Anticipated Monitoring, Inhibited Detection, and Diminished Deterrence

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Regulatory Enforcement

Enforcing regulation when compliance is time-variant & imperfectly observable

- Program of periodic monitoring where potential violations are detected & penalized
- Creates expected cost to violations $\rightarrow$ promotes compliance through **general deterrence** (Becker, JPE 1968)

$$\mathbb{E}\left(\textit{Cost of Violation}\right) = \Pr\left(\textit{Detection}\right) \times \left(\textit{Penalty} \mid \textit{Detection}\right)$$

Imperfect Monitoring & Deterrence

General deterrence *via* imperfect monitoring widespread in regulating (among other things):

- Environmental quality
- Workplace hazards
- Nursing home care
- Driving behavior
- **Safety in retail-food & food-service industries**

Imperfect Monitoring & Deterrence

Safety regulation in retail-food & food-service industries

- Programs of periodic unannounced inspections nearly universal in developed world
  - Foodborne illness in US: annual burden $15.5 bn (2013 USD)[†]
  - US CDC estimates restaurants account for 60% of foodborne-illness outbreaks
  - 2017-2019: US CDC *voluntarily* alerted to 800 foodborne-illness outbreaks involving food establishments[‡]

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Imperfect Monitoring & Deterrence

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  - 2017-2019: US CDC *voluntarily* alerted to 800 foodborne-illness outbreaks involving food establishments[‡]
- Efficient (noncompliance-cost minimizing) deployment of inspections? **Practically complex**

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Imperfect Monitoring & Deterrence

Efficient inspection allocation depends on:

- (i) How inspection deployment $\rightarrow$ perceived $\Pr(\textit{Detection})$
- (ii) How perceived $\Pr(\textit{Detection}) \rightarrow$ compliance
- (iii) Potential heterogeneity in (i) and (ii) across firms

Imperfect Monitoring & Deterrence

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- (iii) Potential heterogeneity in (i) and (ii) across firms

Empirical evidence on these relationships is challenging to attain & sparse[§]

- Variation in $\Pr(\textit{Detection})$ potentially endogenous to compliance
- Perceptions of $\Pr(\textit{Detection})$ difficult to account for
- Deterrence & detection effects move in opposite directions

[§]Food safety: Jin & Lee (RandJE, 2014), Makofske (JEBO, 2021). Env. Quality: Duflo et al. (ECMA, 2018), Zou (AER, 2021).

This Paper

Setting: Food-establishment health inspections by Maricopa County (Arizona) Environmental Services Department (MCESD), 2018-2022

- May 2020: MCESD began remote "virtual" inspections at establishments serving/near vulnerable populations (asst. living, nursing homes, hospitals)
- Virtual inspections scheduled in advance $\Rightarrow$ easily anticipated
- In 2021 began returning to unannounced on-site visits at treated (by virtual inspections) establishments
- **MCESD cont'd unannounced on-site inspections elsewhere**

What I do: use virtual regime & its phase-out to test several facets of imperfect-monitoring model

This Paper

What I find:

- Treated establishments use anticipation ability opportunistically for **detection avoidance**
- Establishments reduce compliance effort in response to detection-probability decrease, consistent with **deterrence**
- Deterrence effect **heterogeneity** could be exploited by a simple dynamic enforcement policy

MCESD Inspection Program

- MCESD inspects 24 different permit/establishment types; establishment food & consumer types $\Rightarrow$ risk classification $\Rightarrow$ annual inspection frequency (2, 3, or 4)
- Inspections check compliance with 52 different codes, violation severity classified as (high to low): *priority*, *priority foundation*, or *core*
- All inspection reports published in online database & **Yelp** incorporates these data into health ratings on establishment profiles
- MCESD grades inspection performance (A, B, C, D)
- Grade disclosure voluntary: irreversibly accept or decline participation before inspection

Virtual Inspections

Lower detection probability in two ways:

- (i) Anticipation enables detection avoidance
- (ii) Format limitations: difficulty observing some violations when not physically present

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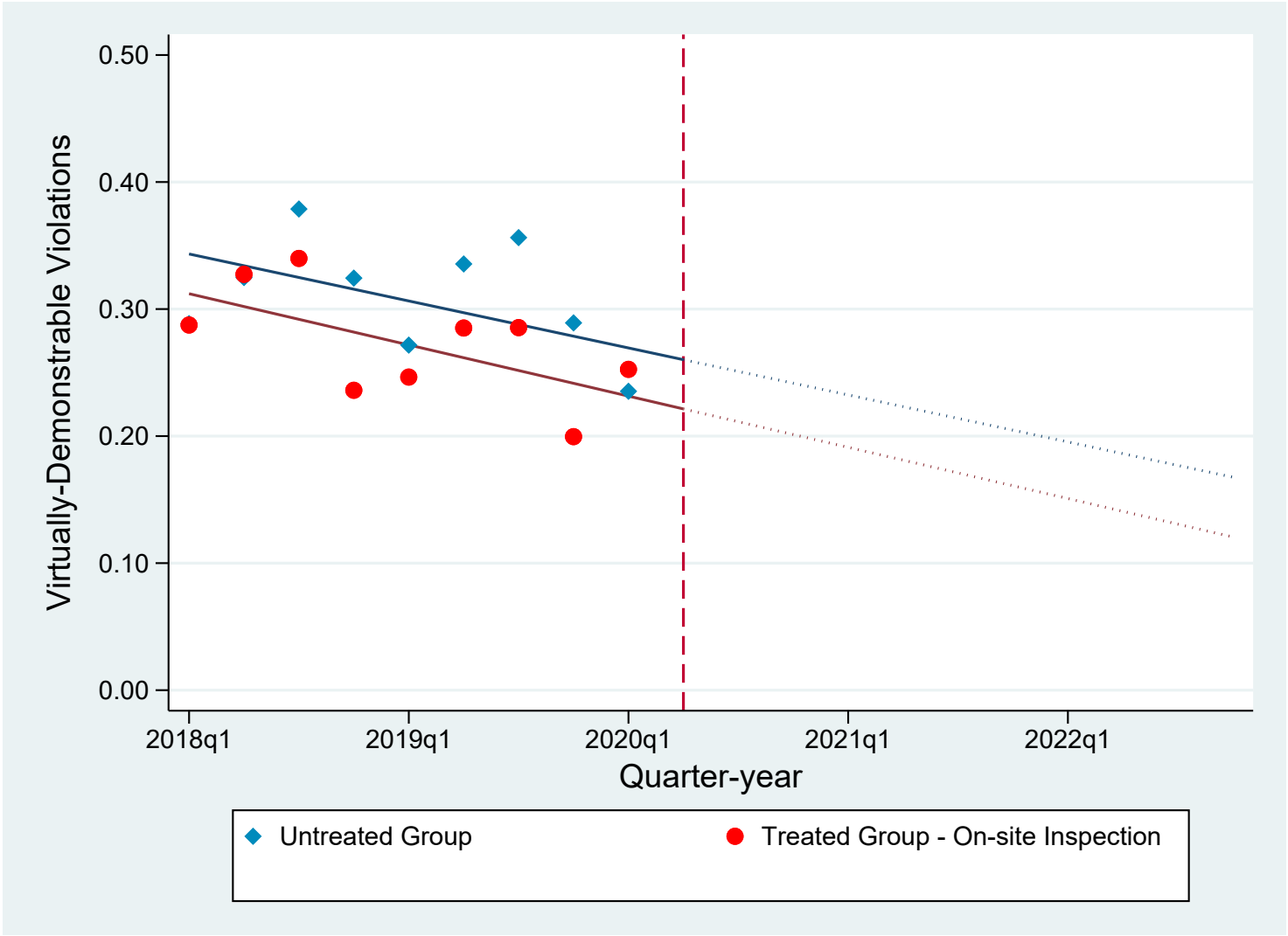
To isolate potential avoidance behavior:

- Focus on 5 "virtually demonstrable" violations
- These violations are detected by tests conducted across both inspection formats
- If not corrected prior to virtual inspections, these violations *will* be detected

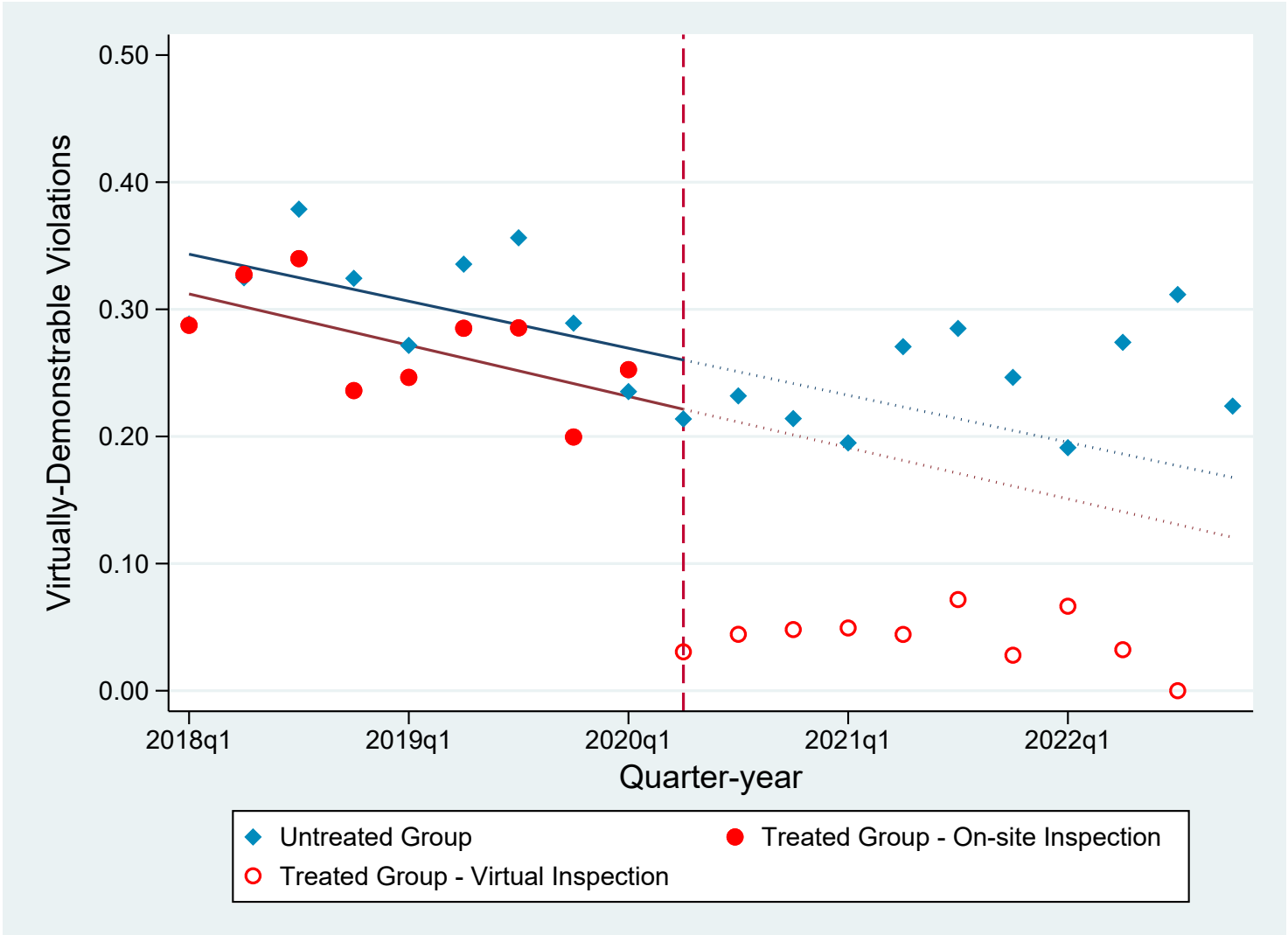
Methodology

$$y^{d}_{i,j} = \alpha_1 \left[(1 - \mathit{Virtual}_{i,j}) \times \mathit{Post}_{i,j}\right] + \alpha_2 \mathit{Virtual}_{i,j} + \mathbf{X}'_{i,j}\boldsymbol{\omega} + a_i + \epsilon_{i,j}$$

- $y^{d}_{i,j}$ is count of virtually-demonstrable violations detected in inspection j of establishment i
- $\mathit{Virtual}_{i,j}$ indicates inspection is virtual
- $\mathit{Post}_{i,j}$ indicates inspection j occurs on & after date of establishment i's first virtual inspection
- $[(1 - \mathit{Virtual}) \times \mathit{Post}\,] = 1$ in post-treatment on-site inspections
- Full specification contains fixed effects for: 14-day period of sample, establishment, day-of-week, month-of-year



- 8,681 inspections of 619 treated establishments (pre-period avg. 0.269)
- 146,604 inspections of 13,660 untreated establishments (pre-period avg. 0.302)



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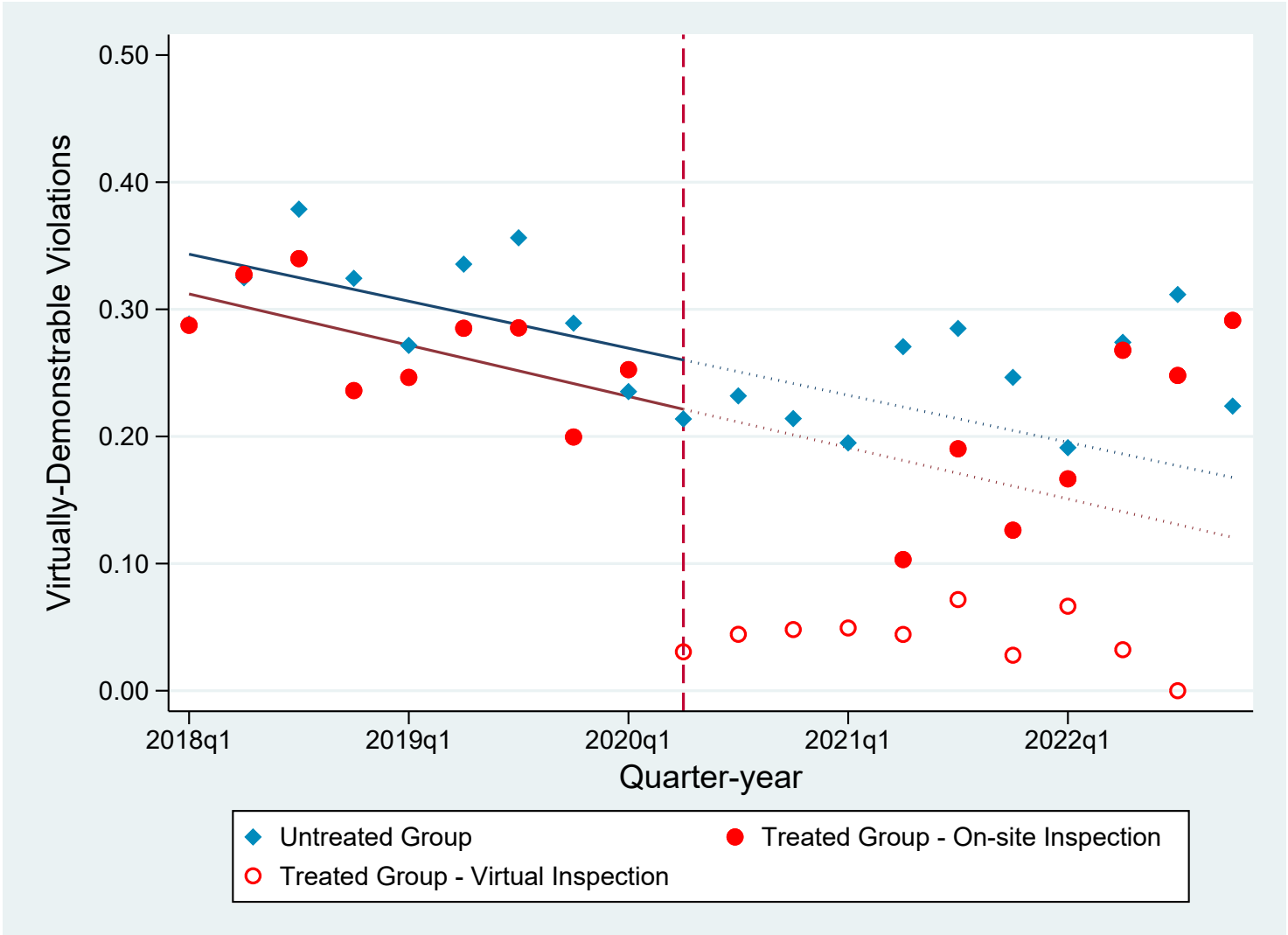

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Anticipation Ability & Detected Compliance

Variable	(1) $y_{i,j}^{d}$	(2) $y_{i,j}^{d}$	(3) $y_{i,j}^{d}$
$(1 - \textit{Virtual}) \times \textit{Post}$	-0.0061	0.0013	0.0044
	(0.0219)	(0.0194)	(0.0298)
Virtual	-0.1354***	-0.1426***	-0.1395***
	(0.0175)	(0.0163)	(0.0272)
Treated × *COVID*			-0.0031
			(0.0302)
Treated	-0.0400**		
	(0.0161)		
14-day period FE	Y	Y	Y
Establishment FE	N	Y	Y
Month-of-year FE	N	Y	Y
Day-of-week FE	N	Y	Y
R-squared	0.0125	0.2713	0.2713
N	155,285	155,285	155,285

OLS estimates. Standard errors clustered two-way on establishment & 14-day period. $\textit{COVID} = 1$ on & after Mar. 9, 2020. $^{***}p < 0.01$, $^{**}p < 0.05$,$^{*}p < 0.1$.

Avoidance or Learning?

$$y^{d}_{i,j} = \alpha_1 \left[(1 - \mathit{Virtual}_{i,j}) \times \mathit{Post}_{i,j}\right] + \alpha_2 \mathit{Virtual}_{i,j} + \mathbf{X}'_{i,j}\boldsymbol{\omega} + a_i + \epsilon_{i,j}$$

- Does $\widehat{\alpha}_2$ reflect opportunistic use of anticipation ability, or learning from PIC's greater involvement in inspection process?
- If learning:
  1. Should persist in subsequent on-site inspections ($\widehat{\alpha}_1$ rejects)
  2. Should only be evident <u>after</u> first virtual inspection

Anticipation Ability & Detected Compliance

Variable	(1) $y_{i,j}^d$	(2) $y_{i,j}^d$	(3) $y_{i,j}^d$
$(1 - Virtual) \times Post$	0.0014	0.0014	
	(0.0193)	(0.0194)	
Virtual	-0.1380***	-0.1371***	-0.1328***
	(0.0256)	(0.0259)	(0.0282)
$Virtual \times Post_{j-1}$	-0.0067	-0.0070	
	(0.0246)	(0.0248)	
14-day period FE	Y	Y	Y
Establishment FE	Y	Y	Y
Month-of-year FE	N	Y	Y
Day-of-week FE	N	Y	Y
R-squared	0.2710	0.2713	0.3399
N	155,285	155,285	88,413

OLS estimates. Standard errors clustered two-way on establishment & 14-day period. ***$p < 0.01$, **$p < 0.05$,*$p < 0.1$.

Column (3): sample ends with first virtual/post-period inspection.

Anticipation Ability & Disclosure Decisions

Variable	(1) $Disc_{i,j}$	(2) $Disc_{i,j}$	(3) $Disc_{i,j}$
$(1 - Virtual) \times Post$	0.0417***	0.0414***	0.1659***
	(0.0155)	(0.0154)	(0.0284)
$Virtual$	0.0540***	0.0532***	0.1631***
	(0.0136)	(0.0136)	(0.0279)
$0 < \overline{Disc}_{i,0} < 1$	N	N	Y
14-day period FE	Y	Y	Y
Establishment FE	Y	Y	Y
Month-of-year FE	N	Y	Y
Day-of-week FE	N	Y	Y
R-squared	0.5562	0.5563	0.3074
N	155,285	155,285	68,548

OLS estimates. Standard errors clustered two-way on establishment & 14-day period. $Disc_{i,j} = 1$ indicates disclosure participation. $^{***}p < 0.01$, $^{**}p < 0.05$,$^{*}p < 0.1$.

$\overline{Disc}_{i,0}$ is establishment's pre-period average of $Disc$.

Compliance Response

- Deterrence theory predicts violations will increase in virtual inspections
- Difficult to test: in virtual inspections, observe net of deterrence & detection effects
- In initial post-treatment on-site inspections: $\Pr(\textit{Detection})$ returns to pre-treatment level, but perceptions of $\Pr(\textit{Detection})$ likely tied to virtual regime

Methodology

$$y_{i,j} = \alpha_1 \left[(1 - Virtual_{i,j}) \times Post_{i,j}\right] + \alpha_2 Virtual_{i,j} + \mathbf{X}'_{i,j}\boldsymbol{\omega} + a_i + \epsilon_{i,j}$$

- $y_{i,j}$ is detected count of all violations in inspection j of establishment i
- Also use *severity-adjusted* count, y^a, which multiplies core (least severe) violations by 0.25 to reflect grade scale
- Sample: up to initial post-treatment on-site inspection among treated establishments observed in one
- α_1 is difference in conditional expectation of y between pre-treatment & initial post-treatment **on-site inspections**

Pre-Period Trends: All Violations

Variable	(1) $y_{i,j}$	(2) $y_{i,j}$	(3) $y^{a}_{i,j}$	(4) $y^{a}_{i,j}$
Trend × *Treated*	0.0043	0.0021	0.0015	0.0002
	(0.0032)	(0.0026)	(0.0026)	(0.0023)
Trend	-0.0101***	0.0419**	-0.0079***	0.0364***
	(0.0023)	(0.0173)	(0.0017)	(0.0137)
Treated	-0.4186***		-0.2458***	
	(0.0617)		(0.0479)	
14-day period FE	N	Y	N	Y
Establishment FE	N	Y	N	Y
Day-of-week FE	N	Y	N	Y
R-squared	0.0060	0.5012	0.0050	0.4696
N	71,249	71,249	71,249	71,249

OLS estimates. Standard errors clustered two-way on establishment & 14-day period. *Trend* is month of sample. ***$p < 0.01$, **$p < 0.05$,*$p < 0.1$.

Testing Deterrence

Variable	(1) $y_{i,j}$	(2) $y_{i,j}$	(3) $y^a_{i,j}$	(4) $y^a_{i,j}$
$(1 - \textit{Virtual}) \times \textit{Post}$	0.1658***	0.1891***	0.0723**	0.0893***
	(0.0425)	(0.0417)	(0.0347)	(0.0337)
Virtual	-0.2536***		-0.1900***	
	(0.0365)		(0.0303)	
14-day period FE	Y	Y	Y	Y
Establishment FE	Y	Y	Y	Y
Month-of-year FE	Y	Y	Y	Y
Day-of-week FE	Y	Y	Y	Y
R-squared	0.4011	0.3999	0.3700	0.3696
N	149,463	146,962	149,463	146,962

OLS estimates. Standard errors clustered two-way on establishment & 14-day period. $y_{i,j}$ is detected violation count. $y^a_{i,j}$ is severity-adjusted detected violation count. $^{***}p < 0.01$, $^{**}p < 0.05$,$^{*}p < 0.1$.

Columns (2) & (4): exclude virtual inspections.

Dynamic Enforcement Mechanism

Requiring: +1 inspection next year for crossing a noncompliance threshold this year

- Will further deter noncompliance if those likely to cross threshold are **responsive** to expected cost
- Will require additional inspections when threshold is crossed
- Could redirect inspections away from highly compliant establishments if they are **unresponsive** to expected cost
- Is improvement if noncompliance costs: $\downarrow$ more at potential targets than they $\uparrow$ from redirection

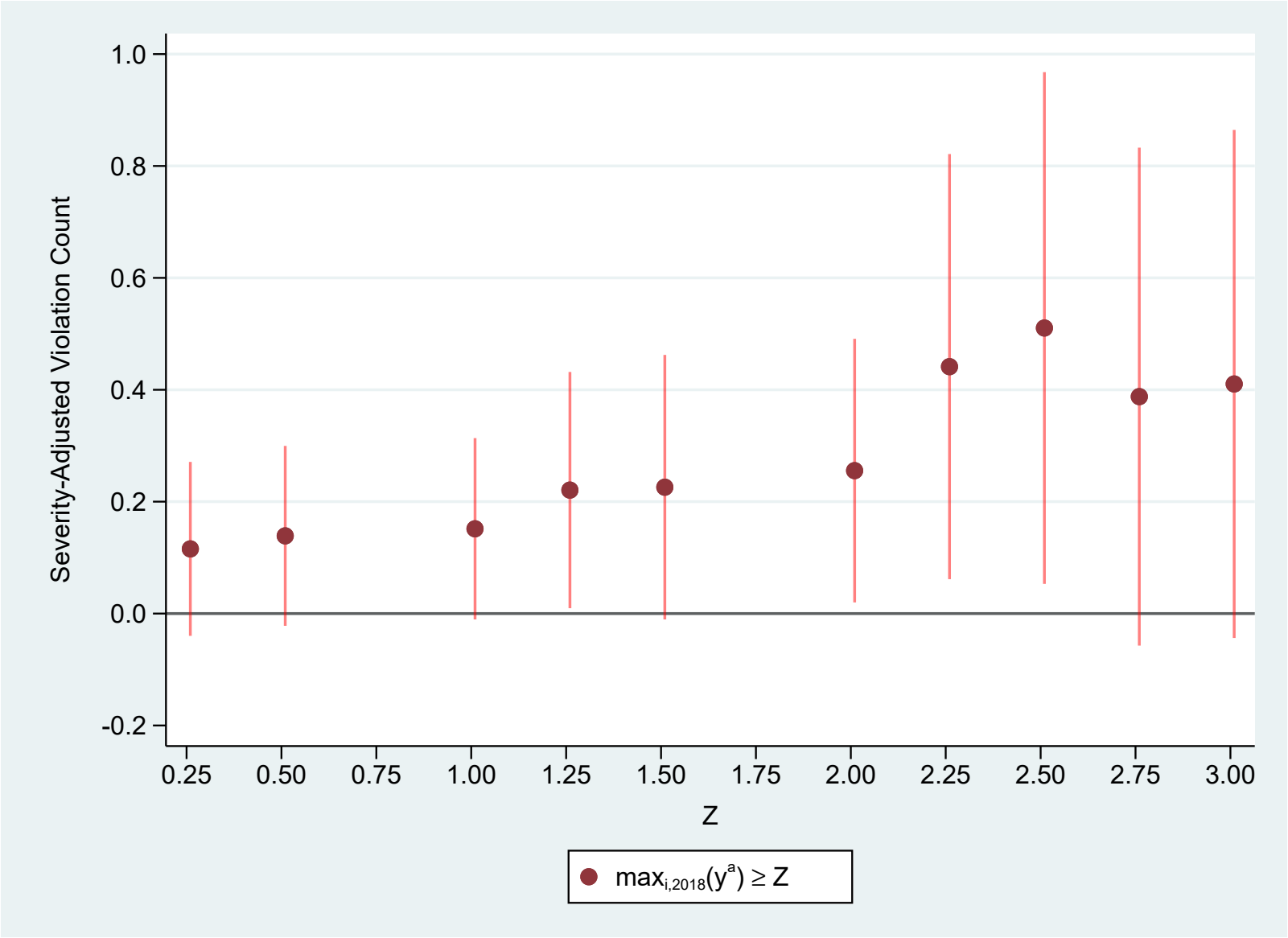
Dynamic Inspection Targeting

With all sampled establishments fully observed since 2018, and using post-2018 on-site observations only, I separately estimate:

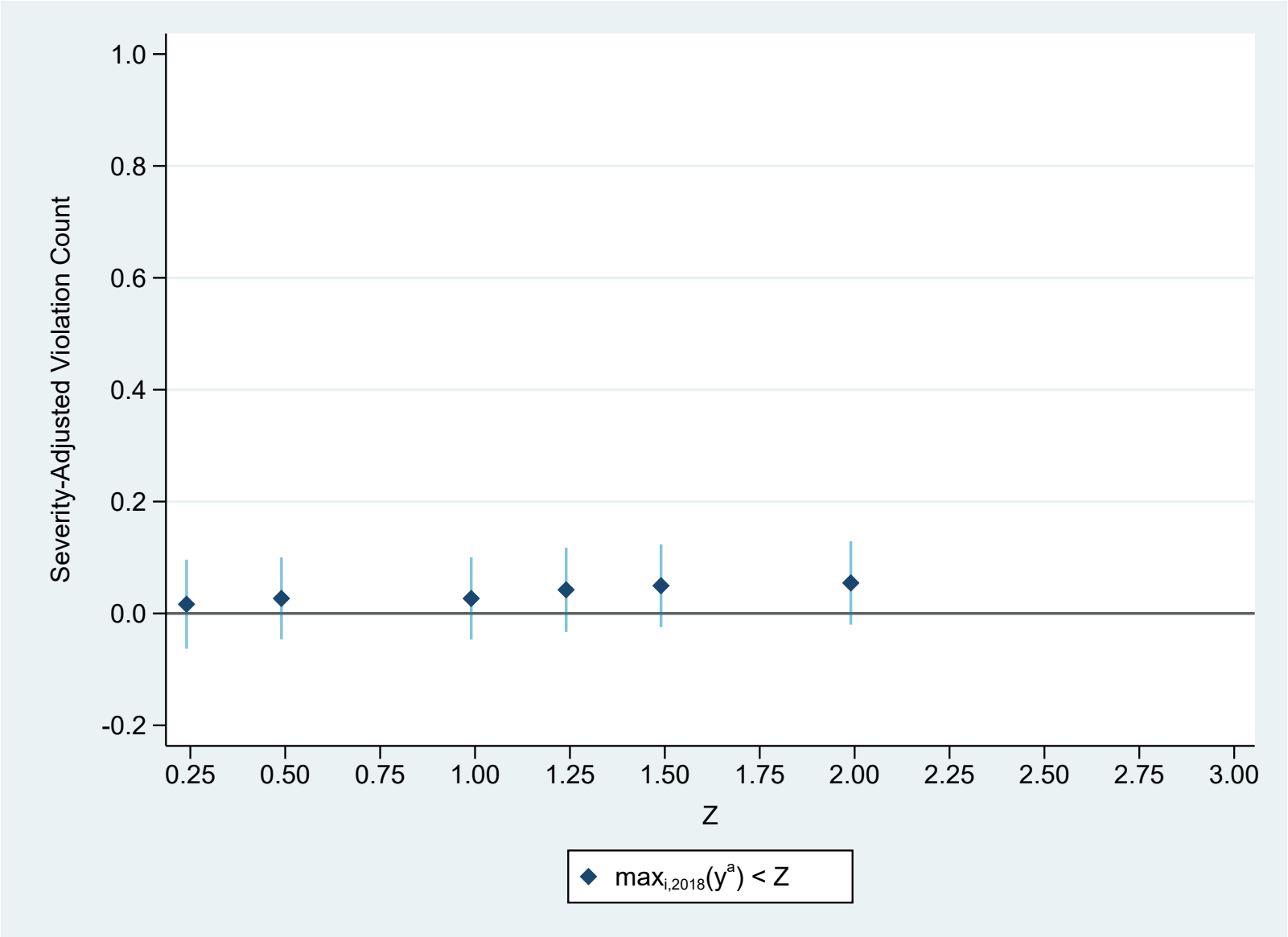
$$y_{i,j}^{a} = \alpha_1 \left[(1 - \mathit{Virtual}_{i,j}) \times \mathit{Post}_{i,j} \right] + \mathbf{X}_{i,j}^{'} \boldsymbol{\omega} + a_i + \epsilon_{i,j}$$

1. Among higher risk establishments where: $\max_{i,2018} (y^{a}) \geq Z$
2. Among lower risk establishments where: $\max_{i,2018} (y^{a}) < Z$

Higher Risk-Class Establishments



Lower Risk-Class Establishments



Anticipation Ability Enables Substantial Avoidance

Detected count of virtually-demonstrable violations:

- 53% ↓ in virtual inspections relative to pre-treatment avg.
- 50% ↓ evident by establishments' 1^{st} virtual inspection
- Returns to pre-treatment levels in subsequent on-site inspections

Disclosure participation:

- 6.6% ↑ in virtual inspections relative to pre-treatment avg.
- 26.9% ↑ among establishments exhibiting pre-period variation in $Disc_{i,j}$

Deterrence Effects & Policy Implications

Detected violation count:

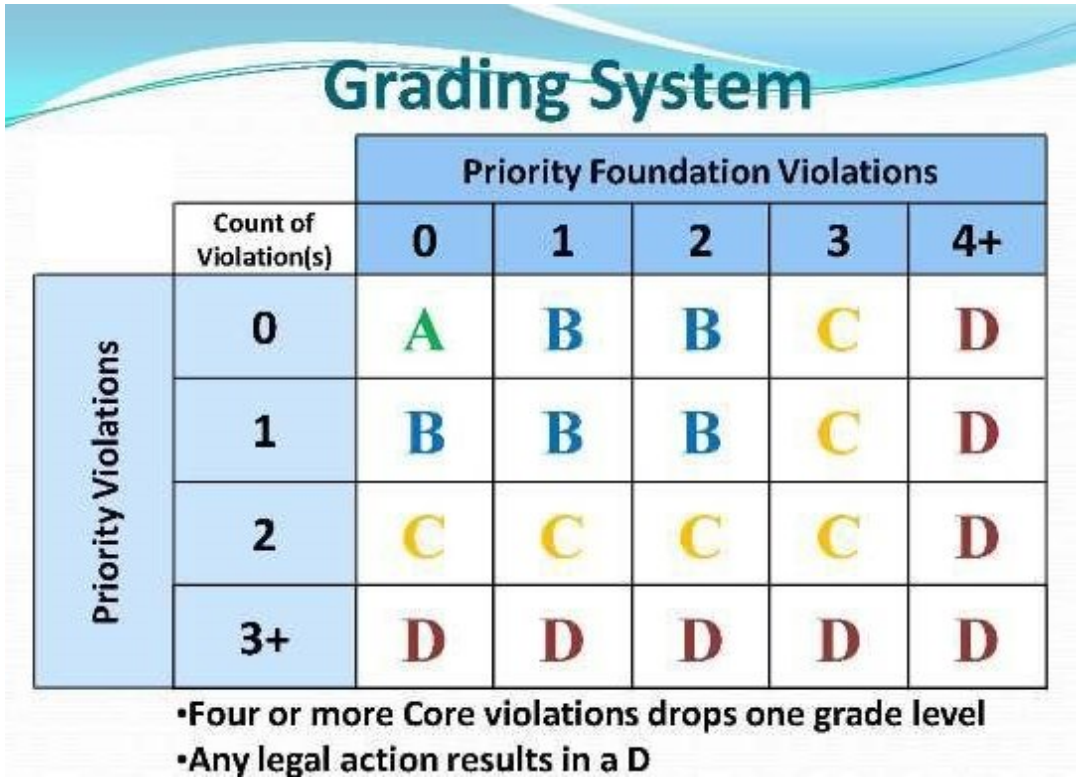
- 39% ↓ in virtual inspections relative to pre-treatment
- In 1^{st} post-treatment on-site inspection: exceeds pre-treatment avg. by 25%

Heterogenous Responses:

- Higher risk establishments with $\max_{i,2018}(y^{a}) \geq 2$: y^{a} in 1^{st} post-treatment on-site inspection exceeds pre-treatment average by 34%
- Dynamic inspection-targeting policy could improve overall compliance with existing inspection resources

Thank you!

MCESD Grading System



Grading Description

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Yelp Information

Fuku Sushi - CLOSED > Health Scores

Fuku Sushi - CLOSED

February 15, 2022 — Routine Inspection

Violations

- Standard not met: In-use utensils: properly used
- Standard not met: Proper cold holding temperatures

Inspections

Date	Inspection Type	Violations	Result	Score
February 15, 2022	Routine	2	Not Participating	N/A
September 29, 2021	Routine	6	Not Participating	N/A
May 25, 2021	Routine	5	Not Participating	N/A
February 26, 2021	Routine	4	B	N/A
October 30, 2020	Routine	0	A	N/A
August 12, 2020	Routine	0	A	N/A
April 24, 2020	Routine	0	A	N/A

Health Score

Powered by Hazel Analytics

Not Participating

About Health Scores

Yelp gets this data from Hazel Analytics, a leading provider of health department data analytics. Hazel Analytics' technology collects public data directly from your local health department. Depending on how frequently your health department publishes inspection results online and how long it takes to process and send that information to us, the most recent inspection for a business may occasionally not be shown here. If an inspection isn't shown yet, this is usually a temporary situation which will be resolved when we receive updated information. If you have any questions or comments about the data on this page, please visit Hazel Analytics' FAQ page.

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