Competition and disclosure incentives: an empirical study of HMOs

Ginger Zhe Jin *

I examine Health Maintenance Organizations' (HMOs) voluntary disclosure of product quality, which is not as complete as unraveling theories predict. After controlling for cost and demand factors, I find that HMOs use voluntary disclosure to differentiate from competitors, with lower disclosure rates in highly competitive markets. These findings are consistent with product differentiation, but challenge the intuition that competition should lead to more provision of quality information.

*Department of Economics, 3115 G Tydings Hall, University of Maryland, College Park, MD 20742. Tel. 301-405-3484. e-mail: jin@econ.umd.edu

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1 Introduction

Sellers in many markets have private information about their product quality. Although information asymmetry may lead to economic inefficiency, it is widely believed that market mechanisms can alleviate or even eliminate the information problem (Stigler 1961, Akerlof 1970). One mechanism is voluntary supply of quality information via an independent verification agency. According to Grossman (1981), Milgrom (1981) and Jovanovic (1982), if disclosure costs are negligible, rational consumers will assume non-disclosing firms have lower quality than those who disclose, thus motivating relatively high quality sellers among the non-disclosing set to reveal private information about product quality.

In contrast to the "unraveling" prediction, voluntary disclosure is incomplete in reality. For example, since the early 1990s, health maintenance organizations (HMOs) have been widely criticized for low service quality. As a result, the National Committee of Quality Assurance (NCQA), an independent, non-profit agency, started to accredit HMOs in 1991. By the end of 1998, less than half of operating HMOs voluntarily applied for NCQA accreditation. In light of the discrepancy between theory and reality, I ask two empirical questions: first, what factors motivate HMOs to voluntarily disclose their qualities through NCQA? Second, what role does competition play in shaping disclosure incentives?

HMOs provide an ideal setting to study disclosure incentives, not only because the quality of health service is difficult to observe, but also because HMOs use non-transparent techniques to restrict patient access to care and doctors. The inability to observe HMO service quality generates intensive debate about HMO regulations. At the beginning of the Clinton Administration, Congress initiated legislation regarding patient rights in HMOs but didn't pass any federal regulation. In the meantime, many states passed legislation regarding HMO licensing requirements, medical benefits and disclosure of specific operations. Despite these political efforts, NCQA is still the dominant source of HMO quality information, and disclosure through NCQA remains voluntary. A study of disclosure incentives will help assess the necessity of mandatory disclosure.

Theoretical models have ambiguous predictions regarding the effect of competition on disclosure incentives, hence an empirical investigation is particularly valuable. After controlling for cost and demand factors, I find that HMOs operating in relatively competitive environments are on average *less* likely to disclose via NCQA. Further evidence suggests that HMOs used NCQA disclosure to differentiate from their competitors. For example, the earliest disclosures appeared in the most competitive areas. But by the end

of 1998, areas with more HMOs had a smaller proportion of disclosing HMOs. Moreover, as the number of competitors increased, disclosure decisions were more likely to be strategic substitutes, suggesting that HMOs in highly competitive markets have stronger incentives to differentiate in disclosure decisions. While all these findings are consistent with product differentiation, they challenge the intuition that competition should lead to more provision of quality information.

The rest of the paper is organized as follows. Section 2 discusses disclosure channels via NCQA and describes the regulatory environment for HMOs. Section 3 reviews the theoretical and empirical literatures. In particular, I describe four theoretical scenarios and their testable implications. After data description in Section 4, Section 5 presents two sets of empirical results: one investigates the effect of competition on the average disclosure propensities at the market level, and the second the disclosure incentives of individual HMOs. Concluding remarks are offered in Section 6.

2 Background

Service quality is always an informational issue for health care. Through search and personal experience, consumers may be able to evaluate whether a doctor's office is well organized or whether a hospital provides quality food for inpatients. However, lack of expertise makes it difficult to assess whether the medical intervention is appropriate and properly carried out.

HMOs amplify the information asymmetry in several ways. HMOs may impose financial incentives such as capitation [1] on participating physicians to influence their choices of treatment. HMOs may also use gatekeepers to block patient access to certain doctors/treatments. Because a typical HMO does not cover care supplied by non-participating physicians, this raises the costs of obtaining a second opinion outside the HMO. These features suggest that, even if observable HMO attributes or personal experience reveal some information about HMO service quality, the information is often imperfect.

The information problem has tarnished the public image of HMOs. In response, HMOs use market mechanisms to disclose credible quality information. NCQA is the earliest and remains the most important verification agency for HMOs. [2] Founded in 1979 by two major managed care trade associations, NCQA

[1] Capitation means a specific dollar payment per patient per unit of time (usually per month) that is paid to cover a specified set of services and administrative costs without regard to the actual number of services provided.

[2] The Joint Commission on Accreditation of HealthCare Organization (JCAHO), a primary accreditation agency for hospitals,

claimed independence in 1990 under support from the Robert Wood Johnson Foundation and matching funds from HMOs and purchaser contributions (Romano 1993). These industry roots suggest that at least some HMOs had strong incentives to disclose their (good) qualities in the early 1990s. According to the NCQA 1997 and 1998 annual reports about the performance of the managed care industry, there is indeed wide variability in most key measures of HMO quality (Fisher 1998).

Specifically, NCQA offers three disclosure channels, aiming to provide quality information that consumers cannot obtain themselves. Because this study uses data from 1991 to 1998, the following discussion is limited to NCQA institutions through 1998.

The first disclosure channel is NCQA accreditation services. Available since 1991, NCQA accreditation allows HMOs to disseminate information about whether their managerial inputs reach certain standards. For example, it assesses whether HMOs have qualified health professionals to conduct peer reviews for determining the appropriateness of medical intervention. Application for accreditation is voluntary. Upon each application, the NCQA sends a team of physicians and managed care experts to conduct an on-and-off site survey of the applicant. A national oversight committee of physicians analyzes the team's findings and assigns one of four possible accreditation statuses – full (valid for three years), one-year, provisional, and denial – based on the extent to which the applicant meets the NCQA standards. The application fee is $10,000. In addition, the cost of preparation for accreditation review ranges from $20,000 to $90,000, depending on the size and organizational form of the applicant. [3] Once assigned, accreditation status, including denials, are publicly available free of charge through the NCQA Web page and a 24-hour phone line. Table 1 shows the steady growth of accreditation. By the end of 1998, 36% of the operating HMOs applied for NCQA accreditation, accounting for 69% of HMO patients.

The second channel, the Health Plan Employer Data and Information Set (HEDIS), has been offered nationwide since 1996. It permits HMOs to disclose standardized summary statistics about physician inputs and patient utilization of certain procedures. Typical examples are breast cancer screening, diabetic eye exams, child immunization, and physician turnover rates. In the third channel, NCQA conducts independent

started to provide accreditation service for HMOs in 1994. However, very few HMOs applied for JCAHO accreditation and most JCAHO applicants also applied for NCQA accreditation. I only consider NCQA disclosures. NCQA is committed to honest and unbiased service because it wants to be the primary agency should federal or state governments mandate HMO accreditation. For this reason, I assume away any potential concern of NCQA incentives as a monopoly of certification agency (Lizzeri 1999 and Durbin 2001).

[3] According to conversation with NCQA staff and numerous articles in trade journals.

consumer surveys and reports satisfaction indices. [4] Because HEDIS measures and consumer satisfaction data appear together in media publications, I group them as HEDIS/MSS.

Each year the NCQA invites all licensed HMOs to participate in HEDIS/MSS at no cost. Upon voluntary participation, NCQA obtains HEDIS measures from HMO self reports and consumer satisfaction data through independent surveys. NCQA also ensures that the data collection procedures, such as sampling methods and the calculation of summary statistics, comply with standard specifications. [5]

Unlike accreditation results which are free for consumers, the NCQA charges $800-$3,000 for any single purchase of HEDIS/MSS per year, mainly targeting employers. Individual consumers can access the HEDIS/MSS data either from their employers or from press releases and local advocacy groups. For example, each year from 1996 to 1998, *the U.S. News & World Report* used the latest HEDIS/MSS data to construct a comparison chart of HMOs, and assigned an overall rating from one to four stars. As shown in Table 1, about 30% of operating HMOs participated in the public release of HEDIS/MSS each year between 1996 and 1998, accounting for roughly 50% of HMO patients.

Both disclosure decisions – applying for NCQA accreditation and participating in the public release of NCQA HEDIS/MSS report – are made by individual HMOs. Because HMOs are defined by state license, different branches under the same parent company are counted as separate HMOs and may make different disclosure decisions. This phenomenon helps me design empirical identification strategies.

An HMO may design different packages for Medicare, Medicaid and commercial enrollees. During our study period, NCQA accreditation applies to all products within the HMO but HEDIS/MSS focuses on commercial enrollees only. Despite this difference, Jin (2002) found that many commercial HEDIS/MSS measures are highly correlated with Medicare-specific measures that the Center of Medicare and Medicaid Services (CMS) collected after the 1997 Balanced Budget Act. Moreover, all products within an HMO are likely to share the same infrastructure of information collection and quality management. For these reasons, I treat disclosure decisions as applicable to all products.

On the regulatory side, HMOs are subject to the HMO Act of 1973, its amendment in 1988, state laws

[4] The survey was named the NCQA Member Satisfaction Survey (MSS) before 1998 and renamed the Consumer Assessment of Health Plan Satisfaction (CAPHS) after 1998.

[5] NCQA started to require auditing in 1998. Before 1998, HMOs may or may not have their HEDIS data audited by a third auditing company. In my data, neither I nor consumers know which observations were audited.

if they sell commercial insurance in a state, and Medicare requirements if they contract with Medicare. Compared to NCQA accreditation standards and HEDIS/MSS data, these federal or state requirements on quality assurance are often crudely defined and account for a small subset of NCQA standards. Therefore, HMOs may still have incentives to disclose via NCQA even if all regulations apply.

Employment may affect consumer knowledge of HMO quality as well. A large employer may hire experts to evaluate HMO quality or persuade HMOs to provide quality information. As a result, employees in large firms may be better informed about HMO service quality. From an HMO's point of view, the benefits of voluntary disclosure may differ by employment patterns in serving areas.

To summarize, NCQA accreditation and HEDIS/MSS services constitute the most widely accepted and the most comprehensive measures of HMO quality. However, to detect the incentives to disclose via NCQA, it is necessary to control for other sources of quality information such as federal qualification, state regulations, and employment patterns.

3 Literature review

This paper draws on three strands of literature: theories about disclosure incentives, empirical studies of disclosure incentives and product differentiation, and empirical studies of consumer responses to HMO quality information. Each strand is reviewed below.

Theories and testable implications

The best-known theory of disclosure incentive is the "unraveling result." Grossman (1981) and Milgrom (1981) independently show that a monopolist facing no disclosure cost will disclose its product quality. The logic is as follows. Suppose the monopolist does not disclose, so consumers perceive quality as average, q_0. Because disclosure involves no cost and consumers are willing to pay for quality, any monopolist with quality strictly above q_0 will disclose. Then if the monopolist does not disclose, consumers believe quality is no better than q_0. The revised belief implies further unraveling until rational consumers assume the monopolist has the worst quality. In that case, disclosing and non-disclosing are equally revealing. Jovanovic (1982) extends the result to markets with an arbitrary number of firms. If disclosure cost is positive, the equilibrium is characterized by a disclosure threshold: firms with qualities above the threshold disclose, and firms below the threshold remain silent.

In its simplest form, the unraveling theory has four testable implications. First, all else equal, higher disclosure costs discourage disclosure. Second, higher consumer willingness to pay for quality encourages disclosure. Third, more diffuse prior beliefs about product quality imply more potential gains from indicating high quality and therefore create greater incentives to disclose. Fourth, a specific firm's disclosure decision is independent of the number of competitors and competitors' disclosure decisions.

The prediction that a firm's disclosure decision is independent of its competitive environment is a surprising result. A closer examination suggests that the prediction relies on many strong assumptions and is no longer valid when some assumptions are relaxed. For example, consumers are assumed to be homogenous in their taste for quality, consumers know the underlying distribution of quality, all consumers are aware of the disclosure possibility, each firm has a fixed capacity, each firm's disclosure cost is independent of the competitive environment, each firm's quality is exogenously given, and the distribution of quality is independent of competition. These assumptions highlight the interaction between firm(s) and consumers but ignore interactions between competing firms.

The following three scenarios relax one or more of these assumptions and show that competition could encourage or discourage voluntary disclosure. They are by no means exhaustive. Rather, they are special cases illustrating the ambiguous relationship between competition and disclosure, hence providing some guidance for the empirical work.

The first scenario concerns consumers' imperfect knowledge about quality distribution. Following Milgrom and Roberts (1986), one cigarette manufacturer may not bother to disclose the addictive feature of cigarettes even if its products are less addictive than its competitors'. This is because the disclosure may lower consumers' general perception of cigarettes and therefore reduce the aggregate demand of cigarettes.

Conversely, a firm may not have full incentives to disclose "high quality" either. If disclosure entails costly efforts in educating consumers about the meaning of "quality," the first discloser may generate a positive externality for competitors. Unable to claim all benefits from disclosure, no firm will rush to be the first discloser. On the other hand, if some competitors disclose, a firm may free ride on their educational efforts and disclose as well. Such a positive externality, if it exists, implies that (1) the earliest disclosures should occur in the least competitive markets, (2) firms in more competitive markets may be less likely to disclose, and (3) among competing firms, disclosure decisions should be strategic complements.

The other two scenarios are related to product differentiation. If firms can choose service quality before

making disclosure decisions, the disclosure game is similar to a standard game of vertical differentiation: instead of choosing within a continuous range of quality, each firm either chooses the lowest level of quality and remains silent, or chooses a quality above a certain threshold and discloses the true quality (Albano & Lizzeri 2001). Since the vertical differentiation literature has ambiguous predictions as to how the distribution of quality changes with competition (Tirole 1988), competition may encourage or discourage voluntary disclosure, depending on how we model competition. The second and third scenarios provide intuition.

In the second scenario, consider a stylized Bertrand model where disclosure is the only way to convey true quality. Two non-disclosing firms appear identical to consumers and therefore engage in Bertrand competition in prices, with zero profit. On the other hand, choosing better quality softens price competition and leads to positive profits. As long as the gain from product differentiation outweighs the cost of disclosure, at least one of the two firms would choose a better quality and disclose. Under this logic, intense price competition among non-disclosing HMOs could lead to higher disclosure rates in highly competitive markets.

In this scenario, voluntary disclosure is a market device that lets firms compete in both price and quality. Market outcomes rely on how firms differentiate in true qualities, much more than on how firms differ in their disclosure decisions. This outcome is driven by two strong assumptions. First, Bertrand competition is extreme because HMOs differ in many other dimensions such as location and network size. The second key assumption is that the disclosure intermediary reveals the exact levels of quality and therefore disclosing firms may differentiate by choosing different qualities, no matter how small the quality difference is. This is unrealistic for the health care industry. Recent studies suggest that consumers respond to overall ratings of health plans but not to detailed quality measures. Given that over 60% of accreditation applicants are fully accredited and *the U.S. News* offers no more than five categories in their rating, the degree of quality differentiation among disclosing firms is not as rich as in vertical differentiation theory.

The third scenario relaxes these two assumptions and points to a new set of predictions. Suppose an increase in the number of competitors intensifies price competition, but less than Bertrand competition. Also, there is a limited degree of differentiation among disclosed qualities. In this world, the main purpose of disclosure is to distinguish from non-disclosing firms rather than other disclosing firms. If competition provides incentives for differentiation, this means that (1) the earliest disclosures should occur in the most competitive markets; (2) competitive markets are more likely to have at least one firm disclosing but not

necessarily more likely to have all firms disclosing; and (3) as the number of firms increases, disclosure decisions are more likely to be strategic substitutes among competitors. This scenario offers no specific prediction regarding the average disclosure rate per market, except that disclosure rates are not necessarily a monotone increasing in the number of firms. The exact relationship remains an empirical question.

Overall, through a simple unraveling theory and three special scenarios, I obtain the following guidance for the empirical work: (1) disclosure cost, consumer willingness to pay for quality, and consumer prior belief of quality are primary cost and demand factors driving disclosure decisions. (2) The relationship between competition and disclosure is theoretically indeterminate. Specifically, different theoretical assumptions may lead to different predictions regarding the effect of competition. At the market level, the key dependent variables are the average disclosure rate, the timing of first disclosure, and the incidence of full disclosure. At the firm level, the key variables are each individual firm's disclosure decision, as well as its correlation with its competitors' disclosure decisions.

Empirical studies on quality disclosure and product differentiation

Two empirical papers test the unraveling results but do not explicitly address disclosure incentives. Mathios (2000) examines nutrition labels in the salad dressing market before and after the 1990 Nutrition Labeling Act. Voluntary disclosure before the regulation was far from complete and all firms that disclosed offered relatively high quality (e.g. low fat or no fat). Jin and Leslie(2003) consider a recent regulation of restaurant hygiene quality in Los Angeles County. The regulation issued grade cards to inspected restaurants but the posting of grade cards was mandatory or voluntary depending on the municipality. They find substantial improvement in restaurant hygiene quality in both mandatory and voluntary regimes. Although the degree of improvement is statistically different across the two regimes, the economic difference is minimal. Both studies find some evidence in favor of the unraveling theory but neither supports it completely.

Several recent papers discuss product differentiation in other industries. Mazzeo (2002) studies the motel industry in isolated markets and finds that motels have strong incentives to differentiate in quality. Ellickson (2000) finds that supermarkets competing in the same market tend to choose similar levels of service quality [6] and therefore quality choices are strategic complements. In a less related work, Vogt (1999) examines the adoption of magnetic resonance imagers among competing hospitals, and concludes that adoption decisions

[6] Measured by the size of supermarkets.

are strategic complements. By drawing different conclusions in different contexts, these studies reflect the ambiguous predictions of the product differentiation literature.

Literature on consumer responses to NCQA information

For any disclosure theory to hold, we must confirm that consumers care about NCQA information. Anecdotal evidence suggests that NCQA efforts received a warm welcome from employers, consumer groups and regulators. The U.S. General Accounting Office pushed for HMO report cards (GAO 1994), a number of states acknowledged NCQA accreditation as a valid external review in satisfaction of state licensing requirements, several states required HMOs report data to NCQA (not necessarily disclosed to the public), and a number of large employers such as Xerox have required or requested the NCQA accreditation for HMO contracts.

In comparison, the literature on consumer responses to HMO quality information is non-conclusive. On one hand, a number of consumer surveys and focus group studies indicate interest in quality information, especially in meaningful summary information that draws clear distinctions between health plans in a given market (NCQA 1995, NCQA 1996, Hibbard & Jewett 1996, Hibbard & Jewett 1997 and Tumlinson et al. 1997). On the other hand, various employer and consumer surveys suggest insufficient use of NCQA information in consumer choice of health plans (Kaiser & AHRQ 2000).

Rather than relying on consumer opinions, another literature compares consumer choices of health plans before and after the dissemination of health plan quality indices. They find positive responses to NCQA accreditation (Chernew and Scanlon 1999 and Jin 2002), positive responses to employer-provided quality indices (Wedig & Tai-Seale 2002, Beaulieu 2002), but mixed responses to HEDIS/MSS measures. Specifically, consumers seem to respond to overall ratings based on HEDIS/MSS data, but not to specific HEDIS/MSS measures (Scanlon et al. 2002 and Jin 2002). This lends support to the scenario where HMOs differentiate by disclosure decisions. Jin (2002) also finds that an HMO's favorable rating in the NCQA HEDIS/MSS report not only increases its own market share in Medicare, but also benefits other HMOs competing in the same market. This points to the possibility that disclosure may have a positive externality on competitors, which motivates the scenario with externality.

Scanlon et al. (2000, 2001) interview 24 managed care health plans regarding disclosure incentives and quality improvement. They find two phenomena: (1) managed care organizations engage in quality improve-

ment activities in response to outside pressure; in fact, the NCQA accreditation ranks the highest among all incentives for quality improvement; and (2) all interviewed health plans use HEDIS/MSS measures for quality control purposes. Health plans further claim that the biggest advantage of HEDIS/MSS is the capability of benchmarking performance against competitors, indicating strong incentives to differentiate from competitors. These interviews suggest that quality is endogenous and competition is a non-negligible factor in disclosure decisions.

4 Data description

I first describe data sources, and then define specific cost and demand factors. The definition of dependent variables and competitive factors depends on whether the unit of observation is market-year or HMO-year, hence deferred until Section 5.

Data sources

NCQA provides a complete history of accreditation reviews from 1991 to 1998, including the identity of reviewed HMOs, review dates, accreditation statuses and the time during which the assigned statuses remained effective. HEDIS/MSS data are drawn from the 9/2/96, 10/13/97 and 10/14/98 issues of *the U.S. News and World Report*. Each year, for every HMO who voluntarily participated in the public release of NCQA HEDIS/MSS, *the U.S. News and World Report* specified its identity, HEDIS/MSS measures in 6-7 categories, and star ratings.

Cost, demand and competitive factors are drawn from six data sources. First, the 1991-1998 InterStudy HMO surveys indicate each HMO's total enrollment, length of operation, affiliation, tax status, federal qualification status, types of products provided, the number of physician and hospital contracts, as well as serving counties as of the beginning of each calendar year. InterStudy also reports non-HMO penetration and the percentage uninsured by metropolitan areas through 1994 to 1998. The other four data sources are: county-level demographic data from the 1990 Census, county-level employment data from 1991-1998 County Business Patterns, state average behavioral risk factors collected by the Center of Disease Control and Prevention (CDC) from 1991 to 1998, and state regulations reported in Blue Cross and Blue Shield (2001). Accreditation, HEDIS/MSS and InterStudy HMO survey data are matched by HMO names. The other area-specific data sets are matched with HMO-level data by serving areas.

I define markets by county because HMO enrollment eligibility usually depends on which county a potential enrollee resides in. [7] InterStudy also reports HMO serving areas by county. Defining market by MSA is less appropriate because many HMOs do not serve *all* counties within an MSA. For example, from 1992 to 1998, 25% of HMOs served less than 60% of counties within each relevant combination of MSA-year. Defining market by MSA over-counts the number of competitors and discards valuable information on the distribution of competition within MSAs. HMOs often advertise their expansion into a county within the same metropolitan area.

Data cleaning takes into account of three facts: (1) many HMOs serve multiple markets, (2) two HMOs may overlap in some but not all the serving markets, and (3) the disclosure decision is made at the HMO level and applicable to all serving areas. For market level analyses where the unit of observation is market-year, I compute average HMO characteristics across all HMOs serving a specific market in a specific year. These averages are unweighted because I do not observe HMO enrollments in specific counties. For HMO level analyses, I group county level data into HMO-year. If a variable is by county-year, I compute its weighted average across all serving counties for a specific HMO in a specific year, where weights are 1990 county populations.

In summary, I construct two datasets. The county-year dataset includes 18,875 observations, covering 8 years and 3020 counties. The HMO-year dataset consists of 4,722 observations across 8 years and 901 HMOs. Table 2 summarizes how competition among HMOs has changed over time. The average number of serving HMOs per county has increased from 3.21 in 1991 to 5.47 to 1998 if every county is treated equally, or from 7.30 to 10.73 if weighted by the 1990 county population. This growth is due to an increase in the number of HMOs and the expansion of existing HMOs. While the number of operating HMOs increased from 568 in 1991 to 647 in 1998, the average number of serving counties per HMO more than doubled from 10.58 in 1991 to 21.90 in 1998. As a result, a typical HMO faced on average 10.32 competitors per county in 1998 – much more than 5.31 competitors per county in 1991. These statistics suggest that competition among HMOs has intensified over time. Table 2 also reports positive correlations among disclosure decisions of competing HMOs.

[7] See federal employee health plan brochures, for example.

Defining cost and demand factors

Disclosure costs are proxied by the number of contracting physicians per 1,000 patients, the growth in the number of participating doctors from the previous year, and the extent to which an HMO contracts with solo practitioners rather than physician groups (*IPA*). All are related to the cost of information systems that an HMO has to install to collect and standardize administrative and clinical information from doctors.

Consumer willingness to pay for quality is captured by per capita income, Medicare AAPCC rate, percentage of population eligible for Medicare [8], and behavior risk factors. Specifically, I consider three risk factors: (1) the percentage of people who have ever had diabetes for non-pregnancy reasons, (2) the percentage of people who are subject to smoking-related illnesses because of current smoking habits, and (3) the percentage of people who are at risk of health problems related to being overweight.

I assume that higher income people and people subject to greater health risks are more willing to pay for quality. The Medicare AAPCC rate is intended to track the average fee-for-service expenditure for the whole population. In principle, expensive fee-for-service makes HMOs attractive to a larger group of people. Because fee-for-service is often regarded as better quality, those switching from fee-for-service to HMOs are more willing to pay for quality than those who are already enrolled in HMOs. Following this logic, an increase in Medicare AAPCC rate should lead to greater demand for HMO quality.

Consumer prior beliefs about the quality distribution are harder to quantify. I rely on year dummies to account for the general belief of HMO quality in a specific year, state dummies for time-invariant factors within states, [9] and counts of state regulations for time-varying state laws about HMOs. Because HMO regulations vary, I aggregate them by (1) the total number of state bills passed for disclosing specific HMO operations, (2) the total number of state bills passed for patient accesses to doctor and care, and (3) the total number of bills passed for benefit mandates.

Employer size and the dominance of large employers are included to account for information that consumers may learn from their employers, as well as costs to employers of using and disseminating NCQA information. Employer size is defined by the average number of employees per establishment in a specific county. The dominance of large employers is defined as the percentage of employees who work for compa-

[8] Replacing this variable with percentage of population over age 65 produces no difference in any regression.

[9] State and year dummies control for more than consumer prior beliefs about HMO quality. They also absorb any other cost and demand factors that are common across HMOs within years or within states.

nies with 1000 or more employees. HMO age, HMO chain affiliation and HMO federal qualification status are included to account for the prior knowledge of quality that consumers may obtain from these observable attributes. Since they may also represent disclosure cost savings associated with mature managerial and information systems, their coefficients should be interpreted as the net effect of these two forces.

Furthermore, because the accreditation application fee is similar across HMOs but revelation of good quality allows HMOs to increase premia per enrollee, there may be economies of scale in disclosure decisions. I use the 1990 census county population and lagged HMO enrollment to capture this effect. Specifically, for market-level analyses, county population is included directly in all regressions. For HMO-level analyses, I compute the total county population across all serving counties as a proxy for potential market size and use lagged HMO enrollment to proxy service capacity. Admittedly, enrollment is an outcome variable and may depend on disclosure of quality information. I repeat all HMO-level analyses without lagged enrollment and the results are robust.

HMOs also compete with Preferred Physician Organizations, fee-for-service plans or even the choice of being uninsured. To take these into account, all regressions control for the proportion of population enrolled in non-HMO plans and the fraction uninsured for metropolitan areas since 1994. Both variables are based on enrollment and therefore may depend on disclosure decisions. To minimize the confounding effect, I use their lagged values. Regressions excluding these two variables generate similar results, suggesting that the confounding effect is negligible.

Finally, since product differentiation is a potential incentive for disclosure, it is necessary to control for the dispersion of consumer tastes. From the 1990 census, I compute the difference between the 10th and 90th percentiles of per capita income for each county ($INCGAP$). If HMOs did use disclosure decisions to differentiate from competitors, early disclosures are more likely to occur in areas with greater degrees of income inequality.

Table 3 summarizes cost and demand factors for disclosing and non-disclosing HMOs. Consistent with theoretical predictions, disclosing HMOs are more likely to be larger, older, federally qualified, affiliated with chains, group-based and contracting with fewer number of doctors per 1,000 patients – although the last two variables are insignificantly different for HEDIS/MSS participation. Disclosing HMOs also serve areas with larger populations, higher per capita income, greater income inequality, and a greater proportion of elderly people, as we expect. Disclosing HMOs appear to be concentrated in areas with high HMO

penetration, suggesting that competition among HMOs is more important than the competition between HMO and non-HMO choices. Also, accreditation applicants are more likely to serve areas with a high AAPCC rate, high risk factors and heavy regulations, confirming the conjecture that high fee-for-service expenditures, a sicker population and active legislation reflect greater demand for HMO quality. In comparison, AAPCC rate, risk factors and state regulations do not differ across participants and non-participants of HEDIS/MSS, probably due to the short panel of data. Several variables appear inconsistent with our theories. HMOs applying for accreditation tend to serve areas with large employers. This may be because only relatively large employers are obliged to provide health insurance for employees. Because of this empirical complication, the employment distribution variables should be viewed as pure controls.

5 Econometric specifications and results

The theoretical literature review suggests two sets of empirical tests: one on disclosure propensity by market, and the other on the disclosure incentives by individual HMOs. I present market-level and HMO-level evidence separately.

Market level evidence

Econometric specification Consider the following specifications by year t and market k:

$$\begin{aligned} Y_{kt} &= \alpha_{(k)} + \beta \times COMPETE_{kt} \\ &+ \gamma_1 \times COST_{kt} + \gamma_2 \times WTP_{kt} + \gamma_3 \times PRIOR_{kt} \\ &+ \gamma_4 \times CONTROL_{kt} + error \end{aligned} \tag{1}$$

where Y_{kt} includes:

$$\begin{aligned} YESACC &= \text{=1 if at least one serving HMO applying for NCQA accreditation} \\ YESHED &= \text{=1 if at least one serving HMO participating in HEDIS/MSS} \\ YESALLACC &= \text{=1 if all serving HMOs applying for NCQA accreditation} \\ YESALLHED &= \text{=1 if all serving HMOs participating in HEDIS/MSS} \\ AVGACC &= \text{proportion of serving HMOs applying for NCQA accreditation} \\ AVGHED &= \text{proportion of serving HMOs participating in HEDIS/MSS} \\ TIME1ACC &= \text{timing of the first accreditation application in market k} \end{aligned}$$

All these dependent variables are designed to summarize disclosure patterns at the market level. The first four – $YESACC$, $YESHED$, $YESALLACC$ and $YESALLHED$ – reflect two extremes of disclosure propensity of no disclosure at all, or complete disclosure. They are binary variables and entail probit regressions. $AVGACC$ and $AVGHED$ reflect the average disclosure rates and are estimated by ordinary least squares. $TIME1ACC_{kt}$ reflects the timing of the earliest accreditation application in each county and therefore is estimated in a duration model. Three variables capture the competitive environment: the number of HMOs by county-year ($NHMO_{kt}$), the non-HMO penetration rate ($PENENHMO_{kt}$), and the uninsured proportion of the population ($UNINSURED_{kt}$). State dummies are included in all regressions. For average disclosure rates, I also control for county fixed effects. [10] To control for nationwide trend, I include a full set of year dummies for OLS and probit regressions, and ensure results from the duration model is robust to a non-parametric baseline hazard.

Identification arises from both cross-section and time-series variation. In a specific year and state, comparing average disclosure rates across counties identifies whether disclosures are more likely to occur in markets with more HMOs. Within a county, the number of serving HMOs changes over time due to entry, merger, and acquisition. The average disclosure rate may change because an incumbent changes its disclosure decision or because new entrants behave differently from incumbents. With county fixed effects, I identify how an over-time change in competition associates with a change in disclosure decisions.

All regressions treat the number of serving HMOs as an independent variable. Arguably, disclosure and entry/exit are both long run decisions and depend on the same omitted cost or demand factors. In this sense, I only demonstrate a correlation between $NHMO$ and disclosure behavior. The coefficients of $NHMO$ should not be interpreted as causal.

One key identification question is whether the presence of omitted cost/demand variables undermines any theoretical distinction. Suppose I cannot fully control for the dispersion of consumer tastes for quality, which may be a primary reason for differentiation and market entry. This means that an increase in the number of HMOs may simply capture greater dispersion in consumer tastes and does not necessarily intensify price competition. I can still distinguish the two differentiation patterns because they imply different disclosure behaviors of new entrants. If HMOs mainly differentiate by disclosing quality, more consumer heterogeneity should motivate new entrants to disclose and operate at different quality levels. This implies

[10] County fixed effects are infeasible for probit and duration models.

an increase in disclosing rate. On the other hand, if the primary differentiation is in disclosure decision itself, some new entrants may choose to disclose and some new entrants choose not to do so. Different disclosure decisions allow these entrants to reap benefits from consumer heterogeneity. Should I find a negative correlation between average disclosure rate and $NHMO$, the data would reject the former in favor of the latter.[11]

Results In the raw data, the proportion applying for accreditation increased substantially from 1991 to 1995, but slowed down since 1995. The slow down is partly due to a less rapid increase in the absolute number of accreditation applications, and partly because most HMOs expanded their serving areas thus increasing the denominator. HEDIS/MSS participation has no clear time trend. In any year between 1991 and 1998, $AVGACC$ and $AVGHED$ are not strongly correlated with $NHMO$, but these raw correlations do not take into account cost or demand differences across counties, nor do they highlight NHMO changes over time within the county.

Table 4 presents regression results regarding accreditation application. Column 1 is the OLS regression of $AVGACC$ with county fixed effects. After controlling for cost and demand factors, $AVGACC$ declines with $NHMO$. This pattern is robust if I use the Cox transformation of $AVGACC$ [12] as dependent variable, or exclude county fixed effects. Columns 2 and 3 present probit regressions for $YESACC$ and $YESALLACC$. Results suggest that competitive markets are more likely to observe at least one disclosing HMO but less likely to have full disclosure. Because most accredited plans renew their accreditation application upon expiration, Column 4 presents a duration regression for $TIME1ACC$. In the duration model, markets with more HMOs are more likely to observe early application(s) for NCQA accreditation. In all four columns, the coefficient of $NHMO$ is significant with 99.9% confidence. Results are robust if I rerun the duration model with distributions other than Weibull [13], replace the probit model with linear probability regressions, and repeat all analyses without state dummies.

Though not reported in a table, HEDIS/MSS participation displays a similar pattern: after controlling

[11] Although a positive correlation is consistent with both, empirical evidence shows a negative correlation, thus avoiding the confounding case.

[12] $log(AVGACC/(1 - AVGACC))$.

[13] Including parametric specifications with exponential, gamma and log normal distributions, and the non-parametric Cox proportional hazard model.

for cost and demand factors, counties with more HMOs have lower disclosure rates on average, are more likely to have at least one HMO disclosing, but are less likely to have full disclosure. Again these results are highly significant and robust to alternative specifications.

Tables 4 also reveal some interesting effects for the other variables. First, competition among HMOs is more important than competition between HMOs and non-HMO insurance. Second, in all regressions except for $TIME1ACC$, counts of state regulations are either positive or insignificant, confirming that heavy regulation reflects greater demand for health plan quality. Finally, areas with greater income inequality ($INCGAP$) are more likely to observe at least one application, but less likely to observe full disclosure, though the latter is insignificant. In comparison, HEDIS/MSS participations always tend to occur in areas with higher average income but less income inequality.

To summarize, market level evidence suggests that competition among HMOs plays an important role in disclosure, rejecting the simplest form of the unraveling theory. After controlling for cost and demand factors, results are consistent with HMOs using disclosure decisions to differentiate from competitors. Externality concerns would have deterred early disclosure in highly competitive markets, and differentiation by disclosed quality would have encouraged disclosure in highly competitive market, both contrary to what we find in the data.

HMO level evidence

This subsection examines disclosure decisions of individual HMOs. I focus on two empirical tests: first, does a competitive environment encourage an HMO to disclose its quality information? Second, when the environment becomes more competitive, are disclosure decisions more likely to be strategic complements or strategic substitutes among competing HMOs?

Econometric specifications The first empirical test is implemented in Specification A by HMO j at time t:

$$\begin{aligned} Y_{jt} &= f(\alpha + \beta \times COMPETE_{jt} \\ &+ \gamma_1 \times COST_{jt} + \gamma_2 \times WTP_{jt} + \gamma_3 \times PRIOR_{jt} \\ &+ \gamma_4 \times CONTROL_{jt}) + error \end{aligned} \tag{2}$$

where Y_{jt} includes:

$$TIM1ACC_{jt} = \text{timing of the first NCQA accreditation review for HMO j}$$

$INHEDIS_{jt}$ = =1 if HMO j participated in HEDIS/MSS at time t.

Because over 90% of accredited HMOs renewed their accreditation applications before their old status expired, the first application is the most meaningful decision, as in a duration model. I aggregate review dates into quarters because the NCQA accreditation service was sometimes congested and therefore minor timing differences may reflect technical delays. For HEDIS/MSS participation, $INHEDIS_{jt}$ is equal to one if HMO j participated in the public release of NCQA HEDIS/MSS report in year t.

The key difference between market-level and HMO-level analyses is that HMO-level regressions must aggregate market-level variables into HMO-year. As described in Section 4, this amounts to computing population-weighted averages across HMO j's serving counties in year t. I construct three variables to describe competitive environments: (1) the average number of competing HMOs ($NCHMO_{jt}$), (2) the average proportion of serving area population enrolled in non-HMO health plans ($PENENHMO_{jt}$), and (3) the average proportion of uninsured population ($UNINSURED_{jt}$). Cost, demand and control variables are constructed similarly.

To examine whether competing HMOs cluster or differ in disclosure decisions, I regress HMO j's disclosure decision Y_{jt} on its competitors' disclosure decisions Y_{-jt}. Two challenges arise. First, an HMO usually serves multiple counties and may face different competitors in different counties. I deal with this issue by computing competitors' average disclosure decisions in two steps. In the first step, if HMO j served county k in time t, I calculate the proportion of competing HMOs in county k that applied for NCQA accreditation by the end of time t and the proportion of them participating in the public release of NCQA HEDIS/MSS in year t. Since these calculations are impossible if HMO j is the monopolist in kt, a dummy variable is created to indicate the monopoly situation. In the second step, I compute population-weighted average for all variables created in the first step.

The second challenge speaks to an identification problem. Disclosure decisions may be correlated among competing HMOs because of a common omitted cost or demand factors. To deal with this confounding effect, I need instruments correlated with Y_{jt} but not correlated with omitted cost or demand factors in common serving areas at time t.

I use competitor sisters' disclosure decisions $Y_{-j,sis,t}$ as instruments for competitors' disclosure decisions Y_{-jt}. Two HMOs are defined as sisters if they belong to the same parent company but serve different geographical markets. Because sister HMOs often share similar organizational features, they are correlated

in service quality. Chain-wide attempts to improve quality assure similar service quality and hence similar disclosure decisions among sister HMOs.

On the other hand, because most sister HMOs serve geographically distinct areas, one chain HMO's local cost or demand factors are unlikely to influence its sisters' disclosure decisions. This argument is based on three assumptions: first, after controlling for year and state dummies, omitted local cost and demand shocks are independent across geographic areas. Second, disclosure decisions are made by individual HMOs rather than by chain headquarters. Therefore, an HMO's disclosure decision should not take into account its impact on consumers' choice of health plans outside its serving areas. Conversation with NCQA staff confirms this assumption. I was told that NCQA never received multiple applications from the same chain headquarter on behalf of different member HMOs. In fact, all accreditation applications and HEDIS reports are dealt with individual HMOs, rather than the chain headquarters. Third, consumers only observe local HMOs' disclosure decisions and therefore do not make any inference from the disclosure decisions of any HMO outside their residential area. This assumption is reasonable because even the largest employer-sponsored health program, the Federal Employee Health Benefits Program (FEHBP), does not draw any quality inference across sisters. [14]

Table 5 provides some support for the validity of $Y_{-j,sis,t}$ as instruments. According to columns (1) to (3), every year since 1993, over 50% of competitors have at least one sister. The prevalence of chain HMOs facilitates the calculation of $Y_{-j,sis,t}$. For the sub-sample of chain HMOs, by 1998, each HMO on average had 35.48 sisters and did not overlap with 34.78 of them in any serving area. This pattern persists even if I exclude the largest chain, Blue Cross Blue Shield. Moreover, by 1998, sister HMO's decisions whether to apply for NCQA accreditation have a correlation coefficient as high as .4. Sister HMOs' participation in NCQA HEDIS/MSS reports also demonstrates high correlation, namely .53 in 1996 and 1997 and .38 in 1998. These summary statistics suggest that $Y_{-j,sis,t}$ is correlated with Y_{-jt} but less so with $-j$'s omitted local-specific cost and demand factors, and therefore is a valid instrument.

The other candidate instruments are less promising. This is because any locally-observable rival characteristic may help consumers infer quality from competitors' disclosure decisions, and therefore should be included in the regression directly. Consequently, the search for instruments must focus on variables unobservable to local consumers. One candidate is the characteristics of those HMOs who do not compete

[14] Based on conversation with FEHBP officials.

with the HMO under study but compete with its competitors. This is infeasible because most HMOs serve metropolitan areas and overlap in the center counties within MSAs. A second choice exploits the areas not served by the HMO under study but served by its competitors. This is difficult because the non-overlapping areas, when they exist, are close to the overlapping areas, and therefore likely to share similar cost and demand factors.

The second empirical test is carried out in Specification B:

$$\begin{aligned} Y_{jt} &= \alpha + \beta \times COMPETE_{jt} \\ &+ \gamma_1 \times COST_{jt} + \gamma_2 \times WTP_{jt} + \gamma_3 \times PRIOR_{jt} + \gamma_4 \times CONTROL_{jt} \\ &+ \delta_1 \times Y_{-jt} + \delta_2 \times Y_{-jt} \times COMPETE_{jt} \\ &+ \theta_1 \times COST_{-jt} + \theta_2 \times PRIOR_{-jt} + error \end{aligned} \tag{3}$$

Specification B adds several variables. Y_{-jt} and $COMPETE_{jt} \times Y_{-jt}$ are intended to capture how strategic interactions among competing HMOs change with competition. Y_{-jt} are endogenous and I use $Y_{-j,sis,t}$ as instruments to address the endogeneity [15]. $COST_{-jt}$ and $PRIOR_{-jt}$ are intended to control for competitors' locally observable characteristics that consumers may use to infer quality from Y_{-jt}.

Y_{-jt} is constructed under the principle that an HMO should take into account all its serving areas but assign more importance to competitors in populated areas. $Y_{-j,sis,t}$ is defined in the same way, but the calculation ensures that any entity contributing to $Y_{-j,sis,t}$ does not overlap with HMO j in any serving area. Detailed procedures are described in the Appendix. Both Y_{-jt} and $Y_{-j,sis,t}$ are continuous variables between 0 and 1, describing the average disclosure propensities of competitors and their sisters.

Another technical problem is the use of instrumental variables in non-linear specifications. Since more than 50% of HMOs had not applied for NCQA accreditations by the end of 1998, the data are censored. To my knowledge, no satisfactory econometric methods have been proposed for instrumental variables in censored duration models. A common practice is first regressing the endogenous variable on instruments, and then inserting the predicted value from the first stage into the duration model. However, there is no justification for this two-step procedure. Due to this limitation, I use $Y_{-j,sis,t}$ as a proxy for Y_{-jt} and include it directly in the duration equation.

In the probit regression of $INHEDIS$, I follow Newey (1987) and Rivers and Vuong (1988). They

[15] Similarly, $COMPETE_{jt} * Y_{-jt}$ are instrumented by $COMPETE_{jt} \times Y_{-j,sis,t}$.

show that estimates for endogenous regressors are consistent if I first regress endogenous variables on valid instruments and the other exogenous explanatory variables, and then include the residuals from the first step regressions in the probit model.

Results Figure 1 depicts the correlation between the average number of competing HMOs ($NCHMO_{jt}$) and the timing of HMO j's first accreditation application. Because $NCHMO_{jt}$ changes over time, the horizontal axis describes $NCHMO_{jt}$ at the time of HMO j submitting its first application. To better illustrate, I group the continuous $NCHMO$ into integers. For those HMOs that applied for NCQA accreditation by the end of 1998, the vertical axis reports the average timing of first applications corresponding to each integer $NCHMO$, where timing is defined by the number of months between January 1991 and HMO j's first review date. The timing of the first accreditation application is an increasing function of $NCHMO$, suggesting that HMOs that applied relatively late on average face more competitors at the time of application. This seems consistent with the market level evidence of lower disclosure rates in competitive markets.

In contrast, from 1996 to 1998, the average HEDIS/MSS participation rate is not a monotonic function of $NCHMO$ (unreported). All show a weak tendency of HEDIS/MSS participation decreasing with $NCHMO$, suggesting that HMOs facing more competition may have (weakly) less incentive to participate in HEDIS/MSS.

Table 6 reports duration regression results for NCQA accreditation applications. Column (1) follows Specification A and indicates how $NCHMO_{jt}$ affects HMO j's probability of applying for accreditation for the first time. Columns (2) and (3) follow Specification B and examine whether competing HMOs cluster or differentiate in their accreditation decisions. For comparison, Column (2) ignores the endogeneity of Y_{-jt} and includes it directly in the regression, while Column (3) uses $Y_{-j,sis,t}$ as proxy for Y_{-jt}. All columns use the Cox proportional hazard model, with a non-parametric base hazard function. This flexibility controls for any nationwide time trend in accreditation applications.

Column (1) indicates that facing one more HMO competitor makes an HMO 10% less likely to apply for accreditation. This effect is precisely estimated. In Column (2), the hazard ratio of Y_{-jt} is bigger than 1 but noisy, but the hazard ratio of $NCHMO_{jt} \times Y_{-jt}$ is smaller than 1 and highly significant. These two hazard ratios suggest an interesting phenomenon: when HMO j faced a very small number of competitors, its accreditation decision is weakly similar to its competitors' decisions, but when the number of competing HMOs increases, HMO j adoption has a tendency to differ from its competitors.

This finding may reflect strategic interactions among competitors. However, it may capture the fact that competing HMOs are responding to common, omitted cost and demand factors. To distinguish these two explanations, Column (3) uses competitor sisters' average disclosure propensity ($Y_{-j,sis,t}$) as a proxy for competitors' disclosure propensity (Y_{-jt}). This alternative specification generates the same pattern as in Column (2), implying that accreditation applications are strategic complements in less competitive markets, but strategic substitutes in competitive markets. Both Columns (2) and (3) suggest that competition motivates HMOs to differentiate in accreditation application.

While not reported in a table, a similar pattern occurs in HEDIS/MSS participation. Under specification A, $NCHMO$ has a negative effect on $INHEDIS$. Because of the short panel, this effect has a large standard error if I include state dummies, but becomes significant at the 90% level if I exclude state dummies. This suggests that the propensity of participating in HEDIS/MSS tends to decline in competitive markets, which is similar to what we observe for accreditation applications. Under specification B, results are similar with and without instruments: the HEDIS/MSS participation decisions are strategic substitutes, and more so in highly competitive markets than in less competitive markets. Significant at 95% confidence level, this pattern reinforces the belief that HMO disclosure behaviors are driven by the incentives to differentiate from competitors.

Due to space limitation, Table 6 only reports a selected group of the other variables. Coefficients for non-HMO penetration and the proportion of uninsured population are either negative or insignificant, suggesting that competition among HMOs are more important for disclosure incentives than competition with non-HMO options. Most cost and demand factors, including counts of state regulations, do not have any effect on the timing of first accreditation applications. But for HEDIS/MSS participation, the effects of cost and demand factors are similar to what we observe in the summary statistics in Table 3. Specifically, disclosing HMOs tend to be larger, older, federal qualified, chain affiliated, tightly organized with doctor groups and serving areas with higher per capita income. These estimates confirm the theoretical predictions that lower disclosure cost and higher consumer demand for quality motivate HMOs to participate in HEDIS/MSS.

To summarize, HMO-level evidence confirms the market-level evidence regarding the role of competition in three aspects: (1) competition among HMOs is an important factor in disclosure incentives; (2) on average, disclosure propensities declines with the degree of competition; and (3) HMOs in highly competitive markets have stronger incentives to differentiate in disclosure decisions. These findings are consistent

with HMOs using disclosure decisions as a differentiation tool.

6 Conclusion

This paper presents a case study of HMOs examining why voluntary disclosure of product quality is not as complete as a simple unraveling theory predicts. Although cost and demand factors play a role, the empirical evidence highlights the role of competition. Specifically, voluntary disclosure seems to be a tool to differentiate among competing HMOs and such differentiation incentives contribute to lower disclosure rates in highly competitive markets.

These results demonstrate how disclosure patterns vary with competition, but do not necessarily imply that competition weakens the provision of information. Three caveats are worth mentioning. First, voluntary disclosure via NCQA is not the only channel for consumers to learn about HMOs. Even if the NCQA provides the best measures of HMO quality, HMOs also differ in many other observable dimensions (such as location). This may account for consumers' insensitivity to small differences in NCQA measures and therefore explain why voluntary disclosure is more effective in drawing crude distinctions between disclosing and non-disclosing firms rather than achieving full quality differentiation among disclosing firms.

The second caveat concerns the causal effect of competition. Because a model of entry is beyond this paper's scope, I only identify correlation between competition and disclosure. It is possible that disclosing firms are more likely to move into areas that have few managed care options, and therefore we observe higher disclosure rates in less competitive markets. This paper suggests that public policy on information disclosure should take into account competition. However, specific policies should rely on a better understanding of the causal relationship between competition and disclosure.

Finally, voluntary disclosure is related to many other decisions an HMO makes, especially price and quality. Although the theoretical scenarios discussed in this paper consider these correlations implicitly, they are mostly special cases illustrating the ambiguous correlation between competition and disclosure. Any welfare judgment would require explicit, simultaneous modeling of price, quality, and disclosure decisions. The empirical study of competition and disclosure found in this paper is intended to motivate future work along these lines.

Appendix

This section describes the definition of Y_{-jt} and $Y_{-j,sis,t}$. There are three complications: (1) competitors may overlap in some but not all serving counties; (2) not all competitors have sisters; (3) those who have sisters often have multiple sisters. I go through the following steps to construct Y_{-jt} and $Y_{-j,sis,t}$.

First, for a specific HMO and year, I calculate the number of competitors who do not have any sisters in every serving county. Then I generate the average proportion of independent competitors, weighted over all the serving counties by the 1990 census population. Because chain membership is observable to local consumers, this variable is included directly in the regression.

Second, even for a competitor with sister(s), I may not use its sister information as instruments if those sisters overlap with the HMO under study. For example, Pacific Care California serves both northern and southern California. It competes with Kaiser Northern California around San Francisco and Sacramento, and competes with Kaiser Southern California around Los Angeles and San Diego. Although Kaiser Northern California and Kaiser Southern California are sisters serving distinctive areas, they are not valid instruments for each other because they both directly overlap with Pacific Care California. Instead, to ensure the exogeneity of $Y_{-j,sis,t}$, I only include those competitors' sisters who have no overlap with the HMO under study, in this case, Kaiser plans in the East Coast, Mid-West and Northwest.

The exact calculation proceeds as follows. First I create two variables for each competitor – a dummy indicating whether it has sisters that do not overlap with the HMO under study, and if yes, the average disclosure decision of its sister(s). The second variable is counted as missing if the first variable is zero. This avoids the arbitrary choice of whether to treat those independent competitors as having sisters but no one discloses, or as having sisters and every one discloses. Then I construct the average of both variables over competitors and over all the serving areas facing competitors, weighted by the 1990 county population. This process generates two continuous variables: the proportion of competitors who have no valid instruments, and the average competitor sisters' disclosure decisions conditional on having valid instruments. If the two variables are unbalanced, I create a dummy to indicate missing values.

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Table 1: Summary of NCQA disclosure

Year	Operating HMOs	HMOs actively seeking for NCQA accreditation		HMOs participating in NCQA HEDIS		Corr (Accreditation application, HEDIS participation)	
	Counts	Counts	% of enrollment	Counts	% of enrollment		
91	568	16	3.4				
92	560	51	13.7				
93	553	98	27.6				
94	550	144	40.0				
95	562	193	59.8				
96	631	228	71.3	151	42.5	.4287	***
97	651	241	71.3	209	53.1	.5153	***
98	647	235	68.8	173	49.0	.3062	***

Notes: (1) The dummy "Actively seeking for accreditation" indicates if the HMO under study applied for accreditation during the year or acquired valid accreditation status before and the status remains valid at the end of the year under study. In the following special cases, the dummy is set equal to zero: first, those who got denial before the beginning of the year and did not file a new application within the year; second, those whose accreditation status expired before the beginning of the year and did not file a new application within the year. (2) All serving area data are based on non-missing reports from InterStudy Publications. (3) *** p<.01.

Table 2: Summary of competition and disclosure behavior

Year	HMO Data						County Data		
	OBS	# of serving counties	% of serving counties facing no competitor	# of competitors (average over serving counties)	Correlation between own and competitor disclosure decisions		OBS	# of Serving HMOs	
			Weighted	Weighted	Accreditation	HEDIS		Non-weighted	Weighted
91	568	10.58	2.34	5.31	.04		1827	3.21	7.30
92	560	10.50	2.23	5.75	.14 ***		1829	3.21	7.29
93	553	11.02	2.12	6.59	.28 ***		1862	3.39	7.83
94	550	12.46	2.27	7.17	.23 ***		2065	3.55	8.12
95	562	14.64	2.09	7.70	.21 ***		2508	3.54	8.38
96	631	17.97	.93	9.20	.15 ***	.07 *	2837	4.36	9.69
97	651	20.43	.60	10.09	.15 ***	.08 **	2948	5.02	10.64
98	647	21.90	.57	10.32	.10 ***	.16 ***	2999	5.47	10.73

Note: *** p<.01, ** p<.05, * p<.10. Weights are 1990 county population. For a specific HMO j serving multiple counties, its competitors' disclosure decision is constructed in two steps: I first compute the average disclosing rate of its competitors in each serving county, and then compute the weighted average of these disclosing rates across all serving counties.

Table 3: Summary of Cost and Demand Factors (Unit = HMO * Year)

Cost and Demand variables	Full Sample 1991-1998 Mean	Accrdapp=1 1991-1998 Mean		HEDIS=1 1996-1998 Mean	
HMO characteristics					
Total enrollment as of 1/1 of the year under study	90312	173944	(+)***	184992	(+)***
Proportion of Medicare enrollment	.0306	.0494	(+)***	.0423	(+)
HMO Age (in years)	10.3	13.68	(+)***	15.09	(+)***
Dummy =1 if IPA model	.5918	.5737	(-)	.574	(-)
Dummy =1 if for profit	.6980	.7073	(+)	.6773	(-)***
Dummy =1 if federally qualified	.4712	.6808	(+)***	.6435	(+)***
Dummy =1 if belongs to national chain other than BCBS	.4922	.6327	(+)***	.5966	(+)***
Dummy =1 if belongs to BCBS	.1387	.1443	(+)*	.1595	(+)**
# of physicians per 1000 patients*	309.32	62.33	(-)**	65.72	(-)
Growth of physician contracts	1.8736	1.6944	(-)	1.6381	(-)*
Serving area characteristics					
Total market size (sum of population in serving areas, in millions)	3.53	4.47	(+)***	4.18	(+)*
Per capita income	14752	15111	(+)***	14867	(+)***
90%-10% household income	62146	63212	(+)***	62164	(+)*
Proportion of population in serving areas over age 65	.1221	.124	(+)***	.1234	(+)
% of population in serving areas with diabetes	3.78	4.15	(+)***	4.25	(-)
% of population in serving areas overweighed	27.48	29.95	(+)***	30.58	(+)
% of population in serving areas with smoking habit	20.91	22.73	(+)***	23.46	(+)**
Average number of employees per establishment	15.11	16.08	(+)***	16.32	(+)*
Proportion of employees hired by big employers	.1141	.1223	(+)***	.1201	(+)
% of population in serving area insured in non-HMO	.591	.5712	(-)***	.5569	(-)***
% of population in serving area uninsured	.1282	.1334	(+)***	.1227	(-)*
Medicare AAPCC rate	434.10	462.85	(+)***	472.00	(-)
State regulations					
Count of state bills passed on HMO disclosure issues	.2517	.4054	(+)***	.5589	(-)
Count of state bills passed on access to doctor /care	.6062	.8324	(+)***	1.2681	(-)
Count of state bills passed on mandated benefits	.2244	.3562	(+)***	.5420	(-)

Note: "Accrdapp=1, 1991-1998" is compared to "Accrdapp=0, 1991-1998". "Hedis=1, 1996-1998" is compared to "Hedis=0, 1996-1998". "+/-" means the mean is bigger/smaller than the mean of the comparison group. *** p<.01, ** p<.05, * p<.10.

Table 4: Market-level evidence

Model	OLS	Probit		Duration
Dep. Var.	**(1) AVGACC**	**(2) YESACC**	**(3) YESALLACC**	**(4) TIME1ACC**
	1991-1998	1991-1998	1991-1998	1991-1998
	Coeff.	Coeff.	Coeff.	Hazard Ratio
NHMO: number of serving HMOs	-.0075***	.3539***	-.5886***	1.2865***
	(.0012)	(.0190)	(.0439)	(.0161)
PENENHMO: penetration of non-HMO health services	-.0341	.0068	-1.1817**	1.2025
	(.0292)	(.3392)	(.5488)	(.9053)
UNINSURED: proportion of population uninsured	-.2832***	-4.9936***	.9009	0.2855
	(.1058)	(1.3038)	(1.8521)	(.5444)
Per Capita Income ($1,000)	dropped	-.0738***	.0171	1.0000
		(.0200)	(.0302)	(.0184)
Income Gap ($1,000)	dropped	.0167**	-.0100	1.0000
		(.0067)	(.0089)	(.0055)
Count of regulations on disclosure	-.0018	-.0121	.2561***	.5838***
	(.0032)	(.0415)	(.0735)	(.0657)
Count of regulations on access to care/doctors	.0000	.0605**	-.0939	.7210***
	(.0024)	(.0300)	(.0625)	(.0355)
Count of regulations on mandated benefits	.0157***	.1035***	.2253***	.8179**
	(.0033)	(.0321)	(.0454)	(.0699)
Year Dummies	Yes	Yes	Yes	No
County Fixed effects	Yes	No	No	No
OBS available	18875	18875	18875	18875
Obs used in estimation	18875	18521	12954	7514
Pseudo R-Square	.4236(within)	.5967	.5516	
Log Likelihood		-5169.41	-1736.77	-16001.587

Note: Standard error in parentheses. ***p<0.01, **p<0.05, * p<0.1. Unit of observation is county-year. All regressions control for state dummies and a full set of cost and demand variables. The duration model assumes Weibull distribution.

Table 5: Summary of the HMO sisters subsample

Year	Full sample			Subsample -- chain members only (i.e having sisters)					
	# of Operating HMOs	Average # of competitors	% of competitors having sisters	# of Operating HMOs	# of sisters		# of sisters with no overlapping in serving area		Correlation between self and sister disclosure decisions	
					including BCBS	excluding BCBS	including BCBS	excluding BCBS	Accreditation	HEDIS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
91	568	5.26	43.44	353	32.83	16.60	32.47	16.44	.1623***	
92	560	5.70	46.38	356	31.97	16.76	31.54	16.58	.2908***	
93	553	6.54	51.14	356	30.87	17.42	30.34	17.21	.3180***	
94	550	7.10	57.09	358	30.44	17.47	29.92	17.24	.2605***	
95	562	7.65	62.46	373	30.37	17.09	29.82	16.88	.3046***	
96	631	9.18	64.72	411	31.22	19.25	30.43	18.91	.3121***	.5283***
97	651	10.07	64.46	391	33.30	19.71	32.66	19.36	.3798***	.5287***
98	647	10.30	64.58	391	35.48	22.48	34.78	22.03	.4008***	.3873***

Note: BCBS stands for Blue Cross and Blue Shield. *** p<.01.

Table 6: HMO Level Evidence - Duration Models of Accreditation Application

Dependent variable: the time of first accreditation review per HMO

	(1) Hazard Ratio (Std Err for Coeff)	(2) Hazard Ratio (Std Err for Coeff)	(3) Hazard Ratio (Std Err for Coeff)
NCHMO: Average number of competitors per county	.9014***	1.0544	1.009
	(.0332)	(.0578)	(.0482)
PENENHMO: penetration of non-HMO health services	.3672	.401	.7192
	(.3822)	(.4872)	(.8572)
UNINSURED: proportion of population uninsured	.0007**	.0004*	.0013*
	(.0024)	(.0017)	(.0052)
COMPACC: % of competitors that applied for accreditation by t		1.3323	
		(.8154)	
NCHMO*COMPACC		.6993***	
		(.0721)	
COMSISA:% of competitors' sisters that applied for accreditation by t			2.1727
			(1.9457)
NCHMO*COMSISA			.8351**
			(.0660)
Per Capita Income ($1,000)	1.0001	1.0001	1.0001
	(.0863)	(.0890)	(.0906)
Income Gap ($1,000)	1.0000	1.0000	1.0000
	(.0266)	(.0263)	(.0273)
Count of regulations on disclosure	.7781	.8060	.7941
	(.1548)	(.1657)	(.1614)
Count of regulations on access to care/doctors	.7629	.6530*	.6962
	(.1608)	(.1473)	(.1624)
Count of regulations on mandated benefits	.9073	1.2058	.9080
	(.4191)	(.5774)	(.4302)
Competitors' characteristics	No	Yes	Yes
Obs used in estimation	14145	14145	14145
Log Likelihood	-1452.37	-1417.92	-1426.73

Note: *** p<0.01, ** p<0.05, * p<0.1. Unit of observation is HMO-time. All regressions are Cox proportional hazard model, controlling for state dummies and a full set of cost and demand variables.

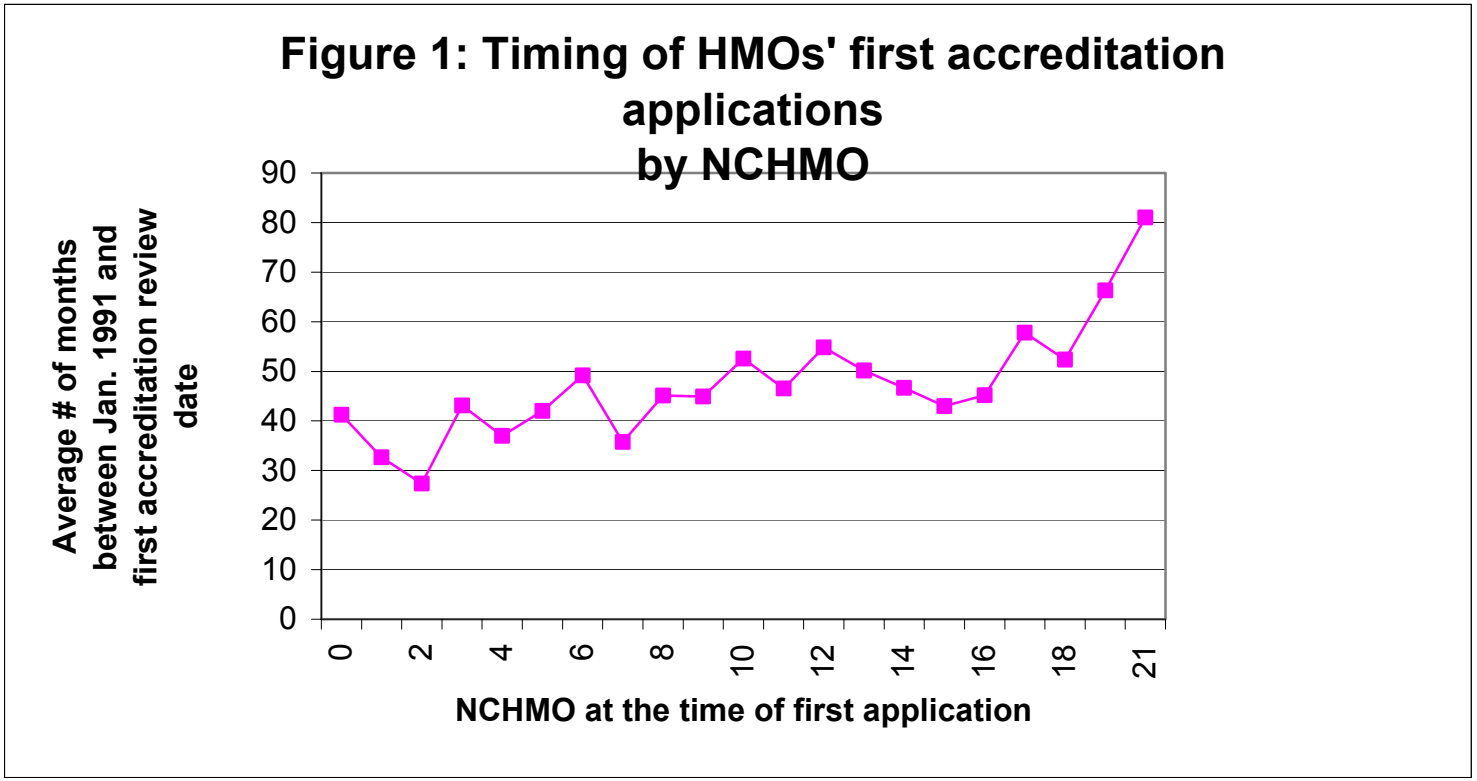
Figure 1: Timing of HMOs' first accreditation applications by NCHMO
Average # of months between Jan. 1991 and first accreditation review date
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
21
NCHMO at the time of first application