Effect of a minimum floor price law for tobacco products on tobacco sales in Oakland, California

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Disclosures

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I have no other competing interests to disclose. My co-authors and I have never received funding from the tobacco-nicotine industries.

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Disclaimer: Researchers' own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

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bit.ly/tobacco_mfpl

Motivation

- Excise taxes have been the primary strategy for regulating tobacco prices.
- Local jurisdictions in many states, including California, are preempted from levying tobacco taxes.
- Minimum floor price laws (MFPLs) set a price below which a product cannot be sold, and are viewed by some policy makers as a complementary pricing regulation to tobacco excise taxation.
  - New York City became the first to set a floor price on cigarettes at $10 per pack in 2013 (↑ to $13 in 2017)
  - 35+ local jurisdictions in California now have an MFPL (PETS 2024)

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- An optimally set MFPL eliminates deadweight loss – like a Pigouvian tobacco tax.
- Unlike a Pigouvian tax, an MFPL generates no tax revenue.
  - Extra revenue goes to the retailer and manufacturer
  - May incur less industry opposition

Literature on MFPLs

- State minimum markup laws have generally not been effective (Tynan et al., 2013; McLaughlin et al., 2014; Huang et al., 2016)
- Simulation-based studies find that MFPLs are projected to ↓ smoking rates (Golden et al., 2020; Doogan et al., 2018; Lin et al., 2025) and smoking disparities (Golden et al., 2016)
  - Oakland MFPL of $8 projected to ↓ smoking prev. by 0.3 percentage points and ↓ smoking intensity among continuing smokers by 2.0% (Boettiger & White, 2021)
- A handful of empirical studies of MFPLs
  - Cigar-only MFPLs in Boston and 3 cities in Minnesota associated with ↑ prices and ↓ sales of cigars (Li et al., 2017; Brock et al., 2017)
  - No effect of NYC's MFPL on cigarette prices, cigarette consumption, or smoking status (Ma & Golden, 2024)

Research questions

What is the effect of a tobacco MFPL on the sale of tobacco products?

1. Retailer compliance
2. Overall change in MFPL-affected tobacco products
3. By price segment (products priced above vs. below MFPL using pre-policy prices)
4. Cross-border shopping
5. Substitution to MFPL-unaffected nicotine products

Tobacco MFPL in Oakland, CA

- MFPL ordinance, effective May 2020
  - $8 per pack of cigarettes
  - $8 per package of cigars, including little cigars and cigarillos
  - Ban on coupons or trade discounts
  - Package size requirement of 20 for little cigars and cigarillos
  - (MFPL adjusted annually for inflation, but not yet done)
- Enforcement delayed by COVID-19 until August 2020
- In May 2020, Oakland also (i) expanded its flavored tobacco sales ban to tobacco specialty shops and (ii) banned tobacco sales at retail pharmacies.

Retail sales data

- Data: Nielsen retail scanner data via Kilts Center
  - Large retail chains
  - Products coded at UPC level
  - Units and dollars sold and average shelf price per unit for each observation
  - 30 million UPC-by-store-by-month observations
- Sample: All available pharmacy, convenience (including gas station), and food stores in California
- Study period: July 2018 through December 2021
- Unit of analysis: 3-digit ZIP code (zip3) by month (N = 26,498)

Sample characteristics

Attribute	Oakland (zip3 “946”)	Oakland-adjacent (zip3 “945”)	Donor pool of potential controls
Number of ZIP codes	14	40	1,371
Number of zip3’s included	1	1	49
Number of stores observed	27	89	3,415
Number of cigarette UPCs	220	253	294
Below $8 per pack	88	102	108
$8 or higher per pack	132	151	173
Number of cigar UPCs	79	102	102
Below $8 per pack	63	73	81
$8 or higher per pack	16	29	27

Outcomes

- Prices and unit sales in Oakland, border zip3, and donor pool for:
  - Cigarettes
    - Overall
    - By price segment ($<$\$8 vs. $\geq$\$8 based on pre-MFPL median)
  - Cigars
    - Overall
    - $<$\$8 segment (sparse sales data for $\geq$\$8 segment)
- Unit sales in Oakland, border zip3, and donor pool for:
  - Electronic nicotine delivery systems (ENDS)
  - Nicotine replacement therapy (NRT)

Synthetic difference-in-differences (SDID)

- Compare tobacco prices and sales in Oakland vs. matched zip3's in non-bordering cities as a counterfactual
  - Algorithmically find the average of zip3's that best match the pre-MFPL outcome trend using synthetic difference-in-differences, or SDID.
- SDID is a recently developed method that combines difference-in-differences (DiD) and synthetic control (SC) methods (Arkhangelsky et al., 2021).

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- SDID is a recently developed method that combines difference-in-differences (DiD) and synthetic control (SC) methods (Arkhangelsky et al., 2021).
- Three major benefits of SDID compared with DiD and SC
  1. Like DiD, a perfect pre-treatment match with the synthetic control is not required; parallel trends are sufficient for identification
  2. Like SC, parallel trends are more likely to be satisfied b/c larger weights are assigned to control units that are more similar to the treated unit
  3. Less biased and more precise estimation than either DiD or SC

Synthetic difference-in-differences (SDID)

- The average treatment effect on the treated ($\hat{\tau}$) is estimated from:

$$(\hat{\tau}^{sdid}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) = \underset{\tau,\mu,\alpha,\beta}{\text{argmin}} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \alpha_i - \beta_t - W_{it}\tau)^2 \hat{\omega}_i^{sdid} \hat{\lambda}_t^{sdid} \right\}$$

  - Fixed effects for zip3 (α_i) and month (β_t)
  - Unit-specific weights ($\hat{\omega}_i$) to construct a synthetic control group with matched pre-trends
  - Time weights ($\hat{\lambda}_t$) that balance pre-periods with post-periods

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  - Unit-specific weights ($\hat{\omega}_i$) to construct a synthetic control group with matched pre-trends
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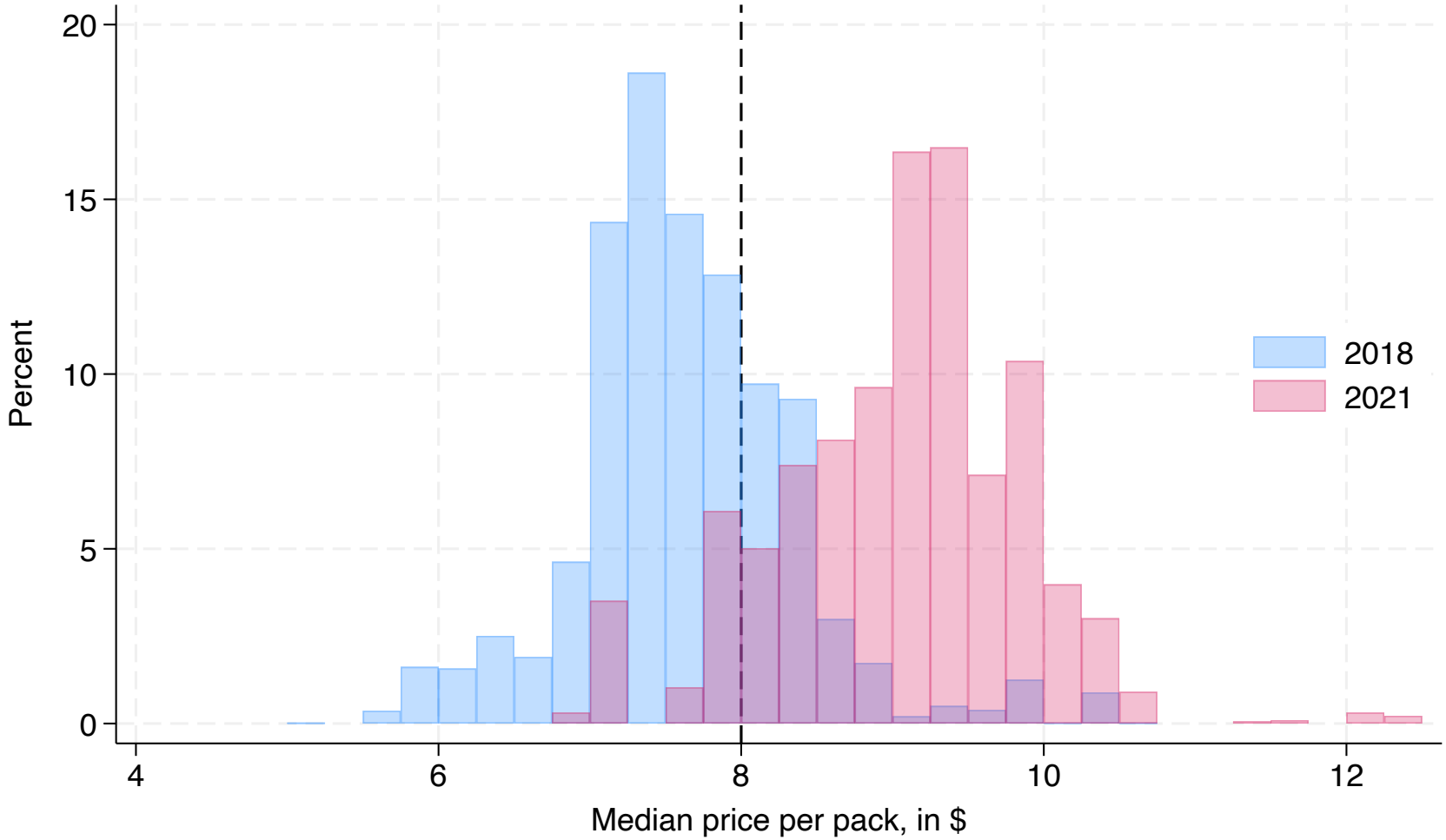
- Permutation-based inference procedure (Clarke et al., 2024)
- Event study SDID estimates (Ciccia, 2024)
- Synthetic control analysis as robustness check
  - Lagged outcomes plus 17 covariates (total pop., median age, sex ratio, race/ethnicity, education, pop. in labor force, unemployed, median wage by sex, poverty, owner-occupied housing, rent-burdened, foreign born)

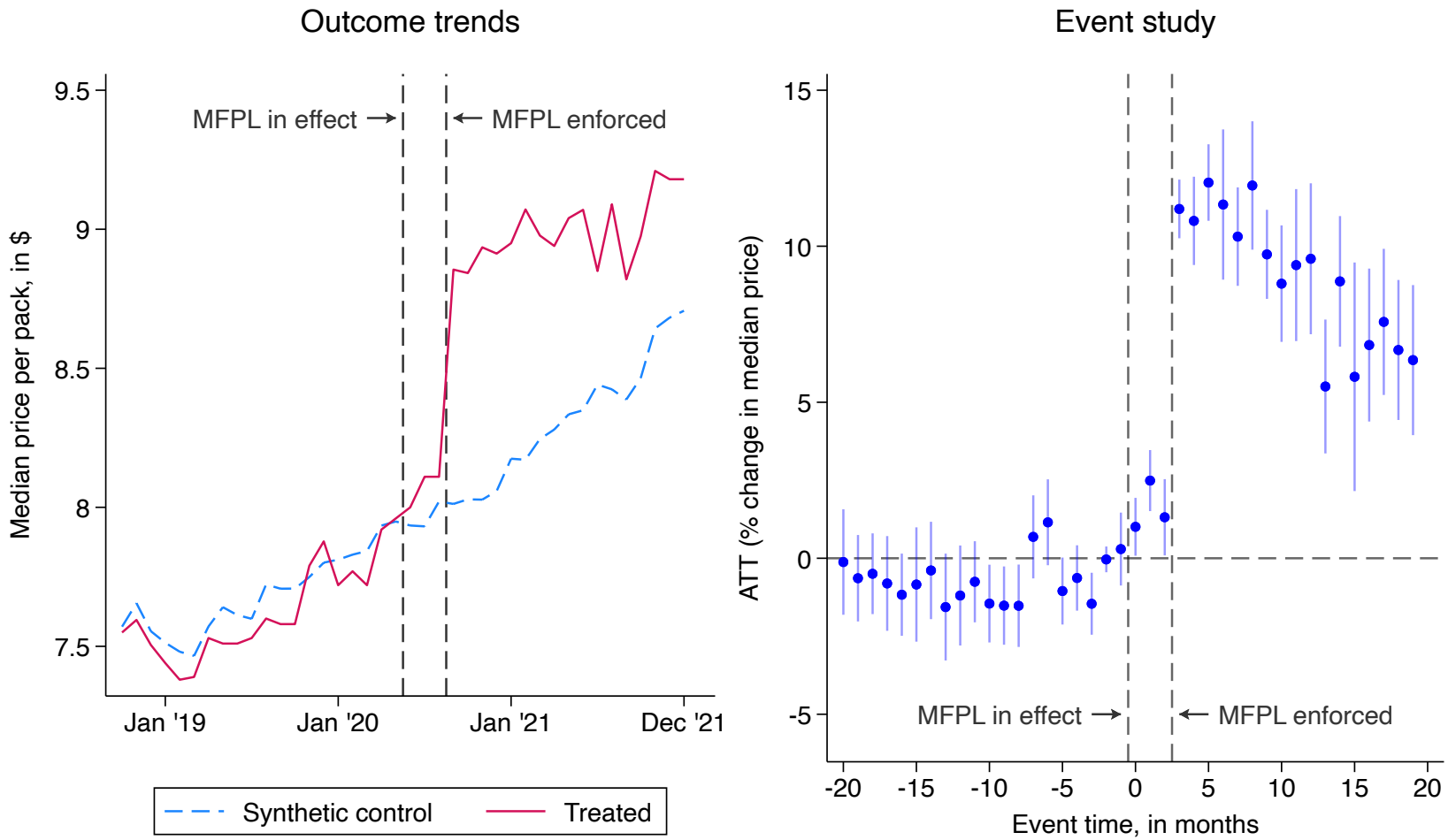
Pause for discussion and questions

Distribution of median cigarette price/pack in Oakland



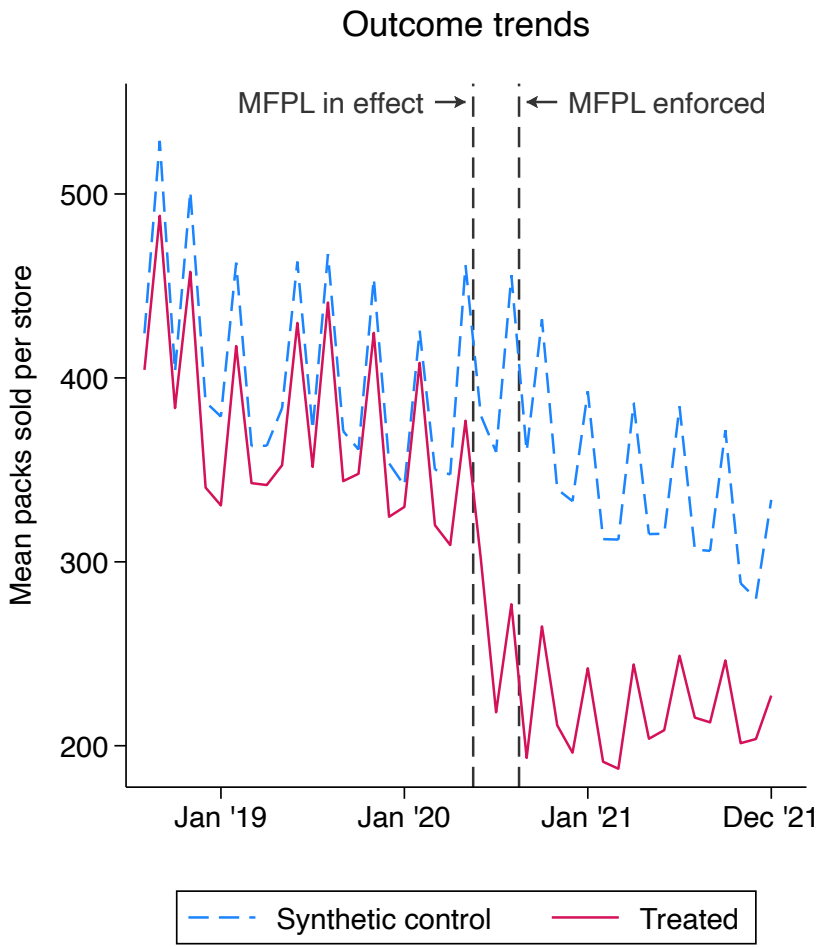
Retailer compliance: 97.5%

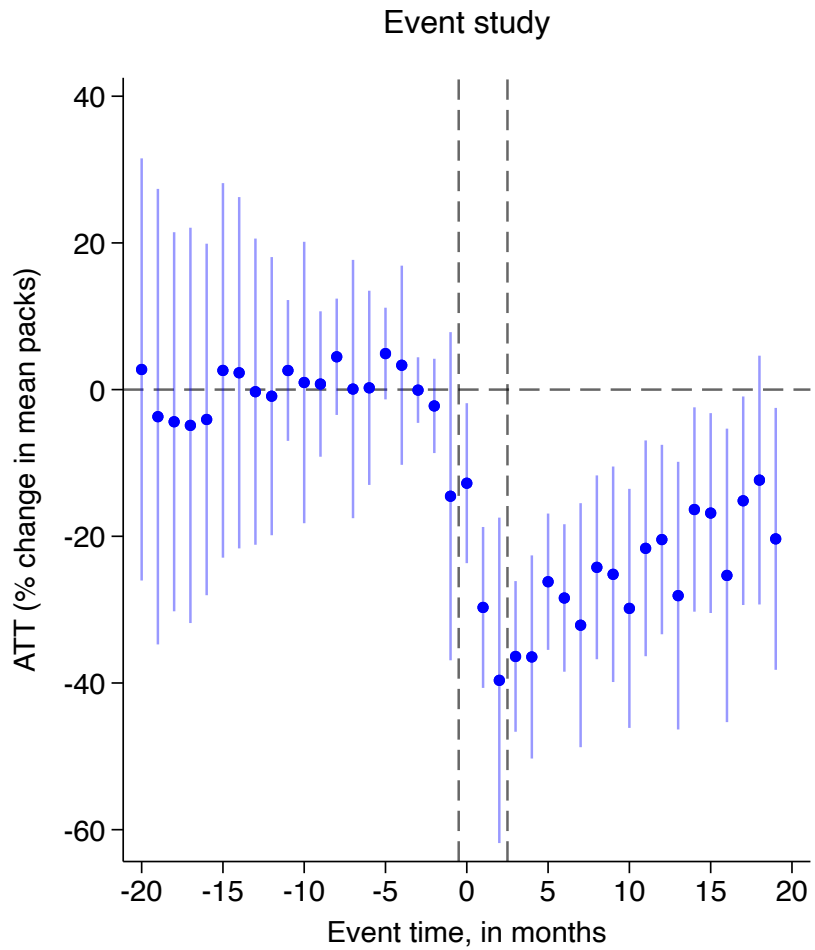
SDID estimates: Median cigarette price per pack, < $8 segment, Oakland



Post-enforcement effect: $0.69 (0.58 to 0.79); 9.0% (7.7 to 10.3)

SDID estimates: Mean cigarette packs sold/store, <$8 segment, Oakland





Post-enforcement effect: -25.2% (-35.7 to -14.8)

MFPL effects for cigarettes in Oakland

	ATT (% change, median price/pack)			ATT (% change, mean packs/store)		
	Full post period	Pre-enforce.	Post-enforce.	Full post period	Pre-enforce.	Post-enforce.
Cigarettes	0.9* (-0.1, 2.0)	0.8 (-0.2, 1.8)	1.0* (-0.1, 2.1)	-15.5 (-40.2, 9.2)	-15.0*** (-25.7, -4.3)	-15.5 (-44.3, 13.3)
Under $8	7.9*** (6.7, 9.1)	1.7*** (0.7, 2.7)	9.0*** (7.7, 10.3)	-24.9*** (-34.7, -15.0)	-25.1*** (-34.9, -15.3)	-25.2*** (-35.7, 14.8)
Above $8	2.0*** (0.6, 3.5)	-0.4 (-1.9, 1.0)	2.4*** (0.9, 3.9)	-14.0 (-46.1, 18.1)	-12.7* (-25.9, 0.5)	-13.8 (-51.5, 23.9)

Note: Point estimates and 95% CIs (in parentheses) are expressed as percent change in the treated zip3 relative to the pre-MFPL mean, based on SDID estimation. Pre-enforcement period is May-July 2020, and post-enforcement is May 2020-Dec 2021. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

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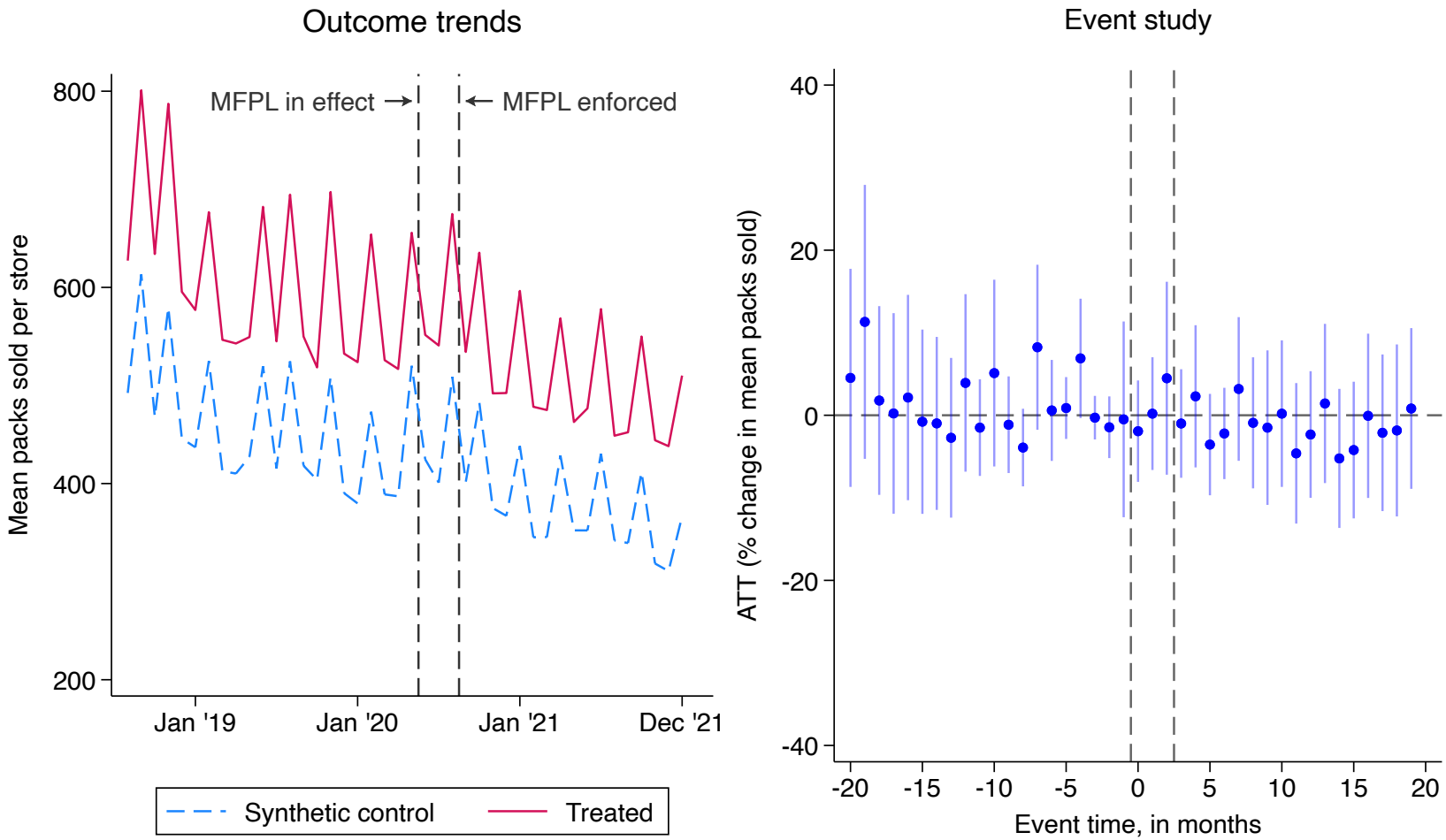
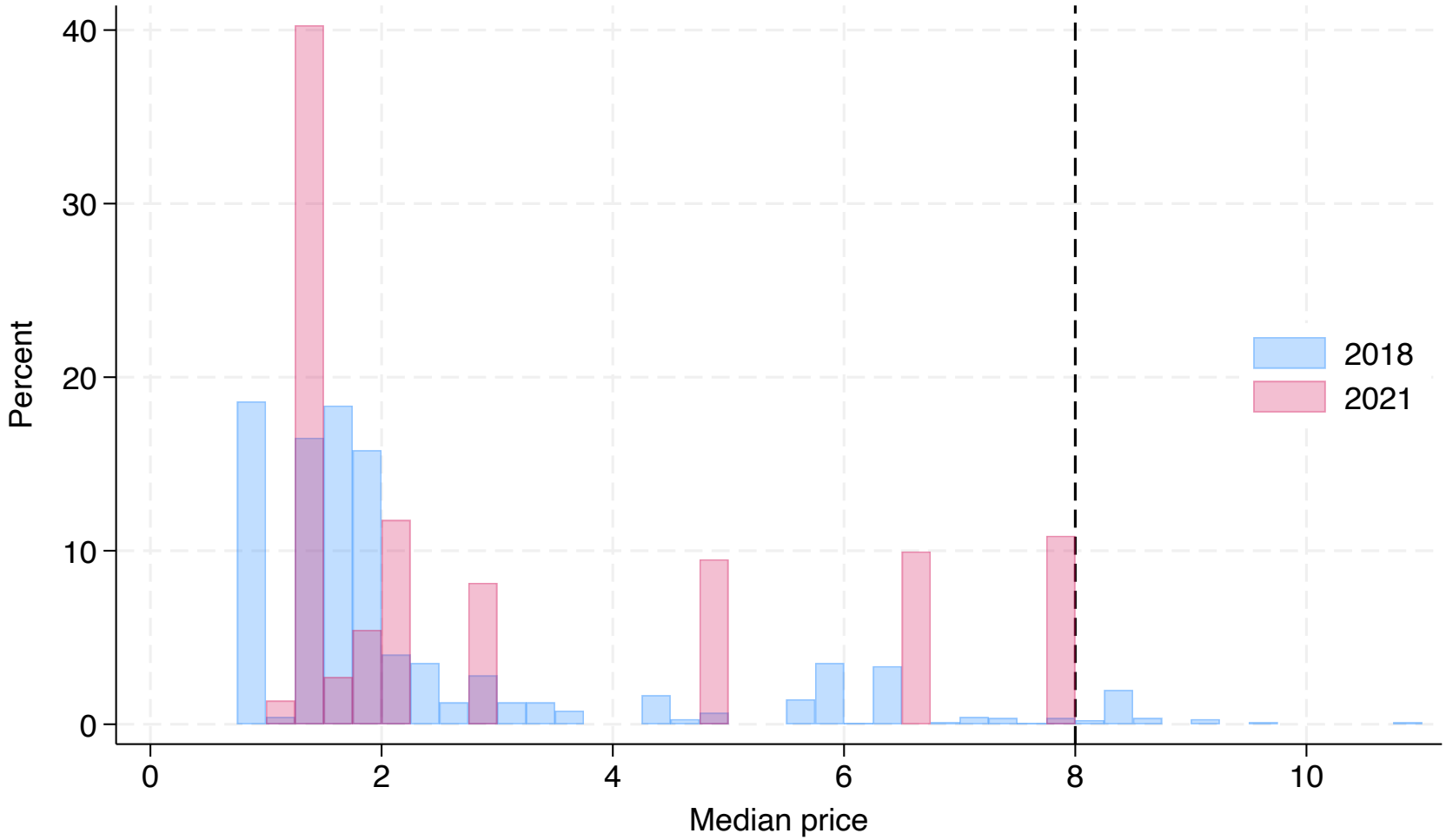
SDID estimates: Change in cross-border sales of under-$8 cigarettes



Post-enforcement effect: -1.2% (-7.4 to 5.0)

Distribution of median cigar price per pack in Oakland



Retailer compliance: 7.4%

Note: Plot was censored for ease of interpretation.

MFPL effects for cigars

	ATT (% change, median price/unit)			ATT (% change, mean units/store)		
	Full post period	Pre-enforce.	Post-enforce.	Full post period	Pre-enforce.	Post-enforce.
A. City of Oakland						
Cigars	-3.8 (-50.4, 42.9)	-13.7 (-100.4, 72.9)	-0.9 (-50.5, 48.7)	-48.9*** (-55.6, 27.8)	-20.6*** (-27.8, -13.4)	-49.7*** (-56.8, -42.6)
Under $8	-2.2 (-15.5, 11.2)	-1.1 (-18.9, 16.7)	-2.6 (-16.3, 11.1)	-54.0*** (-62.0, -45.9)	-20.1*** (-26.9, -13.2)	-58.8*** (-67.4, -50.2)
B. Oakland-adjacent						
Cigars	-12.2 (-35.1, 10.7)	-16.9 (-63.8, 30.1)	-10.3 (-34.7, 14.0)	10.3** (1.6, 19.0)	9.4 (-7.6, 26.5)	11.0** (2.4, 19.5)
Under $8	1.6 (-12.1, 15.2)	1.5 (-14.5, 17.6)	2.6 (-12.1, 17.4)	12.2* (-0.5, 24.9)	9.0 (-6.4, 24.4)	12.7** (0.1, 25.2)

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	ATT (% change, median price/unit)			ATT (% change, mean units/store)		
	Full post period	Pre-enforce.	Post-enforce.	Full post period	Pre-enforce.	Post-enforce.
A. City of Oakland						
Cigars	-3.8 (-50.4, 42.9)	-13.7 (-100.4, 72.9)	-0.9 (-50.5, 48.7)	-48.9*** (-55.6, 27.8)	-20.6*** (-27.8, -13.4)	-49.7*** (-56.8, -42.6)
Under $8	-2.2 (-15.5, 11.2)	-1.1 (-18.9, 16.7)	-2.6 (-16.3, 11.1)	-54.0*** (-62.0, -45.9)	-20.1*** (-26.9, -13.2)	-58.8*** (-67.4, -50.2)
B. Oakland-adjacent						
Cigars	-12.2 (-35.1, 10.7)	-16.9 (-63.8, 30.1)	-10.3 (-34.7, 14.0)	10.3** (1.6, 19.0)	9.4 (-7.6, 26.5)	11.0** (2.4, 19.5)
Under $8	1.6 (-12.1, 15.2)	1.5 (-14.5, 17.6)	2.6 (-12.1, 17.4)	12.2* (-0.5, 24.9)	9.0 (-6.4, 24.4)	12.7** (0.1, 25.2)

Note: Point estimates and 95% CIs (in parentheses) are expressed as percent change in the treated zip3 relative to the pre-MFPL mean, based on SDID estimation. Pre-enforcement period is May-July 2020, and post-enforcement is May 2020-Dec 2021. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

MFPL effects for product substitutes

	ATT (% change, mean monthly units/store)		
	Full post period	Pre-enforce.	Post-enforce.
A. City of Oakland			
ENDS	-55.1 (-172.3, 62.1)	-46.6* (-101.5, 8.4)	-62.0 (-195.0, 71.1)
NRT	-1.9 (-32.6, 28.7)	-1.5 (-20.6, 17.6)	-1.4 (-33.7, 31.0)
B. Oakland-adjacent			
ENDS	1.4 (-39.5, 42.4)	14.9 (-4.3, 34.1)	1.9 (-44.6, 48.4)
NRT	-7.2 (-33.5, 19.1)	3.0 (-13.1, 19.1)	-8.6 (-36.5, 19.4)

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Aggregate change in cigarettes and cigars following MFPL implementation

	Units sold in April 2020	SDID effect (post-enforcement)	Change in units
Panel A: Calculation by product category and price segment			
Cigarettes, Oakland			
Below $8	28,790	−0.252	−2,563
$8 or above	10,172	−0.140	−4,031
Cigarettes, Oakland-adjacent			
Below $8	27,867	−0.009	−251
$8 or above	125,682	0.017	2,137
		Change in below-$8 cigarettes	−2,814
		Change in all cigarettes	−4,708
Cigars below $8, Oakland	12,748	−0.540	−6,884
Cigars below $8, Oakland-adjacent	17,841	0.122	2,177
		Change in below-$8 cigars	−4,707
		Change in below-$8 cigarettes and cigars	−7,521
		% change in below-$8 cigarettes and cigars	−32.8%
		Change in cigarettes and cigars	−9,415
		% change in cigarettes and cigars	−18.2%
Panel B: Calculation by product category			
Cigarettes, Oakland	38,962	−0.155	−6,039
Cigarettes, Oakland-adjacent	153,549	0.015	2,303
		Change in all cigarettes	−3,736
Cigars below $8, Oakland	13,288	−0.489	−6,498
Cigars below $8, Oakland-adjacent	19,930	0.103	2,053
		Change in all cigars	−4,445
		Change in cigarettes and cigars	−8,181
		% change in cigarettes and cigars	−15.7%

Co-occurring tobacco policies in Oakland

1. Flavored tobacco sales restrictions expanded to adult-only stores
   - $\downarrow$ cigarette and cigar sales in general, but flavors already restricted in store types in our data, so might see substitution toward other stores in Oak $\rightarrow$ understate MFPL effect
   - Dampened product substitution to ENDS
   - Exacerbated cross-border shopping

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3. Minimum pack size requirement for little cigars and cigarillos
   - Convenience stores $\downarrow$ the number of cigar UPCs offered $\rightarrow$ contributed to the cigar sales $\downarrow$

Conclusions

- Large ↓ in the sale of lower-priced cigarettes and cigars
- Aggregate sales ↓ of all cigarettes and cigars of 15.7% to 18.2%
- Yet, widespread non-compliance with MFPL for cigars, suggesting other factors responsible for cigar sales ↓
- Limited evidence of cross-border shopping or substitution to ENDS or NRT
  - Co-occurring policies should have ↑ cross-border shopping
  - Substitution to ENDS likely limited by flavor restrictions

Thank you!

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bit.ly/tobacco_mfpl

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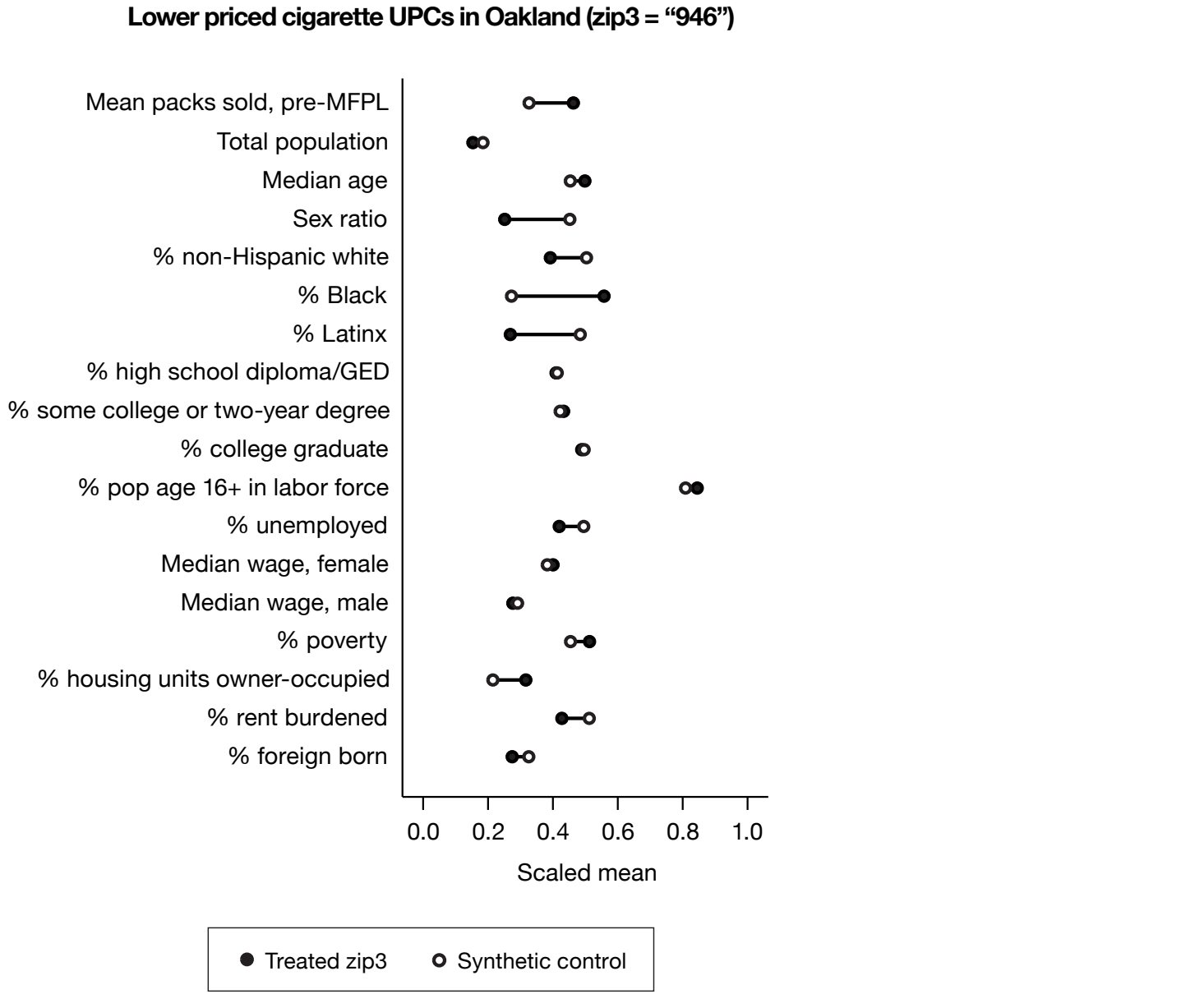
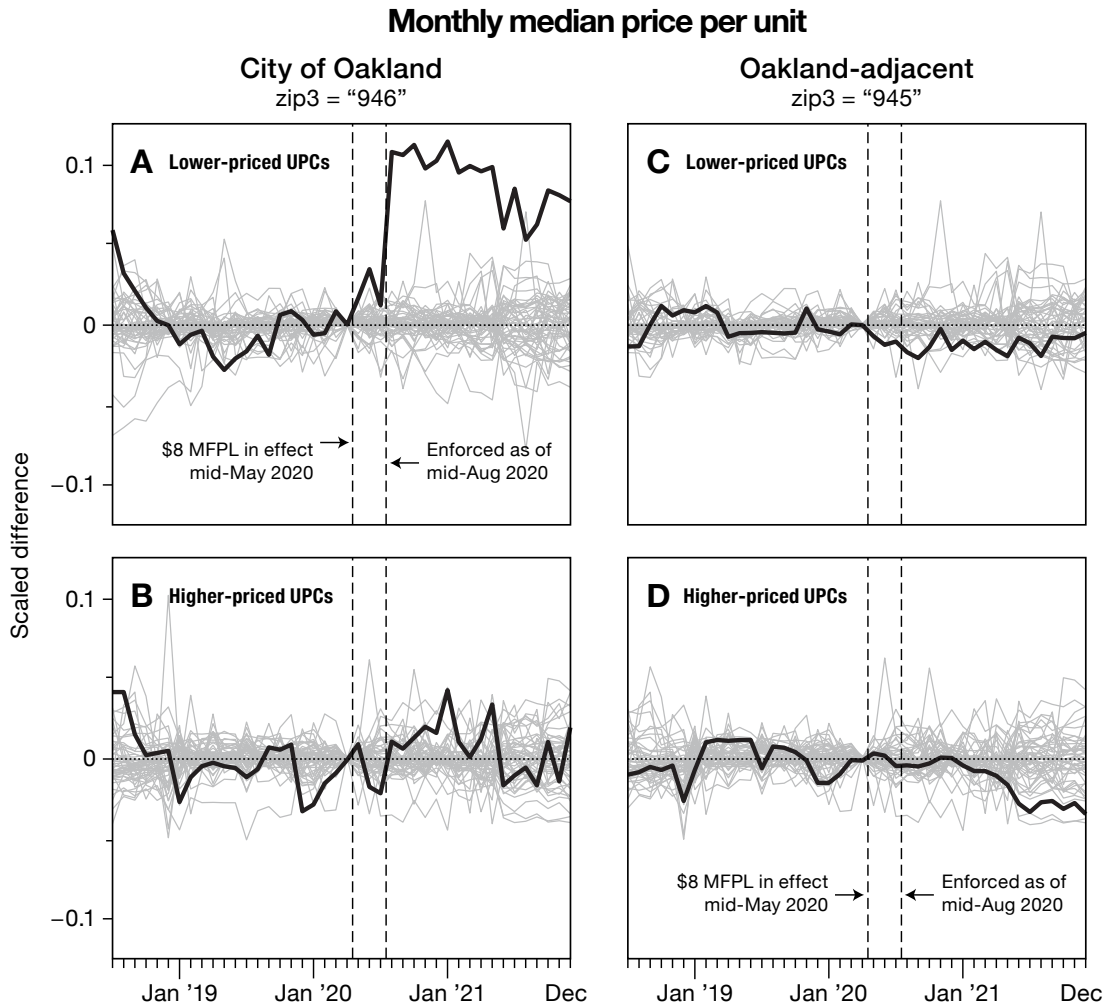
Treated vs. synthetic values of pre-MFPL sales and sociodemographics

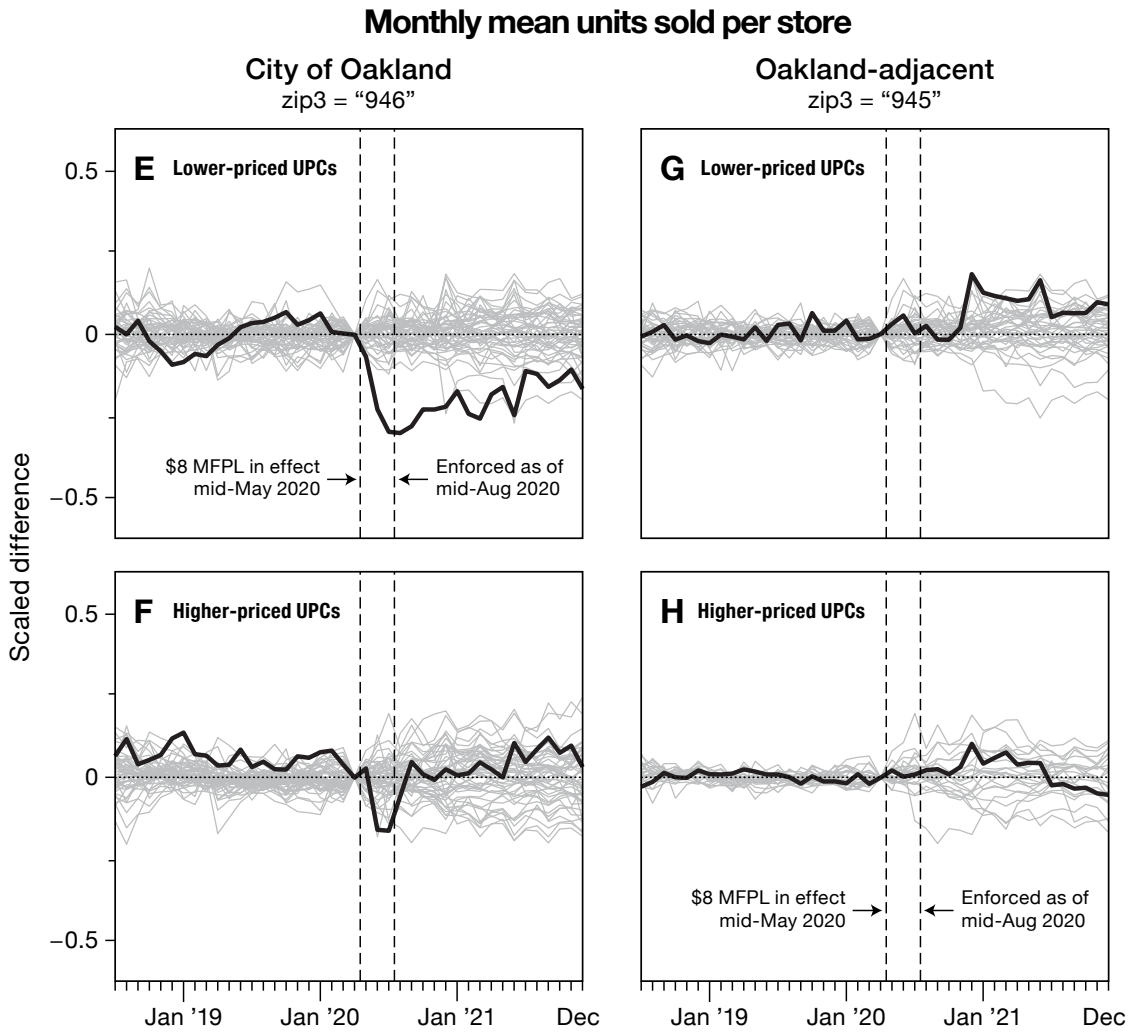


Synthetic control: Cigarette price, by segment



SC effect for under-$8 in Oakland: 9.0% (-0.4 to 18.5)

Synthetic control: Cigarette packs sold, by segment



SC effect for under-$8 in Oakland: -19.6% (-36.3 to -3.0)