

THE EFFECTS OF DISCLOSURE REGULATION: EVIDENCE FROM RESTAURANTS

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Abstract

This study examines the effect of increased product information to consumers on firm behavior. In 1998, Los Angeles County introduced hygiene quality grade cards to be displayed in restaurant windows. This regulatory change provides exogenous variation in whether firms are subject to voluntary disclosure (of hygiene quality) without a standard-format, voluntary disclosure with a standard-format or mandatory disclosure. We analyze the effect of these three regimes on firms' actual quality choices. The results show that mandatory disclosure of hygiene grades causes restaurants to increase hygiene quality by an average of 5.3%. We are also able to test whether the effects of mandatory disclosure are different from the effects of voluntary disclosure with a standard format—a test of the unraveling hypothesis. The results reveal statistically but not economically significant differences. To verify that it is economic incentives driving firms to improve their quality and/or voluntarily disclose information about product quality, we also show that average restaurant revenue is higher due to the introduction of grade cards, and that the increase in revenue is higher for restaurants with better hygiene quality grades.

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1 Introduction

A theoretical literature identifies several ways through which information to consumers may impact the behavior of firms and the efficiency of markets.¹ With rare exception, the insight is typically that more information is better, which has lead economists to support policies that seek to increase the amount of information available to consumers.² Meanwhile existing empirical studies into the effects of information on firm behavior find small or negligible effects from increased information, casting doubt on the importance of such policies. We contend the failure is on the part of the empirical research, and is mainly due to the difficulty of observing exogenous variation in the amount of information available to consumers. In this study, we analyze a regulatory change that provides a context for evaluating the effects of increased product information on firms' product quality choices and disclosure decisions. In contrast to prior empirical studies into these issue, we find both statistically and economically significant increases in product quality due to an increase in information to consumers.

In December 1997 the Los Angeles County government passed an ordinance requiring restaurants to publicly display grade cards resulting from Department of Health Services (DHS) hygiene inspections. Restaurants had been subject to hygiene inspections for many years prior to the change, but the new regulation requires that the results of the inspections be revealed to consumers via a standard-format grade card to be prominently displayed in the window of each restaurant. However for the ordinance to apply to a restaurant, the city in which the restaurant is located must also vote to adopt the county ordinance. If a city does not adopt the ordinance, DHS inspectors nonetheless issue an official grade card, but it is at the discretion of the restaurant whether the grade card is displayed. We have obtained a new panel dataset that includes complete details of all health inspections in restaurants in Los Angeles county from January 1, 1996 to December 31, 1998. In addition, the California State Board of Equalization (SBE) granted us access to confidential quarterly sales tax data for these restaurants over the same period of time, from which we observe quarterly restaurant revenue.

The goals of this study are three-fold. First, we analyze the effect of a policy generating increased information provision on firms' hygiene quality choices. Second, we examine the effect of the policy on restaurant revenue. This is important because it verifies that observed changes

¹The prior literature is discussed in Section 2.

²Fishman and Hagerty (1998) cite the following examples of mandatory disclosure policies in the U.S.: food product labeling, disclosure of fuel mileage for new cars, presence (though not abatement) of lead-based paints in multi-family homes sold or rented, and certain financial information for publicly traded firms.

in quality are driven by economic incentives, and are not merely a spurious correlation or artifact of the regulation. Third, and perhaps most interesting of all, we examine whether mandatory disclosure yields different equilibrium outcomes than voluntary disclosure. We are able to shed light on these issues since our dataset includes exogenous variation in whether firms are subject to one of three regimes: (i) voluntary disclosure without a standard-format, (ii) voluntary disclosure with a standard-format, or (iii) mandatory disclosure with a standard-format.

Mandatory and voluntary disclosures are relevant for many consumer markets in which little information appears available to consumers. The likely failure of a market for information in such cases raises the possibility of benefits from government intervention. At the extreme, the government might require firms to disclose certain kinds of product information. However, such mandatory disclosure requirements may be difficult to implement (industries may lobby against such requirements), and may not be necessary to achieve the desired outcome. An alternative is for the government to facilitate voluntary information disclosure, by verifying information or providing a standard-format for disclosure, for example. Whether voluntary disclosure can perform as well as mandatory disclosure in obtaining favorable market outcomes is an important question for policy-makers.

The theoretical literature on disclosure of firms' private information highlights the possibility of "unraveling" equilibria, in which voluntary and mandatory disclosure yield the same outcome, as long as the information is verifiable with zero cost. Applied to our case, the logic is as follows. Since consumers believe the highest quality non-disclosing restaurants to be no different than the lowest quality non-disclosing restaurants, there are incentives for the highest quality restaurants to reveal their quality. The next highest quality restaurants are then the highest quality non-disclosing restaurants, so these firms then have an incentive to disclose their quality. This unraveling continues as long as the benefit of disclosure outweighs the cost. In our particular situation the cost for a restaurant to display their hygiene grade card is zero, regardless of whether it is mandatory or voluntary. The reason is that in either case the DHS performs inspections and provides the grade card immediately after. Following the logic of unraveling, the effects of the grade cards should be the same in cities with voluntary posting as in cities where posting is mandatory. We are able to test this hypothesis.

The unraveling argument, in its simplest form, takes hygiene quality as exogenous. However the stated purpose of the grade card ordinance is to increase hygiene quality at Los Angeles restaurants. Prior to the ordinance, no restaurants in the county exhibited or advertised any

information concerning their hygiene inspection score.³ This may have been due to the difficulty for consumers to verify and/or evaluate the relative merits of any such claim made by a restaurant. The grade cards, on the other hand, provide credible and comparable information about hygiene quality. Hence, we are able to analyze the effect of increased information provision on firms' choices of quality.

We find that hygiene quality has significantly increased due to the introduction of hygiene grade cards, regardless of whether disclosure is mandatory or voluntary. There are statistically significant differences in the effect on hygiene quality between mandatory and voluntary disclosure. We therefore reject the unraveling hypothesis, in its pure form. However, these differences are economically insignificant, which lends support to the unraveling story. When restaurants are not issued with hygiene quality grade cards, we find that hygiene quality has no effect on restaurant revenue. In contrast, hygiene grade cards give rise to economically and statistically significant effects of hygiene quality on revenue, confirming the role of economic incentives in firms' quality improvements due to the grade cards. The results of this study strongly support the case that mandatory disclosure is less important to achieving the benefits of increased product information, than firms having access to a low cost method of disclosing credible information using a standardized-format. Private institutions may be capable of providing such services to firms without any need for government involvement.

In Section 2 we survey the relevant prior literature. Los Angeles restaurant hygiene regulations are summarized in Section 3, where we also explain why it is reasonable to consider the alternative regulatory regimes as exogenous. The effects of mandatory and voluntary disclosure on hygiene quality are analyzed in Section 4 and the effects on revenue are analyzed in Section 5. Section 6 concludes the paper.

2 Prior Literature

Our study draws on previous developments in two branches of the literature concerning product information in consumer markets. On the one hand, there have been numerous studies into the relationship between changes in the provision of information to consumers, usually in the form of advertising, and firms' responses to this, usually in the form of altering prices. On the other hand, there have been a series of papers that analyze the incentives for firms to reveal their

³Based on conversations with DHS employees and press coverage surrounding the grade cards.

private information, in which the unraveling equilibria described above, is explored in greater depth. It is convenient for our purpose to briefly review each branch separately.

2.1 The Effect of Information on Firm Behavior

In the seminal contribution by Stigler (1961) a connection between information and market outcomes is proposed and a formal model is presented in which price advertising reduces search costs and thereby lowers the mean and variance of the price distribution. Subsequent researchers have refined the idea that search costs play an important role in determining market outcomes, including Nelson (1970) who considers the effect of consumers being uninformed about product quality instead of price which is more in line with our study.⁴ Beginning with Nelson (1974), a quite different role of product information has been put forward in which advertising is a signal of quality.⁵

Existing empirical studies into the effect of information on firm behavior can be divided into three categories: (i) studies that examine the effect of advertising on prices based upon cross-sectional data, (ii) studies that examine the effect of advertising on prices based upon panel data, and (iii) studies that examine the effects of information on outcomes other than prices.⁶ In the first of these groups is the classic study by Benham (1972) which examines the prices of eyeglasses in states that did and did not allow advertising. Prices are found to be lower and exhibit less dispersion in markets where advertising is allowed.⁷ Two prior studies examine panel data to identify the effect of advertising on prices. Devine and Marion (1979) performed an experiment in which they published comparative price information in local newspapers concerning supermarkets and found a small decrease in the mean and variance of prices. Milyo and Waldfogel (1999) analyze the effect of advertising on prices in liquor sales using a panel dataset with an exogenous change in advertising. They find insignificant decreases in prices due to advertising, as well as some evidence that advertising affects different stores differently.

⁴Other examples include Butters (1977) and Salop and Stiglitz (1977) who show that the presence of consumers facing different search costs may not lead to a lower mean and variance in the price distribution due to price advertising.

⁵See also Milgrom and Roberts (1986).

⁶There is also a literature that examines whether, and to what extent, consumers' are responsive to the increased provision of product information. For example, a number of studies examine the effects of product labeling regulations on consumer demand. Teisl and Roe (1998) survey the studies of labeling issues. The focus of our study is firm decision-making in the face of increased provision of information to consumers.

⁷There are numerous reasons, several of which are noted by Benham, why the analysis of cross-sectional data in this context may not identify a causal effect.

A couple of prior studies investigate the effects of information on outcomes other than prices. Kwoka (1984) undertakes a study of the effects of advertising on quality (and prices) of optometric services in a cross-section of geographic markets.⁸ It is found that quality is lower in advertising markets than in non-advertising markets (prices are also lower). In a study of child-care markets, Chipty and Witte (1998) analyze the effects of price and quality information provided by Resource and Referral agencies (R&Rs) on the distribution of prices and quality. Their analysis is based on cross-sectional data for geographic markets. In estimation, an observation is a market since the measure of information is a binary variable for whether there is an R&R in the market. Chipty and Witte find that (i) price dispersion for toddler care is lower in markets with R&Rs than without; (ii) there is no significant difference in price dispersion for pre-school and school-age children care in markets with R&Rs than without; and (iii) distributions of service quality (measured by staff/child ratios) are insignificantly different in areas with and without R&Rs.⁹

Let us summarize the existing empirical results regarding the effects of the increased provision of information on firm behavior. There remains uncertainty about the effect of advertising on the distribution of prices, but this could be due to the competing roles of advertising (reducing search costs versus signalling) and is clouded by the complication that advertising is a choice for firms. When information about product quality is provided by an independent institution there is no strong evidence that this has any effect on quality.

2.2 Information Disclosure Incentives

Beginning with the pioneering study of Akerlof (1970) economists have theorized about the incentives and problems for vertically (or quality) differentiated firms to reveal their private information to consumers. The notion of unraveling equilibria in settings with voluntary disclosure was initially put forward by Grossman (1981) and Milgrom (1981). Subsequent extensions to the theory include the effect of disclosure costs (Jovanovic, 1982), the effect of information acquisition costs (Farrell, 1986), the effect of some consumers being uninformed (Fishman and Hagerty, 1999) and the effect of competition (Jin, 2000b).

⁸Quality is measured by time spent in the examination.

⁹In another related study, but with a different focus, Dranove *et al* (2000) examine the effects of mandatory medical surgery report cards in certain states of the U.S. It is found that the report cards are welfare reducing due to the strong incentives for doctors to increase treatment of the relatively healthy and to not treat the very unhealthy in order to improve their report card.

We are aware of two prior empirical studies focusing on the specific issue of firms' disclosure incentives. The first is Mathios (2000) who studies fat content labeling of salad dressing. Prior to May, 1994, disclosure of fat content was voluntary and Mathios documents that about half the products displayed the fat content on the container, and that these were almost all the products with low fat content. However, there is significant variation in fat content for the non-disclosing firms, and on this basis it is concluded that unraveling is incomplete. In May, 1994, the Nutrition Labeling and Education Act came into force, which requires firms to include fat content on the label. This allows Mathios to compare product-level demand under voluntary disclosure (before May, 1994) with mandatory disclosure (after May, 1994). It is shown that previously unlabeled products generally suffer a decline in demand under mandatory disclosure. The second empirical study is by Jin (2000a) who examines the voluntary disclosure decisions of Health Maintenance Organizations (HMOs). Jin finds that competitive factors play a prominent role in explaining the variation in disclosure decisions by HMOs, while cost and demand variation is less important.

3 Summary of the Data

According to the Census Bureau's 1997 Economic Census, full-service restaurants and limited-service eating places employed almost 7 million people in the U.S., or roughly 5% of total employment. Total annual revenue for these firms was \$220 billion. In Los Angeles County the industry employed 207,000 people, with annual revenues of \$7.9 billion. The DHS randomly inspects all restaurants in Los Angeles county and our data contains every inspection from January 1, 1996, to December 31, 1998. The first column of Table 1 shows the number of restaurants that are subject to DHS inspections in each quarterly period (which is different from the number of inspections). During the period of our data the number of restaurants ranges between 14,506 and 20,086. The second column provides the average hygiene score for all inspections conducted in each quarter. A point to note is the stability of the average score around 75% for the first half of the period, followed by a dramatic rise to 90% in the second half.

The inspection data from the DHS is matched to sales tax data from the SBE. The matching process is imperfect which reduces the number of observations.¹⁰ Columns 3 and 4 of Table 1 show the number of restaurants the SBE successfully matches with the DHS data. After match-

¹⁰As there is no common numerical identifier that DHS and SBE have in their data, matching is done on the basis of establishment name and address. Matching fails in cases where no common address or name is found.

ing the DHS data is reduced by approximately 27%. From the matched data, we then eliminate restaurants for which the tax data are missing, which further reduces the sample by 22%. Hence all results reported in this paper are based on the sample of 13,539 restaurants. There are only minor differences in the average hygiene scores between the full sample and the reduced sample, as shown in Table 1, which gives us confidence that the selection is unbiased for our purposes.

The key feature of our data is the introduction of hygiene grade cards. We consider this to be an exogenous change in particular because the change in regulation was rapid and unanticipated. The timing of events is as follows:

- November 16–18, 1997 — over three consecutive evenings CBS 2 News on the Los Angeles based Channel 2000 aired a three-part report titled “Behind the Kitchen Door”. The report used hidden cameras to show viewers unsanitary restaurant kitchens.
- December 16, 1997 — in response, the Los Angeles County Board of Supervisors unanimously voted in favor of the grade card ordinance.
- January 16, 1998 — the ordinance came into effect at the county-level.

Incorporated cities within the county, however, are free to adopt the ordinance or not.¹¹ Unincorporated cities, and some incorporated cities, adopted the ordinance immediately, while others took longer, and a small number of cities have still not adopted as of June, 2000. Importantly, whether a restaurant is located in a city that adopts the ordinance or not, all restaurants are issued with a grade card at any inspection after January 16, 1998. For restaurants located in cities that have not adopted the ordinance, the restaurant has complete discretion whether the card is displayed or not.

Table 2 shows the extent of adoption on a quarterly basis during 1998, for the restaurants in our sample. Since it may take several months for a restaurant to receive its first inspection after January 16, 1998, Panels A and B distinguish between the number of restaurants in cities that have adopted the regulation, and the number of restaurants subject to each of the three mutually exclusive and exhaustive regimes. “Voluntary disclosure without standard-format” refers to restaurants who have not yet received an inspection after the grade cards are introduced. These restaurants have no grade card, so it is irrelevant whether their city has adopted the ordinance or not. “Voluntary disclosure with standard-format” applies to restaurants that have received a grade card (or equivalently, have been inspected at least once after January 16, 1998), but are located in a city that has not adopted the ordinance at that point in time. Finally, “mandatory

¹¹There are 88 incorporated cities in Los Angeles county.

disclosure” applies to restaurants that have been issued a grade card and are required to display it. We observe inspection dates and city adoption dates, hence the table is constructed by aggregating daily observations to the quarterly level.

As shown in Panel A of Table 2, for the first quarter of 1998, less than 5% of restaurants are located in cities that have adopted the use of grade cards. This number rises to 80% by the end of 1998. Panel B displays a more relevant summary of the frequency of the three policy regimes. In the first quarter of 1998, roughly 85% of restaurant-days have no disclosure possibility. This number rapidly falls to 4% in the fourth quarter. Also in the fourth quarter of 1998, notice that 34% of restaurant-days fall under voluntary standard-format disclosure, with the majority (62%) falling under mandatory disclosure. There is a potential question as to the endogeneity of which cities adopt the ordinance and which do not. The fact that many of the cities which did not initially adopt, eventually do adopt at some point in time, suggests it is more likely due to bureaucratic delays rather than endogenous decisions that causes this variation.

Beginning on January 16, 1998, at the end of an inspection each restaurant is issued a grade card: “A” (90–100%), “B” (80–89%), “C” (70–79%), or if the score is less than 70% the restaurant is issued a card that reports the actual score.¹² In cities that have adopted mandatory disclosure, the signs are required to be in clear view for customers. A restaurant is closed by the DHS if (i) two consecutive inspections result in a score below 60%, or (ii) if there is a severe hygiene problem (such as an infestation).

There have been a few changes in the inspection scoring criteria during our sample which we incorporate in the analysis below. Until July 1, 1997, the inspections included both an objective and a subjective element. The subjective aspect was the inclusion of an “establishment status score” which was one of excellent (zero points deducted), good (5 points), average (20 points), fair (30 points) or poor (40 points), and was intended to be the inspector’s overall evaluation of the hygiene status of the restaurant. Since July 1, 1997, the subjective component of the assessment has been removed and inspections are now objective in nature. Beginning with a score of 100, pre-specified points are deducted for each violation. For example, a food temperature violation results in a 5 point deduction, evidence of cockroaches results in a 3 point deduction, a functioning but unclean toilet results in a 2 point deduction, and improperly washed/sanitized eating utensils results in a 5 point deduction. A minor change in the inspection scoring was again made on March 18, 1998, to add in a small number of additional potential violations.

¹²We have placed a selection of photos of the grade cards in restaurant windows on the web to give an idea of what the consumer sees: www.econ.ucla.edu/pleslie/restaurants

Because this change is only two months after grade cards have begun to be issued, observed changes in hygiene scores in 1998 may be partly due to the introduction of grade cards, and partly due to the change in assessment criteria. In the analysis below, we attempt to distinguish the two effects by exploiting the two month window between the changes.

During the three years covered in our data the average number of inspections per restaurant per calendar year has changed from around 1.9 to over 2.1, while some restaurants are inspected more than four times per year. Over 85% of inspections are regular random inspections. However there are also complaint-initiated inspections and owner-initiated inspections, both of which are identified in the data.¹³

4 The Effect of Hygiene Grade Cards on Hygiene Quality

Restaurants offer products whose characteristics include quality, food type and geographic location. Quality itself involves many dimensions: food quality, service quality, and hygiene quality. In this study, we examine restaurants' hygiene quality. The stated goal of the grade cards was to increase hygiene quality levels in Los Angeles restaurants. In this section of the paper we examine to what extent this goal has been achieved. In so doing we answer the questions: (i) does the increased provision of information about quality cause an increase in quality standards, and (ii) does the effect on quality differ according to whether the increased provision of information is mandatory or voluntary?

Our measure of hygiene quality is the score that results from an inspection by the DHS. The hygiene assessment is very quantitative in nature so we consider this to be a reasonable measure of quality. However, this is only one measure of hygiene quality and, in particular, ignores any count of incidents of unhealthiness for restaurant patrons. There is some evidence that restaurants with A-grade hygiene receive fewer hygiene related complaints. Table 3 shows the proportion of restaurants for which there is at least one complaint to the DHS about hygiene quality, conditional on a particular quarter and hygiene grade. The table reveals that A-grade restaurants generally receive the fewest complaints, even before grade cards were introduced. For these reasons, we are confident that hygiene scores serve as a good measure of true hygiene

¹³The DHS will inspect a restaurant in response to a single customer complaint. The DHS introduced owner-initiated inspections in the last half of 1998 out of concern for the fact that a restaurant may be branded with a low grade for several months for violations that can be corrected in a short space of time. The DHS now allows each restaurant to request an inspection up to a maximum of once per year, for which they must pay the stated marginal cost of the inspection of \$161.

quality. The table also shows that, in 1998, restaurants subject to mandatory disclosure generally receive more complaints (conditional on hygiene grade) than restaurants subject to voluntary disclosure, which suggests that grade cards may have a positive effect on the probability of patrons' complaining.

Figure 1 shows the changing distribution of hygiene quality over time, also indicating the timing of the two assessment changes and the introduction of grade cards. Prior to July 1997 the distribution is stable with a median around 75. The assessment change in July 1997 results in an increase of about 10 points in the median, and reduced dispersion. In November 1997 the distribution shifts down, no doubt a response by inspectors to the television news story. The introduction of the grade cards are followed by two months of increasing hygiene before the second assessment change which is also followed by continued increases. By the end of 1998 the figure shows dramatically reduced dispersion relative to 1996, with approximately 70% of restaurants obtaining a score above 90%. The lower scores in November and December of 1997 perhaps give rise to a misleading impression that the grade cards caused larger improvements in hygiene than is right. Nevertheless, the figure also shows every quartile is higher in January 1998 (and beyond) than in July 1997 which is the month with the highest scores before the news story, suggesting a degree of improvement in true hygiene quality due to the grade cards. The assessment change in March 1998 is a relatively minor one, but we can not be certain the observed increases in hygiene scores in 1998 are not at least partially due to this. In the regression analysis we include dummy variables for each of the assessment changes. Finally, we note that in Figure 1 there is no apparent time trend or seasonality in hygiene quality.

The estimating equation of primary interest is

$$H_{it} = \alpha_i + \beta_1 N_{it} + \beta_2 M_{it} + \beta_3 V_{it} + \gamma_1 C_{1t} + \gamma_2 C_{2t} + \gamma_3 C_{3t} + \epsilon_{it}, \quad (1)$$

where H_{it} denotes the hygiene inspection score obtained by restaurant i at time t , N equals one if no grade card is issued for the inspection (this dummy is excluded in estimation), M equals one if it is mandatory to post a grade card for the inspection, V equals one if it is voluntary to post a grade card for the inspection, C_1 , C_2 and C_3 are dummies for the different inspection score criteria discussed above (C_1 is also excluded in estimation), the α , β and γ terms are coefficients to be estimated and ϵ is a residual. In addition to estimating equation (1), we estimate an equation in which the restaurant fixed-effects are replaced by observable restaurant characteristics.

The effects of mandatory and voluntary grade cards are identified from time-series variation

in firms being subject to the various informational regimes. We have already described why it is reasonable to consider the introduction of grade cards as an exogenous policy change. While each city within Los Angeles county decides whether to adopt the ordinance for mandatory disclosure, we argued this is also exogenous because almost all cities do eventually adopt at some time during 1998 and delays are bureaucratic in nature. To the extent that the timing of ordinance adoption may still be endogenous, we include restaurant fixed effects to control for time-invariant restaurant (as hence also city) characteristics which preclude some sources of endogeneity bias. Any remaining bias due to endogenous city adoption must therefore be due to time-varying city characteristics, which seems fairly unlikely.

Table 4 reports the results from OLS estimation of equation (1). All coefficients are highly significant and there is no substantial difference when observable restaurant characteristics or restaurant fixed effects are included, so we focus on the fixed effects results here. The coefficient on the Inspection Criteria II dummy reveals the change in assessment criteria in July of 1997, prior to the introduction of grade cards, caused hygiene scores to increase by an average of 7.97 points. Since the change in assessment was not trivial in this case, we presume this coefficient identifies a purely nominal change in scoring, with no change in the actual hygiene quality of restaurants.

The estimated effect from mandatory disclosure of hygiene grade cards is an average increase in hygiene quality of 4.40 points, or 5.3%. To emphasize the magnitude of the effect, this is equal to 0.4 of a standard deviation of the hygiene distribution.¹⁴ Therefore the increased provision of information about firm quality does indeed cause firms to increase quality levels. The estimated effect from voluntary disclosure of hygiene grade cards is an average increase in hygiene quality of 3.25 points, or 3.9%. The significance of the coefficient on the voluntary disclosure dummy provides empirical support for the claim that there is an incentive for firms' to voluntarily disclose their private information, and that firms are responsive to this. The estimate for the nominal effect on hygiene scores from changing to Inspection Criteria III in March of 1998, after the introduction of grade cards, is an average increase of 2.33 points.¹⁵

An important question is whether the coefficients on the mandatory and voluntary disclosure dummies are significantly different from each other? This is a test of the unraveling hypothesis.

¹⁴The standard deviation for the distribution of hygiene scores from inspections conducted between July 1, 1997, and January 15, 1998, was 11.29. As verification of the statistical significance, a simple test of the difference in means between the distribution of scores under Inspection Criteria II without grade cards, and Inspection Criteria II with mandatory grade cards, rejects equality with 99.99% confidence.

¹⁵To compute the net effect from changing to Inspection Criteria III, subtract the coefficient on Inspection Criteria II from the coefficient on Inspection Criteria III.

The Wald statistic for equality of the coefficients on the two disclosure dummies is 45.11, which strongly rejects the hypothesis that they are equal. We therefore reject the unraveling hypothesis, at least in its strongest form. But, while the coefficients are statistically different, the magnitude of the difference is only 1.13 points, which is small in comparison to the levels of these effects.¹⁶ The high degree of unraveling is also evident from Figure 2 which shows the distributions of hygiene quality under the three regimes of no grade cards, mandatory disclosure of grade cards and voluntary disclosure of grade cards. The hygiene distributions for mandatory disclosure and voluntary disclosure are remarkably similar to each other, and both are very different to the distribution when there are no grade cards. The evidence, therefore, supports a significant degree of unraveling taking place. The policy of mandatory posting of grade cards seems to make little difference to a policy of issuing grade cards and allowing firms the discretion of whether their grade card is displayed.

Figure 2 also reveals a spike in the hygiene distributions for both mandatory and voluntary disclosure at the score of 90.¹⁷ The distribution of hygiene under the no grade cards regime exhibits no such spike. There are two likely explanations for the spike. On the one hand, since grade cards do not distinguish between a low-A and a high-A score, there is no benefit for restaurants to improve hygiene beyond obtaining a score of 90. Consequently if restaurants face little uncertainty over the score they will obtain from an inspection and it is costly to improve hygiene, then we would expect to observe a spike in the hygiene distribution at 90. On the other hand, if restaurants' profits are harmed by obtaining a B-grade, inspectors may ignore a violation in order to help restaurants that are only a point or two below obtaining an A-grade.¹⁸ The former explanation is consistent with the grade cards having a positive effect on hygiene quality. The latter explanation would lead to an over-estimate of the effect from grade cards. Even if the spike at 90 is due to inspectors' discretion, this would not explain the increased frequency of restaurants obtaining hygiene scores above 92, say. While not shown in a table, we estimated a probit with random effects in which the dependent variable equals one if an inspection results in a score greater than 92. We find that mandatory disclosure of grade cards increases the probability of obtaining a score above 92 by 0.41.¹⁹

To check the robustness of the above estimated effects we considered a few variations on the

¹⁶The effect of mandatory disclosure is larger than the effect of voluntary disclosure. Given there is a difference, this is the direction we would expect.

¹⁷There are also spikes at the score of 80, but they are much smaller than the spike at 90.

¹⁸The DHS conducts random follow-up inspections as a check on the possibility of inspectors being bribed or manipulating scores, which would mitigate this behavior to some extent.

¹⁹The coefficient is statistically significant with 99% confidence. The probability of obtaining a score above 95 increases by 0.26 due to mandatory grade cards.

reported regression. First, we transformed the dependent variable using a logit function which bounds the predicted scores to lie between zero and 100.²⁰ There were no significant changes in the estimated effects. However the logit transformation did reveal statistically insignificant differences between the effects of mandatory and voluntary disclosure, providing further evidence of the high degree of unraveling. Second, we separately re-estimate after excluding (i) restaurants that appear to have exited at some during 1998—this can shed light on the extent to which hygiene improvements are obtained by improving incumbents or by a process of entry and exit); (ii) owner-initiated inspections; and (iii) complaint-initiated inspections. In each case the number of excluded observations is few and in each case the estimated coefficients did not change in any significant way. Finally, to investigate the possibility that the effects on hygiene quality from grade cards are gradual, perhaps even to such an extent that the full effects are not apparent by the end 1998, we also estimate the average effects of grade cards separately for each quarter period in 1998. While not shown in a table, we find that average effects, from both mandatory and voluntary disclosure, in the second quarter of 1998 are significantly higher than in the first quarter, and the effects in the third and fourth quarter are not significantly different from the second quarter. These results suggest the effects on hygiene from the grade cards are realized fairly rapidly.

The dataset includes information on the occurrence of specific hygiene violations at each inspection, which allows us to examine the effect of grade cards on the frequency of particular violations. Some aspects of hygiene quality, such as employee hand-washing, are based on human behavior and it is conceivable that employees may only act on their best behavior during an inspection.²¹ Grade cards could then be misleading to consumers and the effect of the increased provision of information on true hygiene quality would be less than we have estimated above. But some hygiene violations require changes to the building structure, such as adequate and approved ventilation in the cooking area. If we observe significant decreases in the incidence of violations related to the building structure as a result of the introduction of grade cards, then this would be evidence that the increased provision of information in this case does not merely cause transient improvements in hygiene quality.

Table 5 reports the results from OLS regressions in which the dependent variable is the number of points deducted for violations of a particular type in each inspection.²² In Panel A of

²⁰Specifically, we transform the score H using $\ln(H/(100 - H))$.

²¹Prior to grade cards, incentives were effectively zero, so that even temporary best behavior of employees did not occur.

²²A negative coefficient is interpreted as a decrease in the number of points deducted, or equivalently a decrease in the incidence of violations of that kind.

Table 5, we look at building structure violations, specifically the requirements of (i) lavatories in good repair, with hot and cold water available, adequate soap and towel dispenser, and a sufficient number of lavatories; (ii) adequate and approved ventilation in the cooking area and restrooms; (iii) clean walls and ceilings in good repair, easily cleanable and impervious to grease and moisture; and (iv) adequate lighting with shatterproof lights or light shields. As the table shows, we find there are significant reductions in the average number of points deducted for building structure violations because of the introduction of both mandatory and voluntary grade cards. This seems to be strong evidence that grade cards cause restaurants to make relatively long-lasting improvements in hygiene quality.

In Panel B of Table 5 we examine the number of points deducted for particular hygiene violations that we think are unobservable to a typical restaurant customer. Specifically, unobservable violations are all violations excluding those relating to insects, animal/fowl, utensils, premises, toilets, lighting, signs and permits, ventilation, floors, walls and ceilings. The results show significant decreases in the average number of points deducted for these violations due to the introduction of mandatory and voluntary grade cards. The finding of a significant decrease in unobservable (to the consumer) hygiene violations because of voluntary grade cards is compelling evidence of the high degree of unraveling taking place, since it concerns hygiene improvements which patrons are unlikely to notice. The main reason for incurring the cost of these changes is to voluntarily post an A-grade card in the window.

To summarize the main results of this section: we find (i) the policy of mandatory posting of hygiene grade cards causes restaurants to increase hygiene quality by more than 5%; (ii) the effect on hygiene quality from a policy of voluntary posting of hygiene grade cards is statistically but not economically different from the effect of mandatory posting; and (iii) the introduction of grade cards caused restaurants to improve the physical structure of buildings, indicating hygiene quality improvements of a relatively long-lasting nature.

5 The Effect of Hygiene Grade Cards on Revenue

In the preceding section we showed that the increased provision of hygiene quality information causes an increase in the average hygiene quality of restaurants, and that this is true whether disclosure of the information by restaurants is voluntary or mandatory. A concern might be that the increased hygiene scores are the result of some unobserved change in inspectors' behavior, or perhaps driven by restaurant owners/managers pride, rather than economic incentives. By examining the effect of grade cards on revenue, we may verify that demand is responsive to hygiene quality and the increased provision of information. This is a necessary condition if observed increases in quality are motivated by profit maximization. A finding of significant revenue effects would also strengthen our belief that the true data generating process resembles the theories which emphasize firms' incentive to reveal quality information. Lastly, it is inherently interesting to quantify the magnitude of consumer responsiveness to the increase in information in this particular case.

The finding in the previous section, that grade cards cause a decrease in the likelihood of building structure violations, already suggests the presence of economic incentives, since these are likely to be relatively costly improvements for restaurants to make. Some additional evidence of economic incentives comes from the extent of owner-initiated inspections. Of the 446 owner-initiated inspections, 70 were for restaurants in cities with voluntary disclosure. For owner-initiated inspections, hygiene scores increase by an average of 12.02 points above the score from the previous inspection. One interpretation is that restaurants expect an improvement in their score upon re-inspection, allowing them to post a high grade, which causes their profit to be higher by an amount exceeding the cost of the inspection (\$161).

A problem arises when analyzing the effects on revenue because the revenue data is quarterly, while inspections occur on a specific date within a quarter. Hence, in any given quarter in 1998, a restaurant may fall under multiple policy regimes. For example, on May 1 a restaurant may receive its first inspection since the grade cards were first introduced in January, then on June 1 the city in which the restaurant is located decides to adopt the county ordinance. In this case, the disclosure dummies take on values between zero and 1, reflecting the proportion of time during that quarter that each regime applied. A different problem arises when a restaurant starts a quarter with a score of 75%, say, is then inspected during the quarter and receives a score of 95%, say. In such cases we assign the days-weighted average score to the restaurant for that quarter, and determine a grade for that quarter based on the weighted average score. In

each of these examples, we effectively assume that revenue is uniformly distributed over each quarter.

To analyze the effect of the increased information on restaurant’s revenue we estimate the following equation for the log of revenue, $\ln(R_{it})$, obtained by restaurant i in quarter t :

$$\ln(R_{it}) = \alpha_i + \tau_t + \sum_j \beta_j H_{ijt} + \sum_k \gamma_k G_{ikt} + \sum_j \sum_k \delta_{jk} H_{ijt} G_{ikt} + \epsilon_{it}, \quad (2)$$

where

$$\begin{aligned} H_{it} &= \{H_{i1t}, \dots, H_{i4t}\} \equiv \{A_{it}, B_{it}, C_{it}, D_{it}\}, \quad \text{and} \\ G_{it} &= \{G_{i1t}, \dots, G_{i3t}\} \equiv \{N_{it}, M_{it}, V_{it}\}. \end{aligned}$$

The variables for the disclosure regimes of no grade cards (N), mandatory disclosure (M) and voluntary disclosure (V) are no longer dummy variables equal to either zero or one. Instead, because we aggregate to the quarterly level, these variables take on continuous values between zero and one. The variables in H are for hygiene grades (eg. A for A-grade), where D corresponds to all scores below 70, and also take on continuous values between zero and one. In the estimation we exclude the variables A and N due to perfect collinearity. As with the hygiene regressions, we estimate equation (2) with and without fixed-effects (α_i), and all regressions includes a full set of quarterly dummies (τ_t). We also estimate a simpler version of equation (2) by excluding the grade card variables and interaction terms.

An advantage the revenue analysis has over the hygiene quality analysis is that identification comes from both cross-sectional as well as time-series variation. Since we observe restaurant revenue each quarter, regardless of whether an inspection takes place, some restaurants have grade cards (with either mandatory or voluntary disclosure) and some restaurants have no grade card, just as before the grade cards began to be implemented. Since the DHS ensures the timing of inspections is random, both the cross-sectional and the time-series variation in disclosure regimes is exogenous.²³

Table 6 reports OLS estimates for the various revenue regressions. Panel A of Table 6 presents the effects on average restaurant revenue from the introduction of grade cards, without conditioning on particular grades (as in Panel B). The estimated coefficients are significantly different from zero only when restaurant fixed effects are used, so we focus on the estimates with fixed effects. Since the regressions include a full set of quarterly dummies, the primary

²³We already described above why it is reasonable to consider mandatory and voluntary disclosure as exogenous policy changes.

source of identification of these effects is from cross-sectional variation in whether restaurants are subject to disclosure without a standard-format (no grade cards), mandatory or voluntary disclosure of grade cards. The estimates reveal statistically and economically significant increases in average restaurant revenue, because of the introduction of grade cards. Specifically, the policy of mandatory disclosure of hygiene grade cards causes average restaurant revenue to increase by 4.1%, relative to average revenue in the absence of grade cards. The effect from voluntary disclosure is smaller at 1.6%. An explanation of these results is that grade cards cause an increase in aggregate demand for restaurants.²⁴ Of course higher revenue does not imply higher profit, and since there are costs to increasing hygiene quality, the effect on profit is uncertain.

In Panel B of Table 6 we show the effects on revenue for restaurants with different hygiene grades. Note that, even though hygiene scores (and hence grades) endogenously increased, this does not give rise to an endogeneity problem in the sense of biasing the estimated coefficients, because we also include as regressors the policy-regime dummies which cause the hygiene changes.²⁵ The regression with fixed effects reveals the intuitively appealing result that hygiene grades have no significant effect on revenue prior to the introduction of grade cards. The estimates from the regression without fixed effects have many similar features to the results with fixed effects, differing mainly in magnitudes. We therefore again focus attention on the results from the regression with fixed effects.

The estimated coefficient on the mandatory disclosure dummy implies the causal effect of mandatory posting of grade cards for an A-grade restaurant is a 6.1% increase in revenue compared to before the introduction of grade cards. Since average annual revenue for restaurants in our sample in 1997 is roughly \$260,000, the absolute magnitude of the effect is an increase of about \$16,000 in annual revenue. Revenue for B-grade restaurants increases by about 1.2% due to the introduction of mandatory grade cards, or 4.87% less than the effect for A-grade restaurants. For C-grade restaurants under mandatory disclosure, the net effect is approximately zero. And for restaurants with a grade below C, revenue falls by about 1.5% because of the mandatory posting of cards, though the coefficient is insignificantly different from zero. These results confirm the presence of economic incentives underlying the observed increases in hygiene quality.²⁶

²⁴An alternative explanation is that grade cards have caused some restaurants to shut down, leading to less intense price competition and higher revenue for the remaining firms. In future research we intend analyzing the effect of grade cards on entry/exit of restaurants.

²⁵In other words, the assumption that hygiene grades are uncorrelated with the residual is valid.

²⁶That the estimated effects can be ranked in this intuitive order adds to the credibility of the findings.

The effect of voluntary disclosure for A-grade restaurants is estimated to be an increase in revenue of 1.7%. This is less than a third of the effect under mandatory disclosure, but it does reveal an economic gain from disclosure for restaurants with high quality hygiene. The effects of voluntary disclosure for B-grade and C-grade restaurants are insignificantly different from zero, and the effect of voluntary disclosure for restaurants with a grade below C is a highly significant decrease in revenue of 4.67% from before the introduction of grade cards.

The inclusion of restaurant fixed effects allow us to control for time-invariant differences between restaurants. However, there may exist time-varying differences that are correlated with hygiene grades. To account for this possibility we repeated the regressions in Table 6 with the addition of lagged dependent variables. There were no significant changes in the estimated revenue effects. Another possible concern is that the timing of restaurant inspections are endogenous (ie. restaurants with the most to gain are the first to be inspected under the new regime). To address this issue, we repeated the regression in Panel B of Table 6 separately for each risk category of restaurants, where we know there to be exogenous variation in the frequency of inspections.²⁷ While not reported, we found the estimated effects in each case have the same relative signs and relative magnitudes, differing only in absolute magnitudes. We therefore conclude the possibility of endogenous timing of inspections is unlikely to be a source of bias for the estimates reported in Table 6.

Why are the effects on revenue from voluntary disclosure so much smaller in magnitude than the effects from mandatory disclosure? The reason may be that the details of the regulatory change were not well explained to the residents of Los Angeles county. Media coverage at the time the grade cards were introduced emphasized the mandatory disclosure requirement, without explaining that for many cities, disclosure was in fact voluntary. Restaurants located in cities with voluntary posting were able to take advantage of the misconception that the absence of a posted grade card must be because the restaurant has not yet been inspected since the grade cards were introduced. Hence, restaurants obtaining a B-grade may choose not to post the grade, and consumers incorrectly believe the restaurant is likely to be of A-grade standard. This behavior mitigates the benefits from obtaining an A-grade, and eliminates the effects on revenue for B-grade and C-grade restaurants.

²⁷As mentioned above, the DHS assigns a risk assessment to each restaurant, which effects the frequency of inspections.

6 Conclusion

In this study we analyze the effects of a policy that increases the provision of information to consumers. Using panel data, with a large number of observations by the standards of other empirical studies into these issues, we estimate the causal effects of a mandatory increase in the provision of information about restaurant hygiene quality to consumers, on restaurants' choices of hygiene quality and their revenue. A unique aspect of the policy change arises by virtue of the fact that some cities within Los Angeles county do not immediately adopt the county ordinance of mandatory disclosure. In these cities, restaurants undergo the exact same inspections and are issued the exact same grade cards, but the restaurants decide whether to display the resulting grade in their window.

Our dataset provides an appealing setting in which to examine the empirical validity of the unraveling hypothesis. There is no cost to the firm of acquiring the information, there is no cost of disclosing the information, the information is verified by the government, consumers incur no cost in receiving the information, the information is readily understandable by consumers, and the information concerns an important vertical product attribute. We find statistically significant differences between mandatory and voluntary disclosure with respect to the effects on hygiene quality and also revenue. We therefore reject the unraveling hypothesis, at least in its strong form. However we do find strong evidence in support of partial unraveling. Voluntary disclosure of grade cards does cause an increase in hygiene quality, and causes revenue to increase. It is possible the effects from voluntary disclosure would be greater if consumers were better informed about the voluntary nature of disclosure in those cities. Overall, these findings should encourage policy-makers or private institutions to facilitate voluntary disclosure of verifiable product information in consumer-product markets.

The National Restaurant Association has argued against the use of hygiene grade cards, claiming that the scoring is overly simplistic, subjective, and may give consumers a false sense of security. This may still be true, but our analysis suggests grade cards play a positive role. We have uncovered evidence that restaurants make long-lasting improvements to their hygiene quality because of the grade cards, so consumers sense of security cannot be entirely false. Furthermore, we find compelling evidence that grade cards may cause an increase in aggregate demand for restaurants, which raises the possibility that restaurants as well as consumers are benefiting from the hygiene grade cards.

Our finding of a high degree of unraveling, and the associated increase in restaurant revenue due to the introduction of grade cards, leads us to further wonder why restaurants did not disclose the results of their hygiene inspections prior to the grade cards. Why would a restaurant manager not create their own poster clearly showing their latest hygiene score, say, and then display this in the restaurant window?²⁸ The answer, apparently, is that it is important there exists a standardized poster format available for all restaurants to display. It seems striking that the provision of a standardized format for disclosure would be sufficient to change the equilibrium from zero disclosure, to essentially full disclosure.²⁹

The insights of this study lend strong support to the case for introducing restaurant grade cards in other regions. Furthermore, at least qualitatively, our results may also be extrapolated to other industries where quality inspections of one kind or another already take place, and the results of these inspections are not readily available to the public. For firms more generally, our results indicate there may be significant benefits from being able to provide credible information about product quality. While the costs of obtaining and conveying this information are likely to vary substantially across industries, there is reason to believe the benefits greatly outweigh the costs at least in the case of restaurants. The DHS states the marginal cost of a hygiene inspection to be \$161, and we estimate the average increase in annual revenue due to posting an A-grade (which most restaurants obtain) to be around \$16,000. We expect the costs of obtaining and maintaining A-grade hygiene quality in a typical restaurant are substantially less than the increase in revenue.

²⁸We presume restaurants would be honest about their score since customers may ask to see the formal inspection results.

²⁹See Easterbrook and Fischel (1984) for a discussion of these issues. A remaining puzzle is why a private third party did not create a standardized format before grade cards were introduced.

Bibliography

- Akerlof, G.A. (1970): "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics*, 84(3), 488–500.
- Benham, L. (1972): "The Effect of Advertising on Prices of Eyeglasses," *Journal of Law and Economics*, 15(2), 337–52.
- Butters, G.R. (1977): "Equilibrium Distributions of Sales and Advertising Prices," *Review of Economic Studies*, 44(3), 465–91.
- Chipty, T. and A.D. Witte (1998): "Effects of Information Provision in a Vertically Differentiated Market," *NBER Working Paper*, #6493.
- Devine, D.G. and B.W. Marion (1979): "The Influence of Consumer Price Information on Retail Pricing and Consumer Behavior," *American Journal of Agricultural Economics*, 61(2), 228–37.
- Dranove, D., D. Kessler, M. McClellan and M. Satterthwaite (2000): "Is More Information Better? The Effects of 'Report Cards' on Health Care Providers," *Mimeo*.
- Easterbrook, F.H. and D.R. Fischel (1984): "Mandatory Disclosure and the Protection of Investors," *Virginia Law Review*, 70, 669–715.
- Farrell, J. (1986): "Voluntary Disclosure: Robustness of the Unraveling Results and Comments on Its Importance," in R. Greison (ed.) *Antitrust and Regulation*, Lexington Books.
- Fishman, M.J. and K.M. Hagerty (1998): "Mandatory Disclosure," in P. Newman (ed.), *The New Palgrave Dictionary of Economics and the Law*, Macmillan Press, London.
- Fishman, M.J. and K.M. Hagerty (1999): "Mandatory vs. Voluntary Disclosure in Markets with Informed and Uninformed Customers," *Mimeo*, Northwestern University.
- Grossman, S.J. (1981): "The Informational Role of Warranties and Private Disclosure about Product Quality," *Journal of Law and Economics*, 24, 461–489.
- Jin, G. (2000a): "Competition and Disclosure Incentives: An Empirical Study of HMOs," *Mimeo*.
- Jin, G. (2000b): "Detecting the Impact of Competition on Disclosure Incentives," *Mimeo*.
- Jovanovic, B. (1982): "Truthful Disclosure of Information," *Bell Journal of Economics*, 13, 36–44.
- Kwoka, J.E. (1984): "Advertising and the Price and Quality of Optometric Services," *American Economic Review*, 74(1), 211–16.

- Mathios, A.D. (2000): "The Impact of Mandatory Disclosure Laws on Product Choices: An Analysis of the Salad Dressing Market," *Journal of Law and Economics*, 43(2), 651–78.
- Milgrom, P. (1981): "Good News and Bad News: Representation Theorems and Applications," *Bell Journal of Economics*, 12, 380–91.
- Milgrom, P. and J. Roberts (1986): "Price and Advertising Signals of Product Quality," *Journal of Political Economy*, 94(4), 796–821.
- Milyo, J. and J. Waldfogel (1999): "The Effect of Price Advertising on Prices: Evidence in the Wake of 44 Liquormart," *American Economic Review*, 89(5), 1081–1096.
- Nelson, P. (1970): "Information and Consumer Behavior," *Journal of Political Economy*, 78(2), 311–329.
- Salop, S.C. and J.E. Stiglitz (1977): "Bargains and Ripoffs: A Model of Monopolistically Competitive Price Dispersion," *Review of Economic Studies*, 44(3), 493–510.
- Stigler, G.J. (1961): "The Economics of Information," *Journal of Political Economy*, 69(3), 213–25.
- Teisl, M.F. and B. Roe (1998): "The Economics of Labeling: An Overview of Issues for Health and Environmental Disclosure," *Agricultural and Resource Economics Review*, 27(2), 140–50.

Table 1: Sample of Restaurants

Quarter	DHS Definition ¹			SBE Definition ²			Our Sample ³		
	No. Restaurants	Ave. Hygiene Score ⁴	No. Restaurants	Ave. Hygiene Score	No. Restaurants	Ave. Hygiene Score	No. Restaurants	Ave. Hygiene Score	No. Restaurants
1996 Q1	14506	75.62	11913	75.02	9645	75.40			
Q2	16451	75.37	12814	74.67	9958	74.97			
Q3	17789	75.03	13073	74.45	10051	74.84			
Q4	18456	75.27	13439	74.73	10156	74.95			
1997 Q1	18880	75.81	13515	75.35	10195	75.75			
Q2	19289	75.31	13549	74.56	10178	74.96			
Q3	19375	83.99	13485	83.34	10124	83.63			
Q4	19772	81.82	13358	81.04	10049	81.27			
1998 Q1	19927	86.69	13322	86.10	10123	86.44			
Q2	20086	90.26	13310	89.65	10235	89.93			
Q3	19361	89.85	12861	89.27	10219	89.56			
Q4	19864	90.30	12058	89.83	9880	90.01			
Total	23841	81.22	17276	80.50	13539	80.86			

1. In the DHS sample, a restaurant is defined as a physical location serving food other than pre-packaged items. A restaurant is counted in a particular quarter if it is inspected during that quarter, or if it was inspected both before and after the quarter.
2. The SBE sample is derived from successful matches of the DHS inspection data with the SBE tax data.
3. Our sample includes all restaurants for which the DHS data is matched with the SBE data, and for which we observe continuously reported tax payments between the first and last payments of each restaurant.
4. Quarterly average hygiene scores are calculated using all inspections conducted on restaurants in the relevant sample during that quarter. Not all restaurants are inspected every quarter.

Table 2: Timing of Mandatory Grade Card Ordinance

Panel A: Number of restaurants located in cities with or without the ordinance					
Quarter	Total Restaurants	Ordinance Not Adopted		Ordinance Adopted	
		No. Restaurants	% of Restaurants	No. Restaurants	% of Restaurants
1998 Q1	10123	9623	0.95	500	0.05
Q2	10235	3806	0.37	6429	0.65
Q3	10219	2972	0.29	7247	0.75
Q4	9880	2009	0.20	7871	0.80

Panel B: Disclosure status of restaurants ¹					
Quarter	% of Restaurant Days under Regime I:		% of Restaurant Days under Regime II:		% of Restaurant Days under Regime III: <i>Mandatory Disclosure</i>
	<i>Without Standard-Format</i>	<i>Voluntary Disclosure</i>	<i>Voluntary Disclosure</i>	<i>With Standard-Format</i>	
1998 Q1	84.64		15.04		0.32
Q2	40.77		43.21		16.02
Q3	15.58		41.28		43.14
Q4	4.04		34.28		61.68

1. Every restaurant receives an official grade card following inspections conducted after Jan. 16, 1998. However the restaurant is only required to post the grade card if it is located in a city which has adopted the ordinance. Restaurants not yet inspected after Jan. 16, 1998, fall under Regime I.

Table 3: Hygiene Grades and Consumer Complaints about Hygiene Quality

	Year	A grade	B grade	C grade	D grade	Total
	1996	0.0196	0.0408	0.0286	0.0396	0.0257
	1997	0.0232	0.0448	0.0280	0.0351	0.0295
	1998	0.0318	0.0529	0.0498	0.0408	0.0406
Mandatory Disclosure, 1998		0.0358	0.0560	0.0685	0.1154	0.0433
Voluntary Disclosure, 1998		0.0242	0.0350	0.0342	0.0126	0.0275

Notes:

An entry in the table is the average (over quarters in that year) number of restaurants with that grade that were inspected at least once due to a customer complaint, divided by the number of restaurants with that grade in the quarter.

Each restaurants' quarterly grade is based on a weighted average of hygiene scores applicable to each restaurant for that quarter.

For 1998 we also distinguish between restaurants with no grade card (ie. not yet inspected after the grade card ordinance takes effect), restaurants issued with a grade card and mandatory disclosure, and restaurants with a grade and voluntary disclosure. The row for 1998 on its own is for all restaurants, regardless of disclosure regime.

Table 4: The Effects of Grade Cards and Disclosure Regulation on Hygiene Scores

	Without Fixed Effects ¹		With Fixed Effects	
	Coefficient	Std. Error	Coefficient	Std. Error
Mandatory Disclosure	4.9459	0.2712***	4.4002	0.2622***
Voluntary Disclosure ²	4.0598	0.2102***	3.2542	0.2028***
Inspection Criteria II ³	7.7192	0.1261***	8.0876	0.1192***
Inspection Criteria III ⁴	9.9826	0.2573***	10.4139	0.2489***
Observations	69,975			
No. Restaurants	13,539			

1. In the regression without fixed effects, while not reported, we also include the following restaurant characteristics: food type, food style, seating capacity, liquor license dummy, DHS risk assessment, and city dummies. Stars denote significance levels: 99 percent confidence level (***), 95 percent confidence level (**) and 90 percent confidence level (*).
2. The voluntary disclosure dummy is for voluntary verifiable disclosure (ie. grade cards are issued but posting is discretionary). The excluded dummy is for voluntary non-verifiable disclosure (ie. prior to the introduction of grade cards).
3. Inspection Criteria II Dummy is for inspections carried out between 7/1/1997 and 3/18/1998. See text for further details.
4. Inspection Criteria III Dummy is for inspections carried after 3/18/1998. See text for further details.

Table 5: Incidence of Groups of Violations

Panel A: Building Structure Violations ¹				
	Without Fixed Effects		With Fixed Effects	
	Coefficient	Std. Error	Coefficient	Std. Error
Mandatory Disclosure	-0.5252	0.0576***	-0.3812	0.0586***
Voluntary Disclosure ³	-0.5424	0.0447***	-0.3873	0.0453***
Inspection Criteria II ⁴	0.2355	0.0268***	0.1928	0.0266***
Inspection Criteria III ⁵	0.0260	0.0547	-0.0734	0.0556***
Observations	69,975			
No. Restaurants	13,539			

Panel B: Violations Unobservable to Consumers ²				
	Without Fixed Effects		With Fixed Effects	
	Coefficient	Std. Error	Coefficient	Std. Error
Mandatory Disclosure	-2.4458	0.2298***	-1.9798	0.2297***
Voluntary Disclosure ³	-2.9392	0.1781***	-2.4122	0.1777***
Inspection Criteria II ⁴	-0.0285	0.1068	-0.3290	0.1044***
Inspection Criteria III ⁵	-2.7678	0.2180***	-3.1736	0.2181***
Observations	69,975			
No. Restaurants	13,539			

1. The dependent variable is the number of points deducted because of building structure violations in an inspection. Building structure violations concern lavatories, ventilation, walls/ceiling, or lighting.
2. The dependent variable is the number of points deducted because of violations that are unobservable to consumers. Unobservable violations are all violations excluding those relating to insects, animal/fowl, utensils, premises, toilets, lighting, signs and permits, ventilation, floors, walls and ceilings.
3. Voluntary Disclosure is a dummy variable for voluntary verifiable disclosure (grade cards are issued but posting is discretionary). The excluded dummy is for voluntary non-verifiable disclosure (ie. prior to the introduction of grade cards).
4. Inspection Criteria II is a dummy variable for inspections carried out between 7/1/1997 and 3/18/1998. See text for further details.
5. Inspection Criteria III is a dummy variable for inspections carried after 3/18/1998. See text for further details.

In the regression without fixed effects, while not reported, we also include the following restaurant characteristics: food type, food style, seating capacity, liquor license dummy, DHS risk assessment, and city dummies. Stars denote significance levels: 99 percent confidence level (***), 95 percent confidence level (**) and 90 percent confidence level (*).

Table 6: Effects of Grade Cards and Disclosure Regulation
on ln(Quarterly Restaurant Revenue)

Panel A: Unconditional Effects				
	Without Fixed Effects		With Fixed Effects	
	Coefficient	Std. Error	Coefficient	Std. Error
Mandatory Disclosure	0.0257	0.0272	0.0415	0.0078***
Voluntary Disclosure	-0.0050	0.2280	0.0163	0.0067**
Observations	110,814			
No. Restaurants	12,255			

Notes:

Both regressions include quarterly dummies.

In the regression without fixed effects, while not reported, we also include the following restaurant characteristics: food type, food style, seating capacity, liquor license dummy, DHS risk assessment, and city dummies.

Fixed effects are restaurant fixed effects.

Excluded dummy is for voluntary non-verifiable disclosure.

The sample size is slightly reduced (see Table 1) because we discard (i) observations for the first and last quarter when a restaurant is a new entrant or exitor, since we do not know the date of entry or exit; and (ii) observations with negative tax, and hence negative revenue (due to overpayment of tax in a prior quarter).

Stars denote significance levels: 99 percent confidence level (***), 95 percent confidence level (**) and 90 percent confidence level (*).

Table 6 — Continued

Panel B: Conditional Effects					
	Without Fixed Effects		With Fixed Effects		
	Coefficient	Std. Error	Coefficient	Std. Error	
B Grade	-0.0609	0.0147***	-0.0030	0.0045	
C Grade	-0.1536	0.0129***	0.0012	0.0043	
<C Grade	-0.2347	0.0139***	0.0021	0.0048	
Mandatory Disclosure	0.0789	0.0299***	0.0610	0.0086***	
Voluntary Disclosure	-0.0511	0.0266*	0.0169	0.0078***	
Mandatory × B Grade	-0.2998	0.0322***	-0.0487	0.0093***	
Voluntary × B Grade	-0.0247	0.0320	0.0104	0.0094	
Mandatory × C Grade	-0.4386	0.0575***	-0.0573	0.0166***	
Voluntary × C Grade	-0.1080	0.0759	-0.0103	0.0137	
Mandatory × <C Grade	-0.1923	0.1494	-0.0763	0.0426*	
Voluntary × <C Grade	-0.1080	0.0759	-0.0636	0.0222***	
Missing Grade	0.0034	0.0171***	-0.0312	0.0060***	
Observations	110,814				
No. Restaurants	12,255				

Notes:

The variable Missing Grade is for restaurants that have opened but not yet been inspected.

Both regressions include quarterly dummies.

In the regression without fixed effects, while not reported, we also include the following restaurant characteristics: food type, food style, seating capacity, liquor license dummy, DHS risk assessment, and city dummies.

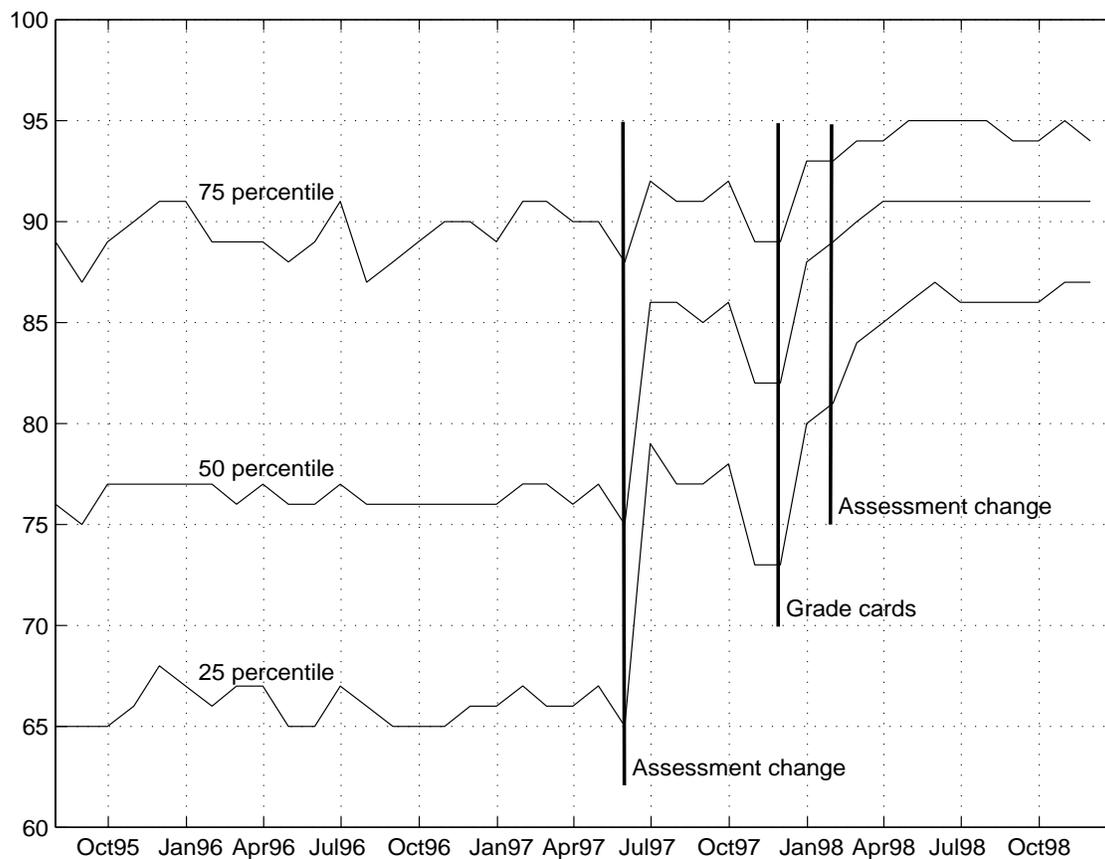
Fixed effects are restaurant fixed effects.

Excluded dummy is for voluntary non-verifiable disclosure. Interactions with A grade are also excluded.

The sample size is slightly reduced (see Table 1) because we discard (i) observations for the first and last quarter when a restaurant is a new entrant or exitor, since we do not know the date of entry or exit; and (ii) observations with negative tax, and hence negative revenue (due to overpayment of tax in a prior quarter).

Stars denote significance levels: 99 percent confidence level (***), 95 percent confidence level (**) and 90 percent confidence level (*).

Figure 1: Quartiles of hygiene quality distribution over time.



Notes:

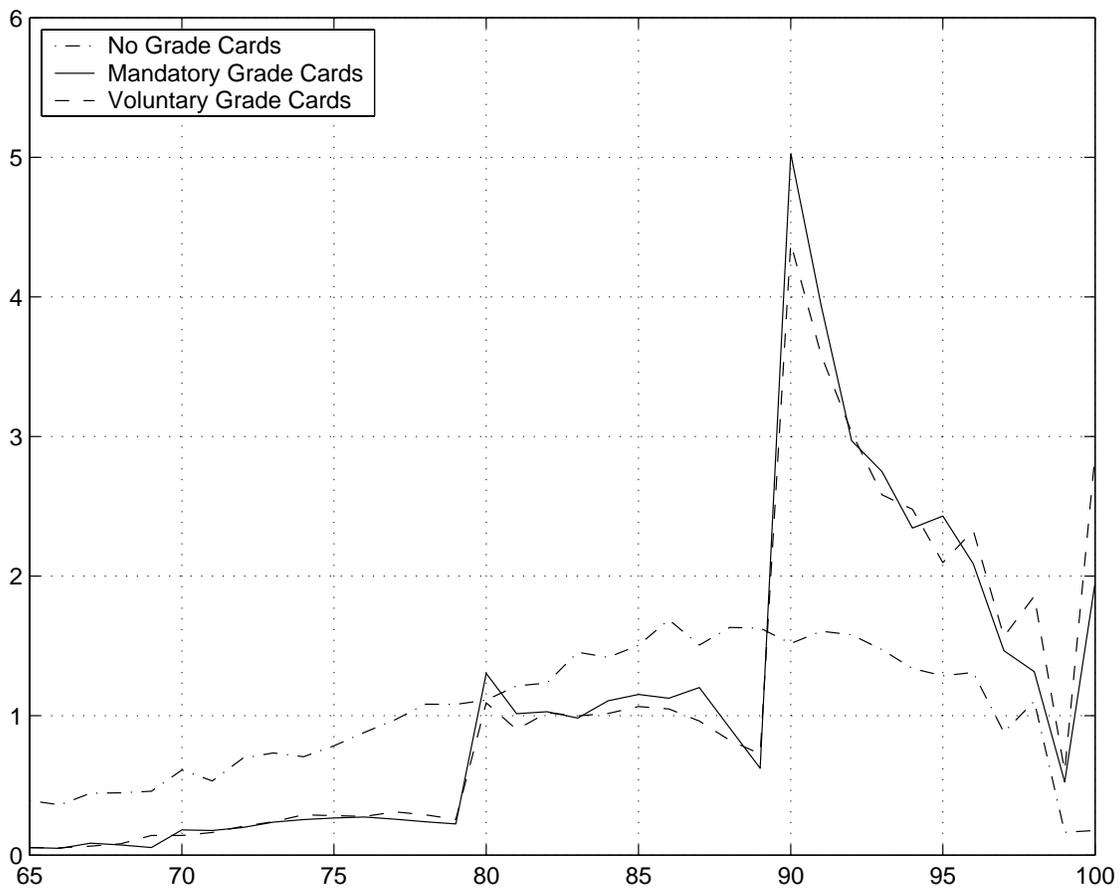
Quartiles are computed based on all inspections in a given month.

The assessment changes took place on 7/1/1997 and 3/18/1998.

The grade cards began introduction on 1/16/1998.

Vertical lines for regime changes are located immediately prior to a change in order to emphasize subsequent impacts on the hygiene distribution.

Figure 2: Distributions of hygiene scores under different disclosure regimes.



Notes:

The figure is no different to a histogram (or an unsmoothed non-parametric density).

Units on the vertical axis are meaningless.