REPUTATIONAL INCENTIVES FOR
RESTAURANT HYGIENE

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Abstract

How can consumers be assured that firms will endeavour to provide good quality when quality is unobservable prior to purchase? We study the example of restaurant hygiene, and test the hypothesis that reputational incentives are effective at causing restaurants to maintain good hygiene quality. We find that chain-affiliation provides reputational incentives, and franchised units tend to free-ride on chain reputation. We also show that regional variation in the degree of repeat-customers affects the strength of reputational incentives for good hygiene at both chain and non-chain restaurants. Despite these incentives, a policy intervention in the form of posted hygiene grade cards causes significant improvement in restaurant hygiene. We conclude that even when there is merit to the argument that reputational incentives operate as a market-based mechanism for mitigating informational problems, they may be a poor approximation of full information.

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1 Introduction

How can consumers be assured that firms will endeavour to provide good quality when quality is unobservable prior to purchase? Consider the example of product safety. What are the incentives for airlines to maintain appropriate safety, for car manufacturers to build safe cars, or for restaurants to maintain safe hygiene? In these situations it is costly for firms to maintain safety, and if they don’t, the risk that something will go wrong may be small. Moreover, as long as nothing goes wrong, consumers will generally never know if the firm exerted appropriate effort. But of course the cost to consumers in the event of a problem can be severe.

The inefficiencies resulting from these kind of information asymmetries are well understood by economists. However, it is less clear whether government intervention is an appropriate remedy, or if there are satisfactory market-based solutions. Arguably the most commonly proposed market solution is reputations. In a reputation mechanism, consumers may not observe product quality before making a purchase, but they learn from experience and form beliefs about product quality.\(^1\) When do reputations provide effective incentives for firms to maintain high unobservable effort, and when should we invoke government intervention based on a failure of the market to provide adequate information?

In Jin and Leslie (2003) we show that a policy of mandatory posting of hygiene grade cards in restaurants’ windows causes hygiene improvements, leading to a 20% decrease in foodborne illness hospitalizations. This implies there is a shortage of information prior to the posting of grade cards. But it leaves open the question of whether there are any incentives for good hygiene in the absence of government issued grade cards. In fact there is reason to suspect the market provided some degree of incentives, because 25% of restaurants in Los Angeles had very good hygiene (equivalent to an A-grade) before the grade cards—why did these restaurants maintain good hygiene? In this study we ask whether reputational incentives caused at least some restaurants to provide good hygiene.

We show that reputational incentives serve to provide effective reputational incentives for good restaurant hygiene. Our findings support the argument that there is a market solution to the problem that customers are generally unable to observe hygiene quality at the time of consumption. However, the fact that grade cards cause significant improvements in hygiene quality, implies that reputational incentives are only partially effective. In other words, we provide evidence that even when reputational incentives are effective, they may be a poor approximation of full information.

\(^1\)See Kreps, Milgrom, Roberts and Wilson (1982) and Holmstrom (1982) for models of reputation based on incomplete information with consumer beliefs. An alternate branch of the literature is reputation models based on complete information, dating back to Klein and Leffler (1981).
Our data cover restaurant hygiene inspections in Los Angeles from July 1995 to December 1998. The inspections are conducted by Los Angeles County Department of Health Services (DHS) officials, and result in a hygiene score out of 100. Central to our analysis is the fact that, before 1998, inspection scores were not available to consumers, as they were for internal DHS use only. Consumers could request to see the list of violations at individual restaurants, but anecdotally we know this was rarely done. Following a hidden-camera television news expose of unsanitary restaurants, since the beginning of 1998 restaurants in Los Angeles are issued hygiene grade cards—a letter grade (A, B or C) to be prominently displayed in the window, based on the score from their last inspection.

Prior empirical studies of reputations focus on identifying the source of reputational incentives—consumers’ responsiveness to new information about a firm’s behavior. Borenstein and Zimmerman (1988) study the incentives for airlines to maintain unobservable product safety. They find a small negative effect of a plane crash on the airline’s demand, suggesting weak reputational incentives. However, as the authors note, the relationship between demand responsiveness to new information and the strength of reputational incentives depends on consumers’ prior beliefs. A mild response by consumers to news of a plane crash may imply that either (i) consumers are unresponsive and therefore provide weak reputational incentives, or (ii) consumers have a strong prior belief that includes the expectation there will be an occasional crash, making them unresponsive to a single crash, but still providing a source of strong reputational incentives. Hence, the challenge in identifying the demand-side component of reputational incentives is to analyze a dramatic piece of new information, such as several plane crashes within a short period of time, or to adequately control for consumers’ prior beliefs.

In contrast to the previous empirical papers that focus on the demand-side, we assess reputational incentives by testing the supply-side implications. We test if there are factors that give rise to a high degree of consumer learning, which cause restaurants to provide better hygiene quality. The appeal of analyzing the supply-side effect is that we eliminate the difficulty of disentangling consumers’ prior beliefs. A couple of key features of the dataset facilitate our analysis. First is that we, the econometricians, observe the outcomes of restaurants’ hygiene inspections, which are unobserved by consumers. In other words, we are in the somewhat unusual situation of observing a product characteristic that is unobserved to consumers, which consumers would like to know, but are limited to forming beliefs about based on imperfect information. Second, the policy change of introducing grade cards provides us with exogenous variation in the provi-

\textsuperscript{2}Hubbard (2002) also analyzes the demand-side effects of reputational incentives. A number of studies examine the role of reputations in eBay auctions. Resnick and Zeckhauser (2002) and Bajari and Hortacsu (2003) provide summaries of this literature. Since eBay fosters the reputation process by recording and revealing information on buyer feedback, consumers are not limited to learning about a seller’s behavior through their own experiences and informal methods of information sharing with other consumers. It is therefore difficult to generalize from the eBay studies to the effectiveness of reputations in other markets.
sion of information to consumers. This allows us to isolate the effect of consumer learning on hygiene quality from other unobserved factors.

We focus on two factors that may affect the degree of consumer learning, and hence reputation formation, about restaurant hygiene: chain-affiliation and the importance of repeat-customers in the local region.\(^3\) There are three main findings. First, comparing chain restaurants to non-chain restaurants in the same region with the same score after the grade cards, we find that the chain restaurants had significantly better hygiene than their non-chain counterparts before the grade cards. We argue that this provides compelling evidence of the reputational incentives provided by chain affiliation. Second, franchised chain units tend to have lower hygiene than company-owned chain units before the grade cards. But after the introduction of grade cards, the difference goes away. We interpret this as evidence of franchisee free-riding on chain reputation, which is further verification that chain affiliation is a source of reputational incentives.\(^4\)

The third main finding concerns the importance of repeat-customers for reputation formation. There is regional clustering in hygiene quality across Los Angeles, allowing us to rank regions according to the average hygiene quality of their restaurants. We find the introduction of restaurant hygiene grade cards causes significant change in the hygiene ranking of regions. Under fairly weak assumptions, we argue that this implies there were significant differences across regions in consumer learning, before the introduction of grade cards. In other words, we interpret this as evidence that the relatively high degree of repeat-customers in some parts of Los Angeles caused restaurants in those regions to provide better quality hygiene (before grade cards).

This study shows that reputational incentives are indeed effective at causing some restaurants to provide good quality hygiene. However, before grade cards, around three-quarters of restaurants in Los Angeles had hygiene that was below A-grade quality. The theory literature on reputational incentives assumes that consumers learn and refine their beliefs about unobserved quality. Our findings indicate that the degree of consumer learning may vary substantially across firms within an industry, leading reputational incentives to be effective for only a subset of firms. In this case, government intervention in the form of posting hygiene grade cards in restaurant windows, leads to substantially better hygiene quality.

In Section 2 we describe the reputational incentives hypothesis and alternative explanations. Section 3 provides a review of the DHS inspections, grade card policy change, and summary

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\(^3\)In Section 2 we describe how each of these factors may impact reputation formation.

\(^4\)Prior empirical studies of franchising include Brickley and Dark (1987), Norton (1988), Lafontaine (1992), and Lafontaine and Shaw (1999).
statistics for our dataset. Basic evidence concerning the presence reputational incentives is presented in Section 4. Section 5 contains our analysis of whether chain affiliation is a source of reputational incentives. In Section 6 we test whether localized consumer learning is a source of effective reputational incentives. The conclusion is in Section 7.

2 Alternative Hypotheses

In this study we consider the question: in the absence of restaurant hygiene grade cards, why do some restaurants have good quality hygiene? What explains why some restaurants consistently have low hygiene scores, while other restaurants have consistently high hygiene scores? In this section we describe our null hypothesis (reputational incentives) and a couple of alternative hypotheses. Later, in Sections 5 and 6, we describe empirical tests that are designed to distinguish the null hypothesis from the alternatives.

Reputational Incentives Hypothesis

The reputational incentives hypothesis is that some restaurants have good quality hygiene because their customers can learn about their hygiene quality, allowing these restaurants to form reputations for good hygiene, and obtain higher profits from doing so. Meanwhile, restaurants whose customers are unable to learn about their hygiene quality obtain no benefit from providing good quality hygiene.

Two factors affect the formation of individual restaurant’s hygiene reputation. First, local customers can learn about a restaurant’s hygiene quality by repeatedly patronizing the restaurant, by talking to friends who have patronized the restaurant, or through exposure to local news reports about the restaurant. Brickley and Dark (1987) propose a prime example of when we expect there to be a low degree of consumer learning: for restaurants located near freeway exits, there are relatively few repeat-customers, leading to weak reputational incentives. Whether the key feature is the degree of repeat-customers, or some other factor affecting consumers’ ability to update their beliefs about hygiene quality, these factors are region-specific. All else equal, two restaurants located beside each other face similar consumer learning. This implies geographic clustering in the magnitude of restaurants’ information differences.

Figures 1a and 1b illustrate how the degree of consumer learning may impact on restaurant hygiene quality. Both figures are maps of Santa Monica, in Los Angeles County, showing the locations of restaurants from certain quantiles of the hygiene score distribution, based on each

\(^5\)Stigler (1961) also refers to tourists as a class of consumers lacking in knowledge about local markets.
restaurants’ average DHS inspection score before the introduction of grade cards. In Figure 1a we show the locations of restaurants that have average scores in the top 33% of the distribution (for Santa Monica). In Figure 1b we show locations of restaurants that have average scores in the bottom 33% of the distribution.6

The figures show that good and bad hygiene restaurants are spread throughout Santa Monica. But there are a few interesting examples of locations with a concentration of either good or bad hygiene restaurants. Consider the region of the Venice boardwalk. This is a major tourist location in Santa Monica, and is surely among the most popular tourist destinations in Los Angeles. Comparing Figures 1a and 1b it is apparent that the restaurants along the Venice boardwalk have generally poor hygiene. This is consistent with the story that restaurants in locations with few repeat customers, or many tourists, are unable to form reputations, and therefore have little incentive to maintain good quality hygiene. The Santa Monica Pier is another example of a popular tourist destination, which also tends to have poor hygiene restaurants, as shown in the figures. In contrast, Montana Ave is a stretch of shops and restaurants that mainly caters to local residents, and is not known as a popular location for tourists. Figures 1a and 1b show that many more restaurants on Montana Ave are from the top 33% of the hygiene distribution than from the bottom 33%.

A second factor that may affect reputation formation is chain affiliation. Chain affiliated restaurants share the reputation of the chain as a whole. Customers of individual chain restaurants learn about hygiene quality for all restaurants in the chain, even if there are few repeat customers at each single unit. For example, a customer who has a bad experience with one restaurant in a chain may infer similar hygiene quality for all restaurants in that chain. We therefore expect that chain restaurants tend to face stronger reputational incentives than independent restaurants.

There is, however, an important distinction between company-owned chain restaurants and franchised chain restaurants. The owners (or investors) of a restaurant chain seek to maximize the sum of the profits of all company-owned units. The owner of a franchised chain restaurant seeks to maximize the profit of that unit alone. Combine this difference with the fact that consumers do not know if individual chain restaurants are company-owned or franchised, and we expect franchised chain restaurants to free-ride on a chain’s reputation for good hygiene.7 Hence, reputational incentives are lower for franchised chain restaurants than for company-owned chain restaurants, all else equal.

While franchised chains face lower reputational incentives than company-owned chains, there

6The cutoff score for the top 33% is 88. The cutoff score for the bottom 33% is 75.
7See Rubin (1978).
are a couple of reasons why franchised units may actually have higher quality hygiene than company-owned units. One reason is that it may be less costly for the owner of a franchised restaurant to monitor the hygiene effort of the employees than it is for the owner of a chain. This is because the owner of a franchised restaurant is often also the on-site manager, while investors in a chain may be a diffuse group of stockholders. A second reason is that the chain management chooses whether a particular unit is franchised, and would presumably take into account the degree of consumer learning in the local region of the restaurant when making this decision.

To summarize: under the reputational incentives hypothesis, variation in hygiene quality across restaurants is at least partly explained by informational differences across restaurants, which may be either region-specific and/or restaurant-specific. The former depends on the learning environment of the local region. The latter depends on whether a restaurant belongs to a chain and whether a chain unit is franchised or company-owned.

Alternative Explanations

There may be other regional factors that impact restaurants' hygiene quality, unrelated to informational differences. There may also be restaurant-specific heterogeneity that explains variation in hygiene, again unrelated to informational differences. We now discuss each.

There could be regional differences in consumers' willingness-to-pay for hygiene quality. Assuming that consumers are able to distinguish restaurants with good from bad hygiene, albeit imperfectly, then restaurants located in regions with a high willingness-to-pay for hygiene will tend to have better hygiene.

Another possibility is regional variation in the degree of competition among restaurants. There are at least a couple of ways that competition may impact hygiene quality. It may be that in areas with a high degree of competition, restaurants seek to differentiate themselves in hygiene quality, leading to greater variance in hygiene. Alternatively, increased competition may cause all competing restaurants to raise quality as an alternative (or complement) to lowering price. As shown in Jin and Leslie (2003), following the introduction of grade cards, there is a dramatic decrease in the variance of the hygiene score distribution (and increase in the mean). In other words, once consumers are well informed about hygiene quality, it does not appear that some restaurants are driven to differentiate themselves from competitors by offering low quality

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8Caves and Murphy (1976) put forward this argument.
9There may also be regional differences in the cost of providing good hygiene, although this seems less plausible to us. Nevertheless, it would make no difference to include this in our approach.
10As with the willingness-to-pay for hygiene explanation, for competition to impact hygiene it must be that consumers can distinguish good from bad hygiene, at least imperfectly.
hygiene at a low price. We therefore assume that, if there is an effect on hygiene quality due to competition in the pre-grade card era, its effect is to cause restaurants to improve hygiene, rather than enhance differentiation in hygiene quality. As with all of the alternative explanations discussed here, our goal is provide empirical tests that distinguish the competition hypothesis from the reputational incentives hypothesis. The details of such empirical tests are provided in Section 6.

There may also be restaurant-specific heterogeneity that affects hygiene quality. For example, restaurants may be heterogeneous in their hygiene costs. In this explanation, the cost of hygiene effort is an exogenous characteristic of each restaurant. A similar explanation could be that restaurant managers/owners are heterogeneous in their hygiene preferences—some managers like having a clean restaurant. As with the hygiene cost heterogeneity, this explanation is based on exogenous restaurant-specific heterogeneity. For our purposes, we merge these two explanations together, along with any other hypothesis based on exogenous restaurant-level heterogeneity, and we label this class of explanations as exogenous restaurant heterogeneity.

If there is exogenous restaurant hygiene, and consumers have imperfect information, there may also be learning by consumers about restaurants’ hygiene quality. While consumers’ choices would be impacted by their learning, restaurants’ hygiene quality is unaffected, as it is assumed to be exogenous. In other words, restaurants may obtain reputations for hygiene quality, but this does not cause any restaurant to improve their hygiene quality. Based on this reasoning, it can be said that learning is a necessary but not sufficient condition for effective reputational incentives. However, restaurants may still sort across regions. For example, restaurants (or managers) with exogenously good hygiene quality, may choose to locate in regions where there is a high degree of consumer learning. Consequently, regions with a high degree of consumer learning may also tend to have restaurants with good quality hygiene, even though hygiene quality is an exogenous restaurant characteristic. We consider this kind of behavior to also be the result of effective reputational incentives, and we make no attempt to distinguish this sorting effect from the impact of learning on restaurant hygiene effort. For this reason, the alternative hypothesis of exogenous restaurant heterogeneity may be better labeled as exogenous restaurant heterogeneity (without sorting).

To summarize, the alternative hypotheses for the variation in hygiene quality across restaurants are: (i) regional differences in willingness-to-pay for hygiene quality or the degree of competition among restaurants, and (ii) exogenous restaurant heterogeneity (without sorting).

11 Again, this explanation requires consumers to possess some degree of information about restaurants’ hygiene, or even low hygiene cost restaurants will have no benefit to providing good hygiene. But there need not be informational differences across restaurants.
3 Data Summary

The data cover every restaurant inspection conducted by Los Angeles County DHS inspectors between July 1995 and December 1998. The DHS implements a scoring system, as an explicit attempt to reduce the impact on inspection outcomes of inspectors’ subjectivity. Los Angeles inspectors deduct pre-specified points for each violation that is detected. For example, a food temperature violation results in a 5 point deduction, evidence of cockroaches results in a 3 point deduction, and a functioning but unclean toilet results in a 2 point deduction. For our purposes, we assume the DHS inspection scores are an objective measure of restaurants’ hygiene quality.\footnote{To the extent that inspectors subjectivity is still a factor in determining scores, this implies measurement error in our dependent variable.}

There was a change in the score criteria that occur during our sample. Prior to July 1, 1997, inspectors could deduct up to 25 additional points based on their overall subjective evaluation of the restaurant’s hygiene. This component was abolished in July 1997, leaving only the pre-specified point deductions for each violation. We presume that the average effect of the change in criteria on observed scores is a nominal change in inspection scores, with no real change in hygiene quality. In our analysis, we control for these changes by including dummy variables to capture differences in mean scores due to the different criteria. We can also exclude the subjective deductions, allowing us to check the robustness of our findings.\footnote{In fact, as we detail in Jin and Leslie (2003), the posting of grade cards is mandatory in some cities within LA county, and voluntary in other cities for an initial period before becoming mandatory. In both cases, grade cards are issued. The only difference is whether the manager has discretion over posting. We show in Jin and Leslie (2003) the effects on hygiene quality are similar in each case. We therefore abstract from this feature of the policy change in this study.}

An important policy change applies to the final year of our data, which we exploit for some hypothesis tests. Beginning January 16, 1998, at the end of every inspection, restaurants are issued with a grade card to be prominently displayed in the window, near the entrance, for customers to see.\footnote{See Jin and Leslie (2003) for more details of the policy change.} An A-grade is given for scores above 90, a B-grade for scores in the 80s, a C-grade for scores in the 70s, and for scores below 70 the numerical score is shown on the card. We assume the introduction of restaurant hygiene grade cards is an exogenous policy change, and in Section 5 we explain how this variation is helpful for identifying the presence of reputational incentives. We believe the exogeneity assumption is reasonable because the policy change was prompted by a hidden-camera expose of unsanitary restaurants by a local television news channel. Furthermore, the response of the regulators to the news story was immediate. The story was aired on November 17, 1997. The county board of supervisors voted to implement grade cards on December 17, 1997. Inspectors began issuing grade cards on January 16, 1998.\footnote{See Jin and Leslie (2003) for more details of the policy change.}
What power do the DHS inspectors have to force restaurants to maintain good quality hygiene? In the absence of grade cards, inspectors have almost no power. There are no fines for hygiene violations. Inspectors may close restaurants, but this is only in extreme cases, such as a fire or infestation, or if a restaurant gets a score below 60 in two consecutive inspections. Even then, the restaurant is closed only for the period of time it takes to rectify the problem (usually only a matter of days). Hence, a restaurant could consistently violate numerous hygiene standards, resulting in scores barely above 60, without incurring any kind of penalty. Inspectors educate restaurants’ staff about hygiene safety, and try to convince them to make improvements, but ultimately have almost no power to assure compliance.

All of the tests we propose for identifying the presence of effective reputational incentives rely on the assumption that, prior to the grade cards, the results of the DHS inspections were not observed by consumers. Each week the Los Angeles Times newspaper reports the names of restaurants closed by the DHS. But as we noted, closures reveal a fraction of all hygiene violations. Restaurants were always required to provide the latest inspection report to any consumer that requested it. While we have no formal evidence concerning the extent to which consumers made such requests, we are confident this was sufficiently rare. The findings in Jin and Leslie (2003) support the claim that there is a general lack of information prior to the grade cards.

We observe the name and address of each restaurant. This allows us to associate local demographic data from the census with each restaurant, as well as information on local businesses (such as the number of hotel employees working in the same zip code). From restaurant names and the Yellow Pages we can identify cuisine type for approximately half of the restaurants. We also obtained the Zagat Survey restaurant guide for each of the corresponding years in our data. From Zagats, we identify which restaurants are included in the guide, and their associated review scores. Restaurant names also allow us to identify chain restaurants. We can further distinguish company-owned chain units from franchised units, on the basis of ownership information, also provided by the DHS. Although the data does not include a variable that indicates if each chain restaurant is franchised, from the name of the owner we can infer the type of ownership. Basically, we distinguish owners that are company-names from owners that are names of individuals. For names that are ambiguous, such as “Licensing Department”, we classify them as company-owned. In doing so, we are more likely to be biased towards underestimating the impact of franchise ownership. Importantly, we also verify that all of the findings in the paper which utilize the franchising variable are robust to the exclusion of the ambiguous cases, and to the assignment of the ambiguous cases as being franchised units rather than company-owned.

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15We use Bond’s Franchise Guide to identify national and regional chains.
Table 1 provides a summary of the score data, by different types of restaurants, and distinguishing pre- and post-grade card scores. There are 24,304 restaurants that were inspected a total of 127,111 times. The mean score for all pre-grade card inspections is 76.77, compared to the post-grade card mean of 89.62. The dispersion of the unconditional score distribution is much less after grade cards. Less than 5% of restaurants are covered by the Zagats guide. These are undoubtedly the more fancy (and expensive) restaurants in the data. As one might expect, the average pre-grade card hygiene score of Zagats restaurants is above the average for all restaurants. After grade cards, Zagats restaurants have slightly below average hygiene scores.

There are 2,632 chain restaurants, equal to nearly 11% of restaurants in the data. Chain restaurants have significantly higher average hygiene scores than non-chain restaurants, before the grade cards. After grade cards, chains continue to have better hygiene, although the difference is reduced by about half. About 63% of chain restaurants in our data are company-owned units. Before the grade cards, the average score for company-owned chain units is about one point higher than franchised units. The difference in average hygiene scores between company-owned and franchised chains, after grade cards, is negligible.

In Table 1 we also show average hygiene scores for each of the top 6 chains, distinguishing between company-owned and franchised units. Comparing average pre-grade card scores for the company-owned units, the lowest is McDonalds (81.09) and the highest is Burger King (86.98). However, before grade cards, the average score of franchised units of Burger King is 4.89 points below the company-owned units of the same chain. Burger King is not alone on this count. The average score of franchised units of El Pollo Loco is 4.91 points below the company-owned units. Table 1 also shows that after grade cards, there are smaller differences in average hygiene between company-owned and franchised units of the same chain. For example, after grade cards, the difference in average scores between company-owned and franchised Burger King restaurants reduces to 0.1.

We also report mean scores for several types of cuisine. Burger, chicken and pizza restaurants all tend to have above average hygiene. Chinese and Mexican restaurants have below average hygiene. Chinese restaurants have the lowest average hygiene scores before grade cards: 70.68, or 6.09 points below the average of all restaurants. However, Chinese restaurants show significant improvement after grade cards, increasing to a mean of 86.13, or 3.49 points below the average of all restaurants. The DHS data also records the number of seats in each restaurant (as a categorical variable), and Table 1 also shows conditional means according to the number of seats.

In the last two rows of Table 1 we compare hygiene on the basis of per-capita income in census tract of each restaurant. A restaurant is designated to be in a lower income area, if
per-capita income in their census tract is below the median for Los Angeles county. Otherwise, the restaurant is designated to be in a higher income area. The results are quite provocative. Before grade cards, the average hygiene score of restaurants in lower income areas is 4.24 points below restaurants in the higher income areas. In contrast, after grade cards, the average score of restaurants in the lower income regions is slightly above the average for the higher income regions. On the face of it, this suggests the introduction of grade cards has an even bigger positive impact on restaurant hygiene in poorer neighborhoods.

4 Basic Evidence

In this section we present basic evidence in support of our approach to identifying an effect of reputational incentives on restaurants’ behavior.

4.1 Score Variance Decomposition

An important premise of the reputational incentives explanation is that variation in hygiene scores is due to systematic differences across restaurants. These systematic differences may be related to restaurant’s characteristics, or characteristics of their local neighborhood. An alternative is that the score variation is due to inspectors’ idiosyncracies (despite the use of a score-based assessment criteria), or due to restaurants incurring hygiene shocks over time. Since we observe each restaurant inspected multiple times, we perform a variance decomposition to gauge the relative importance of these different factors.

Table 2 shows the results of several variance decompositions. In the top panel, an observation is a restaurant inspection before the introduction of grade cards. This includes inspections under regime I (objective plus subjective components) and inspections under regime II (no subjective component). In the middle and bottom panels of Table 2 we report the results using only regime I, and depending on whether we include the formal subjective component.

Conditioning the observed scores on quarterly dummies and inspection regime dummies explains 4% of the score variation. Our data include 38 observable restaurant characteristics (such as number of seats, whether included in Zagats, whether a chain and so forth), and also conditioning on these variables explains 11% of the score variation. However, if instead of conditioning on observed restaurant characteristics, we condition on all time-invariant restaurant characteristics (i.e. restaurant fixed effects) then we explain 62% of the score variation. Put differently, we find that the average absolute difference in inspection scores for two inspections
at the same restaurant is 8.8. While the average absolute difference in scores of inspections at
two separate restaurants is 13.5—hygiene variation across restaurants is over 50% greater than
the variation over time at a given restaurant. This is basic evidence in support of the claim that
pre-grade card hygiene scores are largely due to systematic differences across restaurants.

Some of our tests also focus on identifying differences in the degree of consumer learning
across regions. If regional differences in reputation formation are a determinant of restaurants’
hygiene quality, then we expect region fixed effects to also explain a sizable fraction of score
variation. In the top panel of Table 2, we report that city-level fixed effects (there are 151
cities in Los Angeles county during this period) explain about 20% of the variation in scores.
Five-digit zip code fixed effects (of which there are 315) explain 27% of the variation. This
suggests that local region characteristics may explain up to 43% of the systematic differences
in restaurants’ hygiene qualities.\footnote{Restaurant fixed effects explain 62% and zip fixed effects explain 27%. Suggesting the possibility that zip characteristics account for up to 43% (27/62) of the cross-restaurant variation in scores.} Of course region fixed effects include factors other than the
degree of learning by local consumers. Nevertheless, this is basic evidence in support of the
potentially important role that local factors may play in determining restaurant hygiene.

In the middle panel of Table 2 we report results when we limit the analysis to inspections
only under the first inspection regime. In this case, the constant and quarterly dummies alone
explain effectively zero of the score variation, indicating the absence of any seasonality in hygiene
quality, whatsoever.\footnote{In the top panel, the constant explains 4% of the variation, which is presumably all due to the regime dummy that is included in that specification.} Restaurant fixed effects now explain 69% of the score variation, which
is slightly more than in the top panel. The remaining 31% of unexplained score variation
may be due to inspectors’ subjectivity or shocks to restaurant hygiene. To the extent that
inspectors’ subjectivity is a significant factor, we expect this would be particularly important
in the determination of the formal subjective component of the assessment. In the bottom
panel of Table 2 we decompose the variance of the scores under regime I, with the formal
subjective component subtracted out. Restaurant fixed effects now explain 71% of the variation,
compared to 69% when we include the subjective component. Such a small difference suggests
that inspectors’ idiosyncrasies are not a major factor in the determination of hygiene scores,
although it is not conclusive.

4.2 Multivariate Score Correlations

A simple approach to examining the effect of reputational incentives on restaurants’ hygiene
quality would be to estimate an OLS regression on a cross-section of restaurants, in which
the dependent variable is pre-grade card hygiene inspection scores. Regressors would include variables that capture the degree of consumer learning, and variables that control for other factors which may impact hygiene quality. One could then evaluate whether the coefficients on the learning variables are significantly positive. However, there are two problems with this approach. First, it is difficult to obtain convincing measures of the degree of consumer learning about restaurants. Second, there is good reason to expect consumer learning about restaurants is correlated with other factors that impact on hygiene quality, some of which are invariably unobserved by us. For example, in regions where consumers tend to have a high willingness-to-pay for hygiene quality, consumers may be more likely to obtain information and learn about hygiene quality at their local restaurants.

With these limitations in mind, we nevertheless present the results of such a regression in Table 3, since it can still provide suggestive evidence about the role of reputations. The regression is estimated using pre-grade card inspection only. We include as many restaurant characteristics as possible to mitigate potential bias due to missing variables. In the table we report coefficient estimates for the most interesting variables, leaving off several that are listed in the notes to the table.

Recall that in Table 1, the average hygiene score of company-owned chain restaurants is 6.2 points above the average for all restaurants. In the regression, which controls for numerous other factors, the difference between chains and non-chains is measured by a combination of the four chain-related variables near the top of the table. In Table 1 the difference in average hygiene between company-owned units and franchised units is 1.1. After controlling for many other observables, the difference shrinks to 0.7, and is significantly different from zero with 95% confidence.

If chain affiliation is a source of effective reputational incentives for good hygiene, we expect the more chain units there are in Los Angeles, the greater will be consumer learning about hygiene quality for the chain, creating more powerful incentives for good hygiene. Confirming this intuition, the estimated coefficient on the variable number of chain units in LA is positive and highly significant. Monitoring costs may play an important role in determining hygiene quality at chain units. We expect that monitoring costs are higher for chains that are geographically dispersed. This reasoning suggests that chains which tend to have a higher concentration of their units located in Los Angeles, would tend to have lower monitoring costs, and therefore have better hygiene. Confirming this intuition, we report the coefficient on the variable fraction of US chain units in Los Angeles is positive and significantly different from zero with 95% confidence.

The Zagats restaurant variable is a dummy for whether the restaurant is included in the
Zagat Survey. The guide does not include on hygiene, but food and service quality may be correlated with hygiene quality reputation. Consistent with this view, the estimated coefficient on the Zagat variable is about 2.0 (significantly different from zero with 95% confidence). But we also find the numerical food rating that appears in Zagats (Zagats food rating) is negatively related to hygiene scores, casting doubt on this interpretation. In Table 3 we also report the estimates for several demographic variables.

Of particular interest in Table 3 are various proxies for the degree of repeat-customers. Using the zip code business pattern data from the Census Bureau, we observe employment by industry and zip code, for each year 1995 to 1998. In each case, we normalize the level of employment in a certain industry in each zip, by the population of the zip. One proxy for tourist activity is the number of hotel employees and recreation employees in the zip. As shown in Table 3, hotel employment is positively correlated with hygiene scores, and recreation employment is negatively correlated with the scores.\textsuperscript{18} This provides mixed evidence of the role that tourists may play in determining restaurant hygiene. Employment in white-collar jobs might be a better measure of repeat-business, since these individuals may be regular lunch patrons of local restaurants. In this case we obtain a marginally significant negative estimate, contrary to our expectation. Retail employment may be an indicator of a high degree of consumer traffic, indicating relatively profitable restaurant locations.\textsuperscript{19} We find that retail employment is significantly positively correlated with hygiene scores. Lastly, we find that all other employment is negatively correlated with hygiene. Overall, the estimated coefficients on the zip employment variables provide mixed evidence on the possible effectiveness of reputational incentives.

A second set of proxies for the degree of repeat-customers are based on revealed-preference arguments. Assuming that chain restaurants have an advantage over independent restaurants because of chain reputations, we expect chain restaurants are more likely to open in locations with relatively few repeat customers. We define the variable mostly chain restaurants in zip as a dummy equal to one for restaurants located in zips where at least 15% of restaurants are chains (which is a quarter of the zips). By revealed preference, we expect these zips have relatively few repeat-customers, and therefore expect this variable to be negatively correlated with hygiene scores. Contrary to our expectation, the estimate is positive and highly significant.\textsuperscript{20}

Another revealed-preference measure of repeat-customers is the fraction of chain units that

\textsuperscript{18}Both estimates are also significantly different from zero with 99% confidence.

\textsuperscript{19}It is unclear if this implies a high or low degree of repeat business for those restaurants. The employees may provide repeat business, but the retail customers may or may not.

\textsuperscript{20}We also define the variable mostly independent restaurants in zip as a dummy equal to one if the percent of restaurants that are chains in the zip is less than 5% (which is also a quarter of the zips). In this case, we expect these are regions with a relatively high degree of repeat business, leading to higher average scores. But again in contrast to our expectation, the coefficient estimate is negative and highly significant.
are franchised. Brickley and Dark (1987) conjecture that chain restaurants located near freeways are more likely to be company-owned rather than franchised. This is because of the relatively low degree of repeat-customers traveling along freeways, leading to a higher propensity of free-riding by franchised units in these locations.21 Assuming that chain units are more likely to be company-owned in areas with many relatively few repeat-customers, we may infer from the presence of a high ratio of company-owned to franchised units, that there is a low degree of repeat customers.

Following this logic, we define the variable *mostly company-owned chains in zip* as a dummy equal to one for restaurants located in zip codes where the fraction of chain restaurants that are company-owned is greater than 75% (which is over half the zips). We expect this variable to be negatively related to hygiene scores. Again we find the opposite. We also define the variable *mostly franchised chains in zip* to equal one for restaurants located in zips where the fraction of chain restaurants that are franchised is greater than 50%. We expect the associated coefficient to be positive, because we interpret this as an indicator of a high degree of repeat-customers. Unsurprisingly by this point, the estimate is the reverse.22

Overall, the regression results shown in Table 3 provided mixed evidence on the potential importance of reputational incentives. Although this was never intended to provide convincing evidence, either way. In the next section we present formal hypothesis tests, which are designed to identify a causal effect of reputational incentives on restaurant hygiene quality.

5 Chain Affiliation as a Source of Reputational Incentives

As noted, chain affiliation may be a source of reputational incentives for good quality hygiene. We therefore expect chain restaurants to have higher average hygiene quality than non-chains, before the introduction of grade cards. We also noted that franchised chain units may free-ride on the reputation of the chain, exerting less hygiene effort. Hence, a finding that franchised units have lower average hygiene scores than company-owned units would also be evidence in favor of the reputational incentives provided by chain affiliation. The challenge to testing both of these implications is being able to control for other factors that are correlated with chain affiliation and/or franchise-ownership, which also impact hygiene quality.

The regression results reported in Table 3 indicate that company-owned chains have better

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21 Brickley and Dark (1987) actually find the opposite is true—chain units near freeways are more likely to be franchised. Nevertheless, we also apply the logic that underlies the conjecture of Brickley and Dark (1987).

22 As in Brickley and Dark (1987), we find the empirical relationships are at odds with the stated logic.
hygiene than franchised chains, which in turn have better average hygiene than non-chains. The regression includes controls for observed restaurant and region characteristics. But there may be unobserved region characteristics, such as the degree of consumer learning or degree of competition among restaurants, that are correlated with the chain and franchising variables. To address this concern, we include region fixed effects. Let \( s_{ijt}^B \) denote the hygiene inspection score obtained by restaurant \( i \), in region \( j \), in period \( t \), before the introduction of grade cards (superscript \( B \) denotes “before grade cards”). Using only pre-grade card hygiene inspections, we estimate the specification

\[
s_{ijt}^B = \alpha_j^B + \beta^B c_i + \gamma^B f_i + X_i \theta^B + \epsilon_{ijt},
\]

(1)

where \( \alpha_j^B \) is a region-fixed effect, \( c_i \) is a dummy equal to one if restaurant \( i \) is a chain restaurant, \( f_i \) is a dummy equal to one if the restaurant is a franchised chain unit, and \( X_i \) are observed restaurant characteristics (including cuisine).

If chain affiliation is a source of reputational incentives, we expect \( \beta^B > 0 \) and \( \gamma^B < 0 \). These coefficients are identified by within-region variation in \( c_i \) and \( f_i \), respectively. The results are reported in the first column of estimates in Table 4. The estimate for the chain coefficient is 4.9 and is significantly different from zero with 99 percent confidence. The estimate for the franchising coefficient is -0.6 and is significantly different from zero with 95 percent confidence. These estimates support the hypothesis that chain affiliation is a source of reputational incentives. We also estimate a version of equation (1) that includes separate chain dummies for each of the top ten chains. This ensures we identify the franchising coefficient from within-chain, within-region, variation in franchising (rather than cross-chain variation in franchising). There are only minor changes in the estimates.

Since identification of the parameters of interest does not rely on an explicit source of exogenous variation in chain affiliation or franchising, there may be other differences between company-owned and franchised units that also impact on hygiene quality. The inclusion of region fixed effects precludes some kinds of potential biases, but perhaps not all. There could be variation in willingness-to-pay for hygiene quality or consumer learning across locations within a region, which may introduce bias. An even more serious concern is that chains may tend to have better hygiene because the cost of hygiene effort is lower at chains, unrelated to any effects due to reputational incentives. Including \( X_i \) helps to mitigate this. For example, chains are often hamburger restaurants, and hamburger restaurants may have lower hygiene costs than other kinds of restaurants. But clearly this is not an ideal solution.

To address these concerns, we exploit the grade card policy change. By increasing the provision of information to consumers about restaurants’ hygiene, grade cards are a substitute
for good hygiene reputations. Hence, if the difference in average hygiene quality between chains and non-chains is reduced by the grade cards, we may infer the effectiveness of chain reputation to maintain good hygiene, in the absence of grade cards. One approach to testing this implication is to estimate the following specification, using the pooled data for before and after the grade cards:

$$ s_{it} = \alpha_i + \beta_1 g_t + \beta_2 g_tC_i + \gamma g_t f_i + \epsilon_{it}, $$

where $s_{it}$ is the inspection score at restaurant $i$ in period $t$ (including observations before and after the grade are introduced), $g_t$ is a dummy equal to one for inspections occurring after the introduction of hygiene grade cards. A virtue of this approach is the inclusion of restaurant fixed effects ($\alpha_i$) to control for all time-invariant restaurant heterogeneity. Assuming the grade cards have no impact on the hygiene cost function or consumers’ willingness-to-pay for hygiene, the approach allows us to isolate the informational effect of chain affiliation.

A finding that $\beta_2 < 0$ indicates the increase in average hygiene quality, due to the grade cards, is larger for non-chains than for chains. And a finding that $\gamma > 0$ implies the grade cards have a bigger positive impact on franchised chains than company-owned chains, indicating the presence of franchisee free-riding in the absence of grade cards. The results are reported in the second column of estimates in Table 4. The estimate for $\beta_2$ is -4.1, and the estimate for $\gamma$ is 1.2. Both estimates are significantly different from zero with 99 percent confidence. These findings again support the hypothesis that chain affiliation is an effective source of reputational incentives for good quality hygiene.

Note also that we obtain an estimate for the stand-alone franchise variable in the second specification of Table 4, even though this model also includes restaurant fixed effects. Identification follows from instances of individual chain restaurants changing from being company-owned to franchised (or the reverse). Based on this variation in the data, we estimate a fairly large and significant negative effect of franchising on hygiene (-2.3). Indeed, if we examine the 21 instances of a chain restaurant that changes from being company-owned to franchised, before the introduction of grade cards, we find their average scores decrease from 83.9 to 82.3. Similarly, for the 9 chain restaurants that changed from franchised to company owned, before grade cards, we observe their average scores increase from 80.2 to 80.9. We conclude that there is evidence of some degree of franchisee free-riding, but the evidence is mixed on whether the effect on hygiene quality is large or small in magnitude. The evidence presented in Table 1 suggests that franchisee free-riding may be a major problem for certain chains, and this is probably why the estimated effects differ depending on which source of variation is relied on for the estimates.

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23 Grade cards may be an imperfect substitute for hygiene reputations. The main point is that grade cards reduce the informational differences for consumers between chains and non-chains.

24 The $j$ subscript (indexing regions) is dropped, because the specification includes restaurant fixed effects.
A concern with the interpretation of the negative estimate of $\beta_2$ in equation (2), is that such a finding may be due to a particular form of cost heterogeneity, rather than differences in pre-grade card reputational incentives. Figure 2 illustrates the concern. Suppose that the marginal benefit of hygiene quality is a decreasing function of hygiene quality and is the same for chains and non-chains—so there is no additional benefit to a chain from providing better hygiene than non-chains. Assume that grade cards cause an increase in the marginal benefit of hygiene. In Figure 2, $MB_{bef}$ is the pre-grade card marginal benefit curve, and $MB_{aft}$ identifies the post-grade card marginal benefit curve.

Suppose the marginal cost of hygiene is an increasing function of hygiene quality. Assume that chain restaurants are more efficient and have a marginal cost of hygiene curve identified as $MC_{low}$ in Figure 2. And assume that non-chains have the marginal cost function identified as $MC_{high}$ in the figure. Importantly, suppose the difference between $MC_{high}$ and $MC_{low}$ is decreasing in hygiene quality, as shown. Before the introduction of grade cards, equating marginal cost and marginal benefit, leads non-chains to provide the level of quality that corresponds with the point $A$. Chains initially provide hygiene quality corresponding to the point $B$. Grade cards cause the marginal benefit curve to shift outwards, leading non-chains to move to the point $A'$, and chains to the point $B'$.

In this example, the relative increase in hygiene quality is greater for non-chains than it is for chains. However, in this example chain affiliation is not a source a reputational incentives, since the marginal benefit curves are the same for chains as for non-chains. Hence, we would estimate $\beta_2 < 0$ in equation (2), leading us to incorrectly infer that chain affiliation is an effective source of reputational incentives—the estimated effect arises because of cost heterogeneity, not reputational incentives.

To address this concern, we estimate the following specification, as a robustness check of our earlier findings:

$$s_{ijt}^B = \alpha_j + \beta c_i + \gamma f_i + \delta \bar{s}_{A}^i + X_i \theta + \epsilon_{ijt},$$

(3)

where $\bar{s}_{A}^i$ is the average post-grade card inspection score for restaurant $i$. Conditional on obtaining the same hygiene score after grade cards, $\beta$ captures any systematic difference in pre-grade card scores between company-owned chains and independent restaurants. If the relative impact of the grade cards is greater for restaurants with lower initial scores, and is unrelated to chain affiliation, then we should obtain estimates of $\beta = 0$. Hence, a finding that $\beta > 0$ would indicate that the shortage of information before the grade cards, causes non-chain restaurants to have lower quality hygiene than chain restaurants. Similarly, the coefficient $\gamma$ captures the

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25 We also assume the introduction of grade cards has no impact on the hygiene cost functions.

26 To compute the average we control for the minor inspection criteria change in March 1998.
difference in pre-grade card scores between franchised and company-owned chain restaurants, while controlling for post-grade card scores. If there is free-riding, we should find $\gamma < 0$.

The intuition underlying this approach is as follows. Suppose there are two restaurants, in the same region, that have the same post-grade card hygiene quality. And suppose one restaurant is chain-affiliated and the other is not. Prior to the grade cards, if two restaurants have the same score, they may also face different marginal benefit and marginal cost functions. However, assuming that grade cards equalize consumers' information about hygiene quality at all restaurants, then both restaurants have the same marginal benefit of hygiene. Hence, these two restaurants also possess identical marginal cost functions. We now compare their average pre-grade card scores. If the chain restaurant has better hygiene than the non-chain, then we interpret this as evidence that the marginal benefit of hygiene curve for the chain restaurant, lies above the marginal benefit curve for the non-chain. Hence, chain-affiliation is a source of reputational incentives. It is important that these two restaurants are located in the same region, since it rules out differences in the degree of consumer learning as an alternative explanation for the difference in pre-grade card scores.

The above explanation relies on the assumption that, in the presence of grade cards, the marginal benefit of hygiene quality is the same for chains and non-chains. But it is conceivable that chain affiliation provides an added source of incentives for good hygiene, even with grade cards. For example, positive externalities between units in the same chain, may provide a greater benefit to good hygiene; or because chain reputation is even more informative about hygiene quality than the grade cards. Our method is robust to this possibility. The reasoning is as follows. Again consider the chain and non-chain, in the same region, with the same post-grade card scores. Suppose now that the marginal benefit for the chain is greater than the marginal benefit for the non-chain, in the presence of grade cards. Since the restaurants have the same post-grade card hygiene, it must be that the chain also has a higher marginal cost of hygiene quality. If the chain has a higher pre-grade cards hygiene score, and has a higher marginal cost of hygiene, then the difference in pre-grade card marginal benefit curves for the chain and non-chain must be even larger.

Based on this reasoning, a finding that $\beta > 0$ in equation (3), implies that chain affiliation is a source of reputational incentives, under the following assumptions: (i) marginal cost of hygiene curves are upward sloping and never cross; (ii) marginal cost of hygiene curves are unaffected by the introduction of restaurant hygiene grade cards; (iii) marginal benefit of hygiene curves are downward sloping and never cross; and (iv) in the presence of grade cards, the marginal benefit of hygiene for chain restaurants is greater or equal to the marginal benefit for non-chains.

\[ \text{27} \text{It is also assumed that marginal cost functions do not cross, which seems like a mild assumption.} \]
In Table 4 we report two sets of estimates for the coefficients in equation (3), that vary according to whether the region fixed effects are included ($\alpha_j$). The only difference is whether the estimate for $\gamma$ is significantly different from zero. In the third column of Table 4 we report the estimates for the specification without region fixed effects. In this case, the coefficient on the chain variable is estimated to be 5.4, and the estimate on the franchising variable is -1.7. Both are significantly different from zero with 99 percent confidence. When we include city fixed effects, the chain effect decreases to 3.8 and the franchising effect is insignificant, as shown in the fourth column of estimates.29

In the presence of city fixed effects, the franchising coefficient is identified by within-city variation in franchising, while controlling for post-grade card scores. The ideal variation is to have two chain restaurants in the same city with the same post-grade card scores, but one is franchised and the other company-owned. Perhaps not surprisingly, there is relatively little of this kind of variation in the data, leading to insignificance in the estimate of $\gamma$. Nevertheless, we obtain a high degree of significance on the chain coefficient.

The concern that motivated the specification of equation (3) was that restaurants with low quality before grade cards, would find it easier to improve their hygiene after the grade cards, than restaurants which already have good hygiene quality. This would imply an estimate of $\delta > 1$. Instead, the finding that $\delta = .5$ indicates the reverse—it is harder for restaurants with low pre-grade card hygiene quality to improve, than it is for restaurants with good hygiene.30 It appears that the difference in the marginal cost of hygiene between restaurants with the same score, tends to increase at higher levels of hygiene. In any event, the estimates for this specification reinforce our conclusion that chain affiliation is an effective source of reputational incentives for good quality hygiene.

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28In Figure 2 the marginal benefit and marginal cost curves are drawn as linear curves. However, the approach does not require linearity.

29The results are unchanged if we define regions as zip codes. If we narrow the region definition to the census tract level, the qualitative aspects of the results are robust, but some estimates become statistically insignificant.

30As a robustness check, we estimate a version of equation (3) that allows $s_i^A$ to enter as a set of dummy variables. The result did not change.
6 Local Region Reputational Incentives

The analysis of the previous section concerns reputational incentives related to chain affiliation. In this section, we examine evidence concerning reputational incentives for independent restaurants. If we observed a measure for the degree of repeat customers at each restaurant, it would be possible to analyze its effect on hygiene quality in a similar manner to the analysis of chain effects in the prior section, also drawing on the grade cards to disentangle spurious correlations. But we have no such measure for independent restaurants.

Instead, we rely on the assumption that the degree of consumer learning, through which reputation formation occurs, is a characteristic of the local region, if it exists at all. We noted in Section 4 that city fixed effects explain around 20% of the variance in pre-grade card scores. This suggests region factors play a significant role in determining restaurant hygiene quality, but not necessarily because of consumer learning in particular. There may also be regional variation in consumers’ willingness-to-pay for hygiene quality or the degree of competition among restaurants. The following tests exploit the introduction of grade cards to disentangle these effects. We divide the analysis into three subsections. The first two parts are based on comparisons of regional fixed effects under alternative assumptions. In the third subsection we analyze the importance of regional factors in the reputation effects of chain affiliation.

We separately estimate the following two equations, using inspections conducted before and after grade cards, respectively:

\[ s_{ijt}^B = \alpha_j^B + \beta_j^B c_i + \gamma_j^B f_i + X_i \theta_j^B + \epsilon_{ijt}, \]  
\[ s_{ijt}^A = \alpha_j^A + \beta_j^A c_i + \gamma_j^A f_i + X_i \theta_j^A + \epsilon_{ijt}. \]  

All variables were defined in the prior section. The tests in this section focus on the region fixed effects: \( \alpha_j^B \) and \( \alpha_j^A \). We propose a set of assumptions that allow us to infer variation across regions in the degree of consumer learning, by examining the relationship between the pre-grade card fixed effects and the post-grade card fixed effects. The underlying logic is that the grade card policy change is an exogenous increase in the provision of information to consumers about restaurants’ hygiene qualities, replacing the role previously fulfilled by reputations.

The estimates of the region effects compound reputational incentives and other regional factors that impact hygiene quality. Let \( r_j \) denote the degree of reputational incentives, or consumer learning, facing restaurants in region \( j \). Let \( w_j \) denote consumers’ willingness-to-pay for hygiene quality in region \( j \), or the degree of competition among restaurants in the region, or the net effect of both. We assume the following functional form for the impact of \( r_j \) and \( w_j \) on
average hygiene quality in region \(j\):

\[
\alpha^B_j = \alpha_1 r_j + \alpha_2 w_j + \alpha_3 r_j w_j, \quad \text{and} \quad (6)
\]

\[
\alpha^A_j = \alpha_1 g + \alpha_2 w_j + \alpha_3 gw_j. \quad (7)
\]

The variable \(g\) measures the information content of the grade cards. We expect that \(g \geq r_j\), for all \(j\), but we do not impose this as an assumption. The key assumption is that \(g\) does not vary across regions. In other words, it is assumed that the grade cards equalize informational differences across regions. This implies the incentives to maintain good hygiene, in the presence of grade cards, do not depend on the degree of repeat business in each region.

We do not observe \(r_j\) or \(w_j\), and we make no attempt to estimate them. The reason for specifying equations (6) and (7) is to formalize the assumptions that underly our interpretation of the before and after fixed effects. Based on these equations, we are able to implement empirical tests that allow us to evaluate whether \(r_j\) varies across regions. A finding that \(r_j \neq r\) implies, prior to grade cards, there is regional variation in the degree of consumer learning that impacts on restaurant hygiene quality. Hence, such a finding implies there are effective reputational incentives.

Importantly, the formulation shown in equations (6) and (7) allows for: (i) separate effects from \(r_j\) and \(w_j\), and (ii) an effect due to the interaction \(r_j\) and \(w_j\), which may have either a positive or negative coefficient. Also, there are no constraints on the values that \(r_j\) and \(w_j\) may take. For these reasons, we argue that our functional form assumptions are weak and unrestricted.

The key identifying assumption is that the grade cards equalize informational differences across regions. This does not rule out the possibility that chain affiliation continues to be a source of higher reputational incentives, in the presence of grade cards. Indeed, we include the chain and franchising dummies as covariates in equation (5) for this reason. Furthermore, the interpretation of \(w_j\) can be expanded to include any region characteristics that impact hygiene and are unaffected by the grade cards. This could include, for example, the degree of repeat business. With this in mind, the main assumptions are: (i) the grade cards provide an equal amount of information about restaurant hygiene across regions; and (ii) by doing so, the grade cards erase some (but not necessarily all) of the regional differences in information structure.

6.1 Absolute Differences in Regional Effects

In this subsection, we assume that \(\alpha_3 = 0\) in equations (6) and (7), ruling out any interaction effect between information and willingness-to-pay for hygiene quality or competition. We re-
lax this assumption later. The assumption allows us to test for the presence of reputational incentives by simply computing the difference between the before and after region fixed effects. Combining equations (6) and (7), and assuming $\alpha_3 = 0$, implies:

$$\alpha_j^A - \alpha_j^B = \alpha_1 (g - r_j).$$

Hence, if $(\alpha_j^A - \alpha_j^B)$ is statistically different across regions, then $r_j$ must also be statistically different across regions. Moreover, high values of $(\alpha_j^A - \alpha_j^B)$ imply relatively low values of $r_j$ (assuming $\alpha_1 \geq 0$). Although we are unable to say anything about the absolute levels or $r_j$, since the level is confounded with $g$ which is unobserved.

To implement the test requires a definition of a region. Since our data is for Los Angeles county, rather than, say, isolated rural markets, any definition will be arbitrary. This is particularly concerning given that we intend to allow for regional differences in the degree of competition between restaurants, as part of our test—what’s to say where the boundaries lie in determining which restaurants compete with one another? It is therefore important that we assess whether our findings are robust to alternative region definitions, with varying degrees of fineness. We consider three region definitions: cities, 5-digit zip codes, and census-tracts.

In Table 5 we report the $F$-statistics for the null that $(\alpha_j^A - \alpha_j^B) = constant$, for each of the three region definitions. The $F$-statistics range from 37.72 to 6.83, leading us to reject the null in each case, with 99% confidence. Hence, this test is overwhelmingly in support of the reputational incentives hypothesis.

All of our tests for local region reputation effects rely on the assumption that variation in the region fixed effects, after grade cards, is unrelated to information, since the grade cards equalize consumers’ information across regions. This particular test relies on a stronger version of this assumption—absolute differences in the region fixed effects after grade cards, measure the absolute differences in willingness-to-pay for hygiene quality and/or the degree of competition across the regions. Hence, by subtracting the post-grade card region fixed effects, $\alpha_j^A$, from the pre-grade card region fixed effects, $\alpha_j^B$, we can isolate regional differences in pre-grade card reputational incentives.

How reasonable is it to assume that $\alpha_3 = 0$? It is hard to say. On the one hand it could be argued that, even if $\alpha_3 \neq 0$, it is likely to be small in magnitude compared to the first-order effects of $r_j$ and $w_j$ on hygiene quality. On the other hand, it seems plausible to us that reputational incentives are more powerful for fancy restaurants, which would also be restaurants located in regions with a high willingness-to-pay for hygiene quality. Moreover, we generally expect the degree of competition in any market to depend on the amount of information available to consumers. This suggests that information and competition may have a complementary effect.
on hygiene. In any event, in the next subsection we propose a test that allows for non-zero values of $\alpha_3$.

### 6.2 Relative Differences in Regional Effects

We now allow for the possibility that hygiene quality also depends on the interaction between reputational incentives and willingness-to-pay for hygiene quality and/or competition ($\alpha_3 \neq 0$). Rearranging equation (6) yields

$$ w_j = \frac{\alpha_j^B - \alpha_1 r_j}{\alpha_2 + \alpha_3 r_j}. $$

Substitute into equation (7), to obtain

$$ \alpha_j^A = \left( \alpha_1 g - \frac{\alpha_1 \alpha_2 r_j + \alpha_1 \alpha_3 g r_j}{\alpha_2 + \alpha_3 r_j} \right) + \left( \frac{\alpha_2 + \alpha_3 g}{\alpha_2 + \alpha_3 r_j} \right) \alpha_j^B. \tag{8} $$

If $r_j = r$, then the above equation reduces to

$$ \alpha_j^A = \kappa_1 + \kappa_2 \alpha_j^B, $$

where $\kappa_1$ and $\kappa_2$ are constants. Hence, if there is no regional variation in reputational incentives, then the post-grade card region fixed effects are an affine transformation of the pre-grade card fixed effects. We test if this is true.

A naive approach to implementing the test would be to regress the estimated values of $\alpha_j^A$ (ie. $\hat{\alpha}_j^A$) on a constant and the estimated values of $\alpha_j^B$ (ie. $\hat{\alpha}_j^B$). Deviations of $\hat{\alpha}_j^A$ from the fitted line may then indicate the presence of regional variation in reputational incentives, $r_j$. But deviations will also arise due to estimation error in the regional fixed effects ($\hat{\alpha}_j^B$ and $\hat{\alpha}_j^A$).

We therefore propose an approach that allows us to test for a linear relationship in the pre- and post-grade card fixed effects, that takes account of the estimation error in these fixed effects. Define $RSS_u$ as the sum of squared residuals from the estimated equation (4) plus the sum of squared residuals from the estimated equation (5).\textsuperscript{31} We then estimate a restricted specification, incorporating the restriction that $\alpha_j^A$ is a linear function of $\alpha_j^B$:

\[
\begin{align*}
  s_{ijt} &= I_t^B \left( \alpha_j^B + \beta^B c_i + \gamma^B f_i + X_i \theta^B \right) \\
  &\quad + \left( 1 - I_t^B \right) \left( \kappa_1 + \kappa_2 \alpha_j^B + \beta^A c_i + \gamma^A f_i + X_i \theta^A \right) + \epsilon_{ijt},
\end{align*}
\]

\textsuperscript{31}Equivalently, we could combine equations (4) and (5) into a single equation, while allowing for different fixed effects and different coefficients on all variables before and after the grade cards. Then $RSS_u$ is the same as the sum of squared residuals from this combined equation.
where $I^B$ is an indicator for “before grade cards”, and $\kappa_1$ and $\kappa_2$ are additional parameters to be estimated, in lieu of the post-grade card fixed effects. This restricted specification is nonlinear in the parameters, so estimation is done via nonlinear least squares. Define $RSS_r$ as the sum of squared residuals from the estimated equation (4).

Given our assumptions, if there is significant regional variation in reputational incentives, then an $F$-test will reject the hypothesis that $RSS_u$ equals $RSS_r$. The advantage of this test over the naive approach, mentioned above, is incorporation of estimation error in the fixed effects (and all other parameters). The difference between this test and the above test with the assumption that $\alpha_3 = 0$, is that this test places no significance on absolute differences in region fixed effects. In this case, we focus on the relative impact of grade cards across regions. This is just another way of saying that if $\alpha_3 \neq 0$, then the prior test may lead us to incorrectly conclude there are regional differences in reputational incentives. Allowing for the possibility that $\alpha_3 \neq 0$ provides a more stringent test.

As with the previous test focusing on absolute differences in the region fixed effects, again it is important to check robustness to alternative region definitions. The results for the $F$-tests are reported in Table 5. In this case, the test statistic ranges from 7.94 (at the city level) to 1.87 (at the census-tract level), leading us to reject the assumption that $\alpha_j^A = \kappa_1 + \kappa_2 \alpha_j^B$, with 99% confidence.\(^3\)\(^2\) Hence, this test is also strongly in favor of the reputational incentives hypothesis.

The premise of the above approach is that the variation in hygiene across zips, after the introduction of grade cards, is due to non-informational differences. While the variation across zips before the grade cards, is due to a mixture of informational differences and non-informational differences. The test is basically a check of whether the hygiene quality ranking of regions has been significantly altered because of the grade cards. If the ranking is preserved after the introduction of grade cards, we could not infer the regions differed in the degree of consumer learning before grade cards. The formal test focuses on whether the post-grade card fixed effects are an affine transformation of the pre-grade card fixed effects. This is a stronger assumption than is needed, but is helpful in allowing us to construct a straightforward statistical test that accounts for the standard errors associated with the estimates of the region fixed effects. A more general test would simply examine whether the hygiene ranking of regions has been significantly changed by the grade cards.

To that end, in Figures 3a and 3b we map the hygiene rankings on five-digit zips in Los Angeles, before and after the grade cards. Zips are shaded according to which third of the hygiene

\(^{32}\)Notice, in equation (8), if $\alpha_3 = 0$ then we should find that $\kappa_2 = 1$. For all three region definitions, the estimate of $\kappa_2$ is significantly different from one with 99% confidence. Hence, the correct test allows for $\alpha_3 \neq 0$, as we do here.
score distribution they fall in. As shown in the map legends, darker shading corresponds to lower average hygiene quality. The main feature to notice is that many zips have changed from being in the top third of the distribution of average zip hygiene score to the bottom third after grade cards, and vice versa. Hence, the introduction of grade cards appears to have an obvious impact on the hygiene ranking of regions in Los Angeles.

Figure 4 is a more rigorous version of the maps in Figures 3a and 3b. The figure depicts the region fixed effects during three distinct periods of time. The first period is July 1995 to June 1996, and is shown along the horizontal axis. The second period covers July 1996 to June 1997 (the dots in the figure). And period three covers 1998, following the introduction of grade cards (the crosses in the figure). The inspection regime is identical during the first two periods. It is therefore not surprising that the dots in Figure 4 are close to the 45 degree line. This serves as a robustness check—in the absence of a policy intervention, the hygiene ranking of regions is stable over time. The crosses in Figure 4 depict the relationship between the fixed effects in the first and third periods. Clearly, the ordering of the fixed effects has been dramatically changed in the third period. These patterns reinforce the finding that pre-grade card hygiene levels are at least partly determined by the degree of consumer learning in each region.

6.3 Regional Chain Effects

We can also apply the above tests of the regional effects to the chain restaurants. If reputational incentives are a significant determinant of restaurants’ hygiene quality, and if the strength of these incentives vary across regions, then the incremental impact of reputational incentives due to chain affiliation may also vary across regions. Specifically, the impact of chain affiliation on hygiene quality, relative to non-chain restaurants, may be smaller in regions with a high degree of consumer learning (high $r_j$). In addition, in regions with a high degree of consumer learning, there may be less free-riding on chain reputation by franchisees.

In equation (1), the coefficient on the chain affiliation variable, $\beta^B$, measures the average difference in hygiene quality between chains and non-chains, while controlling for regional variation in average hygiene scores ($\alpha_j^B$). In other words, $\beta^B$ is the average within-region difference in hygiene scores between chains and non-chains. Similarly, the coefficient on the franchising variable, $\gamma^B$, measures the average within-region difference in hygiene scores between franchised chains and company-owned chains. In this section, we focus on the between-region variation in the chain and franchising effects. To do so, we estimate more general versions of equations (4)

---

33 Note the cutoffs differ in the two maps. The maps depict relative, not absolute hygiene differences across zips.
and (5), allowing for region-specific coefficients on the chain and franchising variables:

\[ s_{ijt}^B = \alpha_j^B + \beta_j^B c_i + \gamma_j^B f_i + X_i \theta^B + \epsilon_{ijt}, \quad \text{and} \]

\[ s_{ijt}^A = \alpha_j^A + \beta_j^A c_i + \gamma_j^A f_i + X_i \theta^A + \epsilon_{ijt}. \]  

(9) \hspace{1cm} (10)

To identify the presence of regional differences in the degree of consumer learning, we assume the same functional forms as above. Specifically:

\[ \beta_j^B = \beta_0 + \beta_1 r_j + \beta_2 w_j + \beta_3 r_j w_j, \]
\[ \beta_j^A = \beta_0 + \beta_1 g + \beta_2 w_j + \beta_3 g w_j, \]
\[ \gamma_j^B = \gamma_0 + \gamma_1 r_j + \gamma_2 w_j + \gamma_3 r_j w_j, \quad \text{and} \]
\[ \gamma_j^A = \gamma_0 + \gamma_1 g + \gamma_2 w_j + \gamma_3 g w_j. \]

We then implement the same set of tests that were applied to \( \alpha_j^B \) and \( \alpha_j^A \), depending on whether we assume \( \beta_3 = 0 \) or \( \gamma_3 = 0 \). Note, the tests of the regional franchising effects are the most informationally demanding of all the tests in this study. To identify this test, we rely on multiple observations of both company-owned and franchised chain restaurants in each region, for each of the major chains. It seems likely we will obtain imprecise estimates of these region-specific effects, which may undermine the proposed hypothesis tests.

Under the assumption that \( \beta_3 = 0 \), we test whether \((\beta_j^A - \beta_j^B) \neq \text{constant}\). We again implement test based on the three alternate region definitions. Although not reported in a table, in each case the test statistic allows us to reject equality, in favor of the reputational incentives hypothesis, with 99% confidence. This indicates the reputational effect of chain affiliation varies across regions, according to the degree of consumer learning.

We can also check if the reputational effects embedded in the estimates of \( \alpha_j^B \) are consistent with the reputational effects embedded in the estimates of \( \beta_j^B \). Intuitively, in regions with a high degree of consumer learning, the incremental effect of chain affiliation on hygiene quality should be lower. To examine this, we assume that both \( \alpha_3 = 0 \) and \( \beta_3 = 0 \). This implies

\[ \alpha_j^A - \alpha_j^B = \alpha_1 (g - r_j), \quad \text{and} \]
\[ \beta_j^A - \beta_j^B = \beta_1 (g - r_j). \]

Under these assumptions, if \((\alpha_j^A - \alpha_j^B)\) is negatively correlated with \((\beta_j^A - \beta_j^B)\), then \(\alpha_1\) and \(\beta_1\) are of opposite signs. Presuming that \(\alpha_1\) is positive, we would infer the incremental effect of chain affiliation on hygiene quality is less in regions with high reputational incentives. Consistent with our interpretation, we compute the correlation coefficient to be -0.4163.

Allowing for the possibility that \( \beta_3 \neq 0 \), we also test if \( \beta_j^A \neq \kappa_1 + \kappa_2 \beta_j^B \). The \( F \)-statistic is 0.36—we are unable to reject the hypothesis that \( \beta_j^A = \kappa_1 + \kappa_2 \beta_j^B \). The test suggests there
are not significant differences across regions in the effect of chain affiliation on reputational incentives.

Moving now to the regional franchising effects. First assuming that $\gamma_3 = 0$, so there is no interaction between consumer learning and willingness-to-pay or competition in determining the extent of franchisee free-riding, we test if $(\gamma^A_j - \gamma^B_j)$ $\neq$ constant. The $F$-statistic is 0.52. Hence, we are unable to reject the hypothesis that franchising effects are the same across regions. On the one hand, this finding goes against the reputational incentives hypothesis. On the other hand, our analysis indicate the free-riding effect is relatively small in magnitude, so it is perhaps unsurprising that we do not find significant differences across regions.

We conclude that regional differences in the effect of chain affiliation on hygiene quality are supportive of the reputational incentives hypothesis. However, we are unable to detect regional differences in the franchise effect.

7 Conclusion

Reputation mechanisms are thought to be important in numerous markets where consumers are uninformed about product quality or safety. In this study we present evidence in support of the supply-side effect of reputational incentives, using the example of restaurant hygiene quality. We find that chain restaurants tend to have significantly better hygiene than independent restaurants due to the reputational effects of chain affiliation. This finding is robust to a number of alternative specifications, some of which utilize post-grade card hygiene scores to control for unobserved heterogeneity. To the extent that chain reputation is a source of competitive advantage for chain relative to non-chain restaurants, the introduction of posted grade cards reduces this advantage for chains.34

Prior to the grade cards, company-owned chain units have slightly better average hygiene than franchised chain units. Most of our analysis indicates this is due to franchisee free-riding on chain reputation, although in some specifications the effect is insignificant. These findings provide additional verification of the reputational effect of chain affiliation.

To identify a possible effect of reputational incentives on hygiene quality at independent restaurants, we assume the degree of consumer learning is a characteristic of the local region, defined as either a city or a zip code. Our analysis indicates there are significant differences

\[34\text{Waldfogel and Chen (2003) show a related finding—information, in the form of online price comparison sites, reduce consumers’ attraction to branded web retailers.}\]
across regions in the degree of reputation formation for restaurants. We also show that regions where independent restaurants tend to have relatively good quality hygiene, the incremental effect on hygiene from chain affiliation is lower. This suggests the reputational effect of chain affiliation is reduced in regions with a high degree of consumer learning. These findings support our conclusion that reputational incentives also apply to independent restaurants.

Our findings support the view that reputations can cause firms to provide safe products. However, our prior study (Jin and Leslie, 2003) showed that the grade card policy intervention caused significant improvements in average restaurant hygiene. The results of this paper indicate that, even when there is merit to the argument that reputational incentives operate as a market-based mechanism for mitigating informational problems, it may be inferior to a policy intervention.
Bibliography


Table 1: Summary of Hygiene Scores, 1995 to 1998

<table>
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<tr>
<th></th>
<th>Number of restaurants</th>
<th>Number of inspections</th>
<th>Mean (std dev) score before grade cards</th>
<th>Mean (std dev) score after grade cards</th>
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<tr>
<td>All restaurants</td>
<td>24,304</td>
<td>127,111</td>
<td>76.77 (14.72)</td>
<td>89.62 (7.68)</td>
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<tr>
<td>Zagat restaurants</td>
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<td>4,493</td>
<td>77.43 (14.10)</td>
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<td>9,797</td>
<td>82.94 (11.53)</td>
<td>92.70 (5.65)</td>
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<tr>
<td>All chain (franchised)</td>
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<td>5,635</td>
<td>81.84 (12.67)</td>
<td>92.87 (5.58)</td>
</tr>
<tr>
<td>Brgr King (cmpny-ownd)</td>
<td>64</td>
<td>353</td>
<td>86.98 (9.59)</td>
<td>94.04 (4.06)</td>
</tr>
<tr>
<td>Brgr King (franchised)</td>
<td>61</td>
<td>389</td>
<td>82.09 (11.29)</td>
<td>94.14 (4.38)</td>
</tr>
<tr>
<td>El P Loco (cmpny-ownd)</td>
<td>95</td>
<td>614</td>
<td>82.73 (11.35)</td>
<td>93.15 (4.34)</td>
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<tr>
<td>El P Loco (franchised)</td>
<td>24</td>
<td>175</td>
<td>77.82 (13.82)</td>
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<td>Jack in Box (cmpny-ownd)</td>
<td>109</td>
<td>669</td>
<td>83.63 (11.96)</td>
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<td>229</td>
<td>82.10 (12.43)</td>
<td>93.21 (5.38)</td>
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<td>566</td>
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<td>314</td>
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<td>McDonalds (cmpny-ownd)</td>
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<td>746</td>
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<tr>
<td>0–30 seats</td>
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<td>66,271</td>
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<tr>
<td>31–60 seats</td>
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<td>29,714</td>
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<td>89.05 (7.77)</td>
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<td>5,841</td>
<td>31,126</td>
<td>76.46 (15.13)</td>
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<td>Lower income areas</td>
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<td>89.47 (7.56)</td>
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Table 2: Variance Decomposition of Pre-Grade Card Hygiene Scores

<table>
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All specifications also include a full set of year-qtr dummies. The specifications in the top panel also include inspection regime dummies.
Table 3: Predictors of Pre-Grade Card Hygiene Scores

<table>
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<tr>
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<tr>
<td>Franchised chain</td>
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<tr>
<td>Number of chain units in LA</td>
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<td>0.0023***</td>
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<td>Fraction of US chain units in LA</td>
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<td>Zagats restaurant</td>
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<td>0.9497**</td>
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<td>Zagats food rating</td>
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<td>Licensed to sell liquor</td>
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<td>American-style restaurant</td>
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<td>Burger restaurant</td>
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<td>Zip recreation emplymnt / Zip pop</td>
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<td>0.4503***</td>
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<tr>
<td>Zip white collar emplymnt / Zip pop</td>
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<tr>
<td>Zip retail emplymnt / Zip pop</td>
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<td>0.4767***</td>
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<tr>
<td>Zip other emplymnt / Zip pop</td>
<td>-0.3284</td>
<td>0.0784***</td>
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<tr>
<td>Mostly chain restaurants in zip</td>
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<tr>
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</table>

Unreported variables: year-quarter dummies, a variety of census-tract demographic variables including income, chicken restaurants, Latin food, deli-style restaurants, family-style restaurants, bakery, missing food type dummy, and home delivery dummy.

Stars denote significance levels: 99 percent confidence level (***), 95 percent confidence level (**) and 90 percent confidence level (*).
Table 4: Determinants of Restaurant Hygiene Scores

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std error</th>
<th>Coefficient</th>
<th>Std error</th>
<th>Coefficient</th>
<th>Std error</th>
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<th>Std error</th>
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<tr>
<td>Chain restaurant</td>
<td>4.8834</td>
<td>.3275***</td>
<td>5.3894</td>
<td>.8811***</td>
<td>3.8234</td>
<td>.3243***</td>
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<td>Franchised chain restaurant</td>
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<td>.2766**</td>
<td>-2.3162</td>
<td>.6772***</td>
<td>-1.7100</td>
<td>.4570***</td>
<td>-.1636</td>
<td>.2714</td>
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<tr>
<td>Grade cards × chain</td>
<td>-.0567</td>
<td>.4645***</td>
<td>1.2332</td>
<td>.3881***</td>
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<tr>
<td>Mean post-grade card score</td>
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<td>.4868</td>
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<td>( R^2 )</td>
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<td>No</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td></td>
<td></td>
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<tr>
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<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-grade card observations</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-grade cards observations</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All specifications include year-quarterly dummies. The *grade cards* variable drops out of the second specification due to collinearity with the time dummies. In the third and fourth specifications, post-grade card observations enter in the construction of the independent variable *Mean post-grade card score*. Only pre-grade card scores are used in the dependent variable.

Stars denote significance levels: 99 percent confidence level (***), 95 percent confidence level (**) and 90 percent confidence level (*).
Table 5: $F$-statistics for Local Region Learning Tests

<table>
<thead>
<tr>
<th>Reputation prediction</th>
<th>City level</th>
<th>Zip level</th>
<th>Census-tract level</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(\alpha^A_j - \alpha^B_j) \neq \text{constant}$</td>
<td>37.72</td>
<td>31.54</td>
<td>6.83</td>
</tr>
<tr>
<td>$\alpha^A_j \neq \kappa_1 + \kappa_2 \alpha^B_j$</td>
<td>7.94</td>
<td>5.71</td>
<td>1.87</td>
</tr>
</tbody>
</table>

All $F$-statistics in the table lead to rejection of the null (no regional learning differences), in favor of the reputational incentives hypothesis, with 99%-confidence.
Figure 1a: Locations of restaurants in Santa Monica in the top third of the pre-grade card hygiene score distribution

Figure 1b: Locations of restaurants in Santa Monica in the bottom third of the pre-grade card hygiene score distribution
Figure 3a: Pre-grade card average hygiene scores in each five-digit zip in Los Angeles County

Figure 3b: Post-grade card average hygiene scores in each five-digit zip in Los Angeles County
Figure 4: Mean Hygiene Scores for each City in Different Time Periods

City fixed effects: July 1995 to June 1996
City fixed effects: July 1996 to June 1997
City fixed effects after grade cards