Insurance*, …)