Mapping Human Mobility During the COVID-19 Pandemic

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Apr 25, 2024 - Economy

Visitors are returning to most — but not all — of America's downtowns

METRO

Midtown, Lower Manhattan foot traffic down 33% — one of worst post-COVID rates in US

By Carl Campanile
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261 Comments

Aug 8, 2023 - News

Downtown San Francisco's foot traffic still lags

Research Questions & Contribution

- Q1: How can we quantify the nationwide declines in visits using big data?

  ▶ Contribution: Extend analysis with a larger panel, including non-urban areas (Yabe et al., 2023).

- Q2: How effective were pandemic-era policies in restricting visits?

  ▶ Contribution: First (known) study to evaluate the effect of COVID policies on long-term visit patterns in 2022.

Advan Monthly Patterns

- Dataset of monthly cell phone location records for approximately 40 million individuals from 2019–2022.

  - A visit is logged when a device is detected at a commercial location, such as Walmart.
  - The sample is not fully representative but broadly approximates the U.S. population (Li et al., 2024; Grigoropoulou and Small, 2024).

- Visits are aggregated across locations, covering 98% of Census Tracts.

- Enables analysis of visit patterns across geography and time (Q1).

Figure: Nationwide Visits Time Series

Visits remain 10% below 2019 levels throughout 2022 following the initial shock.

Oxford COVID-19 Government Response Tracker
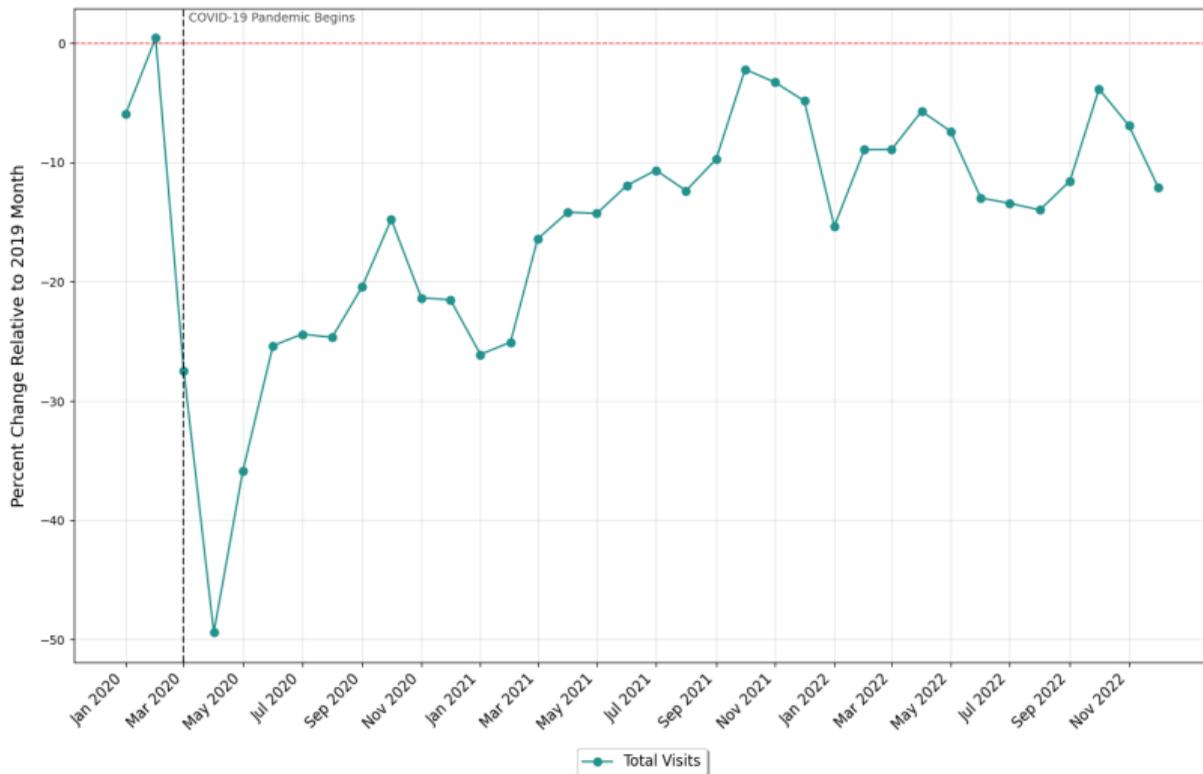
- Dataset documenting state-level COVID-19 policies from 2020-2022 (Hale et al., 2021).
  - ▶ Tracks measures such as school and workplace closures, gathering restrictions, stay-at-home requirements, etc.

- Policies are converted into standardized scores and combined into a single variable called the stringency index.
  - ▶ Provides comparable measures of COVID-restrictions across states and over time.

- Variation across states and over time in the stringency index enables identification of COVID policy effects on visits (Q2).

Figure: Mean Stringency Index by Census Division

State policies diverge across regions after early 2020, enabling identification.
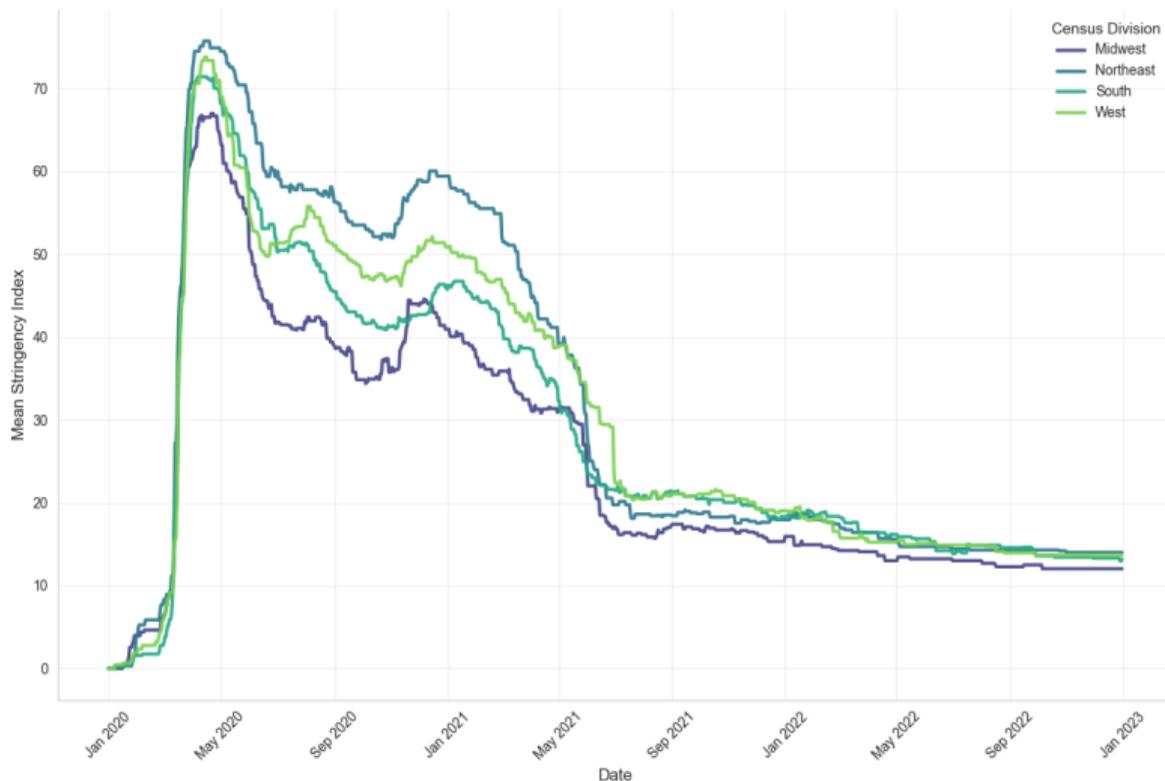
Empirical Strategy

- Leverage county-border pairs to compare similar neighboring counties subject to different policies.

  ▶ "Twin" counties that sit on opposite sides of a state border share local economic and epidemic conditions, but were subject to different COVID policies.

  ▶ Example: Rensselaer County, NY and Berkshire County, MA are neighboring counties separated only by the state line.

  ▶ Allowing multiple county matches yields $33,360$ county-border pairings.

- Regression specification:

$$\ln y_{ipt} = \alpha + \beta\, \text{Stringency}_{i,t}^{\text{z-score}} + \gamma_i + \delta_{p \times t} + \epsilon_{ipt}$$

  ▶ y_{ipt} = aggregated visits in county i, border-pair p, time t.

  ▶ γ_i = county fixed effects.

  ▶ $\delta_{p \times t}$ = border-pair-by-time fixed effects.

  ▶ Standard errors clustered at state and border-pair levels.

Table: County-Border Pairs Regression

	Log Total Visits					
	All Counties				Border Counties	
	(1)	(2)	(3)	(4)	(5)	(6)
Stringency Index (z-score)	−0.060***	−0.039***	−0.052***	−0.034***	−0.065***	−0.020**
	(0.015)	(0.011)	(0.011)	(0.009)	(0.014)	(0.008)
County FE	✓	✓	✓	✓	✓	✓
Year-Quarter FE	✓	✓	✓	✓	✓	✓
Year-Quarter × Census Division		✓	✓			
State Linear Time Trends			✓			
Year-Quarter × MSA				✓		
Year-Quarter × County Pair						✓
Observations	44,912	44,912	44,912	26,208	33,360	33,360

Takeaways

- Cell phone data indicates nationwide visits remain about 10% below 2019 levels through 2022.
  - The composition of who visited which places (e.g., segregation) stays consistent, while the total number of visits declines.

- Using the county-border design, stricter COVID policies are associated with lasting 2% reductions in visits in 2022.
  - Declines are larger in interior counties than border counties, suggesting spillover effects from neighboring states.

Thank you to IAES and all those that listened!