

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 substitute for 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. It is costly for firms to maintain safety, and if they don't the risk that something will go wrong may be small. 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 have motivated government interventions such as licensing requirements, minimum quality standards and liability laws. However, there may also be market-based solutions to these problems. Arguably the most commonly proposed market solution is reputation: see Klein and Leffler (1981), Kreps, Milgrom, Roberts and Wilson (1982) and Holmstrom (1982).¹ 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. 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 suggests 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 focus on two mechanisms that may lead some restaurants to develop a reputation for good hygiene quality. First, chain affiliated restaurants may share the reputation of the chain as a whole. Customers of individual chain restaurants can 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 test the hypothesis that chain restaurants tend to face stronger reputational incentives than independent restaurants.

¹See also Kreps and Wilson (1982), Mailath and Samuelson (2001), Shapiro (1983), Tadelis (1999), and Tadelis (2002).

If chain affiliation is a source of reputation then franchisees may free-ride on the reputation by exerting less effort to maintain good hygiene. This is because the owner of a franchised chain restaurant seeks to maximize the profit of that unit alone, and consumers are unable to distinguish company-owned and franchised units: see Rubin (1978), and Mathewson and Winter (1985). Hence, evidence of franchisees exerting less effort to maintain good hygiene would provide verification that chain affiliation is a source of reputational incentives.

The second mechanism for reputation formation we examine relates to regional differences in the degree of consumer learning. 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. 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.

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 in November 1997 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.

The introduction of grade cards is a key feature of the data that we exploit to disentangle the role of reputational incentives from alternative explanations. In particular, there may be other explanations for why chain restaurants have better hygiene than non-chain restaurants, why franchised chain units have worse hygiene than company-owned chain units, and why there is regional clustering in hygiene quality. Central to our analysis is the notion that hygiene grade cards are a substitute for hygiene reputations. In other words, for restaurants that have developed a strong reputation for a certain level of hygiene quality, the grade cards provide little additional information. But for restaurants without a strong reputation the grade cards are informative to consumers. Hence, we exploit the introduction of hygiene grade cards as a source of exogenous variation in the benefit from reputation formation. In the analysis we explain more formally how the grade cards allow us to identify the presence of reputational incentives.

Based on a variety of tests we find that chain-affiliation is indeed a source of reputational

incentives, driving chains to have better hygiene. Among the evidence is the finding that franchised units of a given chain tended to have lower hygiene scores than company-owned units prior to the introduction of grade cards, but this difference goes away in the presence of grade cards. Since it is reasonable to assume similar costs of hygiene for franchised and company-owned units of a given chain, we interpret this as evidence of franchisee free-riding on chain reputation, helping to verify that chain affiliation is a source of reputational incentives.

To the best of our knowledge, this is the first study to provide empirical evidence of franchisee free-riding on chain reputation. Several studies look at how franchise units differ from company-owned units in terms of pricing or observed product characteristics more generally: Norton (1988), Lafontaine (1992), Lafontaine (1999) and Lafontaine and Shaw (1999), and Shepard (1993). There is also a literature on the endogeneity of organizational form that considers the role of franchisee free-riding, but does not test for its presence (e.g. Brickley and Dark, 1987). None of these papers show evidence of free-riding. Also, our finding that grade cards eliminate the difference in hygiene quality between company-owned and franchised chain units verifies that free-riding is a symptom of asymmetric information.

We also show the presence of significant regional clustering in hygiene quality across Los Angeles, allowing us to rank regions according to the average hygiene quality of their restaurants. And we find that the introduction of restaurant hygiene grade cards causes significant change in the hygiene ranking of regions. Under fairly weak assumptions, we argue that this indicates there were significant differences across regions in consumer learning before the introduction of grade cards and the variation impacts restaurants' hygiene qualities.

These findings suggest 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 truly effective for only a subset of firms. Thus, in the case of restaurant hygiene, government intervention in the form of posting grade cards in restaurant windows leads to substantially better hygiene quality.

A number of prior papers examine empirical evidence concerning the role of reputational incentives. Some of these rely on purported measures of reputation, showing that firms with reputation behave differently from firms without reputations, such as Banerjee and Duflo (2000) and Gorton (1996).² Another line of research seeks to infer the presence of reputational incentives

²Along the same lines, several studies examine the role of reputations in eBay auctions. Recent examples include Cabral and Hortacsu (2005) and Jin and Kato (2005). Resnick and Zeckhauser (2002) and Bajari and

based on how consumers' respond to new information about firms. For example, Borenstein and Zimmerman (1988) study the impact of a plane crash on the airline's demand (see also Hubbard, 2002). As the authors' note, consumers' prior beliefs may already incorporate the possibility of an occasional crash. Hence, it is unclear whether demand insensitivity implies weak reputational incentives. But even if the analysis adequately controls for consumers' prior beliefs demand-side studies of this kind can only provide verification of consumer learning. On the one hand, we may expect such learning to translate into higher firm effort, as reputation theory predicts. On the other hand, firm effort may be exogenous—an airline may provide poor safety quality because of organizational constraints, regardless of the threatened loss in profits following a crash.

Our approach is quite different. Instead of measuring consumers' responsiveness to adverse events that may be linked to poor product quality, we examine whether a change in consumer learning causes a change in restaurant hygiene quality. Our supply-side analysis is facilitated by a couple of features of the data. First, we observe the outcomes of restaurants' hygiene inspections. Hence, we are in the somewhat unusual situation of observing a product characteristic that consumers would like to know, but are limited to forming beliefs about based on imperfect information. Second, the introduction of grade cards is a source of exogenous variation in consumer learning. These features allow us to explicitly test the claim that consumer learning causes firms to produce or maintain good quality products. We are aware of one prior study that also examines the supply-side implications of reputational incentives: based on a series of laboratory and field experiments List (2006) finds evidence that enhanced consumer learning causes sellers to provide higher quality products (when quality is unobserved at the time of the transaction).

The rest of the paper is organized as follows. In Section 2, we provide a review of the DHS inspections, grade card policy change, and summary statistics for our dataset. Section 3 contains our analysis of whether chain affiliation is a source of reputational incentives. In Section 4 we test whether localized consumer learning is a source of effective reputational incentives. The conclusion is in Section 5.

Hortacsu (2004) 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.

2 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. 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.³

There was a change in the score criteria that occurred 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.

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.⁴ 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 below 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, 1998.⁵

³To the extent that inspectors subjectivity is still a factor in determining scores, this implies measurement error in our dependent variable.

⁴In fact, as we detail in Jin and Leslie (2003), the posting of grade cards is mandatory in some cities within Los Angeles 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.

⁵See 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. In principle, chain headquarters could also utilize DHS inspection results to bolster their own monitoring efforts of their franchisees. We have asked several franchisees and chain managers about this issue and have always been told they do not use this information, instead relying on their own monitoring processes. This may be because each county has its own idiosyncratic approach to restaurant hygiene inspections, making it difficult for chains to use inspection results from multiple counties.

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 the restaurants. We also obtained the Zagat Survey restaurant guide for each of the corresponding years in our data. From Zagat we identify which restaurants are included in the guide and their associated review scores. Restaurant names also allow us to identify chain restaurants.⁶ We can further distinguish company-owned chain units from franchised units on the basis of ownership information 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

⁶We use *Bond's Franchise Guide* to identify national and regional chains.

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.⁷

First Glance

Table 1 provides a summary of the score data, distinguishing by restaurant type and 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.

About 4% of the restaurants in Los Angeles are included in the Zagat restaurant guide. These are undoubtedly the more fancy (and expensive) restaurants in the data. The Zagat guide does not provide information about hygiene, but it is conceivable that food, decor and service quality are correlated with hygiene quality. If so, then the Zagat guide may also generate reputational incentives for the included restaurants to maintain good hygiene. Consistent with this view, the average pre-grade card hygiene score of Zagat restaurants is above the average for all restaurants. However, after grade cards the Zagat restaurants tend have slightly below average hygiene scores. This may be because food, decor and service quality are in fact poor proxies of hygiene quality.

There are 2,632 chain restaurants, equal to nearly 11% of restaurants in the data. Before grade cards the chain restaurants have significantly higher average hygiene scores than non-chain restaurants. After grade cards the chains continue to have better hygiene, although the difference is reduced by around half. About 63% of chain restaurants in our data are company-owned units. Before grade cards the average score for company-owned chain units is about one point higher than franchised units. This difference becomes negligible after grade cards. We also report mean scores for each of the top 6 chains, again distinguishing between company-owned and franchised units. Burger King is an excellent example for reputational incentives because the data suggests a high degree of free-riding by franchisees: before grade cards the average score of franchised Burger King units is 4.89 points below the company-owned units of the same chain; after grade cards the difference reduces to 0.1.

To help understand the content of the data, Table 1 also shows the scores for different cuisines, various seating capacities, and by income of local residents. The distinction by income is somewhat interesting. The data indicates the introduction of grade cards has an even bigger

⁷Some chains such as Starbucks follow a policy of no franchising. However, because some landlords do not allow Starbucks to own the location, these locations are subject to leasing and contracting, which may result in an individual name in our ownership data. Our results are robust to excluding these special chains.

positive impact on restaurant hygiene in poorer neighborhoods.

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 (such as chain affiliation) or characteristics of their local neighborhood (such as the degree of repeat business). An alternative is that the score variation is due to inspectors' idiosyncrasies (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 presents variance decompositions, in which observation is a restaurant inspection before the introduction of grade cards. Conditioning the observed scores on quarterly dummies and inspection regime dummies explains 4% of the score variation. Conditioning on 36 observed covariates explains 11% of the score variation. Including restaurant fixed effects explains 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, compared to an average difference of 13.5 for two randomly chosen restaurants. This is basic evidence consistent with the hypothesis 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. In the top panel of Table 2, we report that adding city-level fixed effects (there are 151 cities in Los Angeles county during this period) explains an additional 16% of the variation in scores. Adding five-digit zip code fixed effects (of which there are 315) explains an additional 7% of the variation. This suggests that local region characteristics may explain up to 40% of the systematic differences in restaurants' hygiene qualities (i.e. $(27-4)/(62-4)=40\%$). Overall, data summary suggests that hygiene scores differ systematically across restaurants and across regions before the grade cards. Can we attribute these score differences to chain affiliation and variations in the degree of local consumer learning? We examine these issues in the next two sections.

3 Chain Affiliation as a Source of Reputational Incentives

In this section we first present a model that highlights chain affiliation as a source of reputational incentives, while assuming everything else equal between chain and non-chain restaurants. After

testing predictions from this simple model, we turn to alternative explanations and examine whether our evidence of reputational incentives is robust to confounding factors.

3.1 A Simple Model for Chain Affiliation as a Source of Reputational Incentives

All models of reputational incentives share the feature that past behavior affects future outcomes. In the case of restaurant hygiene, the threat of reduced future demand may provide an incentive for restaurants to maintain good hygiene. But this incentive relies on the presence of consumer learning.

We hypothesize that, prior to grade cards, the degree of consumer learning is greater for chain restaurants than for non-chain restaurants. This is because consumers may learn about a chain restaurant's hygiene condition from experience in the restaurant itself, or from experience in other restaurants that belong to the same chain.⁸ If chain restaurants internalize the externality, better consumer learning implies more repeat-business and therefore higher demand. Drawing marginal revenue as a function of hygiene quality (h) and using superscript b to denote “before grade cards”, Figure 1 shows that the marginal revenue curve should be higher for a chain restaurant than for an independent restaurant ($MR_c^b(h) > MR_{nc}^b(h), \forall h$). If the two restaurants were to face the same marginal cost of producing hygiene quality ($MC(h)$) then the chain restaurant should provide better hygiene than the independent restaurant ($h_c^b > h_{nc}^b$).

After the introduction of grade cards consumers observe a hygiene grade *specific to each restaurant*. Assuming grade cards replace consumer learning via experience, there is no need to learn hygiene quality across different units of the same chain. In this sense, the grade card equalizes the marginal revenue curve for all restaurants. To the extent that grade cards are more informative than any learning process consumers used before, the new marginal curve ($MR^a(h)$), lies above both $MR_c^b(h)$ and $MR_{nc}^b(h)$. Since the grade card does not impose any change on the marginal cost curve and we assume (for now) equal marginal cost for chain and independent restaurants, the two restaurants should choose the same hygiene quality in the presence of grade cards ($h_c^a = h_{nc}^a = h^a$). Also, comparing hygiene quality before and after grade cards, we predict a larger hygiene improvement for the independent restaurant than for the chain restaurant ($h^a - h_{nc}^b > h^a - h_c^b$).

⁸Formally, there must be a mechanism that justifies why the experience of a consumer at one unit of a given chain is informative about the hygiene quality at other units of the same chain. There are several possibilities, including standardized hygiene technologies and practices throughout the chain, or common food sources. Our model does not depend on any specific mechanism.

Figure 1 relies on an important assumption that chain restaurants internalize the reputation externality within the chain. The degree of externality depends on the chain’s prevalence in the Los Angeles area. We therefore expect the marginal revenue of hygiene quality to increase with the number of chain units located in Los Angeles, implying higher hygiene quality for bigger chains. If we also allow for imperfect monitoring from the chain headquarters, then the degree to which chain units internalize the reputation externality may also depend on monitoring intensity. Consider two chains that have the same number of units in Los Angeles: one is part of a big national chain and the other focuses on the Los Angeles area only. Compared with the Los Angeles chain, the headquarter of the big national chain may be likely to spend less monitoring effort on each unit in Los Angeles, resulting in a lower ability to internalize the externality across all the Los Angeles units. This reasoning implies that, prior to grade cards, the marginal revenue of hygiene is increasing in a chain’s own concentration in Los Angeles. Each of these predictions is also testable.

A special case of imperfect monitoring relates to franchised chain units. A number of case studies document that chain headquarters are keenly aware of the reputation externality and conduct their own hygiene inspections to ensure good hygiene throughout the chain. However, a significant literature concerns the problem of franchisee free-riding. Unlike company-owned units who maximize the profits of the whole chain, franchisees only maximize the profit of their own units. With imperfect monitoring this implies a lower marginal revenue curve for a franchised unit compared to a company-owned unit. As shown in Figure 1, a lower marginal revenue curve ($MR_{cf}^b(h) < MR_c^b(h)$) leads to a lower hygiene quality in the franchised units ($h_{cf}^b < h_c^b$). Since grade cards display hygiene quality specific to each restaurant, the externality across chain units (at least on the hygiene dimension) is eliminated after the grade cards. This implies that the hygiene score variation due to chain affiliation, chain size, and franchisee free-riding should all reduce to zero after the grade cards.

3.2 Basic Tests

The most straightforward test is to focus on inspections before the introduction of grade cards and examine whether hygiene scores of restaurant i differs by four chain variables: whether i belongs to a chain (c_i), whether i is a franchised unit (f_i), the number of restaurants that belong to the same chain in Los Angeles ($nchain_i$), and the fraction of US chain units located in Los Angeles ($perchain_i$). We estimate the following specification:

$$s_{ijt}^b = \alpha_j + \beta c_i + \gamma f_i + \delta_1 nchain_i + \delta_2 perchain_i + X_i \theta + \epsilon_{ijt}. \quad (1)$$

The dependent variable s_{ijt}^b denotes the hygiene inspection score obtained by restaurant i , in region j , in inspection t , before the introduction of grade cards (superscript b denotes “before

grade cards”). To isolate chain affiliation from the amount of consumer learning in a local region, which is the focus of next section, we include region-specific fixed effects (α_j). Moreover, because chains may differ from non-chains in terms of cuisine-type, size, and so forth, we include as many restaurant observables as possible (X_i). An example of the ideal test would be to compare two burger-style restaurants located next to each other, where one is a chain and the other is an independent. The inclusion of region fixed effects and observed characteristics allows us to approximate the ideal experiment on a large scale. The error component (ϵ_{ijt}) contains unobserved hygiene shocks.

As shown in the first column of Table 3 the estimate for the chain coefficient is 3.7 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 findings 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 rather than cross-chain variation in franchising. In this case the estimated coefficient on the franchised dummy is -0.71, with a standard error of .29 ($p = 0.015$).

As discussed above, if chain affiliation is a source of effective reputational incentives for good hygiene then we expect the more chain units there are in Los Angeles, the greater will be consumer learning about hygiene quality for the chain, which creates more powerful incentives for good hygiene. Confirming this intuition, the estimated coefficient on the variable the number of chain units in Los Angeles is positive and highly significant. Similarly, we expect that monitoring costs are higher for chains that are geographically dispersed. Also confirming this intuition, the coefficient on the fraction of US chain units in Los Angeles is positive and significantly different from zero with 99% confidence.

Among the other restaurant characteristics the *Zagat guide* variable is a dummy for whether the restaurant is included in the Zagat Survey guide. The guide does not include information on restaurant hygiene, but food and service quality may be correlated with hygiene reputation. Consistent with this view, the estimated coefficient on the Zagat variable is about 3.1 (significantly different from zero with 99% confidence). But we also find the numerical food rating that appears in Zagat (*Zagat guide food rating*) is negatively related to hygiene scores, casting doubt on this interpretation.

It is conceivable that reputational incentives for hygiene quality are different in the sub-population of restaurants covered in the Zagat survey guide.⁹ This could be because food and service quality are so much more important to consumers in this segment, or because of a non-

⁹Recall from Table 1 that less than 5% of restaurants in Los Angeles are included in the Zagat guide.

linear effect of reputation on hygiene quality. We therefore re-estimate equation (1) using only the population of restaurants in the Zagat guide. In this case, the estimate for the coefficient on *Chain restaurant* is 13.19 (standard error of 4.32), and the estimate for the coefficient on *Franchised chain restaurant* is 4.43 (standard error of 2.65). This suggests that chain affiliation is an effective source of reputational incentives even among Zagat-rated restaurants. Although the franchise effect is insignificantly different from zero (at the 95% confidence level). We also find the estimate on *Zagat guide food rating* is now insignificantly different from zero (estimated coefficient of -.05, standard error of .05).

Since equation (1) 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 hygiene quality. The inclusion of region fixed effects precludes some kinds of potential biases, but perhaps not all. For example, price elasticity of demand may vary across restaurants in a given region, possibly leading restaurants with high price elasticity of demand to offer lower prices as a substitute for better hygiene quality.¹⁰ In the above analysis, this can be a source of bias if price elasticity of demand is correlated with chain affiliation but is unrelated to hygiene reputation.

We therefore consider another specification which allows for restaurant fixed effects and incorporates the exogenous grade card policy change:

$$s_{it} = \alpha_i + \beta_0 g_t + \beta g_t c_i + \gamma g_t f_i + \delta_1 g_t nchain_i + \delta_2 g_t perchain_i + \epsilon_{it}, \quad (2)$$

where s_{it} is the inspection score at restaurant i in period t (including observations before and after the grades are introduced), g_t is a dummy equal to one for inspections occurring after the introduction of hygiene grade cards.¹¹ A virtue of this approach is the inclusion of restaurant fixed effects (α_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. The model in the preceding subsection implied several predictions for how different types of restaurants will respond to the grade cards, and this specification allows us to test those predictions while including restaurant fixed effects to control for all time-invariant restaurant heterogeneity.

As reported in the second column of Table 3 the negative estimate of β (-3.9) indicates that the increase in average hygiene quality, due to the grade cards, is larger for non-chains than for chains. The positive estimate of γ (1.1) 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. Similarly, the negative estimate of δ_2 (-3.5) indicates that chains

¹⁰We thank a referee for pointing this out.

¹¹The j subscript (indexing regions) is dropped, because the specification includes restaurant fixed effects.

of higher concentration in Los Angeles improve significantly less after the grade cards. This is not surprising as chains concentrated in Los Angeles had better hygiene quality before the grade cards—in theory we expect chains that have more units in Los Angeles had better hygiene before the grade cards and hence improve less after the grade cards. The positive sign of δ_1 defies the prediction, but the estimate is indistinguishable from zero. Overall, these findings are consistent with 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 3 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 (-1.8). Regression analysis aside, if we examine the 34 instances of chain restaurants that changed from franchised to company owned, before grade cards, we observe their average (median) scores increase from 79.6 (79) to 80.9 (81.5). This is consistent with the free-riding view of franchising. However, if we examine the 20 instances of chain restaurants that change from company-owned to franchised, before the introduction of grade cards, we find their average (median) scores increase from 78.9 (77) to 83.2 (86). This is counter to the free-riding view of franchising, in which we expect these scores to decrease. One way to interpret these patterns is that ownership changes are related to positive operational improvements—new owners (whether franchisees or the chain itself) seek to make improvements in the businesses they acquire. If the free-riding theory is correct, this may be a temporary phenomenon. Indeed, the regression results are consistent with the presence of franchisee free-riding more generally.

We also obtain an estimate for the coefficient on the Zagat dummy based on variation over time for some restaurants. The estimate suggests that changes in Zagat status has no significant effect on restaurant hygiene. While unreported in the table, the regression also includes the interaction of grade cards with Zagat dummy and Zagat food rating. The associated estimates indicate that Zagat restaurants do improve less after the grade cards than the non-Zagat restaurants, as we would expect from the reputation theory. But higher Zagat food rating is associated with greater hygiene improvement after the grade cards.

We again re-estimate equation (2) using only the sub-population of restaurants covered in the Zagat guide, as we did with equation (1). The estimated coefficient on (*Grade cards* \times *chain*) is -13.31 (standard error of 5.04). The estimated coefficient on (*Grade cards* \times *franchised*) is insignificantly different from zero. The estimated coefficient on *Zagat guide food rating* is insignificantly different from zero. These findings are consistent with the results for the full population of restaurants.

Since the grade cards provide categorical information about inspection scores (e.g. A-grade implies a score between 90 and 100) to consumers, it is conceivable that restaurants respond to incentives only with respect to grades, rather than the finer measure of scores. Consequently, it is important to examine whether our findings are robust to using grades rather than scores as the measure of restaurant hygiene.¹² We re-estimate equation (2) in which we replace the dependent variable s_{it} with a dummy variable equal to one if $s_{it} \geq 90$. None of the results are qualitatively different to those reported in column (2) of Table 3.

3.3 Alternative Explanations and Extended Tests

While the findings presented in the first two columns of Table 3 are consistent with chain affiliation as a source of reputational incentives, they do not exclude alternative explanations. One plausible explanation relates to the cost of hygiene production. Chains may tend to have better hygiene because the cost of hygiene effort is lower at chains than non-chains, unrelated to any effect from reputational incentives. To illustrate this possibility Figure 2 duplicates Figure 1 but allows a lower marginal cost curve for chain restaurants. Due to the cost advantage chain restaurants will choose a higher hygiene even after the grade cards. In this scenario the score difference between chain and non-chain restaurants before the grade cards is partly due to the difference in marginal revenue (which indicates reputational incentives), and partly due to the cost difference.

How shall we separate the two explanations? As shown in Figure 2, if we assume the two marginal cost curves are parallel then the chain restaurant improves from h_c^b to h_c^a following the introduction grade cards. The non-chain restaurant improves from h_{nc}^b to h_{nc}^a . Assuming parallel marginal cost curves for chains and non-chains, the difference in scores between chains and non-chains that is attributable to the cost difference is a constant amount. Hence, if the score difference between chains and non-chains is lower after the grade cards than before, it must be that the marginal revenue curve for chains is higher than the marginal revenue curve for non-chains in the pre-grade card era. This is exactly the interpretation of β in equation (2). In other words, the significantly negative estimate of β (-3.9) provides strong support for reputational incentives, even if chain and non-chain restaurants have different (but parallel) marginal costs in hygiene production.

The comparison between franchised and company-owned unit provides even more convincing evidence. Conditional on the same chain, franchised and company-owned units should face exactly the same cost of hygiene production. Therefore, their pre-card score difference, as well

¹²The analysis based on equation (1) utilizes only pre-grade card inspection results. Hence, there is no issue of replacing scores with grades for that analysis.

as the differential improvements after the grade cards, should only reflect franchisee free-riding.

So far we have assumed the marginal cost functions for chains and non-chains are parallel. Is it possible that a negative coefficient on the chain dummy is due to a particular form of cost heterogeneity, rather than differences in pre-grade card reputational incentives? Suppose that chain restaurants face a marginal cost curve that is lower in absolute terms but steeper than that of independent restaurants, as shown in Figure (3).¹³ In this case, chain restaurants improve hygiene less than non-chains because of the difference in marginal cost curves. Hence, we can no longer difference out the amount of score variation due to cost heterogeneity.¹⁴

To address this alternative explanation, we propose the following specification:

$$s_{ijt}^b = \alpha_j + \beta c_i + \gamma f_i + \delta_1 nchain_i + \delta_2 perchain_i + \delta \bar{s}_i^a + X_i \theta + \epsilon_{ijt}, \quad (3)$$

where the variable \bar{s}_i^a is the average post-grade card inspection score for restaurant i (superscript a denotes “after grade cards”).¹⁵

Compared with equation (1), equation (3) adds the average post-grade card score as a new regressor. To see why it is helpful consider two restaurants in the same region: one belongs to a chain and the other is an independent. Suppose the two restaurants have the same inspection score after the grade cards, but the chain restaurant had a better score before grade cards. Is the pre-grade card difference consistent with reputational incentives? As before, we assume grade cards equalize the marginal revenue curve for all restaurants. Under the typical assumptions about MR and MC (i.e. MR curves do not cross each other, and MC curves do not cross each other), if two restaurants face the same MR and have the same hygiene scores after the grade cards, they must have the same MC. Since MC does not change after grade cards, the two restaurants must face the same MC before grade cards as well. As a result, the score difference between the two restaurants must reflect the fact that the chain restaurant faces a higher marginal revenue before grade cards. Put differently, the post-grade card score allows us to effectively compare a chain restaurant and an independent restaurant on the same MC curve. Consequently, the pre-grade card score difference is attributable to the difference in marginal revenue, which indicates reputational incentives.

The above argument hinges on the assumption that grade cards equalize MR for all restaurants. It is conceivable that chain affiliation provides an added source of incentives for good

¹³Note, at this point we are considering differences that may exist between chains and non-chains in terms of the second derivative of their respective hygiene cost functions. The analysis so far is robust to differences in the intercept and first derivative of their respective marginal cost functions.

¹⁴If the marginal cost curve for chains is instead flatter than for non-chains, the above differencing approach leads to an underestimate of the difference in pre-grade card marginal revenue curves, which strengthens our conclusion.

¹⁵To compute the average we control for the minor inspection criteria change in March 1998.

hygiene, even with grade cards. Because grade cards publish letter grades rather than detailed hygiene scores, if consumers care about the difference between scores 90 and 95, say, they won't see it in the letter grade but they may learn about it via experience. Hence, the positive externality across chain units may generate higher marginal revenue for chain restaurants than for independent restaurant even in the presence of grade cards.

Our method is robust to this possibility. Again consider the chain and non-chain (in the same region) with the same post-grade card scores. Suppose now that $MR_c^a(h) > MR_{nc}^a(h)$. Since both restaurants have the same post-grade card score, it must be that the chain also has a higher marginal cost of hygiene quality. If the chain has a higher score in the pre-grade card era, 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 than what equation (3) suggests.

In econometric terms, conditional on post-grade card hygiene scores, β captures any systematic difference in pre-grade card scores between company-owned chains and independent restaurants. If chain affiliation is a source of effective reputational incentives we should find $\beta > 0$. Similarly, the coefficient γ captures the 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 $\gamma < 0$. As in equation (1), positive δ_1 and δ_2 are consistent with the hypothesis that reputational incentives are stronger for chains that are more prevalent and more concentrated in Los Angeles.

The last two columns of estimated coefficients in Table 3 report two sets of estimates for equation (3), according to whether regional fixed effects are included. For the specification without city fixed effects, the coefficient on the chain variable is estimated to be 4.7, and the estimate on the franchising variable is -1.6. Both are significantly different from zero with 99 percent confidence. When we include city fixed effects, the chain effect decreases to 2.7 and the franchising effect is insignificant, as shown in the fourth column of estimates. In both columns, the fraction of US chain units in Los Angeles has a significant and positive coefficient (δ_1), indicating that chains that are concentrated in Los Angeles have better hygiene before grade cards. This is consistent with the view that geographic concentration ensures better monitoring, which in turn generates stronger reputational incentives to maintain good hygiene. In comparison, the reputation effect of the number of chain units in Los Angeles is less stable throughout the columns. The 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.¹⁶

¹⁶As another robustness check, replacing s_{ijt}^a with a dummy equal to one for scores above 90, yields the same qualitative findings. See the discussion of this issue at the end of Section 3.2.

In summary, the estimates for all specifications in this section are consistent with the hypothesis that chain affiliation is a source of reputational incentives giving rise to better hygiene quality than at non-chain restaurants. All of the estimates also point in the direction of there being franchisee free-riding, although sometimes these effects are not statistically significant.

4 Local Region Reputational Incentives

Aside from chain affiliation, 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. Stigler (1961) also refers to tourists as a class of consumers lacking in knowledge about local markets. 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.

In this section we first present a naive regression aimed at detecting regional differences in reputational incentives. After explaining the limitations of this approach we turn to a formal model that exploits the exogenous introduction of grade cards, which we then test with the data.

4.1 Preliminary Analysis

A simple approach to examining the effect of regional 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 in the local region surrounding the restaurant, 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.

There are two problems with this approach. First, it is difficult to obtain convincing measures of the degree of consumer learning across 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 present the results of such a regression in Table 4, as a way of describing some of the geographic patterns in the data. We use pre-grade card inspections only, and include as many restaurant characteristics as possible to mitigate potential bias due to missing variables. While many restaurant characteristics (such as chain affiliation) have significant power predicting pre-grade card hygiene scores, we only report results of the various proxies for the degree of local consumer learning. Following Brickley and Dark (1987) a straightforward starting point is to use restaurant address to define whether a restaurant is close to a freeway exit or not. However, since a dense freeway system covers most of the Los Angeles area, distance to freeway exit is a poor measure of repeat customers. Instead, we rely on employment patterns and chain restaurant locations to indirectly infer 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 each industry in each zip, by the population of the zip. One proxy for tourist activity is the number of hotel employees, which we expect to be negatively correlated with the degree of repeat customers. As shown in Table 4 the estimated coefficient is unexpectedly positive (and significant). A similar proxy is recreation employment, and in this case the estimated coefficient is negative (and significant). These findings provide 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.¹⁷ 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 their chain reputations, we expect chain restaurants are more likely to open in

¹⁷It 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 not.

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.¹⁸

Another revealed-preference measure of repeat-customers is the fraction of chain units that 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.¹⁹ Following this logic, if we assume that chain units are more likely to be company-owned in areas with 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.

We therefore 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. The estimate is the reverse.²⁰

We also estimate a version of this specification in which we include interactions between the various learning proxies discussed above, and a dummy equal to one for the presence of grade cards (we include post-grade card observations in this regression). This is analogous to the approach shown in equation (2). Although not reported in a table, the estimates on the interaction terms are also mixed: some estimates are consistent with reputation effects, and some are not.

Overall, the preliminary analysis discussed in this subsection provides mixed evidence on the potential importance of local region reputational incentives. We suspect the mixed evidence re-

¹⁸We 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. Again in contrast to our expectation, the coefficient estimate is negative and highly significant.

¹⁹Brickley 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).

²⁰As in Brickley and Dark (1987), we find the empirical relationships are at odds with the stated logic.

flects a correlation between our proxies for the degree of consumer learning and other unobserved factors that may impact restaurant hygiene.

4.2 A Formal Model of Local Region Repeat Customers

We now present a framework that separates regional variation in the degree of consumer learning from other confounding factors. These confounding factors may be differences in consumers' willingness-to-pay for hygiene quality, hygiene costs, or the degree of competition among restaurants. The key to our identification strategy is to exploit the exogenous introduction of grade cards. Our approach hinges on two assumptions: (i) grade cards change the degree of consumer learning but not the other regional factors; and (ii) grade cards, as a superior information tool, equalize the degree of consumer learning about restaurant hygiene across all regions.

Define I_{ij} as a measure of how well informed the consumers are about the hygiene quality of restaurant i in region j . Since reputational incentives depend on the informational environment for a given restaurant, we believe I_{ij} is a function of chain affiliation (c_i), whether there are posted hygiene grade cards (g_t), and the degree of repeat business in region j (r_j).²¹ For example, r_j is lower in regions where restaurant patrons are mainly tourists, and higher in regions where most customers are local residents. Hence, we have $I_{ij} = I(c_i, g, r_j)$.

Restaurant i in region j has marginal revenue of hygiene and marginal cost of hygiene functions given by

$$MR(h_i, I(c_i, g, r_j), w_j) \quad \text{and} \quad MC(h_i, c_i, w_j),$$

respectively. The term w_j captures the net value of all other local characteristics that impact either the marginal revenue or marginal cost of hygiene quality in region j . For example, w_j includes consumers' willingness-to-pay for hygiene quality, the degree of competition among restaurants, and any local factors that may impact the cost of hygiene. The formulation clarifies that c_i , g and r_j impact MR via their informational effects. Importantly, the model explicitly incorporates other region-specific factors that can impact either the costs or benefits of hygiene quality (w_j). It also allows for the possibility that c_i can affect hygiene costs in addition to revenue.

The goal is to test if there are differences across regions in the degree of consumer learning that impacts restaurants' hygiene qualities. If such differences do not exist, we have the null hypothesis: $r_j = r$. Assuming grade cards equalize the degree of consumer learning across

²¹We assume g_t varies by time but not regions, since the grade cards were implemented across all regions in Los Angeles at the same time.

regions implies

$$I(c_i, g, r_j | g = 1) = I(c_i, \bar{r}),$$

where \bar{r} is the level of consumer learning associated with the presence of posted hygiene grade cards. In other words, grade cards supersede the degree of learning that was due to repeat customers. We emphasize that the presence of w_j implies there can be regional differences in hygiene quality in the presence of grade cards, since grade cards may not impact other factors that imply between-region variation in the costs or benefits of hygiene quality.

Each restaurant chooses a level of hygiene quality (h_{ij}^*) that equates marginal revenue and marginal cost of hygiene quality. Given $MR_{ij}(\cdot)$ and $MC_{ij}(\cdot)$ we can derive $h_{ij}^*(c_i, g, r_j, w_j, \bar{r})$. Assuming a flexible functional form for $h_{ij}^*(\cdot)$, we have

$$h_{ij}^*(g = 0) = a_1 r_j + a_2 w_j + a_3 r_j w_j + b_1 c_i, \quad \text{and} \quad (4)$$

$$h_{ij}^*(g = 1) = a_1 \bar{r} + a_2 w_j + a_3 \bar{r} w_j + b_2 c_i. \quad (5)$$

We do not observe r_j or w_j , although we do observe c_i as well as other restaurant characteristics. However, we can compute the net value of the components that include r_j and w_j , specifically:

$$\alpha_j(g = 0) \equiv \alpha_j^b = a_1 r_j + a_2 w_j + a_3 r_j w_j, \quad \text{and} \quad (6)$$

$$\alpha_j(g = 1) \equiv \alpha_j^a = a_1 \bar{r} + a_2 w_j + a_3 \bar{r} w_j \quad (7)$$

In the empirical analysis, α_j^b is the region fixed effect before grade cards, and α_j^a is the region fixed effect after grade cards, for region j . The model provides a particular interpretation for what is contained in these fixed effects. Importantly, the model allows the region fixed effects to include other factors that may explain hygiene differences across regions, and these other factors may interact with the informational factors, r_j and \bar{r} .

It follows from equations (4) and (5) that under the null hypothesis ($r_j = r$) the ordering of region fixed effects is the same before and after the grade cards. In other words, if $r_j = r$ we can re-write the post-grade card region fixed effects as an affine transformation of the pre-grade card fixed effects. More formally, rearranging equation (6) yields

$$w_j = \frac{\alpha_j^b - a_1 r_j}{a_2 + a_3 r_j}.$$

Substitute into equation (7) to obtain

$$\alpha_j^a = \left(a_1 \bar{r} - \frac{a_1 a_2 r_j + a_1 a_3 \bar{r} r_j}{a_2 + a_3 r_j} \right) + \left(\frac{a_2 + a_3 \bar{r}}{a_2 + a_3 r_j} \right) \alpha_j^b. \quad (8)$$

If $r_j = r$, then equation (8) reduces to

$$\alpha_j^a = k_1 + k_2 \alpha_j^b,$$

where k_1 and k_2 are two constants.

The premise of this analysis is that the degree of consumer learning is similar for restaurants that are geographically close. However, it is possible that r and w could actually vary across restaurants within a region. We partially address this possibility by allowing for the possibility that learning also depends chain affiliation (see below). Also, we test whether our conclusions are robust to alternative definitions of geographic markets.

4.3 Empirical Tests

We now present two progressively more stringent tests of the null hypothesis ($r_j = r$). As indicated above, the approach is to test whether the post-grade card region fixed effects are an affine transformation of the pre-grade card region fixed effects.

To start, suppose we can separately estimate the following two equations, using inspections conducted before and after grade cards, respectively:

$$s_{ijt}^b = \alpha_j^b + \beta^b c_i + \gamma^b f_i + X_i \theta^b + \epsilon_{ijt}, \quad \text{and} \quad (9)$$

$$s_{ijt}^a = \alpha_j^a + \beta^a c_i + \gamma^a f_i + X_i \theta^a + \epsilon_{ijt}. \quad (10)$$

All variables were defined in the prior section. The tests in this section focus on the region fixed effects: α_j^b and α_j^a . Recall the interpretation of the region fixed effects:

$$\alpha_j^b = a_1 r_j + a_2 w_j + a_3 r_j w_j, \quad \text{and} \quad (11)$$

$$\alpha_j^a = a_1 \bar{r} + a_2 w_j + a_3 \bar{r} w_j \quad (12)$$

Our first test concerns the simple case in which we assume $a_3 = 0$ in equations (11) and (12). This effectively rules out any interaction effect between information and other regional factors that affect hygiene. Under this assumption the null hypothesis ($r_j = r$) implies

$$\alpha_j^a - \alpha_j^b = a_1(g - r).$$

In other words, we can test for the presence of reputational incentives by simply computing the difference between the before and after region fixed effects, and testing whether $(\alpha_j^a - \alpha_j^b)$ is statistically different across regions. Note that we are unable to say anything about the absolute level of r since it 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. In Table 5 we report the F -statistics for the null that $(\alpha_j^a - \alpha_j^b) = \text{constant}$ for three region definitions: city, 5-digit zip code, and census tract. 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 consistent with the reputational incentives hypothesis.

Our second test allows for the possibility that hygiene quality also depends on the interaction between reputational incentives and willingness-to-pay for hygiene quality and/or competition ($a_3 \neq 0$). As shown above, if $r_j = r$ then the post-grade card regional fixed effects are an affine transformation of the pre-grade card fixed effects. A naive approach to implementing the test would be to regress the estimated values of α_j^a (ie. $\hat{\alpha}_j^a$) on a constant and the estimated values of α_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 ($r_j \neq r$). 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 before- and after-grade card fixed effects, taking account of estimation error in the fixed effects. Define RSS_u as the sum of squared residuals from the estimated equation (9) plus the sum of squared residuals from the estimated equation (10).²² We then estimate a restricted specification, incorporating the restriction that α_j^a is a linear function of α_j^b :

$$\begin{aligned} s_{ijt} &= I_t^b (\alpha_j^b + \beta^b c_i + \gamma^b f_i + X_i \theta^b) \\ &\quad + (1 - I_t^b) (\kappa_1 + \kappa_2 \alpha_j^b + \beta^a c_i + \gamma^a f_i + X_i \theta^a) + \epsilon_{ijt}, \end{aligned}$$

where I^b is an indicator for “before grade cards”, and κ_1 and κ_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 (9).

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 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. Rather, we focus on the relative impact of grade cards across regions. In other words, if $\alpha_3 \neq 0$, then the prior test may lead us to incorrectly

²²Equivalently, we could combine equations (9) and (10) 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.

conclude there are regional differences in reputational incentives. Allowing for the possibility that $\alpha_3 \neq 0$ provides a more stringent test.

Conditional on the three 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.²³ Hence, this test is also strongly in favor of the reputational incentives hypothesis.

Figures 4 and 5 illustrate the statistical test in a more intuitive way. Before the grade cards, regional hygiene variation is due to a mixture of informational and non-informational differences across regions. Grade cards eliminate the informational differences but leave the non-informational differences unchanged. If there were informational differences across regions then the hygiene quality ranking of regions would have been significantly altered because of the grade cards. To confirm this intuition, in Figures 4a and 4b 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 score distribution they fall in.²⁴ 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 5 is a more rigorous version of the maps in Figures 4a and 4b. 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 5 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 5 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.

Indeed, Figure 5 is arguably the most compelling evidence of regional differences in the

²³Notice, in equation (8), if $\alpha_3 = 0$ then we should find that $\kappa_2 = 1$. For all three region definitions, the estimate of κ_2 is significantly different from one with 99% confidence. Hence, the correct test allows for $\alpha_3 \neq 0$, as we do here.

²⁴Note the cutoffs differ in the two maps. The maps depict relative, not absolute hygiene differences across zips.

degree of consumer learning. The fact that average region scores vary across regions, but are also stable over time when there is no change in the information environment, makes the analysis all the more convincing. Moreover, this is not driven by functional form assumptions.

The above framework can be extended to explore regional effects for chain restaurants. Specifically, consumers may learn about a restaurant's hygiene via chain affiliation or via local information environment. If the two types of learning are substitutes, we may expect the impact of chain affiliation on hygiene quality, relative to non-chain restaurants, is smaller in regions with a high degree of consumer learning (high r_j). Similarly, in regions with a high degree of consumer learning, there may be less free-riding on chain reputation by franchisees. To do so, we generalize equations (9) and (10) to allow for region-specific coefficients on the chain and franchising variables. In unreported tests we find no significant differences across regions in the effect of chain affiliation on reputational incentives. Nor do we find any significant regional differences in the degree of franchisee free-riding. These results suggest that chain affiliation and local consumer learning are not strong substitutes, although each of them generates some reputational incentives for restaurant hygiene.

5 Conclusion

Reputation mechanisms are thought to be important in numerous markets where consumers are uninformed about product quality or safety. If reputations are indeed an effective mechanism, then it suggests government intervention may be unnecessary. But testing this hypothesis is challenging for at least a couple of reasons, as described in the introduction, which may explain the paucity of papers that seek to do so. The dataset we study has several features that provide a unique opportunity to test for the presence of reputational incentives in a market setting. It is also an interesting market to study these issues because policymakers are debating whether to increase government regulation in order to improve food-safety.²⁵

We find that chain restaurants tend to have significantly better hygiene than independent restaurants because of the reputational effects from 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.²⁶ It would be interesting to analyze whether,

²⁵Following Los Angeles, a number of regions in the U.S. have debated whether the introduction of restaurant hygiene grade cards. For example, in April 2007 legislation has been proposed in New York state for the introduction of restaurant hygiene grade cards.

²⁶Waldfogel and Chen (2006) show a related finding—information, in the form of online price comparison sites,

in fact, the profits of non-chains relative to chains has increased. This may provide further verification of our conclusion that chain affiliation is a source of reputational incentives. However, the evidence we have presented on hygiene scores is a more direct indicator of this effect—it is hard to imagine a better proxy of unobserved effort than pre-grade card hygiene scores.

How large are chain-driven reputational effects on hygiene quality relative to the effect of posted hygiene grade cards? Combining the estimates from this paper along with the results from Jin and Leslie (2003), a back-of-the-envelope calculation suggests that hygiene improvements at chain restaurants due to reputational incentives are equal to about 70% of the average score improvement caused by grade cards at non-chain restaurants.²⁷ This seems large, but note that only 11% of restaurants are chain affiliated in Los Angeles in 1998.

Our analysis also verifies the common belief that franchisees may free-ride on the reputation of their chain. We believe our study is the first empirical verification of this hypothesis. The basic fact that supports this conclusion is quite striking—before grade cards franchised units tend to have lower hygiene scores than company-owned units of the same chain, and this difference is eliminated by the introduction of posted grade cards. The result is robust in regressions for a variety of specifications. The presence of free-riding reinforces the main result that chain affiliation is a source of reputational incentives.

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. The analysis indicates there are significant differences across regions in the degree of reputation formation for restaurants. Hence, some independent restaurants also provide good hygiene quality because of reputational incentives.

Our findings support the view that reputation 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. It is important to note that grade cards merely provide information to consumers. Moreover, since the DHS already performs the inspections the additional cost of providing the information is limited to the trivial cost of the cards themselves. There is no requirement for restaurants to incur additional hygiene costs. But of course restaurants typically choose to incur greater hygiene costs in response to consumers' demand for hygiene. Viewed in this way, it would be hard to argue that grade cards reduce social surplus. More generally, however, if there are additional costs associated with policy of collecting and/or communicating product information to consumers, then these costs should be weighed against the benefits to consumers. Nevertheless, the results of this paper indicate that,

reduces consumers' attraction to branded web retailers.

²⁷The detailed calculation is available from the authors upon request.

even when there is merit to the argument that reputational incentives operate as a market-based mechanism for mitigating informational problems, it may be socially inferior to a policy intervention.

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Table 1: Summary of Hygiene Scores, 1995 to 1998

	Number of restaurants	Number of inspections	Mean (std dev) score before grade cards	Mean (std dev) score after grade cards	
All restaurants	24,304	127,111	76.77 (14.72)	89.62 (7.68)	
Zagat restaurants	1,017	4,493	77.43 (14.10)	88.97 (7.54)	
All chain (cmpny-ownd)	1,655	9,797	82.94 (11.53)	92.70 (5.65)	
All chain (franchised)	977	5,635	81.84 (12.67)	92.87 (5.58)	
Burger King (cmpny-ownd)	64	353	86.98 (9.59)	94.04 (4.06)	
Burger King (franchised)	61	389	82.09 (11.29)	94.14 (4.38)	
El P. Loco (cmpny-ownd)	95	614	82.73 (11.35)	93.15 (4.34)	
El P. Loco (franchised)	24	175	77.82 (13.82)	92.17 (4.58)	
Jack in Box (cmpny-ownd)	109	669	83.63 (11.96)	94.82 (3.68)	
Jack in Box (franchised)	39	229	82.10 (12.43)	93.21 (5.38)	
KFC (cmpny-ownd)	85	566	81.49 (11.43)	90.83 (6.65)	
KFC (franchised)	49	314	78.12 (13.75)	92.04 (5.60)	
McDonalds (cmpny-ownd)	109	746	81.09 (12.16)	91.50 (5.91)	
McDonalds (franchised)	147	883	81.78 (11.78)	92.69 (5.22)	
Taco Bell (cmpny-ownd)	131	736	85.39 (10.49)	95.25 (4.04)	
Taco Bell (franchised)	42	238	85.44 (12.04)	95.58 (4.00)	
Burger restaurants	1,283	7,982	78.77 (14.13)	91.30 (5.32)	
Chicken restaurants	320	2,014	78.94 (12.78)	90.67 (6.26)	
Chinese restaurants	818	5,449	70.68 (16.51)	86.13 (8.78)	
Mexican restaurants	1,592	9,752	74.83 (15.19)	88.92 (8.08)	
Pizza restaurants	1,098	6,452	79.26 (12.83)	90.87 (6.54)	
0–30 seats	13,019	66,271	77.43 (14.39)	90.06 (7.54)	
31–60 seats	5,444	29,714	75.61 (14.97)	89.05 (7.77)	
61+ seats	5,841	31,126	76.46 (15.13)	89.29 (7.80)	
Lower income areas	12,130	60,993	74.55 (15.30)	89.78 (7.79)	
Higher income area	12,174	66,118	78.79 (13.87)	89.47 (7.56)	

Table 2: Variance Decomposition of Pre-Grade Card Hygiene Scores

	Number of Variables	Sum of Squared Residuals	R^2
Constant	10	17,402,286	0.0419
Restaurant characteristics	46	16,155,534	0.1106
City fixed effects	161	14,614,335	0.1954
Zip code fixed effects	325	13,298,310	0.2679
Restaurant fixed effects	22,211	6,826,502	0.6242
Number of observations	83,790		

All specifications also include a full set of year-qtr dummies.

Table 3: Determinants of Restaurant Hygiene Scores

	(1)			(2)			(3)			(4)		
	Coefficient	Std error										
Chain restaurant	3.7283	.8761***					4.6846	1.2806***	2.7024		.8806***	
Franchised chain restaurant	-.5772	.2789**	-1.8020	.6656***	-1.5693	.4601***			-.1556		.2739	
Number of chain units in LA	.0082	.0023***					-.0006	.0030	.0037		.0022*	
Fraction of US chain units in LA	5.1924	1.3542***					5.4510	1.7476***	2.6899		1.3219**	
Zagat guide	3.0692	.9238***	.5823	1.0496	3.2020	1.2748***			1.9246		.9102**	
Zagat guide food rating	-.0963	.0488**	-.0701	.0558	-.1103	-.0572*			-.0757		.0480	
Grade cards × chain							-3.9350	.5745***				
Grade cards × franchised							1.0948	.3924***				
Grade cards × num. of chain units							.0026	.0031				
Grade cards × frac. of chain units							-3.4512	1.8439***				
Mean post-grade card score									.4908	.0499***	.4857	.0078***
Number of observations	83,790				127,111				77,255			77,255
R^2	.2437				.6021				.1550			.2872
City fixed effects	Yes				Absorbed				No			Yes
Restaurant fixed effects	No				Yes				Yes			No
Restaurant characteristics	Yes				Yes				Yes			Yes
Grade cards × rest. chars	No				Yes				No			No
Pre-grade card observations	Yes				Yes				Yes			Yes
Post-grade cards observations	No				Yes				No			No

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 (***), 90 percent confidence level (*).

Table 4: Relating Pre-Grade Card Hygiene Scores to Proxies of Local Repeat Customers

	Estimated coefficient	Standard error
Zip hotel empymnt / Zip pop	0.3468	0.0783***
Zip recreation empymnt / Zip pop	-2.3559	0.4503***
Zip white collar empymnt / Zip pop	-0.0195	0.0102*
Zip retail empymnt / Zip pop	2.1805	0.4767***
Zip other empymnt / Zip pop	-0.3284	0.0784***
Mostly chain restaurants in zip	1.6512	0.1227***
Mostly independent restaurants in zip	-3.0807	0.1669***
Mostly company-owned chains in zip	1.4001	0.1079***
Mostly franchised chains in zip	-2.6339	0.1245***
Number of observations	82,950	
Adjusted R^2	.2015	

Unreported variables: year-quarter dummies, grading regime dummies, chain affiliation variables, Zagat status, number of seats, cuisine types, restaurant styles, alcohol license, DHS assigned risk assessment groups, and a variety of census-tract demographic variables including income, household size racial composition, the percent of married adults, and the percent age over 65.

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

Reputation prediction	City level	Zip level	Census-tract level
$(\alpha_j^A - \alpha_j^B) \neq constant$	37.72	31.54	6.83
$\alpha_j^A \neq \kappa_1 + \kappa_2 \alpha_j^B$	7.94	5.71	1.87

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 1: Basic model for chain affiliation as a source of reputational incentives

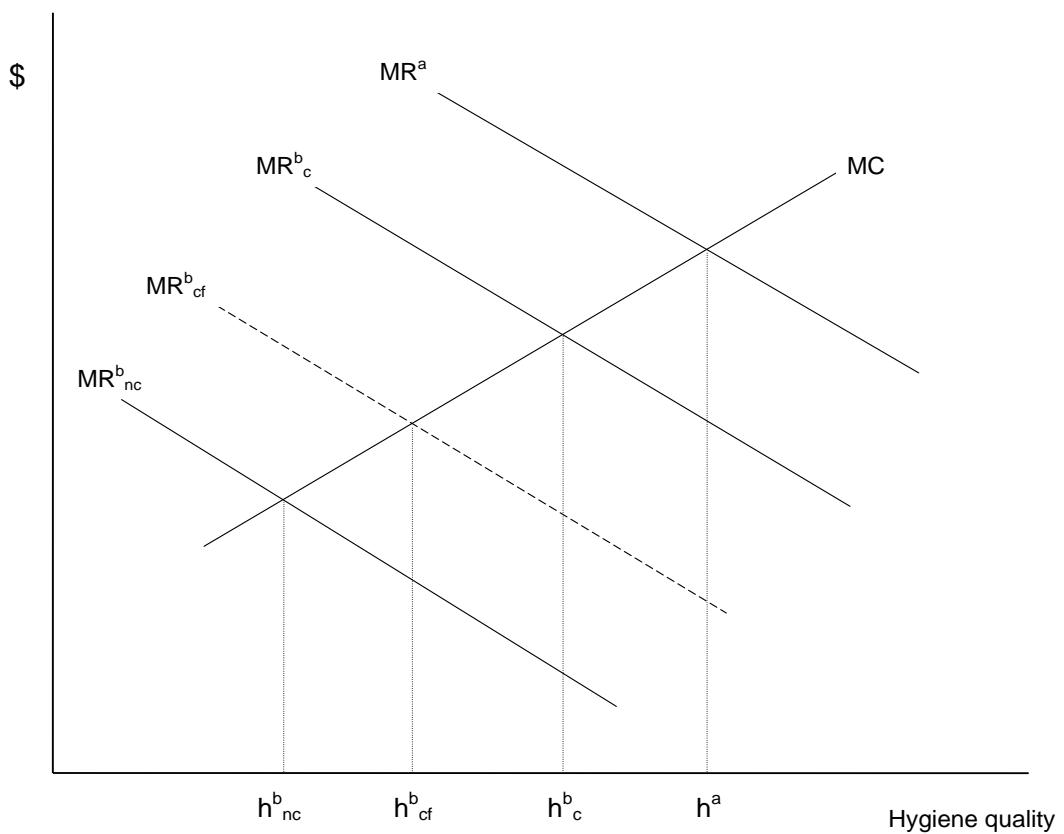


Figure 2: Extended model for chain affiliation as a source of reputational incentives

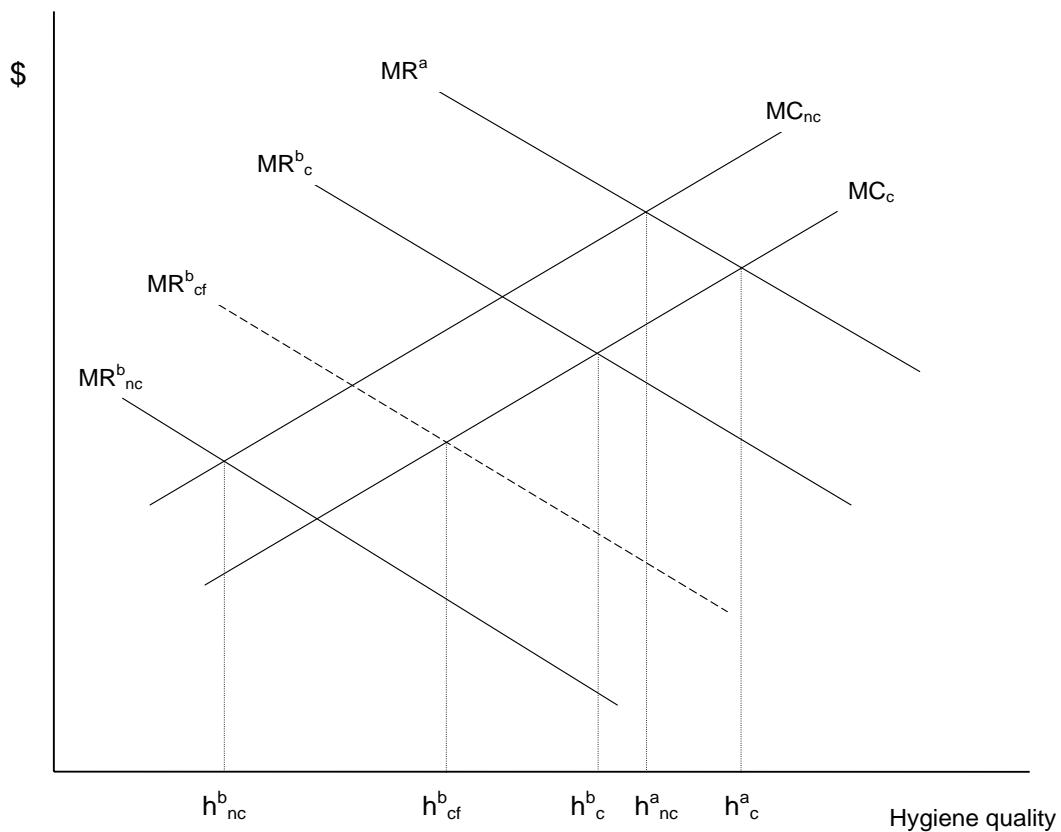


Figure 3: Extended model for chain affiliation as a source of reputational incentives

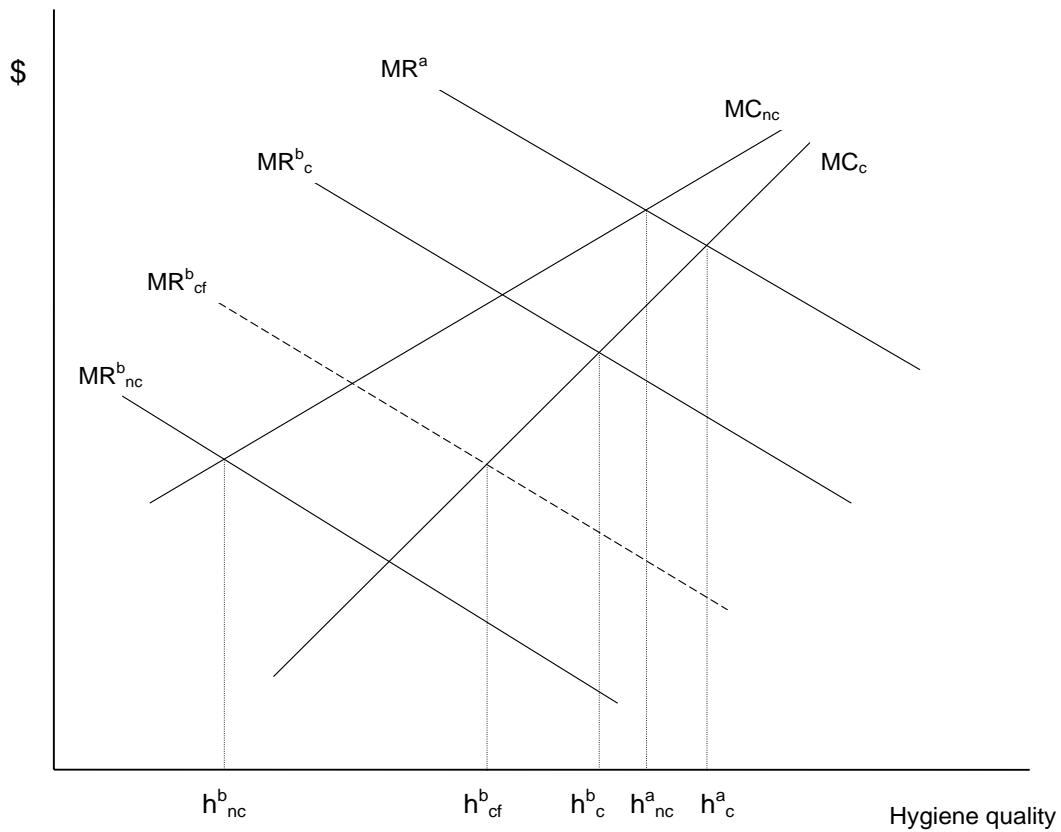


Figure 4a: Pre-grade card average hygiene scores in each five-digit zip in Los Angeles County

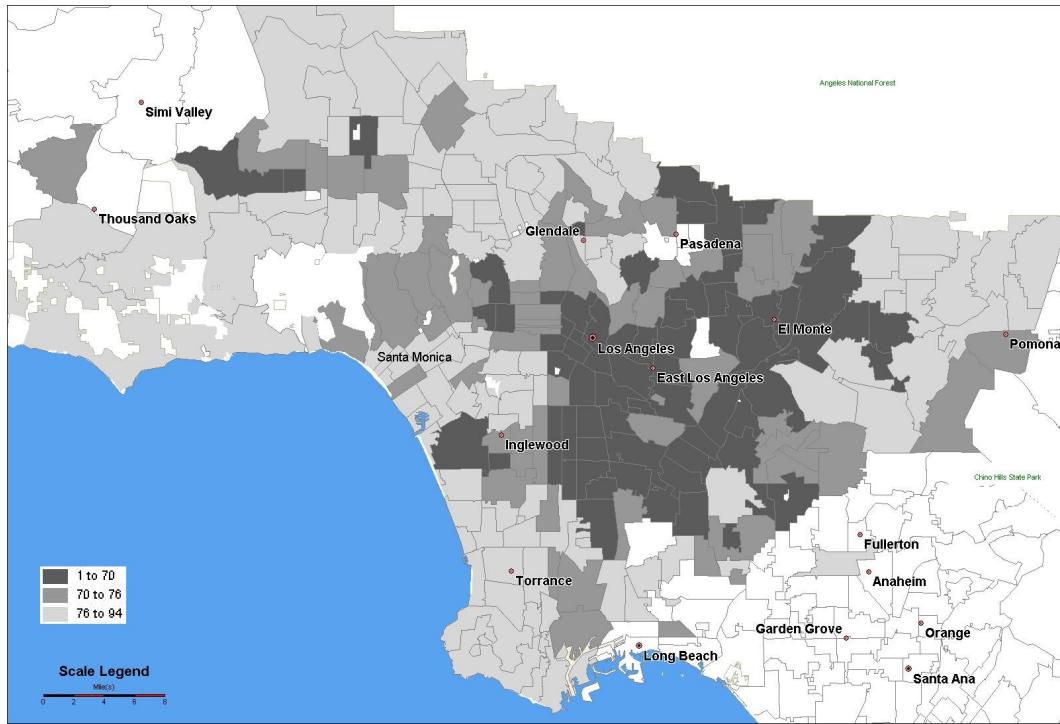


Figure 4b: Post-grade card average hygiene scores in each five-digit zip in Los Angeles County

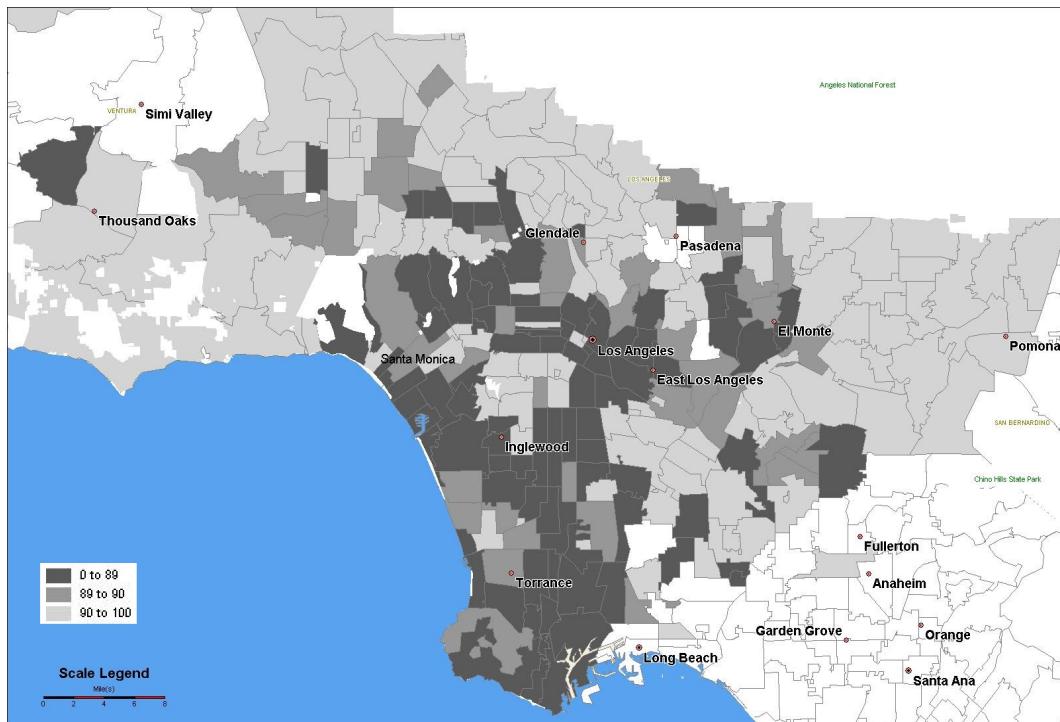


Figure 5: Mean hygiene scores for each city
in different time periods

