The Short(ish)-Run Effects of Congestion Pricing in New York City

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Hunt Allcott[24] Neha Arora[1] Freek van Sambeek[2] Andrew Tomkins[1] Eray Turkel[1]

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Motivation

Source: Fox 5

Motivation

New York says 1 million fewer vehicles have entered Manhattan since congestion pricing start

By **David Shepardson**

January 29, 2025 1:45 PM PST · Updated 2 months ago

Source: Reuters

This Paper

- What happened inside the Central Business District (CBD)?
  - ⇝ Speeds improved ∼10%
  - ⇝ Not much effect on air quality, visits to shops and restaurants, or foot traffic
- Were there spillover effects outside the CBD?
  - ⇝ Yes. Roads throughout the NYC metropolitan area got faster
- What have we learned about congestion pricing policy (in NYC)?
  - ⇝ Welfare gains come from the unpriced trips
  - ⇝ Still room for significant speed increases on some roads (but not all)

Data

- Aggregated + anonymized stats from Google Maps trips (Sept. 2024-June 2025)
  - **Segment-level outcomes**: hourly volume-weighted outcomes at the "road" level
    - traversal speeds
    - estimated fuel consumption
  - **Origin-Destination outcomes**: hourly volume-weighted outcomes at the "trip" level
    - realized trip travel times and speeds

Data

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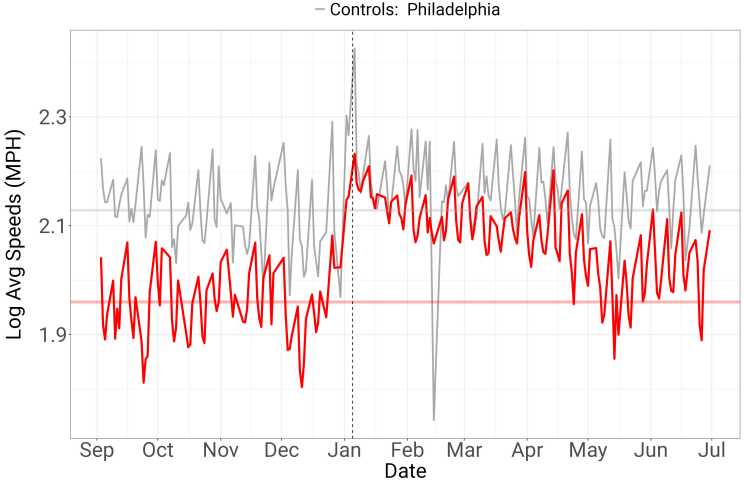
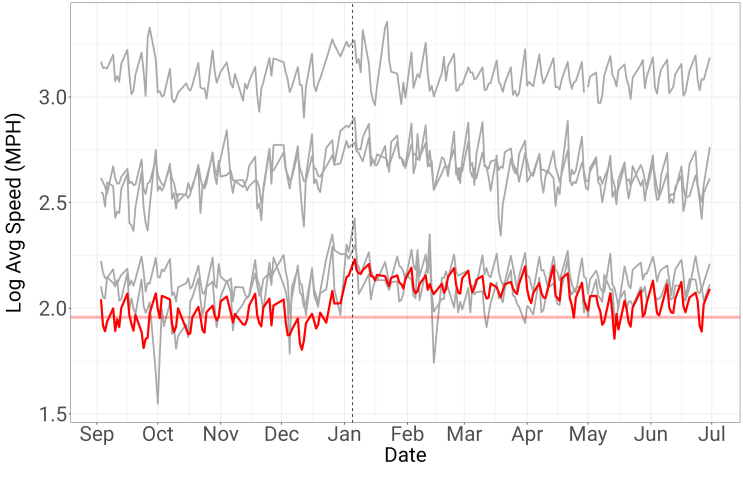
    - estimated fuel consumption
  - **Origin-Destination outcomes**: hourly volume-weighted outcomes at the "trip" level
    - realized trip travel times and speeds
- Non-traffic outcomes (Jan. 2024 - June 2025)
  - Ambient air quality from PurpleAir sensors
  - Transactions at restaurants and shops from credit/debit cards
  - Foot traffic from GPS devices

What happened inside the CBD?

Key idea: average daily speeds in CBDs in NYC and Philadelphia



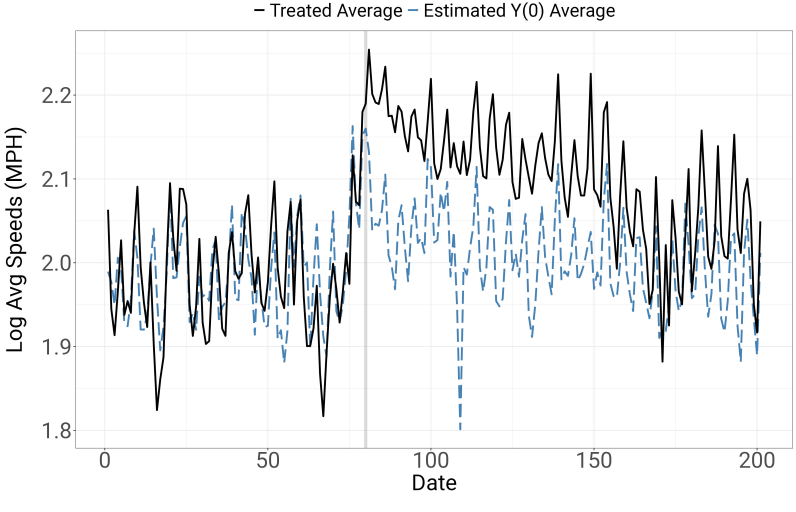
Key idea: average daily speeds in CBDs of 6 major cities



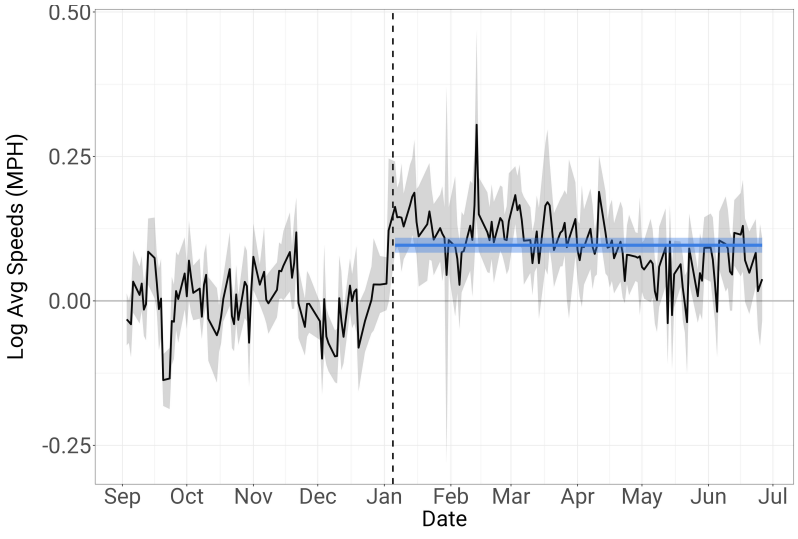
Note: New York City, Philadelphia, Chicago, Boston, Atlanta, and Baltimore

▸ By road type

Key idea: synthetic control (Xu, 2017)



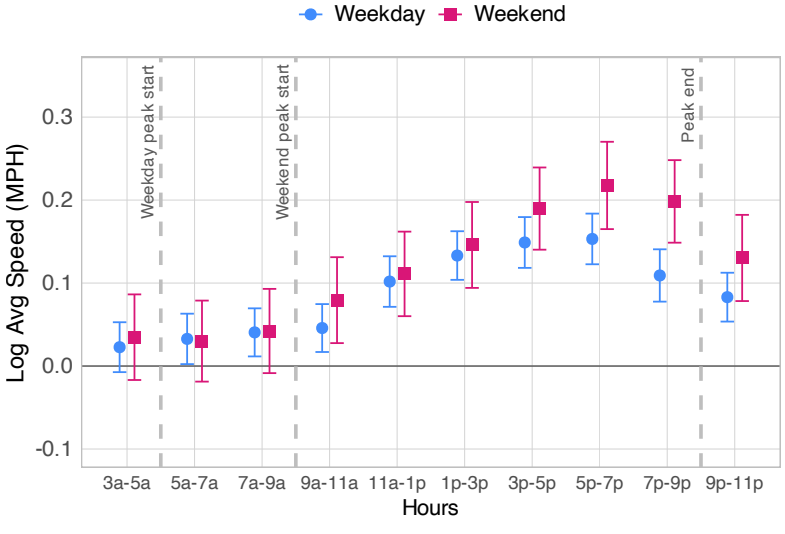
Result 1: Average CBD speeds increased by 10%



Note: Blue line is estimated ATT for post-period. Shaded areas represent 95% confidence intervals.

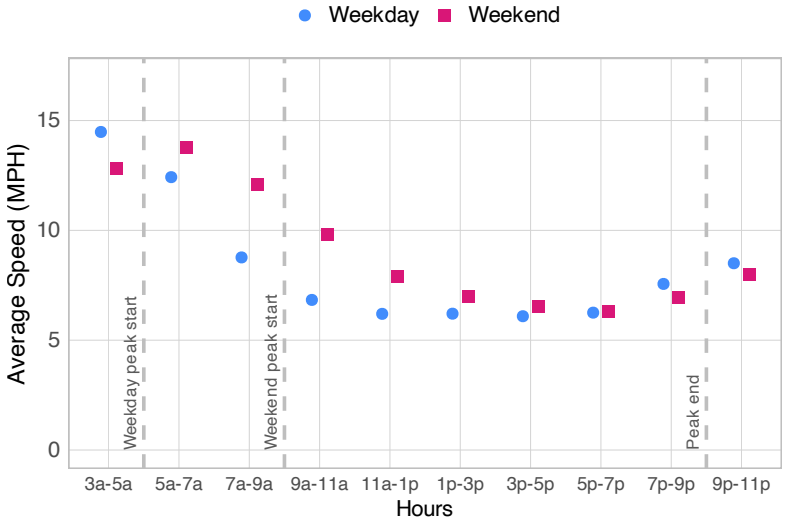
▸ P90/P10 speeds

Result 2: CBD speeds increased the most during the afternoon...



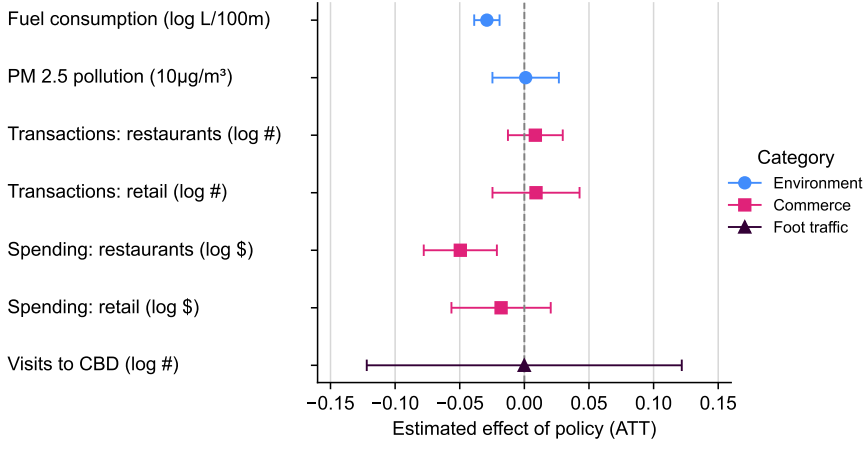
Note: Each ATT is separately estimated using traffic conditions from the other CBDs during the same time of day as synthetic controls. Vertical lines represent 95% confidence intervals.

Result 2: ... which is when speeds are usually the slowest



Note: Each ATT is separately estimated using traffic conditions from the other CBDs during the same time of day as synthetic controls. Vertical lines represent 95% confidence intervals. Averages are based on pre-treatment data.

Result 3: Little-to-no effects on pollution, commerce, or foot traffic



Note: Each point is the estimated ATT using the same five control cities. Fuel consumption is estimated for an average passenger car based on segment characteristics and speed profile. Pollution data from PurpleAir are at day-sensor level, transactions data from MBHS3 are at the zipcode-day level, and foot traffic from Advan are at the tract-day level. All outcomes besides fuel consumption use data from Jan 2024 through June 2025. Horizontal bars represent 95% confidence intervals.

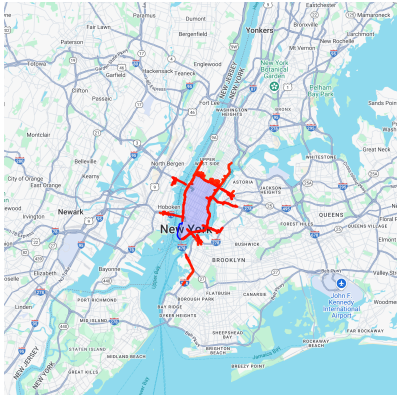
▸ Pollution ▸ Transactions ▸ Foot traffic

Were there spillovers outside the CBD?

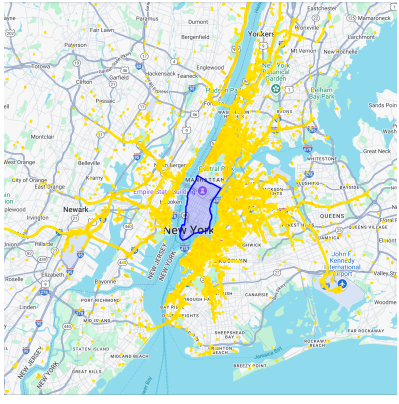
Result 4: Speeds also increased *outside* the CBD

Segment co-occurrence: share of pre-period trips crossing a segment that enter CBD

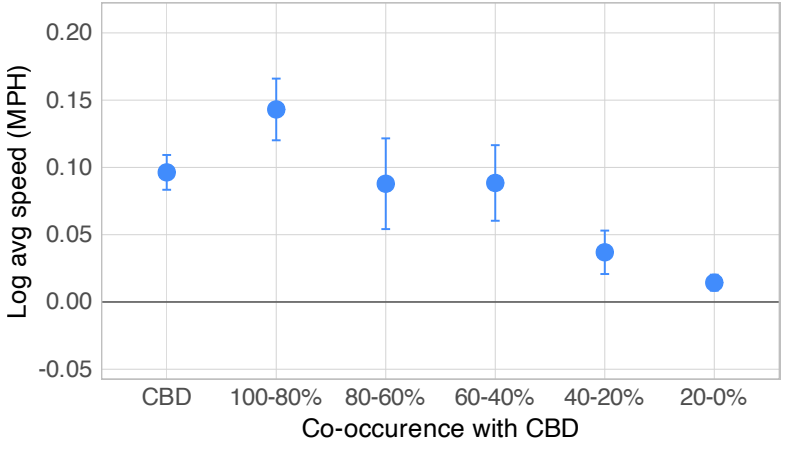
(a) High co-occurrence (80-100%)



(b) Low co-occurrence (10-20%)



Result 4: Speeds also increased *outside* the CBD



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▸ By tract income and special region

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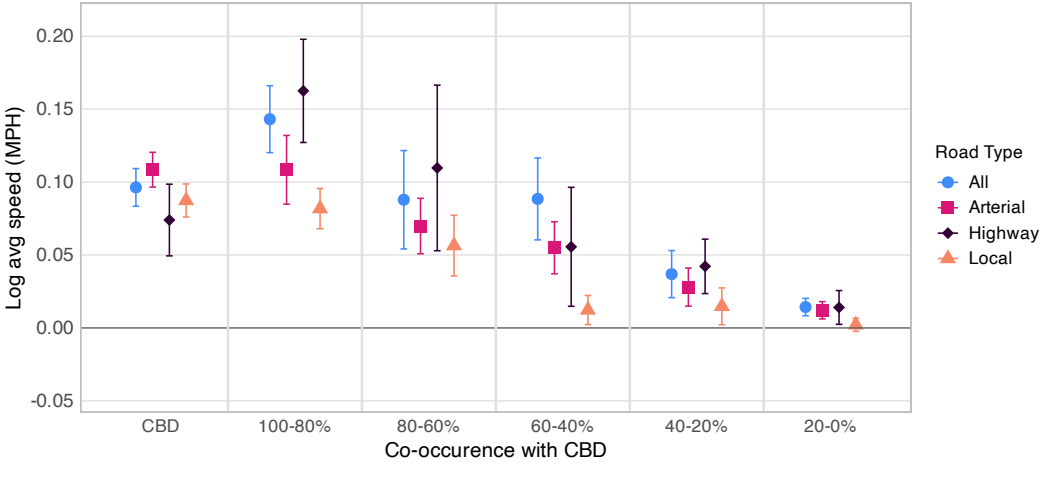

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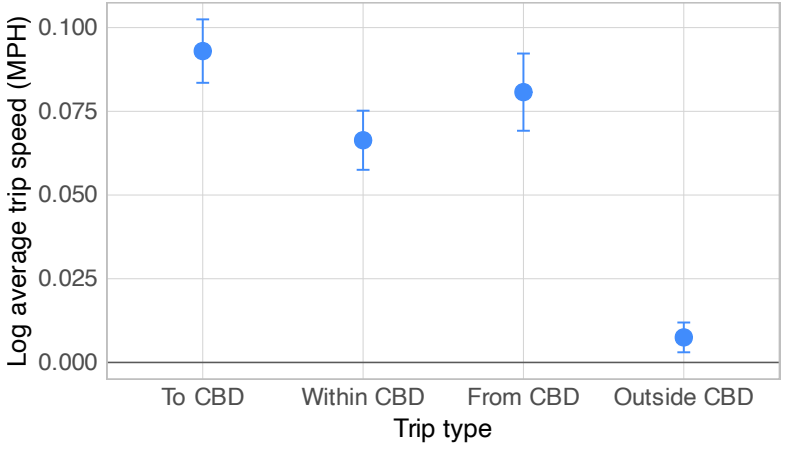
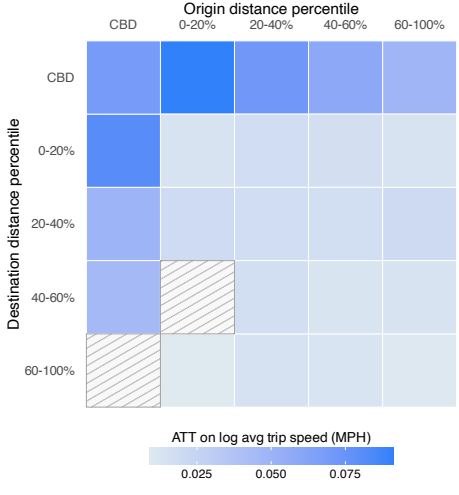
Result 5: Trips to, from, within, and outside the CBD all became faster



Note: Each point is the estimated ATT using the same five control cities. "To CBD" includes trip that pass through the CBD, even if they end outside. Vertical lines are 95% confidence intervals.

Result 6: Welfare gains come from *unpriced* trips



Note: Grey hashes indicate results that are not different from zero at 5% level; these are excluded for aggregate time savings and welfare. Number of trips is the average tract-to-tract passenger car trips from Replica for 2025. Average price is approximated and is below $9 because of crossing credits for some entries. The welfare estimates are computed for each cell separately and assume a Value of Travel Time (VOTT) of $40/hour and no revenue recycling.

▸ Map of bins ▸ Trip counts ▸ OD welfare ▸ Taxi welfare

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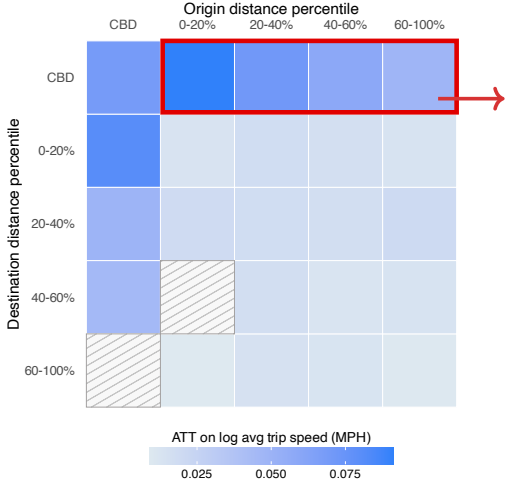

Daily aggregates
(private autos only)

Priced trips

Number of trips:	274,000
Time savings:	12,780 hours
Average price:	$7.9
Approx driver welfare:	-$1.7 million

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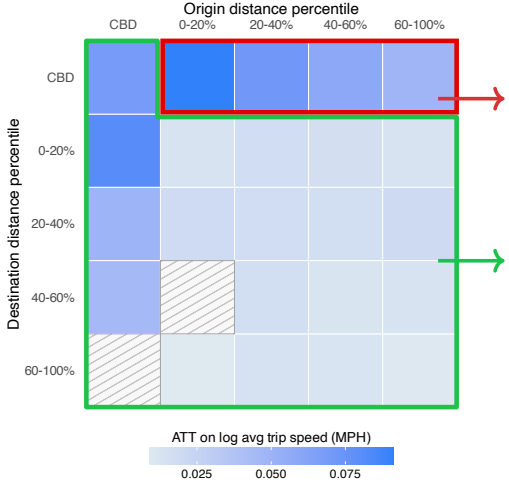

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Time savings:	89,930 hours
Approx driver welfare:	$3.6 million

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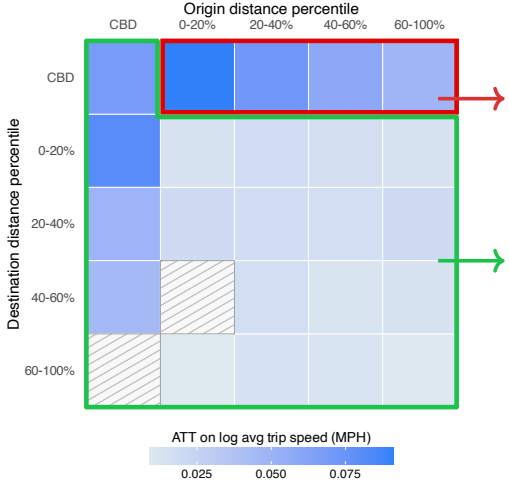

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Time savings:	89,930 hours
Approx driver welfare:	$3.6 million

'Break-even' VOTTs

Average trip to CBD:	$169/hour
Overall driver welfare:	$21/hour

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Implications for Policy

- Spillover effects are first order
  - CBD roads got 10% faster (so far) but the baseline was very slow
  - Speed improvements throughout the metro accumulate to a big welfare effect

- How much faster can CBD roads get?
  - Not a ton of variation in congestion across hours
  - Average speeds at 3am are <15MPH

- A key mechanism: how *convex* is the congestion function of a given road?
  - Biggest gains when the status quo is on a *steep* part of the curve ▸ examples

Thank you!

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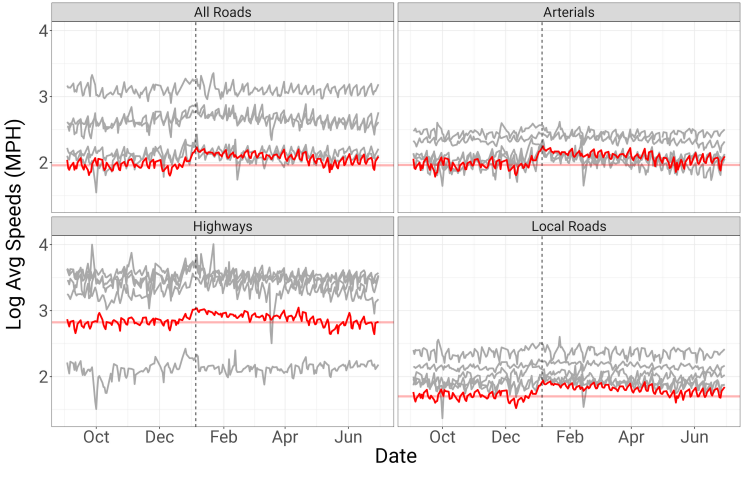
References

Barkjohn, Karoline K., Amara L. Holder, Samuel G. Frederick, , and Andrea L. Clements. 2022. "Correction and Accuracy of PurpleAir PM2.5 Measurements for Extreme Wildfire Smoke." *Sensors*, 22(24): 9669.

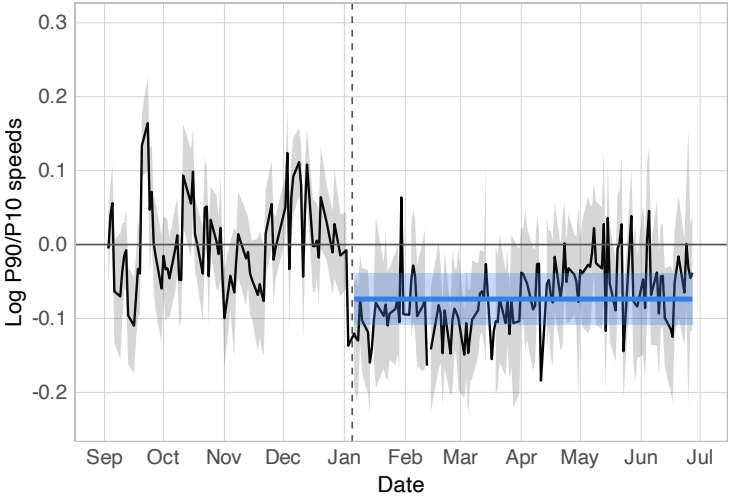
Xu, Yiqing. 2017. "Generalized synthetic control method: Causal inference with interactive fixed effects models." *Political Analysis*, 25(1): 57–76.

Average speeds by road type



Back

Speeds became less variable, according to P90/P10 ratio



Note: Blue line is estimated ATT for post-period. Shaded areas represent 95% confidence intervals.

Back

Pollution data from PurpleAir

We use day-sensor level measures of PM2.5 from PurpleAir. There are 22 outdoor sensors in the NYC CBD. There are few sensors in our control city CBDs, so we use data from 800 sensors throughout the control metro areas when computing ATTs.

We follow EPA's recommended calibration method for PurpleAir data (Barkjohn et al., 2022) to clean the data:

1. Drop records where difference between A and B channels is over $5\mu g/\text{m}^3$ or relative difference is over 70%
2. Calibrate adjusted PM2.5 measures using EPA's formula and the relative humidity measurement
3. Aggregate to the day level, dropping any that have fewer than 18 hours of observations
4. Impute missing sensor-date PM2.5 values using a regression with interacted sensor, month, and day of week fixed effects.

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Transactions data from MBHS3 (Jan 2024-April 2025)

The data are at the day-zipcode level. Category is defined using 3-digit NAICS. We weight ATTs by the outcome total (transactions or spend) in the pre-period

		All			CBD-only		
City	Category	Count (millions)	Amount (millions $)	Avg. size ($/trans.)	Count (millions)	Amount (millions $)	Avg. size ($/trans.)
NYC	Restaurant	164.7	4613.2	28.0	26.1	941.7	36.0
	Retail	286.1	13247.0	46.3	39.6	2196.0	55.4
PHL	Restaurant	88.5	2291.9	25.9	3.9	125.3	32.1
	Retail	168.6	7549.0	44.8	3.2	115.0	35.5
CHI	Restaurant	114.2	2773.8	24.3	5.8	172.5	29.7
	Retail	148.2	7425.8	50.1	3.7	137.5	37.3
BOS	Restaurant	59.2	1433.1	24.2	0.8	25.6	32.4
	Retail	68.4	3390.8	49.6	0.2	15.9	79.2
BAL	Restaurant	61.7	1066.6	17.3	–	–	–
	Retail	58.4	2644.8	45.3	–	–	–
ATL	Restaurant	141.7	3368.8	23.8	3.6	90.3	25.2
	Retail	190.0	8995.0	47.3	1.2	43.2	37.2
Total	Restaurant	629.9	15547.4	24.7	40.2	1355.6	33.7
	Retail	919.7	43252.4	47.0	47.9	2507.5	52.3

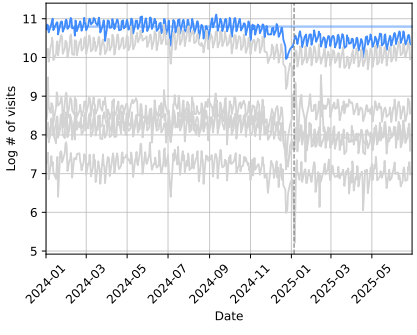
Note: This table documents the aggregate number of transactions and total spending in the MBHS3 data for zipcodes within each of the sample cities. The Baltimore CBD is small and there are no zipcodes whose centroids lie within it.

Back

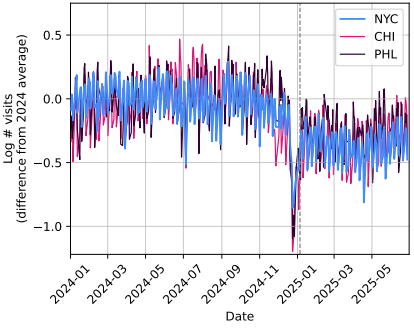
Foot traffic data from Advan Neighborhood Patterns (Jan 2024-June 2025)

We use data at the day-tract level, aggregating foot traffic across all peak hours that day. We weight the ATTs by the number of pre-period stops in a tract

(a) Log average stops per day



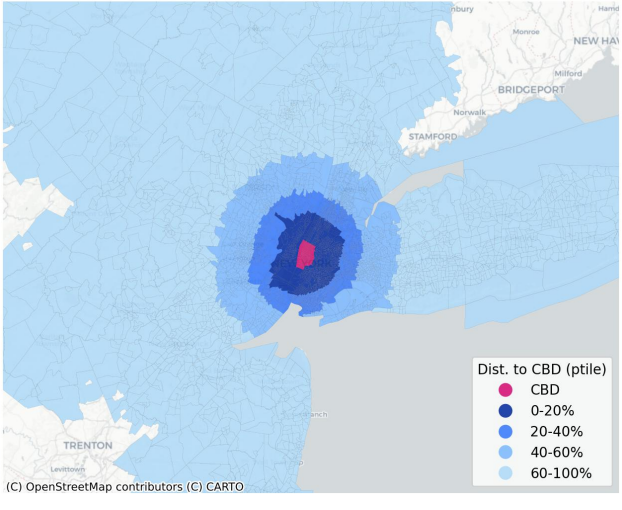
(b) Log stops relative to 2024 average



Note: These figures plot daily CBD foot traffic, restricted to weekday peak hours (5am to 9pm). The first panel plots the log total number of visits. The blue horizontal line is the pre-period average for the NYC CBD. The second panel restricts attention to the three largest cities and plots the difference in log trips between a given date and the 2024 average.

Back

Distance from CBD for NYC metro area

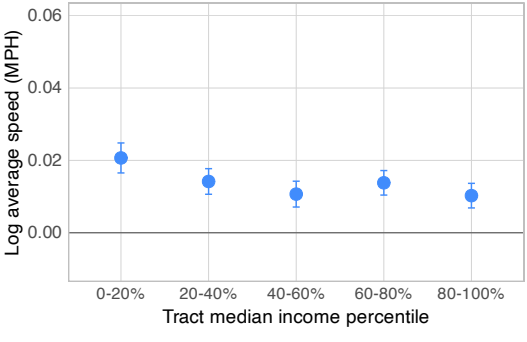


Note: The boundaries are based on the Core Based Statistical Area boundaries. The map is zoomed in slightly to make the CBD more visible; the CBSA extends further in each direction, especially east down Long Island. Distance to CBD is based on the distance between centroid and the closest point of the CBD.

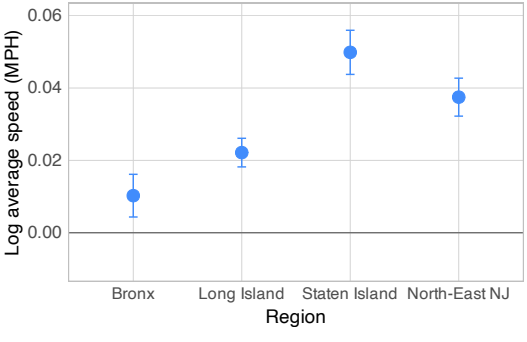
Back

Road speeds increased within tracts of all incomes and areas

(a) Tract median income



(b) Other regions of interest



Note: Speeds are for the road segments within given geography. Each point is the estimated ATT using the same five control cities. Vertical lines are 95% confidence intervals.

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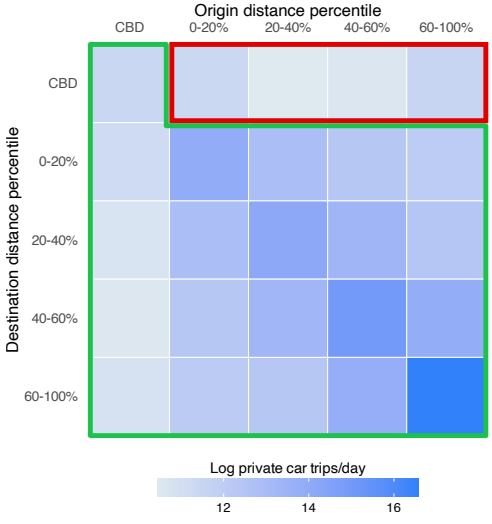
Private auto trips by origin/destination



Note: We compute trips between each OD using a combination of data from Replica and MTA. Replica estimates are used for all trips that do not end in the CBD. For trips to the CBD, we scale the Replica estimates to match the total number of personal auto entries from the MTA. All data are for Jan-June 2025.

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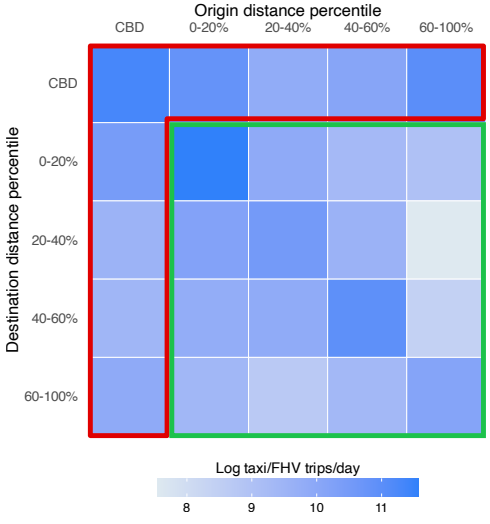
Taxi/FHV trips by origin/destination



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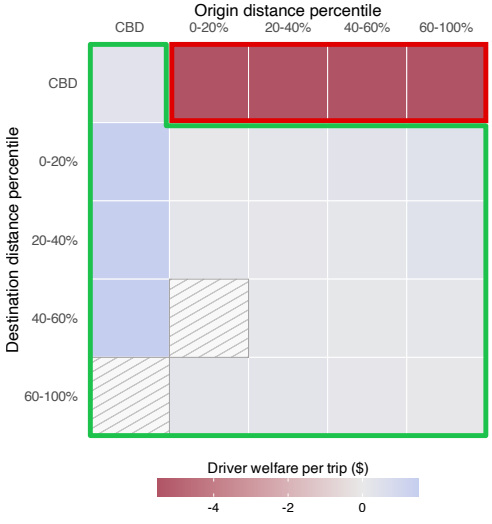
Driver welfare per trip by OD



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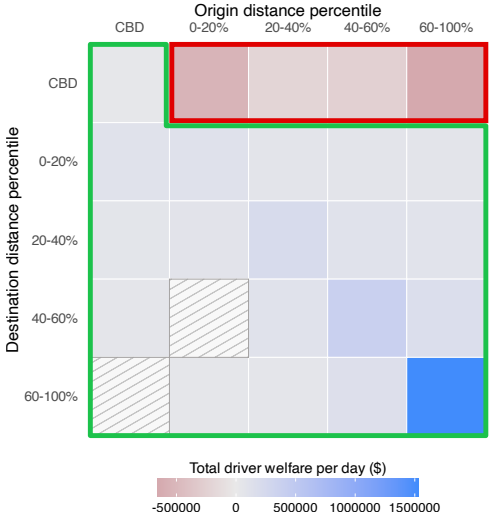
Total driver welfare by OD



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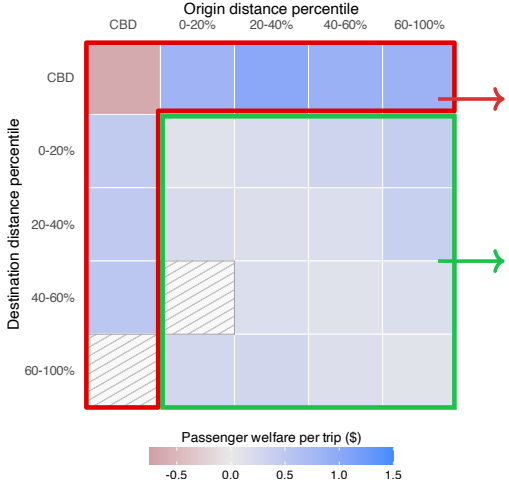
Back

Taxi passenger welfare per trip by OD



Daily aggregates
(taxi passengers only)

Priced trips

Number of trips:	319,000
Time savings:	10,300 hours
Average price:	$1
Approx driver welfare:	$113,100

Unpriced trips

Number of trips:	381,000
Time savings:	1,440 hours
Approx driver welfare:	$57,700

'Break-even' VOTTs

Average priced taxi trip:	$31/hour
Overall taxi passenger welfare:	$27/hour

Note: Grey hashes indicate results that are not different from zero at 5% level; these are excluded for aggregate time savings and welfare. Number of trips is the average tract-to-tract passenger car trips from Replica for 2025. Average price is approximated based on $0.75 for taxis and $1.5 for ridesharing. The welfare estimates are computed for each cell separately and assume a Value of Travel Time (VOTT) of $40/hour and no revenue recycling or taxi price changes.

Back

Result 7: On some roads, still room for additional speed increases

Congestion function: relationship between density & speeds on a given road

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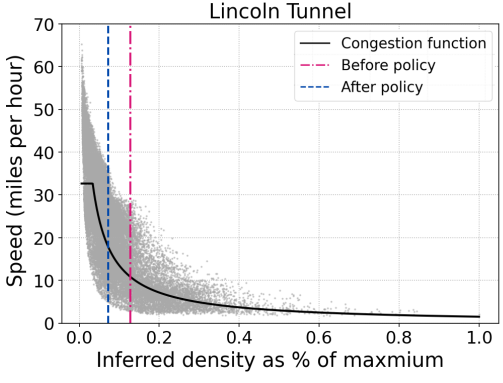

Note: Vertical lines correspond to average inferred densities at 3pm before and after the implementation of congestion pricing. Gray dots are a sample of underlying observations.

More roads Back

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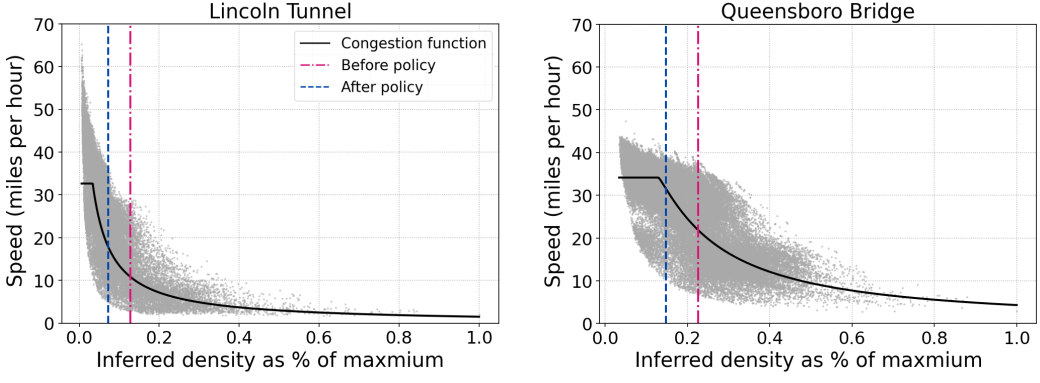

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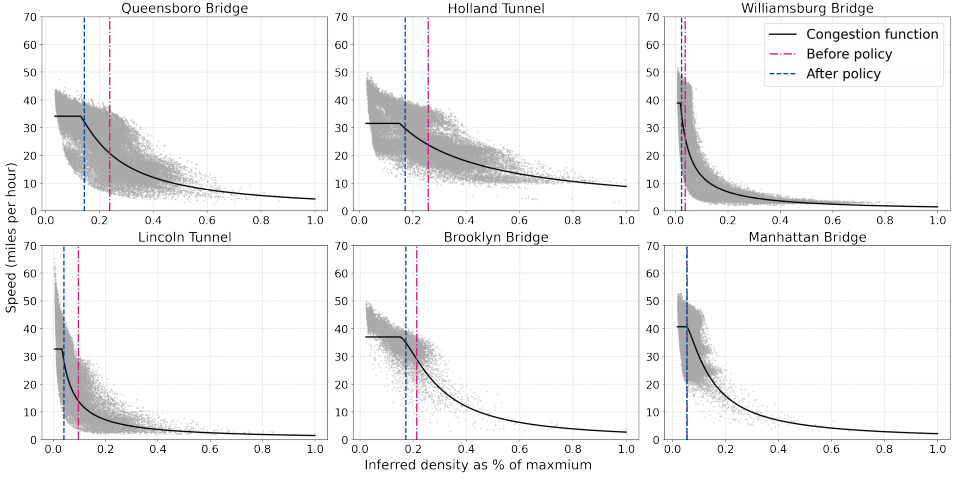
More roads Back

Congestion functions: major CBD entrances



Note: Congestion function are estimated using pre-period data. The vertical lines are based on 3pm average inferred densities.

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