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Abstract

Periodic inspections, in which firms are punished for detected violations, are a popular means of enforcing environmental, health, and safety regulations. The effectiveness of these programs typically hinges on the timing of inspections being unannounced and difficult to anticipate, lest firms comply only when they believe inspections are likely. In Las Vegas, Nevada, many facilities—*e.g.*, casinos, hotels, and shopping malls—house multiple food-service establishments, several of which are often inspected during the same inspector visit. Within such visits, all but the first establishment inspected likely anticipate their next inspection to a meaningful extent. Using data which record inspection starting times and span more than six years, I find that establishments in such facilities perform significantly and substantially worse when they receive the first inspection of a visit. Relative to their own performances on days when inspected later than first, establishments are assessed 21% more demerits and cited for 31% more critical violations in these surprise inspections.

JEL: K32, Q18

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1 Introduction

Periodic inspections, in which firms are punished for detected violations, are widespread in the monitoring and enforcement of environmental, health, and safety regulations. Inspection programs promote compliance by generating an expected cost to regulatory violations: the penalty assessed if the violation is detected, multiplied by the current probability of inspection and subsequent detection. This approach, which is often central to the provision of environmental quality and public safety, hinges on inspections being unannounced and difficult to anticipate. For if firms can correctly predict when their inspection probabilities are low, much of the expected cost will be mitigated.

Regulatory agencies, and the governments funding them, confront a tradeoff: limiting the ability of firms to anticipate inspections promotes compliance, but is also costly.[1] As such, the sensitivity of compliance to the ability to anticipate inspections is fundamental to understanding the optimal design, implementation, and funding of inspection programs. This sensitivity is also, however, difficult to cleanly estimate. Exploiting a feature of food-service health inspections in the Las Vegas, Nevada, metropolitan area; I circumvent typical complications and find that a modest ability to anticipate inspections can significantly undermine the monitoring and enforcement efforts of inspection programs.

Accounting for firms' abilities to anticipate inspections—and more generally, their perceptions of inspection probabilities and regulatory stringency—poses an empirical challenge.[2] Gray and Deily (1996), Laplante and Rilstone (1996), Eckert (2004), and Telle (2009), estimate the effect of perceived inspection probabilities on observed compliance using a two-step approach. First, inspection probabilities are estimated for different time periods using firm observables. Then, compliance outcomes are estimated as functions of predicted probabil-

[1] For instance, a measure such as increasing the frequency of inspections, *cet. par.*, likely requires the hiring of additional inspectors.

[2] Gray and Shimshack (2011) discuss these challenges, and provide a thorough review of empirical evidence regarding the effects of monitoring and enforcement effort on compliance.

ities from the first step, which proxy for firms' perceptions.[3] More recently, Duflo et al. (2018) assess experimental variation in the frequency of environmental inspections of Indian factories. They find that plants treated with increased inspection frequency were more likely to be cited for violating emissions standards.

Instead of proxying for firm perceptions, I utilize a feature of Southern Nevada Health District (SNHD) food-service health inspections that creates sharp within-firm variation in the ability to anticipate inspection timing. The Las Vegas metropolitan area is home to many facilities—particularly casinos, hotels, and shopping malls—that house more than one food-service establishment. SNHD environmental health specialists (inspectors) will commonly inspect multiple establishments during a single visit to these facilities. When this happens, all except the first establishment inspected likely anticipate their next inspection to a meaningful extent.

Using rich data on SNHD food-service inspections conducted from 2014 to 2020, I find that: compared to visits in which they are inspected *after* another establishment at their facility, restaurants perform significantly and substantially worse during visits when they receive their facility's *first* inspection. Relative to instances where ability to anticipate inspections is elevated, restaurants are assessed 20.82 percent more demerits, and are cited for 30.96 percent more critical violations (among the most severe violations defined by the SNHD) when inspected first during a visit. Moreover, consistent with the assumption underlying this empirical strategy, the effect of being inspected first on detected non-compliance is concentrated among violations capable of relatively quick remedy. A series of tests suggest that the results are not artifacts of endogenous inspection ordering, repeat visits by the same inspector, or inspector fatigue.

This empirical approach improves on the identification strategy of Makofske (2019), which uses routine health inspections from Los Angeles County, and finds that: compared to days

[3] Gray and Deily (1996), Laplante and Rilstone (1996), Eckert (2004), and Telle (2009) use this approach and find that higher predicted inspection probabilities suggest greater compliance with environmental regulations among Canadian petroleum sites, pulp and paper plants in Quebec, the United States steel industry, and Norwegian plants, respectively.

when they receive the only inspection at their facility, food-service establishments are cited for significantly fewer violations on days when they receive one of multiple inspections at their facility. Yet, because the LA County data used in that study recorded only the dates of inspections, on days when multiple inspections were conducted at a facility, the establishment inspected first was unknown. As such, the Makofske (2019) estimates likely understate the true sensitivity of compliance to inspection anticipation.

My results imply that sampled establishments exhibit significantly lower compliance levels than are often detected due to their ability to anticipate some inspections. They also suggest that average compliance among these establishments might improve if inspections were deliberately scheduled so as to limit this ability, perhaps by making team visits to multiple-establishment facilities.[4]

These findings also demonstrate a significant tradeoff that many public health agencies, perhaps unknowingly, face. While it presumably reduces per-inspection costs, inspecting multiple establishments during a single facility visit may also carry considerable consequences relating to public health. In southern Nevada, it especially undermines the ability to detect critical violations—described by the SNHD as "items directly related to the protection of the public from foodborne illness or injury". The Centers for Disease Control and Prevention (CDC) estimates that 48 million Americans contract a foodborne illness each year. Specific pathogens can be identified as the cause in about 9.4 million of the annual cases, and Hoffmann et al. (2015) estimate that the economic burden of those cases alone exceeds 15.5 billion dollars.[5] The potential drawbacks of these same-visit inspections merit serious consideration wherever multiple-establishment facilities are common. Beyond estimating the effect of inspection anticipation on detected compliance, this paper contributes a methodology for doing so that public health departments may have sufficient data to employ themselves.

[4]There are rare occasions in the data where multiple inspectors were sent to larger facilities together. Once arriving at a facility, inspectors then conducted separate inspections simultaneously. This practice could potentially limit the frequency of anticipated inspections, while holding inspection resources fixed.

[5]See `https://www.cdc.gov/foodsafety/foodborne-germs.html` for the CDC estimate. The Hoffmann et al. (2015) estimate is measured in 2013 USD.

My results are also relevant to recent work emphasizing the effectiveness of dynamic enforcement in promoting compliance (Helland, 1998; Duflo et al., 2018; Blundell, 2020; Blundell et al., 2020). Under dynamic enforcement regimes, firms are typically targeted for more frequent inspections and/or subjected to harsher prospective punishments following detected non-compliance. Just like their traditional counterparts, dynamic enforcement regimes are underpinned by surprise (unanticipated) inspections. Moreover, because they redirect enforcement resources over time based on observed compliance histories, inspection anticipation could be especially problematic under dynamic enforcement regimes. For instance, if inspections can be anticipated to some extent, dynamic enforcement measures may unintentionally target firms that are least able to anticipate, rather than the worst offenders. It is worth noting that SNHD policy includes some dynamic enforcement elements, which are discussed in Section 2.

In the space remaining, I review the policies and process governing SNHD food inspections, the data and construction of my estimating sample. I then describe my empirical strategy and present the main results. Finally, I subject these findings to a battery of robustness tests that largely rule out alternative explanations, and then conclude.

2 Inspection Process and Regulatory Background

The Southern Nevada Health District (SNHD) conducts routine health inspections of food-service establishments in the Las Vegas, Nevada, metropolitan area. The SNHD was established jointly by Clark County, and the cities of Boulder City, Henderson, Las Vegas, Mesquite, and North Las Vegas, as the public health authority within those entities.

Annually, the SNHD conducts at least one routine unannounced inspection of all licensed food establishments. Health code violations fall into four categories, and may carry demerits. The most serious, *imminent health hazards*, result in immediate closure of the establishment and fines. The SNHD defines the second most serious category, *critical violations*, as "items directly related to the protection of the public from foodborne illness or injury". *Major violations* are items that "if left un-addressed may lead to a situation detrimental to public health". Violations of *good food management practices*—which I call *good-practices violations* for expositional ease—are considered least severe. Descriptions of all violations in each category are provided in Tables A3, A4, and A5 of the Appendix.

Inspection performances are scored through the assessment of demerits on detected violations. Critical violations carry 5 demerits; major violations carry 3 demerits; and good-practices violations carry 0 demerits. While imminent health hazards result in immediate closure and the assessment of a fee, they do not actually carry demerits. Prior to 2014, good-practices violations carried 1 demerit; and prior to March 25, 2010, the demerit schedule as well as the violations and violation categories defined by the SNHD, were very different from the current framework. Because of these changes, the sample is restricted to the current regulatory regime, which began January 1, 2014.

The SNHD requires hygiene-quality disclosure through a grade-card policy. Section 8-303.11 of revised *Regulations Governing the Sanitation of Food Establishments*, adopted March 25, 2010, mandates that "every food establishment in the health authority's jurisdiction shall post the health permit and grade card, stating the grade received at the time of the most recent inspection, in an area that is clearly conspicuous to the consumer upon entering the food establishment".[6]

Letter grades are primarily based on total demerits from an establishment's most recent inspection. In general, 10 demerits or fewer result in an *A* grade, 11 to 20 demerits result in a *B* grade, 21 to 40 demerits result in *C* grade, and more than 40 demerits force immediate closure of the establishment and assessment of the closure fee. The basic letter-grade schedule is then supplemented by dynamic-enforcement elements, whereby potential punishments escalate based on an establishment's past non-compliance. Any inspection involving a consecutive identical critical or major violation—*i.e.*, if the establishment commits the same

[6]The full regulations are available at https://www.southernnevadahealthdistrict.org/permits-and-regulations/food-establishment-regulations/.

major or critical violation for a second straight inspection—will be downgraded one letter.[7] Establishments must also be re-inspected within 15 business days of receiving a B or C grade. Establishments assessed more than 10 demerits in re-inspections are: downgraded to a C if the re-inspection follows a B grade, and closed with fines if the re-inspection follows a C grade. Closed establishments require re-inspection and SNHD approval before re-opening.

3 Data and Estimation Sample

Data are from the Southern Nevada Health District (2020) website.[8] Each observation corresponds to an inspection and records (among other things) the establishment's total demerits from the inspection, the corresponding letter grade, the date and starting time of the inspection, and identifiers for the establishment inspected, the facility where the establishment is located, and the inspector conducting the inspection.

The raw data span January 1, 2014 to March 9, 2020, and consist of 111,902 routine inspections of 21,949 different licensed food establishments.[9] The modal establishment inspected by the SNHD is classified as a restaurant. However, as seen in Table A1, the SNHD conducts food inspections of various other establishment types. My primary estimating sample is restricted establishments categorized as restaurants by the SNHD, which account for 42,524 routine inspections in the raw data.[10] Section A1.1 of the Appendix discusses the process of cleaning the raw data, through which a relatively small number of observations were corrected in some way, or dropped.

In estimation, the explanatory variable of interest is an indicator, $First_{i,j,t}$, which equals 1 if establishment i receives the first inspection of a visit at facility j on date t, and equals

[7] Thus, when a consecutive identical major or critical violation is detected: 10 demerits or fewer result in a B, 11 to 20 demerits result in a C, and 21 to 40 demerits force closure and assessment of the closure fee.

[8] See `https://www.southernnevadahealthdistrict.org/permits-and-regulations/restaurant-inspections/developers/`.

[9] I exclude re-inspections.

[10] The sign, significance, and relative magnitude of results are robust to broader samples, as shown in Section 6.5.

0 otherwise.[11] To enable the inclusion of establishment fixed effects, the estimating sample is restricted to establishments with: at least one routine inspection where $First_{i,j,t} = 1$, and at least one routine inspection where $First_{i,j,t} = 0$.

A peculiar feature of SNHD regulations is that bars located within restaurants are assigned separate permits and receive their own inspections. Although the data do not directly distinguish between stand-alone bars and those that are located within a restaurant, I am able to identify the latter using names and permit numbers.[12] In 4,019 visits where these restaurants and the establishments they encompass were inspected, the apparent convention is to inspect the restaurant first. However, there are 725 visits where the bar (or other establishment type) located within the restaurant is inspected first, and the restaurant second. After the inspector's arrival, these cases do allow the restaurants time to potentially remedy violations before their inspections begin. But given that they break from the convention of inspecting the restaurant first, they may be influenced by the inspectors' initial impressions, and thereby endogenous.[13] For this reason, I exclude such observations from the estimating sample as well as from the counts described in the previous paragraph.

These restrictions leave 8,411 routine inspections of 1,315 restaurants. To support the inclusion of inspector fixed effects, the sample is further restricted to observations with inspectors who conducted: at least one routine inspection where $First_{i,j,t} = 1$, and at least one routine inspection where $First_{i,j,t} = 0$. This yields the primary estimating sample of 8,375 routine inspections involving 1,312 restaurants, located within 704 different facilities. These inspections are conducted by 129 different inspectors.

[11]Technically, t denotes the date that a visit to a facility began. Of 19,740 multiple-inspection visits, there are 57 where, because the visit began very late, inspection starting times within the visit span two dates.

[12]When bars are located within restaurants, the permit numbers for the restaurant and bar are typically different by one. See Table A2 of the Appendix for examples. While less common, there are also cases of other establishment types (*e.g.*, snack bars and prep kitchens) that appear to be located within restaurants, but that are separately inspected and assigned unique license numbers.

[13]For instance, inspectors may have deviated from the conventional ordering if initial on-site observations led them expect high compliance levels from the restaurant.

4 Methodology

To estimate how inspection anticipation affects detected compliance, I compare individual establishments' performances across two inspection states: (1) inspector visits where the establishment receives the first inspection at their facility (and has minimal ability to anticipate the inspection), and (2) inspector visits where the establishment is inspected after at least one other establishment in the facility (and has an elevated ability to anticipate the inspection). An underlying assumption is that when $First_{i,j,t} = 0$, in the time between the inspector's arrival at the facility and the start of the inspection, establishments are capable of complying with health codes that they were violating at the time of arrival.[14]

Table 1 reports summary statistics for the estimating sample, and makes comparisons across these two inspections states. Following a routine inspection, establishments are closed if they receive more than 40 demerits, or if an imminent health hazard is found. There are 38 inspections in the estimating sample where establishments were closed due to an imminent health hazard, but assessed fewer than 41 demerits. The variable, *adjusted demerits*, assesses 41 demerits in these inspections in an attempt to better reflect the severity of the non-compliance. Relative to inspections where $First_{i,j,t} = 0$, establishments are assessed 46.41 percent more demerits, and are cited for 41.98 percent more violations when they receive the first inspection of a visit at their facility. However, if propensity to be inspected first correlates with establishment-specific characteristics that influence hygiene quality, these simple comparisons may mislead. As such, establishment fixed effects are included in estimation to overcome this issue.

Estimating equations take the form,

$$y_{i,j,t} = \alpha_1 First_{i,j,t} + \mathbf{X}'_{i,j,t}\boldsymbol{\alpha} + a_i + \epsilon_{i,j,t}, \tag{1}$$

[14]Support for this assumption is provided in Section 6.

where $y_{i,j,t}$ is an inspection outcome (*e.g.*, total demerits) for establishment i, located in facility j, during a routine inspection on date t. Recall, $First_{i,j,t}$ equals 1 if establishment i receives the first inspection at facility j on date t, and equals 0 otherwise.

Establishment fixed effects are included to account for time-invariant and restaurant-specific characteristics which might otherwise correlate with hygiene quality and propensity to be inspected first. Under the full specification for equation (1), the vector $\mathbf{X}_{i,j,t}$ contains fixed effects for the inspector conducting an inspection, the starting hour of the inspection,[15] and: the day of the week, month of the year, and year when the inspection occurred.

5 Results

Table 2 reports ordinary least squares (OLS) estimates of equation (1) with demerits as the dependent variable. Standard errors are clustered two-way on facility and inspector allowing for error-term correlation (of arbitrary form) within facilities, as well as inspector-specific correlation that may arise across facilities. Column (1) reports a simple specification in which establishment fixed effects are the only included controls. In column (2), fixed effects for the starting hour of the inspection, as well as the day of the week, month of the year, and year in which the inspection occurred, are added. The full specification, reported in column (3), includes inspector fixed effects as well. Column (4) reports full-specification estimates but using adjusted demerits as the dependent variable.[16]

These estimates show a significant and substantial increase in detected non-compliance when restaurants lack the ability to anticipate their inspection. Recall that on average, 5.7325 demerits are detected when the ability to anticipate inspections is elevated. Relative to that value, the full-specification coefficient on *First* of 1.1934, represents a 20.82 percent

[15] A small number of inspections begin in the early hours of days, prior to 7 A.M. There are insufficient observations to include separate indicators for each of these hours. Thus, among the starting-hour fixed effects is an indicator equal to 1 if the inspection began prior to 7 A.M.

[16] The *demerits* and *adjusted demerits* variables are identical with the exception of 38 observations where imminent health hazards were detected and *demerits* were less than 41. In these observations *adjusted demerits* equals 41.

increase in demerits.

To evaluate the effect of anticipation in different terms, Table 3 reports full-specification estimates with counts of detected violations in each of the SNHD categories as dependent variables. Relative to means when $First = 0$, these estimates demonstrate that establishments are cited for 30.96 percent more critical violations, and 14.51 percent more major violations when the inspections are unanticipated. Imminent health hazards are relatively rare, and the estimated difference in their detection conditional on $First_{i,j,t}$ is statistically insignificant at conventional levels. Descriptions in Table A3 suggest that many imminent health hazards are violations that can't be quickly remedied, even with several hour's notice of an inspector's presence (*e.g.*, interruption of electrical service, lack of potable water, or lack of hot water). As such, this estimate seems consistent with the modest differences in anticipation ability reflected by variation in $First_{i,j,t}$.

In contextualizing these results, the substantial effect of inspection anticipation on critical-violation detection seems especially meaningful. Per the SNHD's description, this finding suggests that actions which are "directly related to the protection of the public from food-borne illness" go significantly under-detected due to anticipation of inspections. Paired with that description, this result suggests that the practice of inspecting multiple establishments during a single facility visit may carry very significant public health costs.

6 Robustness Analysis

6.1 Testing an Underlying Assumption

An assumption underlying my empirical strategy is that, just prior to inspections where $First_{i,j,t} = 0$, establishments are able to remedy some violations that would otherwise be detected. In the estimating sample's 3,361 inspections where $First_{i,j,t} = 0$, establishments are inspected about 84 minutes after the inspector's arrival on average; and roughly 81 percent of these inspections begin within two hours of arrival (the distribution of starting times, measured in minutes since the inspector's arrival at a facility, is shown in Figure 1).[17] Thus, $\hat{\alpha}_1$ should reflect the detection of violations that can be fixed rather quickly.

To test the validity of this underlying assumption, I endeavor to distinguish violations that can likely be remedied on short notice (*flexible* violations), and violations that clearly can't be remedied the same day as an inspector visit (*rigid* violations). If $First_{i,j,t}$ is capturing—as intended—sharp variation in anticipation ability, it should have a significant effect on the detection of *flexible* violations, but little effect on the detection of *rigid* violations.

I construct both a narrow and broad classification for *flexible* violations. An establishment's staff may commit some violations by not following certain procedures or by doing things that are prohibited (*e.g.*, by not washing hands as and when required, or by reusing single-use items). Because anticipation of an upcoming inspection gives an establishment's person-in-charge a chance to quickly remind staff about such practices, the narrow classification consists of these sorts of procedural violations. The broader grouping also includes violations that can be quickly fixed but require actions that go beyond simply issuing reminders (*e.g.*, cleaning food contact surfaces, or ensuring that food has been properly stored to prevent contamination).

By contrast, *rigid* violations involve requirements such as the installation and maintenance of warewashing and refrigeration equipment, having adequate and functional plumbing, and preventing pest infestation. Because establishments can't suddenly fix these sorts of violations given a few hours' notice, we wouldn't expect *First* to affect their detection. Table 4 lists and describes the violations categorized into each group.[18]

Table 5 reports full-specification estimates of equation (1) with narrowly-defined *flexible* violations, broadly-defined *flexible* violations, and *rigid* violations, as dependent variables. Consistent with the underlying assumption, significantly and substantially more *flexible* violations are detected when establishments receive the first inspection of a visit at their facil-

[17]The recorded starting time of the first inspection is treated as the arrival time.

[18]Attention was restricted to penalized violations only (*i.e.*, imminent health hazard, critical, and major violations).

ities. Relative to means when $First_{i,j,t} = 0$, unanticipated inspections detect 25.56 percent more of the narrowly-defined *flexible* violations, and 18.10 percent more of the broadly-defined *flexible* violations. Also consistent with the underlying assumption, the effect of *First* on the detection of *rigid* violations, while positive, is relatively small (a 4.91 percent increase) and very close to zero.

6.2 Testing Exogeneity of Inspection Ordering

The evidence presented thus far demonstrates that, relative to their own performances when inspected after others in their facility, establishments perform significantly worse when they receive the first inspection of a visit. The effect is robust to a variety of additional controls and, consistent with underlying assumptions, concentrated among violations that can be quickly remedied. In this section, I consider whether endogenous inspection ordering could alternatively explain these results.

The methodology employed consistently estimates the effect of inspection anticipation, so long as *First* is uncorrelated with any omitted or unobservable factors that also affect the inspection outcome. Establishment fixed effects control for any time-invariant and establishment-specific traits explaining cross-sectional variation in compliance. Thus, omitted variables are only problematic if, conditional on included controls, propensity to be inspected first and *within-establishment* variation in compliance correlate over time.

To address this potential issue, I entertain the possibility that inspectors' compliance expectations may influence the order in which they inspect the establishments at a facility. For instance, if propensity to be inspected first is higher for establishments that performed worse than usual in their prior inspection, and if worse-than-usual performances tend to indicate persistent declines in hygiene quality; then $\hat{\alpha}_1$ might partially capture these persistent declines, rather than the effect of inspection anticipation. To the extent that inspectors' current compliance expectations are influenced by establishments' inspection histories, this potential issue can be resolved by controlling for past inspection performances.

Table 6 reports full-specification estimates of equation (1), with lagged demerits—an establishment's total demerits from their most recent prior routine inspection—included as a control. Dependent variables in Table 6 are: demerits, adjusted demerits, critical violations, and major violations. In all four columns, coefficients on $First_{i,j,t}$ are very similar in sign, significance, and magnitude, to corresponding estimates in Tables 2 and 3. Table A6 of the Appendix reports this same analysis, but with narrowly-defined *flexible* violations, broadly-defined *flexible* violations, and rigid violations, as dependent variables. Those coefficients on *First* are similar in sign, significance, and magnitude, albeit slightly smaller for broadly-defined *flexible* violations, and slightly larger on *rigid* violations.

At some of the sampled facilities, there are visits where multiple establishments are inspected, as well as visits where only one establishment is inspected. As an additional test, I restrict the estimating sample to exclude observations from single-inspection visits, in case such visits were targeted to establishments where hygiene quality declines were suspected. Table 7 reports full-specification estimates from this restricted sample with demerits, adjusted demerits, critical violations, and major violations as dependent variables. Across all four outcomes, coefficients on *First* remain very similar in sign, significance, and magnitude, to corresponding estimates in Tables 2 and 3.[19]

The estimates in Table 6 reveal that establishments perform significantly worse when inspected first, even after conditioning on their previous inspection performance (in case persistent hygiene quality declines increase propensity to be inspected first). However, perhaps inspection ordering is influenced by information that is observable to inspectors, but not reflected in establishments' inspection-performance metrics? To address this possibility, I restrict the estimating sample to observations where establishments faced a different inspector than in their previous routine inspection. Because these inspectors weren't present for the restaurant's prior inspection, it is doubtful that their expectations are informed by

[19]Estimates from this restricted sample using *flexible* and *rigid* violations as the dependent variable are reported in Table A7 of the Appendix. These estimates are similar in sign, significance, and magnitude to results from Table 5.

much—if anything—more than reported inspection-performance metrics. Using this subsample, Table 8 reports estimates of the same specifications used in Table 6. These estimates, though slightly smaller and with slightly larger standard errors, are still qualitatively similar to those in Table 6, as well as those in Tables 2 and 3.

Finally, recall from Table 5 shows that the effect of *First*—conditional on controls—is largely concentrated among violations capable of quick remedy. While this *is* consistent with *First* capturing differences in anticipation ability, we wouldn't necessarily expect endogenous inspection ordering to produce such a pattern. This same point applies to repeat inspector visits and inspector fatigue, which are addressed below.

6.3 Accounting For Repeat Inspector Visits

Jin and Lee (2018) find that a combination of heterogeneous inspector criteria and diminishing attention explain a significant gap in cited violations between new and repeat inspectors in Florida restaurant inspections. To test whether repeat visits correlate with inspection ordering in a problematic way, I estimate

$$y_{i,j,t} = \beta_1 \left(First_{i,j,t} \times Diff_{i,t} \right) + \beta_2 First_{i,j,t} + \beta_3 Diff_{i,t} + \mathbf{X}'_{i,j,t}\boldsymbol{\beta} + b_i + u_{i,j,t}; \qquad (2)$$

where $Diff_{i,t}$ equals 1 if, on date t, establishment i is inspected by a different inspector than in their previous inspection, and equals 0 otherwise. $\hat{\beta}_2$ estimates a similar parameter to the estimates from Table 8, but with a larger sample and without controlling for lagged inspection performance.

Estimates of equation (2) are reported in Table 9. While additional violations and demerits are associated with non-repeat inspector visits, the differences when $First = 0$, and when $First = 1$, are both statistically insignificant at conventional levels. Moreover, in non-repeat-inspector visits, the effects of *First* on demerits, adjusted demerits, and critical violations are still quite large. Overall, the main results are largely robust to the effect of repeat inspector visits.

6.4 Allowing for Inspector Fatigue

Ibanez and Toffel (2019) find evidence suggesting inspector fatigue may affect the detection and citation of violations in food-safety inspections. Using data from Lake County, Illinois, Camden County, New Jersey, and the state of Alaska, they find that inspectors cite fewer violations later in their shifts. Such an effect might confound my estimates as inspections where $First_{i,j,t} = 0$ are, by nature, more likely to occur later in inspector shifts. To address this potential issue, I estimate equation (1) under several subsamples in which inspector fatigue is unlikely to explain differences in detected compliance.

Although inspector shifts are not formally recorded in the data, I use inspector identifiers and inspection starting times to determine when the first and last inspections of shifts likely began. Table 10 reports estimates of equation (1) with the sample restricted to restaurant inspections where $First_{i,j,t} = 1$, or $First_{i,j,t} = 0$ where the inspection begins within 4 hours of the first inspection of an inspector's shift. Coefficients on *First* are very similar in sign, significance, and magnitude, to corresponding estimates under the primary estimating sample.

Additionally, I repeat this estimation with demerits as the dependent variable, and the sample restricted to restaurant inspections where: $First_{i,j,t} = 1$, or $First_{i,j,t} = 0$ that began within x hours of the first inspection of the inspector's shift, for all $x \in \{1, 2, \ldots, 8\}$. Figure 2 displays coefficients from these regressions along with 99-percent confidence intervals. Notice that the effect of $First_{i,j,t}$ on detected demerits is very stable across all of these samples, and even after excluding any inspections where $First_{i,j,t} = 0$ that began more than one hour after the first inspection of a shift. These estimates give no indication that inspector fatigue is driving any of the estimated effect of *First*.

Finally, I also exclude inspections where $First_{i,j,t} = 0$ that begin 90 minutes or less before the last inspection of an inspector's shift.[20] Estimates from this restricted sample—reported in Table A8 of the Appendix—are very similar to those from Section 5 in sign, significance, and magnitude. The estimates reported in this subsection strongly suggest that the estimated effects of *First* are not an artifact of inspector fatigue.

6.5 Robustness to Broader Estimating Samples

The primary estimating sample was limited to establishments coded by the SNHD as restaurants. Nonetheless, my main results are robust to broader estimating samples. Table A9 of the Appendix reports full-specification estimates of equation (1) with the sample expanded to include establishments coded by the SNHD as a: restaurant, bar/tavern, buffet, or snack bar. Coefficients on *First* are similar to those from the primary sample in sign and significance, and—with the exception of the effect of major violations—slightly smaller in absolute magnitude. In relative magnitude however, the effects are slightly larger. Relative to this sample's means when $First_{i,j,t} = 0$, these estimates suggest that establishments are assessed 26.97 percent more demerits, and are cited for 35.08 percent more critical violations, and 23.17 percent more major violations when inspected first.[21]

Table A10 of the Appendix reports similar estimates with the estimating sample expanded to include all establishment types. Coefficients on *First* from this broadest possible estimating sample are quite similar to the primary results in sign and significance, and slightly smaller absolute and relative magnitude.

7 Concluding Remarks

Inspection programs are central to enforcing a wide range of environmental, health, and safety regulations. However, an ability among regulated firms to anticipate inspection tim-

[20] Ibanez and Toffel (2019) hypothesize that inspectors may cite fewer violations in inspections that risk extending their shifts past normal durations.

[21] By comparison, full-specification estimates with the primary estimating sample yielded relative effects of 20.82 percent more demerits, 30.96 percent more critical violations, and 14.51 percent more major violations.

ing could render these programs—which are central to ensuring environmental quality as well as consumer and worker safety—less effective.

Using Southern Nevada Health District food inspections spanning 2014 to early 2020, I find that detected compliance is quite sensitive to the ability to anticipate inspections. Compared to visits when they are inspected after another establishment in their facility, restaurants are assessed 20.65 percent more demerits, and are cited for 28.86 percent more critical violations when they receive the first inspection of a visit to their facility. These findings suggest that within multiple-establishment facilities, even on days of inspection visits, a substantial number of critical violations go undetected because establishments anticipate their coming inspection in advance. A battery of tests rule out endogenous inspection ordering and inspector fatigue as possible alternative explanations of these results.

Given the relative ubiquity of multiple-establishment facilities, and the apparent cost-effectiveness of conducting multiple inspections during a single visit, these results are may be widely relevant. Following the methodology employed here, public health authorities with sufficient data can estimate the sensitivity of compliance to the practice of conducting multiple same-visit inspections within their own jurisdictions; and potentially, use that information to improve the effectiveness of their inspection programs.

More generally, the incorporation of dynamic enforcement elements into inspection programs is very promising (Helland, 1998; Duflo et al., 2018; Blundell, 2020; Blundell et al., 2020). To be effective however, dynamic enforcement requires that inspections reliably detect which firms are truly least compliant, and thus, the correct targets of elevated scrutiny. This underscores the importance of appropriately limiting the ability to anticipate the timing of visits in inspection programs.

Finally, an interesting feature of SNHD food inspections over this period are occasions when multiple inspectors were sent to larger facilities together. Once arriving at the facility, inspectors then conducted separate inspections simultaneously.[22] This practice, though relatively rare, is promising because it limits inspection anticipation in a cost-effective manner. Each additional inspector sent provides an additional surprise inspection without incurring the cost of a separate visit to the facility. Moreover, if inspectors carpool on these occasions, team visits presumably reduce the explicit per-inspection costs of inspecting multiple-establishment facilities. The practice of teams visits has potential to mitigate some of the inherent tradeoff between the surprise nature of inspections and the costs associated with inspecting multiple-establishment facilities.

[22] Muehlenbachs et al. (2016) find that sending additional inspectors to offshore oil and gas platforms increases both the number and severity of sanctions issued, suggesting that *team inspections* of a single entity are more intense. Here, teams being sent to a single facility, but then inspecting separate entities independently.

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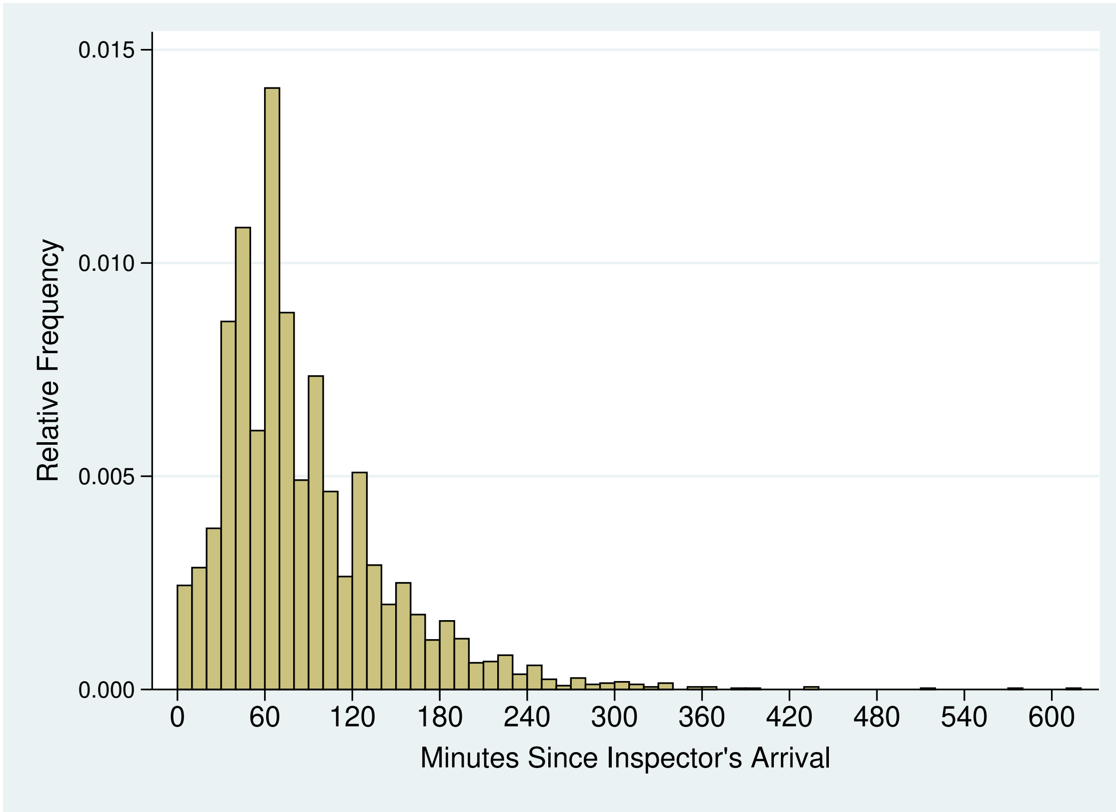

Figure 1: Start of Inspection After Inspector's Arrival

For inspections in the estimating sample where $First_{i,j,t} = 0$, the distribution of minutes elapsed between an inspector's arrival at a facility and the start of an inspection. Starting time of a visit's first inspection is treated as the inspector's arrival time at the facility. Bins are 10 minutes wide.

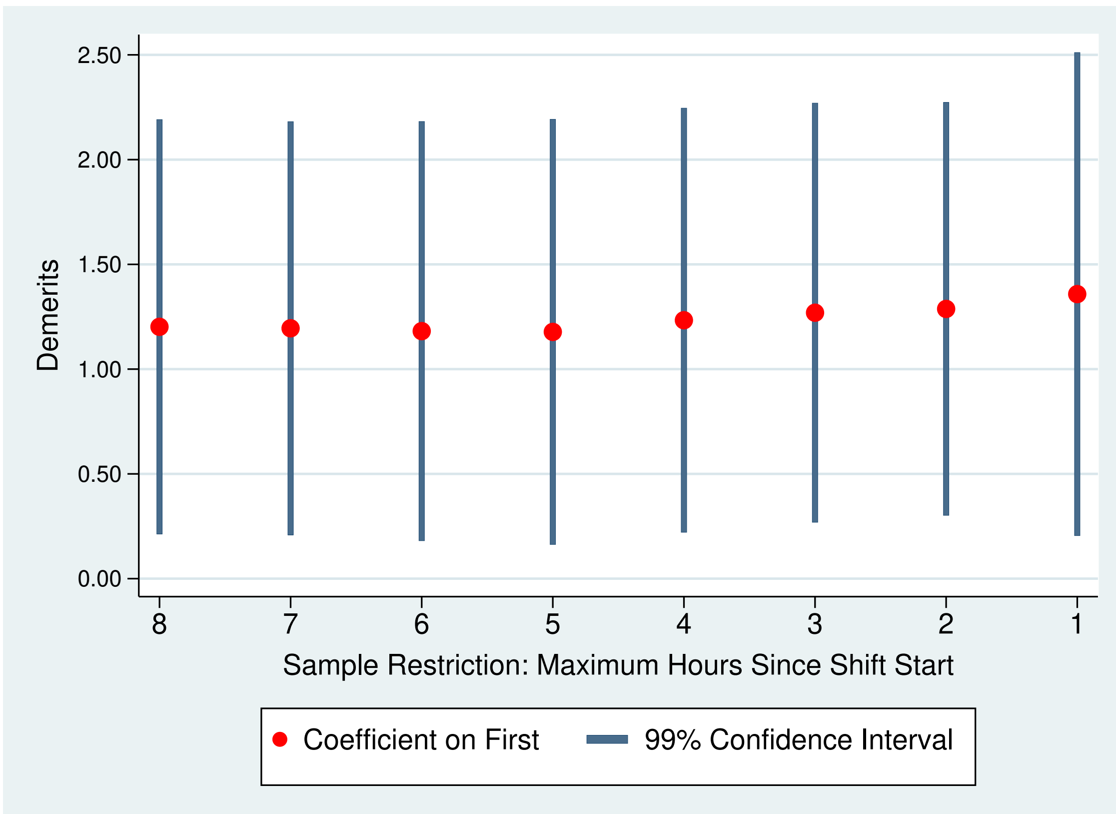

Figure 2: Allowing for Possible Inspector Fatigue

Restricted-sample estimates of the effect of *First* on detected demerits, from the specification given in column (1) of Table 10. The horizontal axis measures x, where samples are restricted to inspections where $First_{i,j,t} = 1$, or $First_{i,j,t} = 0$ and the inspection began within x hours of the first inspection of an inspector's shift. Red dots mark coefficients on *First*, and navy bars mark 99% confidence intervals from standard errors clustered two-way on inspector and facility.

Table 1: Summary Statistics

Variable	N	Mean	Std. Dev.	Min.	Max.
Establishment Level					
Inspections	1,312	6.3834	(2.0958)	2	17
Inspections $\mid First_{i,j,t} = 1$	1,312	3.8216	(2.2570)	1	13
Inspections $\mid First_{i,j,t} = 0$	1,312	2.5617	(1.6135)	1	10
Inspection Level					
Demerits	8,375	7.3251	(7.1185)	0	61
Demerits $\mid First_{i,j,t} = 1$	5,014	8.3927	(7.5673)	0	61
Demerits $\mid First_{i,j,t} = 0$	3,361	5.7325	(6.0512)	0	50
Adjusted Demerits	8,375	7.4220	(7.3899)	0	61
Adjusted Demerits $\mid First_{i,j,t} = 1$	5,014	8.5112	(7.8542)	0	61
Adjusted Demerits $\mid First_{i,j,t} = 0$	3,361	5.7971	(6.2974)	0	50
All Violations	8,375	3.2004	(2.6981)	0	26
All Violations $\mid First_{i,j,t} = 1$	5,014	3.6312	(2.8362)	0	26
All Violations $\mid First_{i,j,t} = 0$	3,361	2.5576	(2.3347)	0	18

Summary statistics from the primary estimation sample of restaurants from January 1, 2014 to March 9, 2020, with at least: one inspection where $First_{i,j,t} = 1$, and one inspection where $First_{i,j,t} = 0$.

Table 2: Inspection Anticipation and Detected Compliance

Variable	(1) *Demerits*	(2) *Demerits*	(3) *Demerits*	(4) *Adj. Demerits*
First	1.1930***	1.2576***	1.1934***	1.2386***
	(0.3394)	(0.3118)	(0.3784)	(0.3833)
Establishment FE	Y	Y	Y	Y
Starting Hour FE	N	Y	Y	Y
Day-of-Week FE	N	Y	Y	Y
Month-of-Year FE	N	Y	Y	Y
Year FE	N	Y	Y	Y
Inspector FE	N	N	Y	Y
R-squared	0.3727	0.3874	0.4559	0.4398
N	8,375	8,375	8,375	8,375

$^{***}p < 0.01$

OLS estimates from routine inspections of restaurants. Standard errors, clustered two-way on inspector and facility, are reported in parentheses. In 38 inspections, establishments were closed due to imminent health hazards, but were assessed fewer than 41 demerits (the threshold at which establishments are forced to close absent imminent health hazards). Adjusted demerits, the dependent variable in column (4), equals 41 in these 38 observations, and is identical to the assessed demerits otherwise.

Table 3: Inspection Anticipation and Detected Compliance: Violations

Variable	(1) *IHH Violations*	(2) *Critical Violations*	(3) *Major Violations*	(4) *Good-practices Violations*
First	0.0008	0.1414***	0.1667**	0.1180*
	(0.0027)	(0.0409)	(0.0782)	(0.0624)
Mean $\mid First_{i,j,t} = 0$	0.0036	0.4567	1.1488	0.9485
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.1468	0.3470	0.4405	0.4824
N	8,375	8,375	8,375	8,375

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

OLS estimates from routine inspections of restaurants. Standard errors, clustered two-way on inspector and facility, are reported in parentheses. The third row of results reports simple averages from the estimating sample when $First = 0$.

Table 4: Rigid and Flexible Violations

Code	Description
	RIGID VIOLATIONS
Imminent Health Hazards	
IHH-1	Interruption of electrical service
IHH-2	No potable water or hot water
IHH-3	Gross unsanitary occurrences or conditions including pest infestation
IHH-4	Sewage or liquid waste not disposed of in an approved manner
IHH-5	Lack of adequate refrigeration
IHH-6	Lack of adequate employee toilets and handwashing facilities
Critical Violations	
3	Commercially manufactured food from approved source with required labels. Parasite destruction as required. Potentially hazardous foods/time temperature control for safety (PHF/TCS) received at proper temperature.
4	Hot and cold running water from approved source as required.
Major Violations	
10	Food and warewashing equipment approved, properly designed, constructed, and installed.
16	Effective pest control measures. Animals restricted as required.
17	Hot and cold holding equipment present. Properly designed, maintained, and operated.
22	Backflow prevention devices and methods in place and maintained.
	FLEXIBLE VIOLATIONS
Critical Violations	
* 2	Handwashing (as required, when required, proper glove use, no bare hand contact of ready to eat foods). Foodhandler health restrictions as required.
* 7	PHF/TCSs cooked and reheated to proper temperatures.
* 8	PHF/TCSs properly cooled.
* 9	PHF/TCSs at proper temperatures during storage, display, service, transport, and holding.
Major Violations	
** 11	Food protected from potential contamination during storage and preparation.
** 12	Food protected from potential contamination by chemicals. Toxic items properly labeled, stored and used.
** 14	Kitchenware and food contact surfaces of equipment properly washed, rinsed, sanitized, and air dried. Equipment for warewashing operated and maintained. Sanitizer solution provided and maintained as required.
* 20	Single use items not reused or misused.

* Included in narrow and broad *flexible* violation categories.

** Included only in broad *flexible* violation category.

PHF stands for potentially hazardous food. TCS stands for temperature control for safety. Common TCS foods include dairy products (which must be stored below certain temperatures to prevent spoilage) and meats (which must reach a certain temperatures when cooked in to kill possible pathogens).

Table 5: Inspection Anticipation and Detected Compliance by Nature of Violation

Variable	(1) *Narrowly-defined Flexible Violations*	(2) *Broadly-defined Flexible Violations*	(3) *Rigid Violations*
First	0.0823**	0.1515**	0.0102
	(0.0341)	(0.0607)	(0.0223)
Mean | $First_{i,j,t} = 0$	0.3219	0.8367	0.2083
Establishment FE	Y	Y	Y
Starting Hour FE	Y	Y	Y
Day-of-Week FE	Y	Y	Y
Month-of-Year FE	Y	Y	Y
Year FE	Y	Y	Y
Inspector FE	Y	Y	Y
R-squared	0.3333	0.4248	0.2506
N	8,375	8,375	8,375

**$p < 0.05$

OLS estimates from routine inspections of restaurants. Standard errors, clustered two-way on inspector and facility, are reported in parentheses. The third row of results reports simple averages from the estimating sample when *First* = 0.

Table 6: CONTROLLING FOR MOST RECENT PERFORMANCE

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First	1.2100***	1.2248***	0.1454***	0.1616**
	(0.4075)	(0.4064)	(0.0418)	(0.0802)
Lagged Demerits	-0.0955	-0.0990	-0.0106	-0.0142
	(0.0967)	(0.0966)	(0.0086)	(0.0187)
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.4778	0.4605	0.3712	0.4603
N	6,451	6,451	6,451	6,451

***$p < 0.01$, **$p < 0.05$

OLS estimates from routine inspections of restaurants. Lagged demerits is the establishment's total demerits from their most recent prior routine inspection. Standard errors, clustered two-way on inspector and facility, are reported in parentheses.

Table 7: Inspection Anticipation and Detected Compliance: Multiple-Inspection Visits Only

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First	1.2360***	1.2673***	0.1434***	0.1723**
	(0.3676)	(0.3739)	(0.0402)	(0.0764)
Mean | $First_{i,j,t} = 0$	5.8417	5.9034	0.4685	1.1655
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.4509	0.4347	0.3406	0.4387
N	7,807	7,807	7,807	7,807

***$p < 0.01$, **$p < 0.05$

OLS estimates from routine inspections of restaurants, during visits where multiple inspections were conducted at the facility. Standard errors, clustered two-way on inspector and facility, are reported in parentheses.

Table 8: INSPECTION ANTICIPATION AND DETECTED COMPLIANCE: VISITS FROM NEW INSPECTOR

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First	1.1115**	1.0423**	0.1297***	0.1543*
	(0.4576)	(0.4714)	(0.0494)	(0.0916)
Lagged Demerits	-0.1473	-0.1545	-0.0177	-0.0196
	(0.1147)	(0.1183)	(0.0119)	(0.0213)
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.5581	0.5518	0.4706	0.5230
N	3,307	3,307	3,307	3,307

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

OLS estimates from routine inspections where restaurants faced an inspector other than the one who had conducted their most recent prior routine inspection. Lagged demerits is the establishment's total demerits from their most recent prior routine inspection. Standard errors are clustered two-way on the inspector and facility, and reported in parentheses.

Table 9: Accounting for Repeat Inspector Visits

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First×Diff	0.2526	0.1494	0.0084	0.0674
	(0.5016)	(0.5228)	(0.0563)	(0.1043)
First	1.0682**	1.1589**	0.1374**	0.1280
	(0.4766)	(0.4832)	(0.0554)	(0.0908)
New	0.5444	0.5018	0.0536	0.0943
	(0.4529)	(0.4773)	(0.0476)	(0.0966)
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.4577	0.4409	0.3479	0.4420
N	8,375	8,375	8,375	8,375

$^{**}p < 0.05$

OLS estimates. $Diff_{i,t} = 1$ if establishment i is isnpected by a different inspector than in their most recent inspection. Standard errors are clustered two-way on the inspector and facility, and reported in parentheses.

Table 10: Addressing Potential Inspector Fatigue

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First	1.2335***	1.2445***	0.1431***	0.1719**
	(0.3929)	(0.3889)	(0.0427)	(0.0822)
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.4595	0.4432	0.3532	0.4455
N	7,350	7,350	7,350	7,350

$^{***}p < 0.01$, $^{**}p < 0.05$

OLS estimates from routine inspections of restuarants where $First_{i,j,t} = 1$, or $First_{i,j,t} = 0$ and the inspection began at within 4 hours of the first inspection in an inspector's shift.

A1 Appendix

A1.1 Data Cleaning

In cleaning the raw data, corrections were made for 35 inspection starting times where the entry of AM or PM appeared mistaken. These were found by grouping the inspections conducted by inspectors on each date, and noticing unusually large gaps between starting times in those groupings. Upon closer examination the gaps could be explained by a single entry of AM or PM that was inconsistent with the others from that inspector-date.

In 36 inspections, the date is reported without a starting time. These observations, and all inspections conducted at the same facility that date (48 additional observations) are dropped, because the first establishment inspected for these visits can't be known with certainty.

In 153 inspector-visits, the two earliest reported inspection starting times are the same; and in 6 inspector-visits, the three earliest reported inspection starting times are the same. The 324 observations with identical starting times in these visits are excluded in estimation; because it is unknown which of the establishments were inspected first, and which were not.

Finally, there are 44 routine restaurant inspections where an *A* grade is reported for establishments with more than 10 demerits, which contradicts SNHD grading policy. Because it is unclear which entry (demerits or grade) is incorrect, these observations are also excluded in estimation. Excluding versus including these observations ultimately has a negligible effect on results.

Table A1: Establishment Types in Raw Data

Establishment Type	Number of Establishments
Bakery Sales	81
Banquet Kitchen	89
Banquet Support	38
Bar/Tavern	4,151
Barbeque	127
Beer Bar	14
Buffet	437
Caterer	332
Childcare Kitchens	50
Concessions	69
Confection	38
Elementary School Kitchen	263
Farmer's Market	32
Food Trucks / Mobile Vendor	755
Frozen Meat Sales	23
Garde Manger	84
Grocery Store Sampling	82
Institutional Food Service	140
Kitchen Bakery	100
Main Kitchen	4
Meat/Poultry/Seafood	198
Pantry	446
Portable Bar	74
Portable Unit	918
Produce Market	102
Restaurant	7,646
Self-Service Food Truck	63
Snack Bar	2,287
Special Kitchen	2,115
Vegetable Prep	47

Table A2: Bars Located Within Restaurants

	Establishment		
Inspection Time	Permit #	Name	Type
2019-06-28 16:40:30	0132075	LA CATRINA BAR & GRILL	Restaurant
2019-06-28 17:30:00	0132074	LA CATRINA BAR & GRILL BAR	Bar/Tavern
2014-04-02 12:10:00	0018364	Buffalo Wild Wings - Grill #179	Restaurant
2014-04-02 12:55:00	0018365	Buffalo Wild Wings - Bar #179	Bar/Tavern
2015-09-17 12:40:00	0009001	Steiner's Pub Restaurant	Restaurant
2015-09-17 14:00:00	0009002	Steiner's Pub	Bar/Tavern
2016-07-07 14:35:00	0017430	On The Border - Restaurant	Restaurant
2016-07-07 15:30:00	0017431	On The Border - Bar	Bar/Tavern
2018-01-11 15:45:00	0004084	Chili's Grill #1264 Restaurant	Restaurant
2018-01-11 17:00:00	0004085	Chili's Grill #1264 - Bar	Bar/Tavern

Table A3: SNHD Food Establishment Violations: Imminent Health Hazards and Critical Violations

Code	Description
Imminent Health Hazards	
IHH-1	Interruption of electrical service
IHH-2	No potable water or hot water
IHH-3	Gross unsanitary occurrences or conditions including pest infestation
IHH-4	Sewage or liquid waste not disposed of in an approved manner
IHH-5	Lack of adequate refrigeration
IHH-6	Lack of adequate employee toilets and handwashing facilities
IHH-7	Misuse of poisonous or toxic materials
IHH-8	Suspected foodborne illness outbreak
IHH-9	Emergency such as fire and/or flood
IHH-10	Other condition or circumstance that may endanger public health
Critical Violations	
1	Verifiable time as a control with approved procedure when in use. Operational plan, waiver or variance approved and followed when required. Operating within the parameters of the health permit.
2	Handwashing (as required, when required, proper glove use, no bare hand contact of ready to eat foods). Foodhandler health restrictions as required.
3	Commercially manufactured food from approved source with required labels. Parasite destruction as required. Potentially hazardous foods/time temperature control for safety (PHF/TCS) received at proper temperature.
4	Hot and cold running water from approved source as required.
5	Imminently dangerous cross connection or backflow. Waste water and sewage disposed into public sewer or approved facility.
6	Food wholesome; not spoiled, contaminated, or adulterated.
7	PHF/TCSs cooked and reheated to proper temperatures.
8	PHF/TCSs properly cooled.
9	PHF/TCSs at proper temperatures during storage, display, service, transport, and holding.

PHF stands for potentially hazardous food. TCS stands for temperature control for safety. Common TCS foods include dairy products (which must be stored below certain temperatures to prevent spoilage) and meats (which must reach a certain temperatures when cooked in to kill possible pathogens).

Table A4: SNHD Food Establishment Violations: Major Violations

Code	Description
Major Violations	
10	Food and warewashing equipment approved, properly designed, constructed, and installed.
11	Food protected from potential contamination during storage and preparation.
12	Food protected from potential contamination by chemicals. Toxic items properly labeled, stored and used.
13	Food protected from potential contamination by employees and consumers.
14	Kitchenware and food contact surfaces of equipment properly washed, rinsed, sanitized, and air dried. Equipment for warewashing operated and maintained. Sanitizer solution provided and maintained as required.
15	Handwashing facilities adequate in number, stocked, accessible, and limited to handwashing only.
16	Effective pest control measures. Animals restricted as required.
17	Hot and cold holding equipment present. Properly designed, maintained, and operated.
18	Accurate thermometers (stem & hot/cold holding) provided and used.
19	PHF/TCSs properly thawed. Fruits and vegetables washed prior to preparation or service.
20	Single use items not reused or misused.
21	Person in charge available and knowledgeable/management certification. Foodhandler card as required. Facility has an effective employee health policy.
22	Backflow prevention devices and methods in place and maintained.
23	Grade card and required signs posted conspicuously. Consumer advisory as required. Records/logs maintained and available when required. NCIAA compliant. PHFs labeled and dated as required. Food sold for offsite consumption labeled properly.

PHF stands for potentially hazardous food. TCS stands for temperature control for safety. Common TCS foods include dairy products (which must be stored below certain temperatures to prevent spoilage) and meats (which must reach a certain temperatures when cooked in to kill possible pathogens).

Table A5: SNHD Food Establishment Violations: Good Food Management Practices

Code	Description
Good Food Management Practices	
24	Acceptable personal hygiene practices, clean outer garments, proper hair restraints used. Living quarters and child care completely separated from food service.
25	Non-PHF and food storage containers properly labeled and dated as required. Non-PHF/TCS not spoiled and within shelf-life. Proper retail storage of chemicals.
26	Facilities for washing and sanitizing kitchenware approved, adequate, properly constructed, maintained, and operated.
27	Appropriate sanitizer test kits provided and used. Ware washing thermometer(s) as required. Wiping cloths and linens stored and used properly.
28	Small wares and portable appliances approved, properly designed, in good repair.
29	Utensils, equipment, and single serve items properly handled, stored, and dispensed.
30	Nonfood contact surfaces and equipment properly constructed, installed, maintained, and clean.
31	Restrooms, mop sink, and custodial areas maintained and clean. Premises maintained free of litter, unnecessary equipment, or personal effects. Trash areas adequate, pest proof, and clean.
32	Facility in sound condition and maintained (floors, walls, ceilings, plumbing, lighting, ventilation, etc.).

PHF stands for potentially hazardous food. TCS stands for temperature control for safety. Common TCS foods include dairy products (which must be stored below certain temperatures to prevent spoilage) and meats (which must reach a certain temperatures when cooked in to kill possible pathogens).

Table A6: DETECTED COMPLIANCE BY NATURE OF VIOLATION: CONTROLLING FOR MOST RECENT PERFORMANCE

Variable	(1) *Narrowly-defined Flexible Violations*	(2) *Broadly-defined Flexible Violations*	(3) *Rigid Violations*
First	0.0836**	0.1352**	0.0152
	(0.0372)	(0.0668)	(0.0228)
Lagged Demerits	-0.0090	-0.0123	-0.0035
	(0.0062)	(0.0133)	(0.0043)
Establishment FE	Y	Y	Y
Starting Hour FE	Y	Y	Y
Day-of-Week FE	Y	Y	Y
Month-of-Year FE	Y	Y	Y
Year FE	Y	Y	Y
Inspector FE	Y	Y	Y
R-squared	0.3505	0.4435	0.2647
N	6,451	6,451	6,451

**$p < 0.05$

OLS estimates from routine inspections of restaurants. Lagged demerits is the establishment's total demerits from their most recent prior routine inspection. Standard errors, clustered two-way at the inspector and facility levels, are reported in parentheses.

Table A7: Detected Compliance by Nature of Violation: Multiple-Inspection Visits Only

Variable	(1) *Narrowly-defined Flexible Violations*	(2) *Broadly-defined Flexible Violations*	(3) *Rigid Violations*
First	0.0802**	0.1557***	0.0120
	(0.0343)	(0.0604)	(0.0228)
Establishment FE	Y	Y	Y
Starting Hour FE	Y	Y	Y
Day-of-Week FE	Y	Y	Y
Month-of-Year FE	Y	Y	Y
Year FE	Y	Y	Y
Inspector FE	Y	Y	Y
R-squared	0.3268	0.4208	0.2473
N	5,692	5,692	5,692

***$p < 0.01$, **$p < 0.05$

OLS estimates from routine inspections of restaurants during visits where multiple inspections were conducted at the facility. Standard errors are clustered two-way on the inspector and facility, and reported in parentheses.

Table A8: Accounting for Inspector Fatigue: Excluding Inspections Near the End of a Shift

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First	1.1989***	1.2799***	0.1258**	0.1886**
	(0.4177)	(0.4234)	(0.0493)	(0.0861)
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.4783	0.4597	0.3945	0.4407
N	3,692	3,692	3,692	3,692

***$p < 0.01$, **$p < 0.05$

OLS estimates from routine inspections of restuarants where $First_{i,j,t} = 1$, or $First_{i,j,t} = 0$ and the inspection began at least 90 minutes before the final inspection of the inspector's shift.

Table A9: Inspection Anticipation and Detected Compliance: Restaurants, Bar/Taverns, Buffets, and Snack Bars

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First	1.0172***	1.0234***	0.0841***	0.1986***
	(0.2553)	(0.2599)	(0.0232)	(0.0529)
Mean | $First_{i,j,t} = 0$	3.7723	3.8212	0.2397	0.8572
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.4765	0.4552	0.3658	0.4307
N	27,975	27,975	27,975	27,975

$^{***}p < 0.01$

OLS estimates from routine inspections of establishments coded by the SNHD as a: Restaurant, Bar/Tavern, Buffet, or Snack Bar. Standard errors, clustered two-way on inspector and facility, are reported in parentheses. The third row of results reports simple averages from the estimating sample when $First = 0$.

Table A10: Inspection Anticipation and Detected Compliance: All Establishment Types

Variable	(1) *Demerits*	(2) *Adj. Demerits*	(3) *Critical Violations*	(4) *Major Violations*
First	1.0945***	1.1265***	0.0966***	0.2034***
	(0.2442)	(0.2542)	(0.0219)	(0.0481)
Mean $\mid First_{i,j,t} = 0$	3.5781	3.6280	0.2442	0.7852
Establishment FE	Y	Y	Y	Y
Starting Hour FE	Y	Y	Y	Y
Day-of-Week FE	Y	Y	Y	Y
Month-of-Year FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Inspector FE	Y	Y	Y	Y
R-squared	0.4745	0.4477	0.3588	0.4326
N	44,816	44,816	44,816	44,816

$^{***}p < 0.01$

OLS estimates from routine inspections of all establishment types inspected by the SNHD. Standard errors, clustered two-way on inspector and facility, are reported in parentheses. The third row of results reports simple averages from the estimating sample when $First = 0$.