Theoretical Inflation For Unavailable Products

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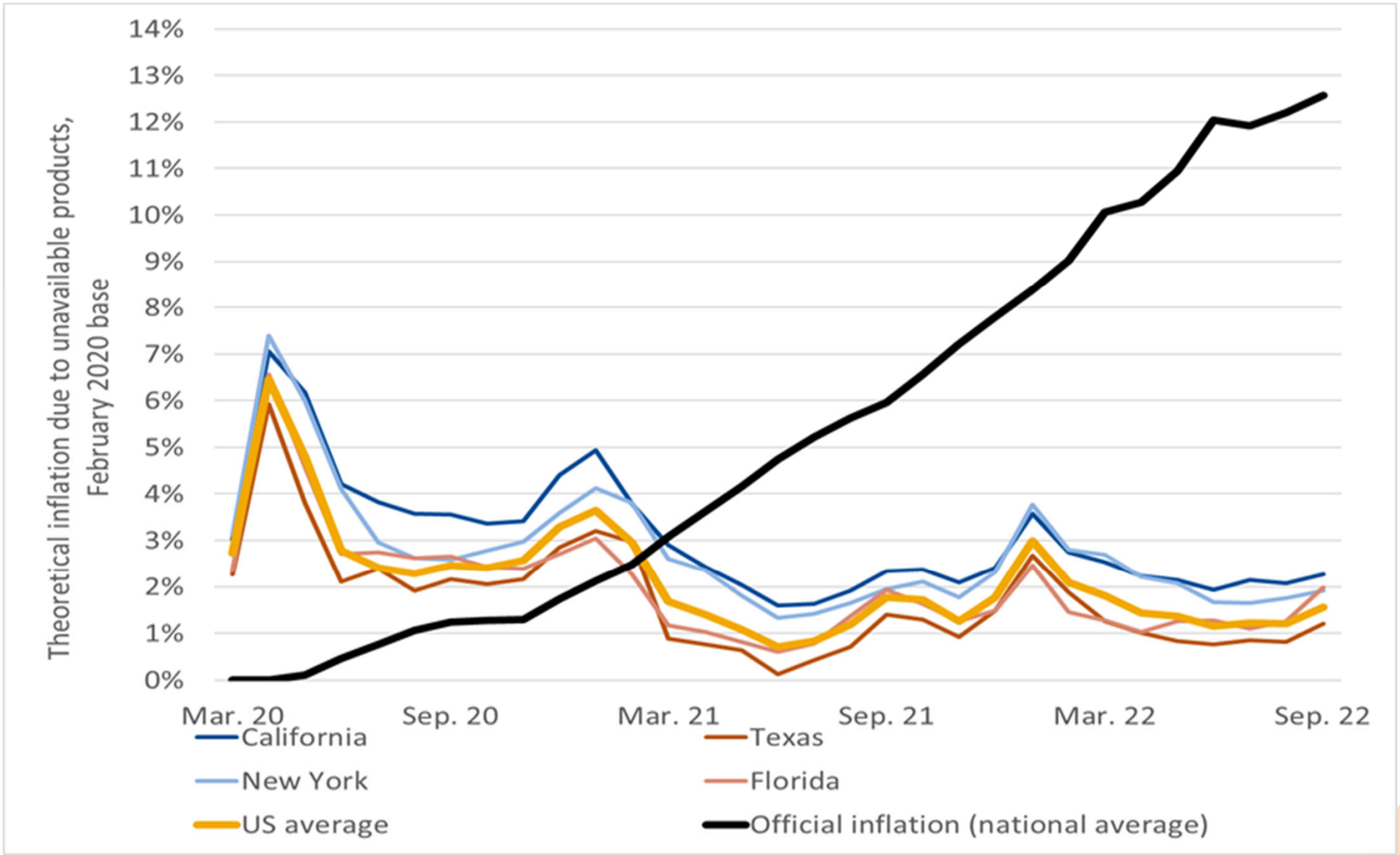
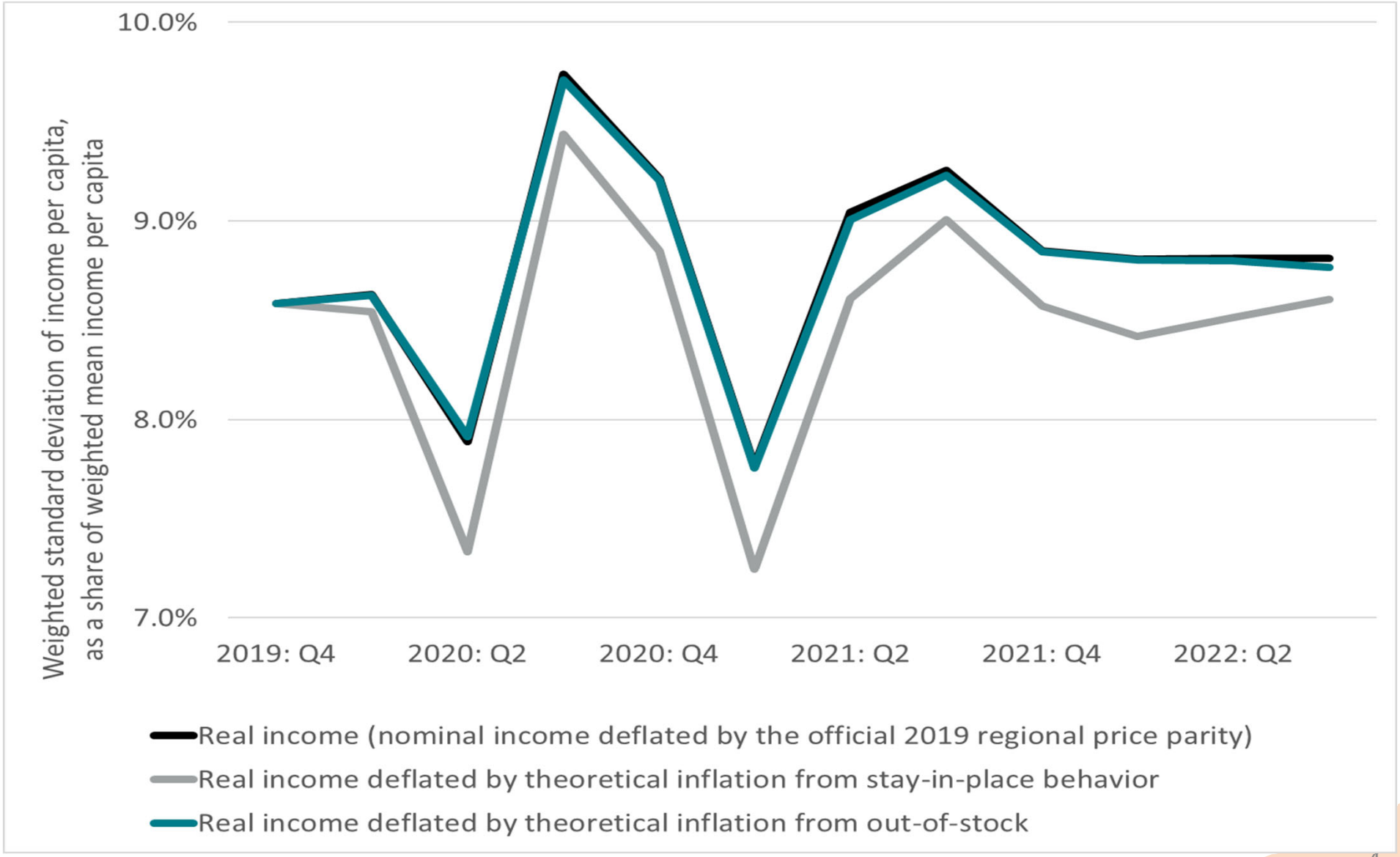
Outline of Talk

- Preview of empirical results
- Discussion of price measurement literature
- Imputing prices for unavailable products:
  - Official price index method
  - Theoretical method for products which are only available remotely
  - Theoretical method for products which are completely unavailable
  - Theoretical method for essential products which are out of stock
- Measuring theoretical inflation by state
  - Observed impact of actual stay-in-place behavior
  - Observed impact of supply chain disruptions

Preview of Results: Cumulative Inflation in U.S.



Preview of Results: Inequality Across States



Previous Price Index Research

- Theoretical papers studying imputed prices:
  - "New Goods": (Hausman 1999), (Hausman 1997), (Petrin 2002), (Goolsbee and Petrin 2004), (Berndt et al. 1996), (Nordhaus 1996), (Diewert and Feenstra 2019), and (Diewert et al. 2019)
  - "Outlet Substitution Bias": (Reinsdorf 1993), (Hausman and Liebtag 2009), and (Greenlees and Mclelland 2008)
  - "Variety Bias": (Feenstra 1994), (Broda and Weinstein 2010), (Handbury and Weinstein 2014), and (Dolfen et al. 2021)
- Measurement papers studying practical issues:
  - Price aggregation formulas: (Diewert 2003), (Diewert 2001), (Passero, Garner, and McCully 2015), and (Barret, Levell, and Milligan 2015)
  - Price weights in pandemics: (Cavallo 2020) and (Diewert and Fox 2020)

Theoretical Price Measurement Problem

- Standard price indexes summarize prices for products 1 to n into a single value
  - Laspeyres Price Index$_t$ = $w_{10}(p_{1t}/p_{10})+ w_{20}(p_{2t}/p_{20})+\ldots+ w_{n0}(p_{nt}/p_{n0})$
- Standard price index formulas require prices for every product in the market basket
  - Economists generally can't observe unavailable product prices
  - Some businesses might list a price for unavailable products – but that list price isn't economically meaningful

Official Price Index Imputation Method

- Products which are only available remotely:
  - BLS links remote prices at a retail outlet to the previous in-person prices at that retail outlet without adjustment
- Products which are completely unavailable:
  - BLS links each unavailable product with a similar available product and uses that product's observed prices as an extrapolator
- Products which are out-of-stock:
  - BLS links each unavailable product with a similar available product and uses that product's observed prices as an extrapolator
- These assumptions work well in normal economic times (Bradley 2003)

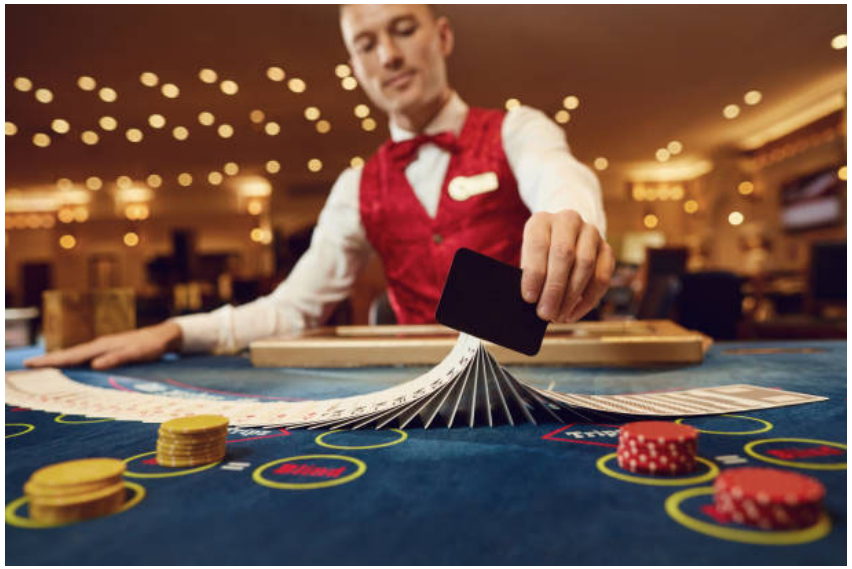
Nonessential Products, Available Remotely

- Assumption: remote shopping is only a partial substitute for in-person shopping
  - During stay-in-place behavior, individuals switch to remote only
  - The welfare loss from unavailable in-person shopping tracks the welfare gain from the introduction of remote shopping

Restaurant Meal: In-Person vs. Remote

Nonessential Products, Completely Unavailable

- Assumption: remote services aren't even partial substitutes for some in-person services
  - During stay-in-place behavior, individuals stop consuming
  - Assumption: the welfare loss from completely unavailable products tracks the welfare gain for tourists from specialized leisure amenities



Gambling: In-person vs. Remote

Essential Products That Are Out of Stock

- Assumption: shoppers have strong brand preferences and don't like substituting
  - About 31 percent of the time, the missing items are so important that shoppers visit another store to get them (Corsten and Gruen 2004)
  - The fixed cost of store visit is quintuple the average item list price

Formula: Fully Stocked vs. Partially Out of Stock

Calculating Theoretical Inflation

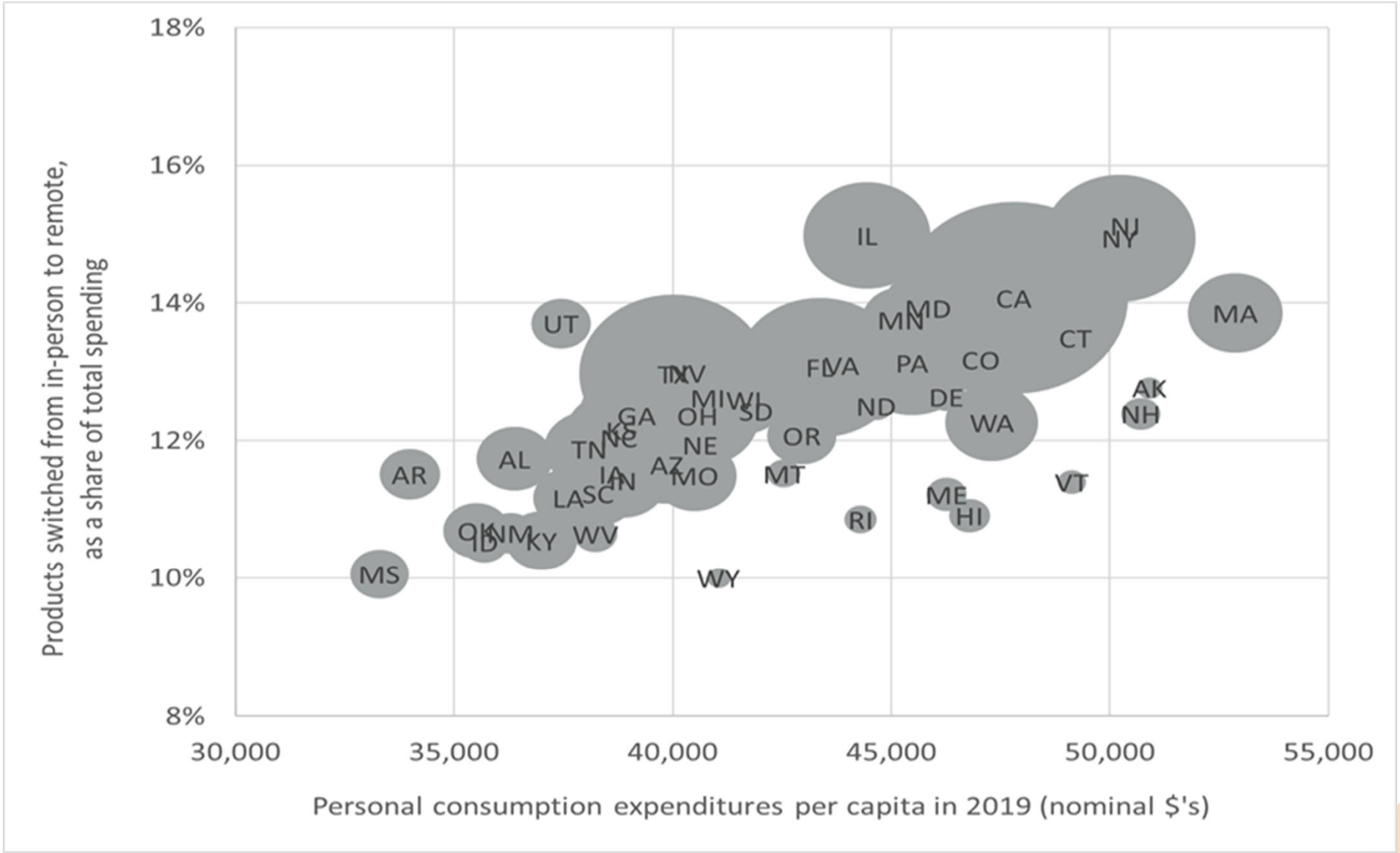
- Nonessential products, available remotely:
  - Elasticity of online shopping is estimated at 4.3 (Dolfen et al. 2021)
  - Theoretical price for product = (official price for product)*(1+1/4.3)
- Nonessential products, completely unavailable:
  - Elasticity for unavailable products is estimated at 1.7 based on a model of tourist behavior and BEA's regional price parities
  - Theoretical price for product = (official price for product)*(1+1/1.7)
- Essential products that are out of stock:
  - Welfare cost for unavailable products is assumed to equal the expected cost of the additional shopping trips required
  - Theoretical price for product = (official price for product)*(1+1.53)

Measuring Theoretical Inflation By State:
Hypothetical Impact of Full Stay-in-Place Behavior

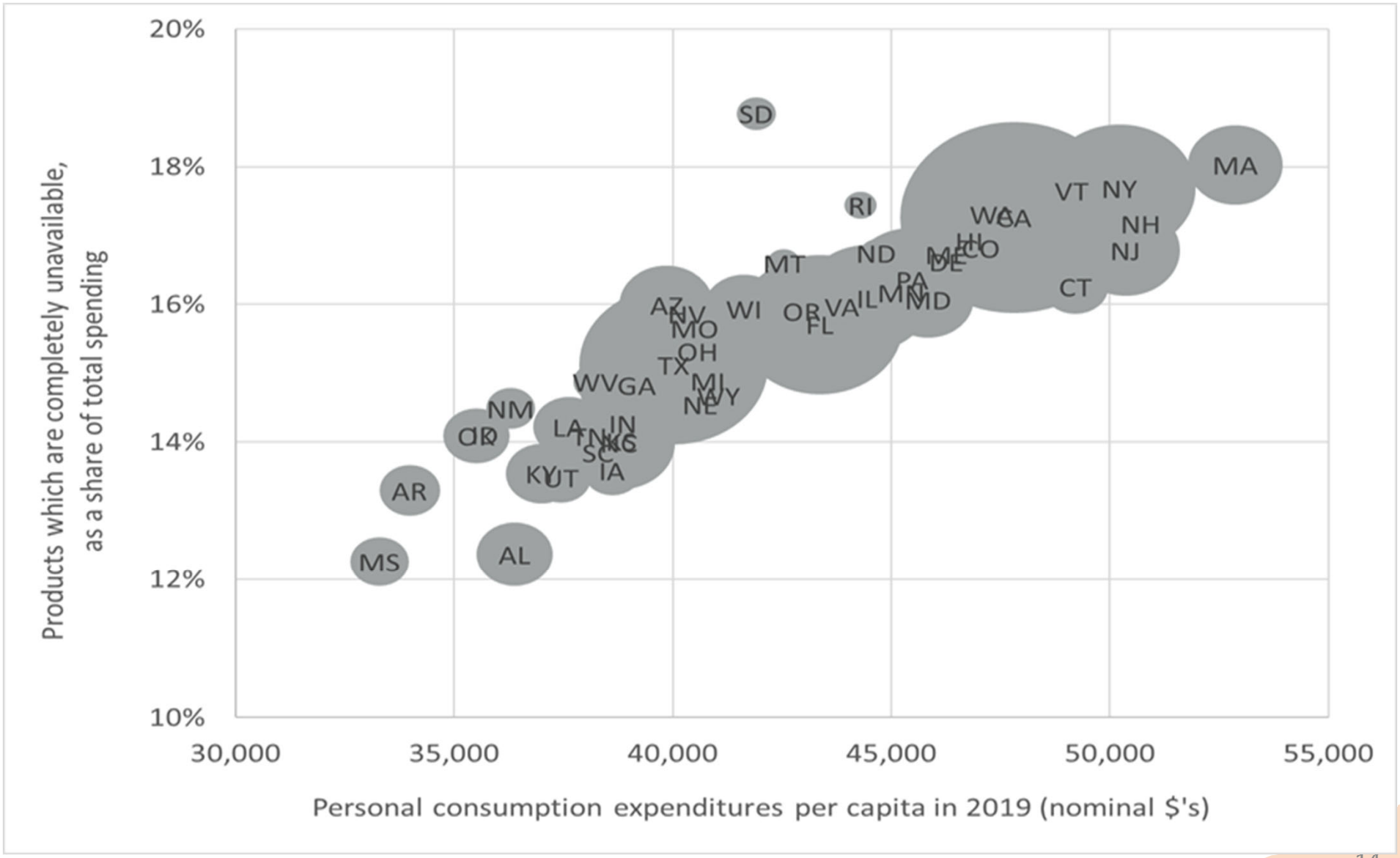
- Assumptions:
  - Goods and services purchased remotely in 2019 are available
  - Essential in-person services are available, but nonessential in-person services are either only available remotely or completely unavailable
  - Goods purchased in-person at essential retailers are available, but other goods are only available remotely

- Datasets used:
  - Product detail by state and industry from the 2017 Economic Census
  - BEA's statistics report 15 categories of consumer spending by state
  - Earnest Research reports remote shopping by purchaser residence
  - Section 2 of the paper estimates spending and availability for 52 subcategories of consumer spending by state

Nonessential Products, Available Remotely



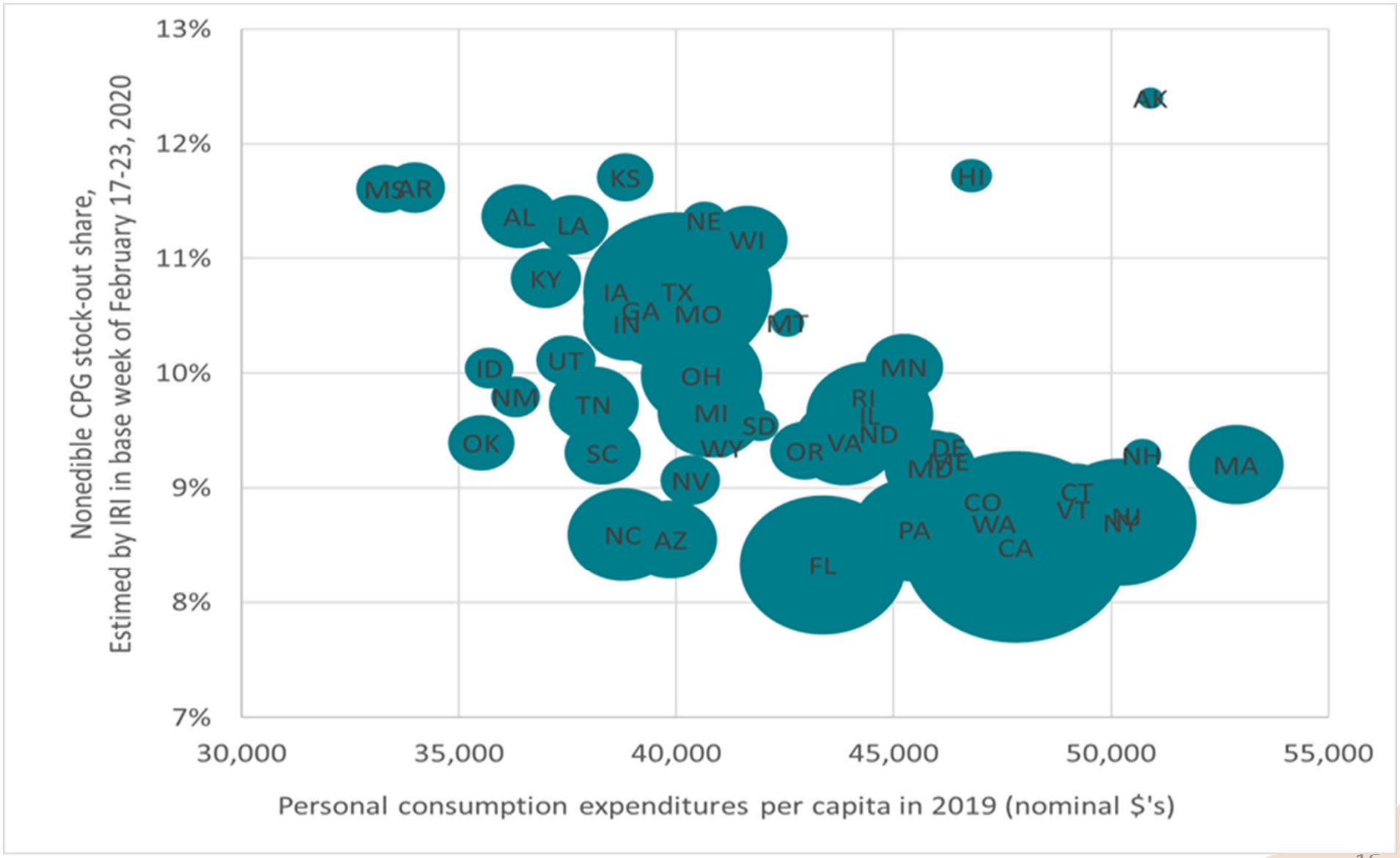
Nonessential Products, Completely Unavailable



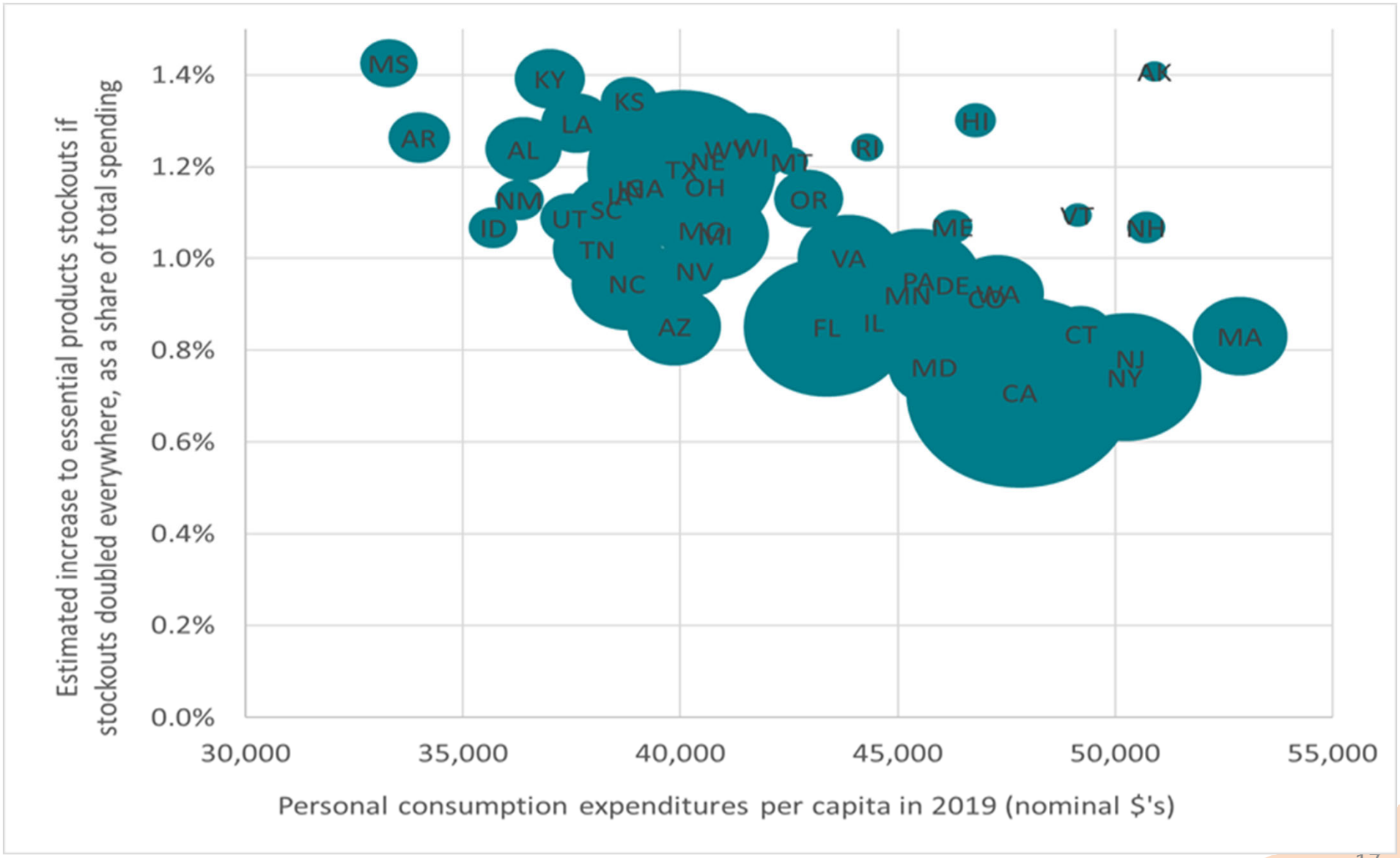
Measuring Theoretical Inflation By State:
Hypothetical Impact of Doubled Stockout Rate

- Assumptions:
  - Essential goods are never completely unavailable, so a stockout is an inconvenience rather than a cause of death
  - Nonessential goods which are unavailable can be purchased remotely
- Datasets used:
  - Product detail by state and industry from the 2017 Economic Census
  - BEA's statistics report 15 categories of consumer spending by state
  - IRI's published estimates of stockout rates for both edible and nonedible consumer packaged goods (CPG) in February 2020
  - Academic research giving stockout rates by product (Matsa 2011)

CPG Stockout Rate in February 2020



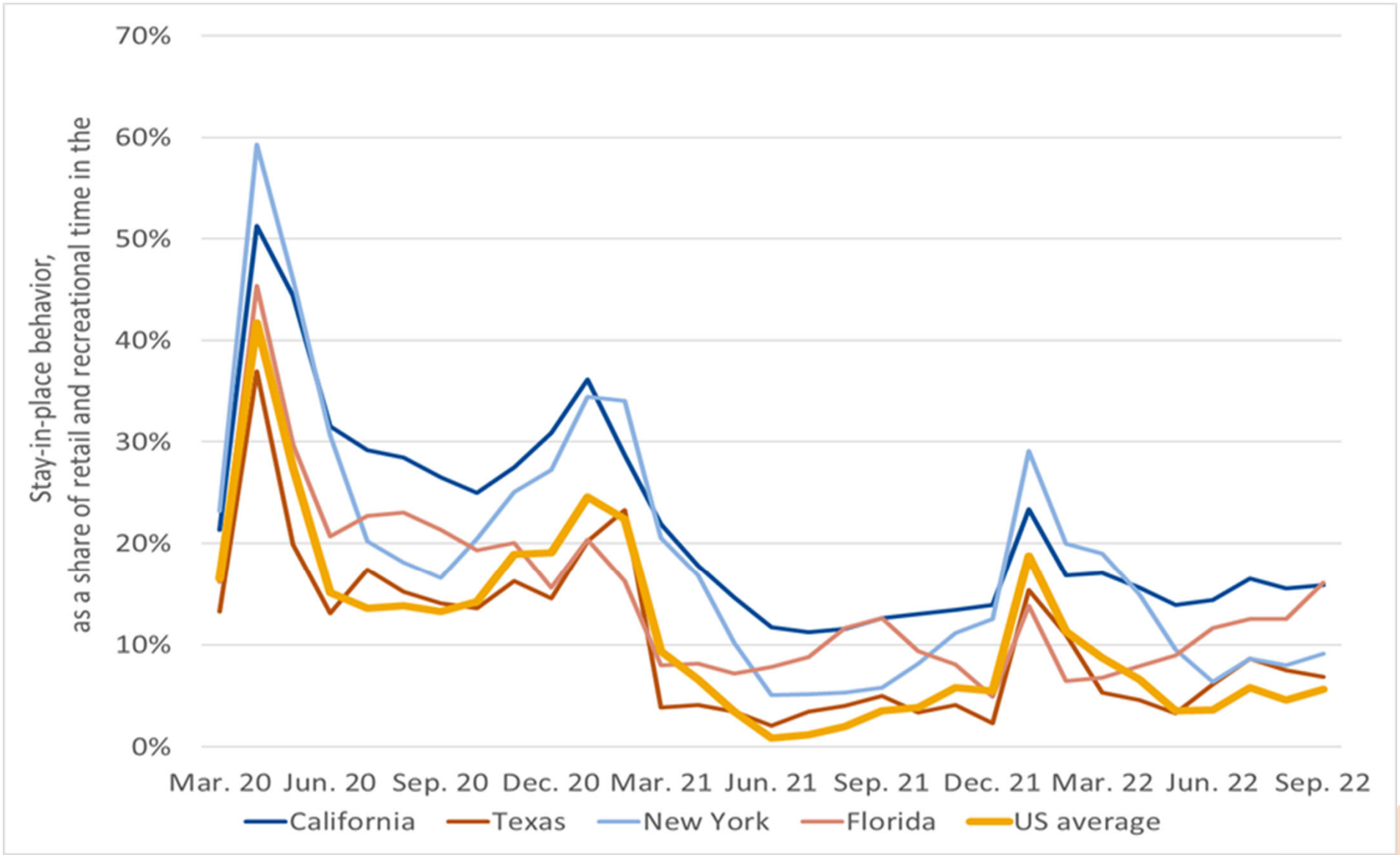
Essential Budget Share That is Unavailable,
Following a Uniform Doubling in the Stockout Rate



Measuring Theoretical Inflation By State:
Observed Impact of Actual Stay-in-Place Behavior

- Data tracking actual stay-in-place behavior by state and month was not located
  - Some sources track official government rules – but the actual stay-in-place behavior depend on voluntary choices as well as laws
- Google's COVID-19 community mobility reports are used to proxy for theoretical inflation:
  - Assumption: time spent at retail and recreational locations proxies for availability of nonessential products sold both there and elsewhere
  - Assumption: Google's sample of smartphones is representative of overall consumer spending
  - Assumption: theoretical inflation is linearly with product unavailability

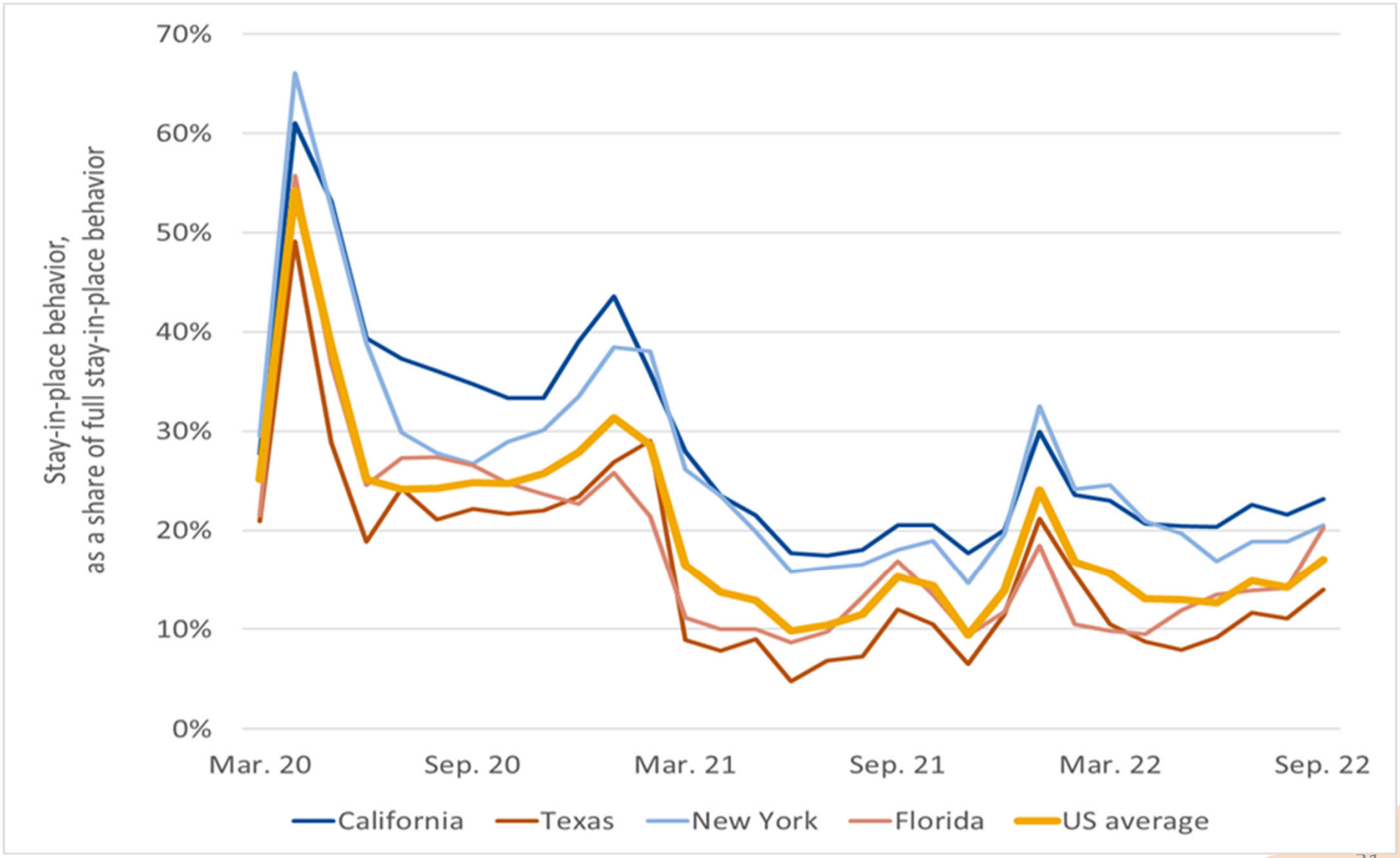
Stay-in-Place Behavior, Unadjusted



Adjustments to Google's Retail Time

- Daily retail time is higher during moderate weather, so the paper controls for daily weather
  - Early sunsets and short days also reduce retail time
  - The impact of weather is similar before and during coronavirus
- Daily retail time is adjusted for holidays using data from the American Time Use Survey (ATUS)
- Google's category 'retail and recreation' includes essential stores – so retail time can't fall to zero
  - Adjusted mobility formula: (observed mobility)/(potential mobility)

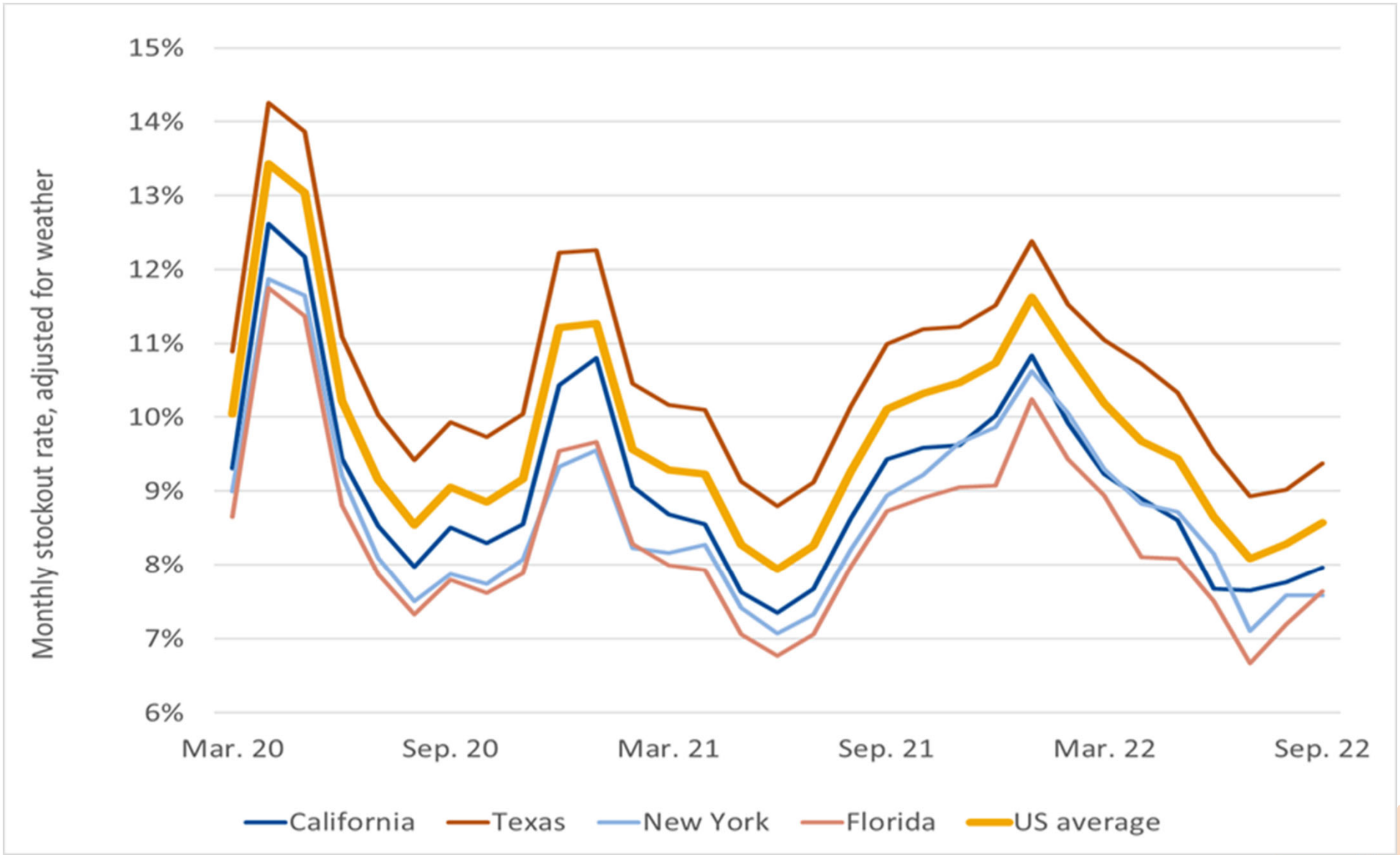
Stay-in-Place Behavior, Adjusted for Weather



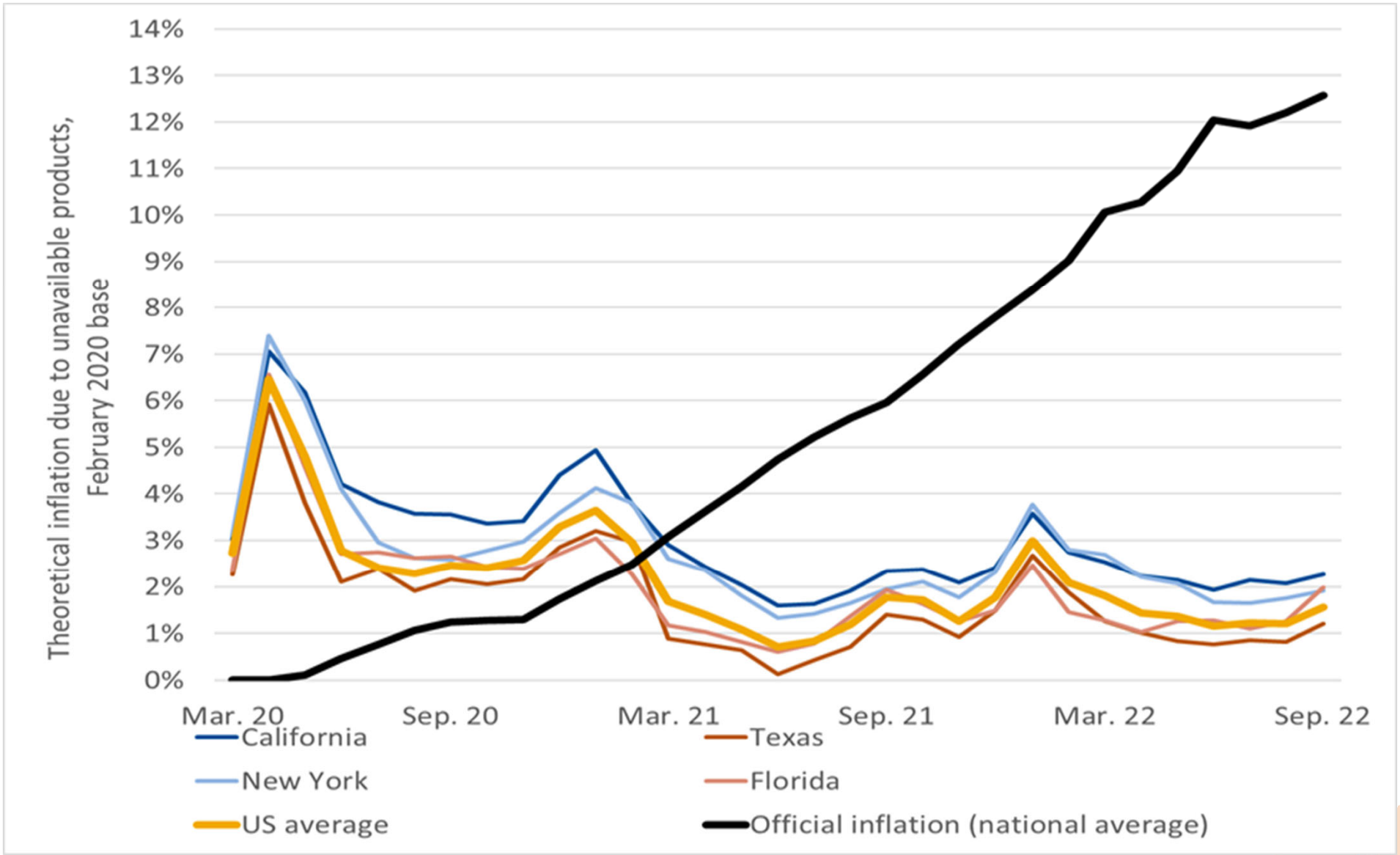
Measuring Theoretical Inflation By State:
Observed Impact of Actual Stockouts

- Data tracking overall product stockouts by state and month was not located
- IRI's published estimates of consumer packaged goods (CPG) stockouts are used instead
  - Assumption: stockouts of gasoline during the Colonial Pipeline hack are unrelated to coronavirus and therefore excluded
  - Assumption: the retailers who are in IRI's sample are representative of overall consumer spending
  - Assumption: theoretical inflation is linearly with product unavailability
  - This paper adjusts IRI's data for weather and product mix

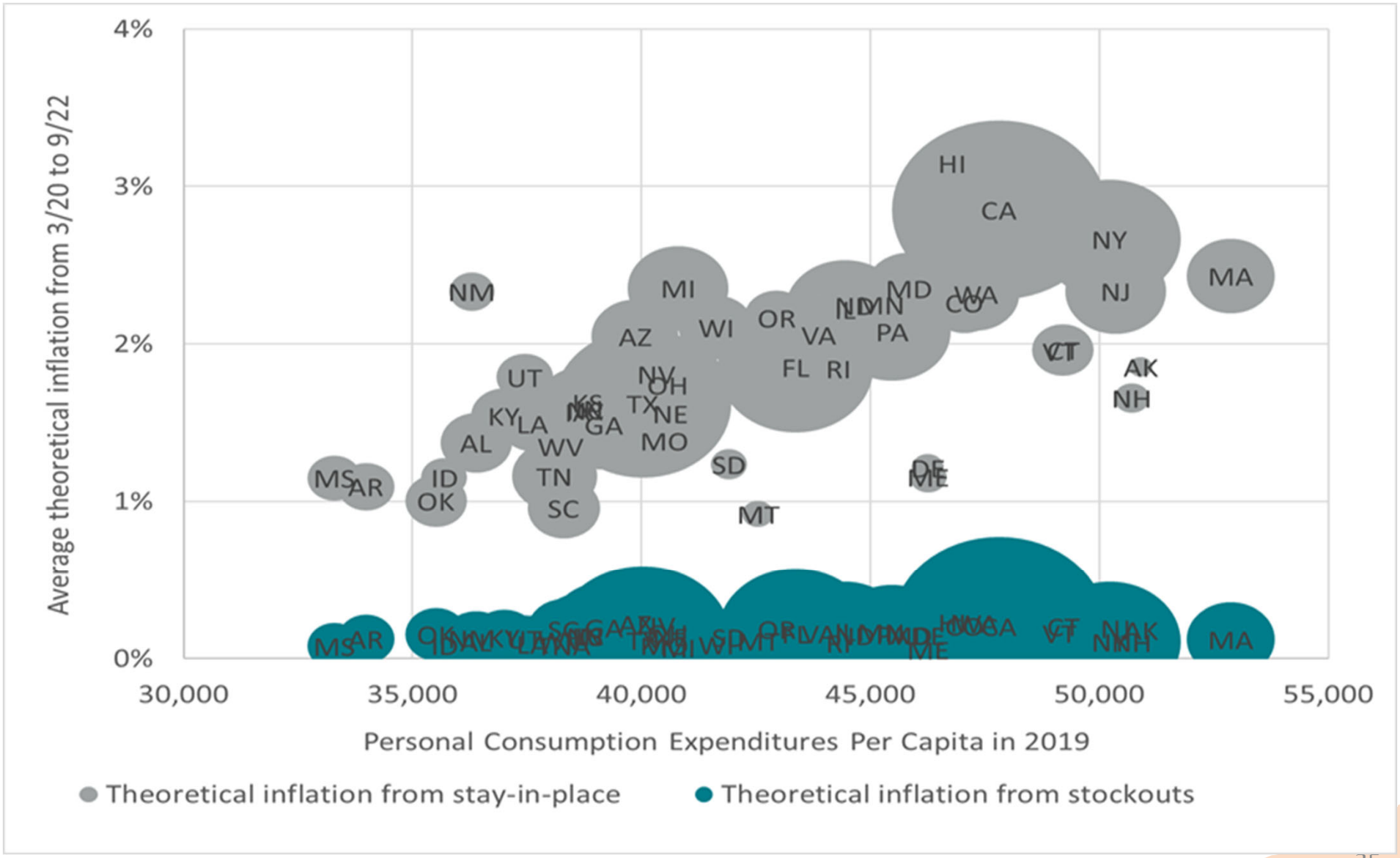
Stockout Rates, Adjusted for Weather



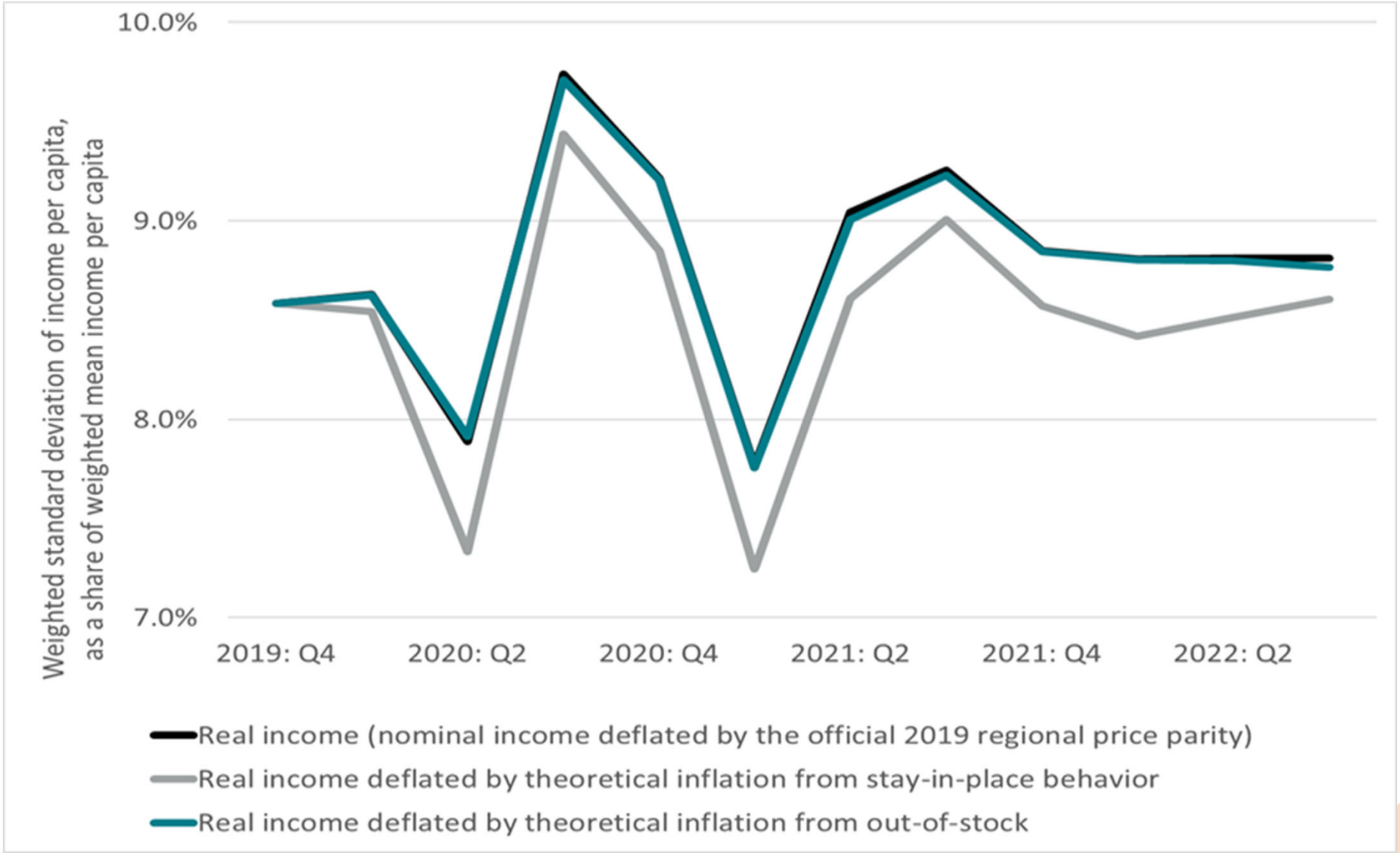
Cumulative Inflation



Theoretical Inflation By State



Inequality Across States by Quarter



Conclusion

- This paper developed a simple formula to calculate theoretical inflation when products are unavailable
  - The theoretical model in this paper does not imply any data problems or computational mistakes with published government price indexes
- Revisions to monthly inflation:
  - 0.11 (official) vs. 0.38 (theoretical) percentage point for 2020
  - 0.50 (official) vs. 0.37 (theoretical) percentage point for 2021
  - 0.49 (official) vs. 0.48 (theoretical) percentage point for Q1-Q3 2022
- Wealthy states have more theoretical inflation