

Differentiation and Competition in HMO Markets

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Abstract

This paper examines the effect of differentiation among Health Maintenance Organizations (HMOs) on local market competition. Most markets for HMOs appear to be sufficiently unconcentrated when considered in aggregate; however, differences among HMOs may allow for higher margins than one would expect given the number of competitors. To investigate this possibility, we divide HMOs into those that serve only the local area, and those that serve a larger regional or national area. We then analyze the extent to which one type of HMO affects the local market structure of the other using an equilibrium model of entry and product choice. We find that the two types of HMOs have strong competitive effects within segments, but that the competitive effect of differentiated firms is negligible.

I. Introduction

In this paper we examine the effect of differentiation among Health Maintenance Organizations (HMOs) on local competition. When analyzing HMO competition, researchers and antitrust enforcers alike have recognized that HMOs compete for customers within distinct local geographic markets.¹ In addition, they have considered all HMOs within a local market as equivalent competitors. However, HMO differentiation may blunt competition across HMO types, and thus such market analyses may misstate the competitiveness of local markets. In this paper we identify and investigate the effects of one such difference, geographic scope, and demonstrate that local markets are strongly segmented between narrow scope, or HMOs that serve local clients, and broad scope, or HMOs that serve regional or national clients.

Until recently, it was widely regarded that HMOs offered homogeneous products and that most HMO markets were competitive. As a result, policy makers gave little thought to the competitiveness of HMO markets, and HMO mergers were largely immune from antitrust scrutiny. Recently, however, this view has changed. When the Department of Justice required Prudential and Aetna to divest some holdings in a few local markets as a precondition for merger approval, it signaled that all HMO markets were no longer assumed to be competitive. This merger also called attention to the growth of a handful of "national HMOs," which appear to differentiate themselves from local HMOs by offering one stop shopping for national employers. The combination of consolidation and differentiation among HMOs necessitates a closer look at how HMOs compete.

A common yardstick for assessing the competitiveness of a market is to compute a

¹ For example, studies of price competition among HMOs, such as Wholey, Feldman and Christianson (1995), treat HMOs as homogeneous products.

concentration index such as the Herfindahl. Another approach is to compute own and cross-price elasticities of demand.² Neither approach offers a definitive measure of competitiveness, particularly not in markets with differentiated competitors. The theoretical basis for the use of the Herfindahl is the Cournot equilibrium with homogeneous firms, so it is not well suited for assessing the extent of competition among differentiated sellers. The cross-price elasticity of demand approach requires more detailed data than are commonly available, and does not account for strategic interaction among firms in concentrated markets.

Recent research in empirical industrial organization offers new methods for evaluating the competitiveness of markets using counts of operating firms. In these approaches, the estimation model comes from a reduced form profit function combined with a game theoretic model of entry and competition. Based upon this relatively simple structure, the researcher makes inferences on margins and rivalry from information about market size and the number of competitors. The reasoning behind this analysis is straightforward. As Bresnahan and Reiss (1991) (henceforth “BR”) note, the quantity needed for a firm to cover its fixed costs of entry will be lower if that firm earns higher margins. Therefore, to the extent that the presence of additional competitors reduces margins, the average quantity needed to support additional entrants increases. In terms of the estimation, if we observe the average size of the market, or quantity, per firm increasing with the number of firms, we can infer that margins are falling as the number of firms increases. The rate at which average quantity is increasing indicates how rapidly margins are falling. As the average quantity per firm levels off, margins are no longer falling. This insight extends to segmented markets where competitors can have different types,

² Feldman et al. use their analysis of cross-price elasticities of demand to draw conclusions about HMO competition.

but here the effect on margins is more complicated.

In markets where products are not homogenous, the effects of competitors on margins are less certain. If there are distinct groups of customers that strongly prefer each product based on its particular characteristics, high margins can be maintained in the presence of multiple competitors. The empirical model developed by Mazzeo (2000) uses data on the number of operating firms that are categorized into discrete product types. These observations represent the outcomes of decisions made by firms whether to enter the market and which product type is optimal, given the choices of their competitors. Estimates from this model measure the incremental effect of additional competitors on operating profits, explicitly distinguishing between the effects of firms with similar and different product characteristics.

We use the BR and Mazzeo methods to examine the nature of competition in HMO markets. First, we treat all HMOs symmetrically. This BR-style analysis suggests that, initially, average margins do not fall as firms enter, as the market size required to support a second firm is the same as the average size of monopoly markets. After two firms, margins fall with additional firms. One potential explanation for this result is product differentiation — HMOs that pursue broad geographic coverage may not directly compete with HMOs that operate exclusively within a particular local market. This differentiation effect will be particularly evident in duopoly markets where there may be one HMO of each type. Another explanation would be that HMOs find it easier to collude in duopoly markets, resulting in high margins for both firms.

We then divide HMOs into two types, local and national. This Mazzeo-style analysis confirms the differentiation hypothesis: the estimates of the entry and product choice model indicate that competition within product types is quite strong, but that HMOs of the other

product type provide little additional competition. The presence of two distinct product types makes HMO markets less competitive than they would otherwise appear.

The remainder of the paper is organized as follows. Section II describes the HMO industry, highlighting distinct HMO strategies. We outline our data in section III. In section IV we present the alternative estimation methodologies and show how to incorporate product differentiation into the empirical model. Section V presents our estimation results and section VI concludes.

II. Differentiation Among HMOs

To understand differentiation among HMOs, it is important to recognize that HMOs typically sell to employers. Thus, differentiation among HMOs would reflect differences in preferences among employers. There may be several dimensions along which employer preferences for HMOs may differ. For example, some employers may prefer HMOs that excel in preventive care, whereas others prefer HMOs that offer access to the best physicians in their local market. Almost all HMOs offer similar coverage and contract with virtually the same set of providers, so differentiation along these dimensions is likely to be minimal.

We focus on differentiation based on the geographic scope of the HMO's business. Just as some employers have a single, local establishment whereas others have establishments throughout the nation, some HMOs do business in only one market, whereas others do business nationwide. For reasons we discuss below, employers whose operations cover broader geographic regions may prefer to contract with HMOs that also cover a broad geographic area.³

³We had several conversations with executives at HMOs. They generally agreed that HMOs can be divided into "national" and local" sellers serving substantially different markets. However, they felt that there is some overlap in

If geographic coverage turns out to be an important source of differentiation, this could profoundly affect measures of competition. This is because there are only a handful of national HMOs. To identify them, we list the HMOs in order of the share of U.S. population that is represented in the area in which the HMO does business in Table 1. In 1997, there were over 500 HMOs in the United States. Six HMOs did business in enough markets to be available to at least half the nation's population. A second group of 10 are available to between 10 and 25 percent of potential U.S. customers. The remaining HMOs, which we call local HMOs, are available to no more than 7 percent of the population. Hence, there appears to be a clear demarcation between the few HMOs that have built large regional or national networks and the rest, which limit their operations to a particular local area. This pattern appears to be stable over time; prior to a wave of mergers in the late 1990s, HMOs did not appear to be significantly expanding or reducing their geographic coverage.

Table 1 — National Population Coverage of Largest HMOs

HMO Firm	Population Coverage
CIGNA HealthCare, Inc.	81.0%
Humana, Inc.	60.5%
Aetna U.S. Healthcare, Inc.	60.1%
United Healthcare Corporation	58.6%
Foundation Health Systems	53.6%
Prudential Health Care Plans, Inc.	49.2%
NYLCare Health Plans	25.9%
Kaiser Foundation Health Plans, Inc.	25.6%
Great West Life & Annuity Insurance Company	25.4%
PacifiCare Health Systems, Inc.	25.4%
Maxicare Health Plans, Inc.	21.8%
Oxford Health Plans	17.1%
Principal Health Care, Inc.	16.9%
Mid-Atlantic Medical Services, Inc.	12.1%
Health Insurance Plan of Greater New York	11.1%
Anthem Health Plans	11.0%
AmeriChoice Corporation	7.0%
Mutual of Omaha Companies	6.8%

the customer groups served by each type of HMO. It remains an empirical question as to whether this overlap provides a substantial check on profitability.

WellCare Management Group, Inc.	6.5%
Medical Mutual of Ohio	6.5%
United American Healthcare Corporation	6.3%
AMERIGROUP Corporation	5.7%
Coventry Corporation	5.7%
Watts Health Systems, Inc.	5.1%
AmeriHealth, Inc.	5.0%

The drivers of geographic scope differentiation have not been widely studied in the literature on HMOs. Several hypotheses, based upon demand and cost drivers, might explain the differences. On the demand side, geographically disperse employers may prefer to contract with a single HMO that operates in all of their locations to provide employment based health services rather than contracting with several, local providers. Using a single provider potentially lowers contracting costs, and may result in standardized contracts and care. On these criteria, smaller employers are indifferent between contracting with national or local HMOs; some may even prefer local HMOs that tailor their offerings to the needs of local populations.

Other explanations focus on cost differences. For example, one might conjecture that there are two cost curves for HMOs. Small, local HMOs may have relatively low average costs because they have greater local market knowledge and contracts and have better relationships with hospitals. An HMO run by a local hospital system, for example, would have this sort of advantage, as would one run by former hospital administrators and other members of the community. In addition, having a small, local scale may reduce monitoring costs. Finally, a local HMO may be able to custom-design a modest, low-cost benefits package to meet the needs of price-sensitive employers, whereas national HMOs may offer relatively standardized, generous packages that reflect the desires of their national clients.

National HMOs may enjoy certain economies of scale and scope that reduce their costs. National HMOs can implement monitoring and screening programs to assure that contracting

providers practice cost-effective medicine. National HMOs can develop drug evaluation programs and purchase prescription drugs in bulk to reduce pharmacy costs. It would be very difficult for a local HMO to obtain these sorts of cost advantages. The types of large-scale investments required to successfully operate a national HMO may serve as barriers to entry, limiting the number of participants in this segment of the market.

In addition to these demand and cost considerations, there are a number of regulations that might affect the profitability and ease of entry by local and national HMOs. Medicare allows seniors to enroll in HMOs, but the process of establishing a Medicare-eligible HMO is cumbersome and payment levels can fluctuate from year to year. Certain state Medicaid programs encourage or even mandate enrollment in HMOs. But Medicaid usually pays less than do private employers for the same HMO services. States also have laws regarding capital and other financial requirements for new HMOs. We are agnostic as to how any and all of these laws might affect the number of each type of HMO.

The various explanations for geographic differentiation are not mutually exclusive and both may well contribute to the potential for earning profits for the two types of firms. For example, it may well be that large employers with geographically diverse locations prefer to contract with one HMO. In addition, there may be significant production differences and economies of scale that limit the number of HMOs that provide national coverage options. Whatever the underlying reasons for the emergence of local and national HMOs, an important question for market analysis is to what extent an additional national HMO affects competition among national HMOs, and whether the effect is the same, or less on competition among local HMOs. The answer to this question provides insight into the degree of segmentation in the market, and to what extent one should consider each segment separately when analyzing the

effect of a change in market structure due to merger, acquisition or entry. It is this question that our empirical analysis addresses.

Our focus on geographic scope contrasts existing literature on HMO differentiation that has looked at organizational differences that affect costs and flexibility of services. Prior research has investigated the difference between staff and group model HMOs on the one hand, and network and IPA models on the other.⁴ Ownership status (for-profit versus nonprofit) and cost containment strategy (e.g., use of stringent financial controls) have also been studied. While these differences may represent meaningful sources of differentiation in the eyes of some patient-consumers, preferences about these differences are unlikely to differ systematically across employers and create significant competitive differences.

III. Data

Our HMO data come from the Interstudy database for the year 1997. Interstudy uses data collected by state regulatory agencies to create a complete census of HMOs operating throughout the United States, including the states and counties in which each HMO offers its services.⁵ An HMO is considered to operate in a specific county if it has contracts with providers in that county. We do not have information on whether the HMO actually enrolls individuals in all the counties in which it operates. We assume that HMOs are actively competing in all counties in which they operate. Based on this assumption, we constructed a list of the HMOs in each

⁴The first category of HMOs typically have tightly restricted access to physicians who are either employed by the HMO or belong to a physician group that is closely aligned with the HMO. The second category of HMOs generally contract with independent physicians or groups of physicians; in turn, the physicians may contract with many different HMOs.

⁵The Interstudy dataset also contains information on enrollment, age, affiliation, tax status, federal qualification, services offered, HMO penetration, and the percent of uninsured patients. These data are not used in the current analysis.

market, and identify their type (national or local) based on the set of markets they serve.

To define geographic markets, it is essential to recognize that employers purchase HMO services in behalf of employees, and that employees strongly prefer to purchase medical services from local providers.⁶ Thus, in any given geographic area, only those HMOs that have contracted with local providers are in a position to compete for the business of local employers.

With these requirements in mind, we use the Census-defined Metropolitan Statistical Area (MSA) unit as the model for our market definitions. An MSA typically consists of a reasonably large central city and the neighboring counties from which a substantial portion of the residents commute into the central city for work. Thus, an employer might expect to have employees living throughout the MSA that would look for an HMO that operated near their homes. Larger markets that potentially have distinct submarkets may be inappropriate for this analysis, as they encompass regions that extend well beyond what many employees might be expected to travel. Therefore, we do not include the Census's Consolidated Metropolitan Statistical Areas (CMSAs), which combine a series of contiguous MSAs into a single market definition.⁷ Some additional markets not large enough to qualify as MSAs but that nonetheless constitute markets for HMO services were also added. Any U.S. county with at least 40,000 in total population was designated as a market, so long as it contains a single city with population of at least 25,000 and it does not border an MSA. Finally, we exclude markets with greater than 10 HMOs operating, limiting the data to the most comparable markets. These definitions result

⁶ See, for example, Capps et al. (2001).

⁷ For example, the Chicago CMSA covers a stretch of territory from Kenosha County in Wisconsin southeast to Porter County, Indiana. While it is conceivable that firms in Chicago might have employees living in both areas, there are likely many employers at the extremes of the CMSA who would only require locally provided health services. In addition, we omit MSAs from New England, whose borders do not correspond to county boundaries (recall that the Interstudy data list the counties in which each HMO operates).

in a total of 263 markets to be used for this study.

Tables 2 displays a summary of our data by the number of HMOs operating in a market.

While 5 markets do not have any HMOs operating and 10 only have a single HMO, 64 markets have 7 or more HMOs.

Table 2 — Total Number of HMOs per Market

Number of HMOs operating	Number of markets	Frequency (%)
0	5	1.9
1	10	3.8
2	31	11.79
3	42	15.97
4	37	14.07
5	37	14.07
6	37	14.07
7	22	8.37
8	25	9.51
9	17	6.46
Total	263	100.00

In Table 3, we split the HMOs into two mutually exclusive categories — local and non-local.

We define local HMOs to be those available to less than 7 percent of the population. The non-local category contains the regional and national HMOs listed in Table 1, as well as the Blue Cross affiliated HMOs.⁸

Table 3 —Number of HMOs per Market by Type

Non-local HMOs	Local HMOs				
	0	1	2	3	4+
0	5	7	1	8	2
1	3	24	16	7	13
2	6	17	15	6	14

⁸The Blue Cross designation is granted to a single HMO in each state — a multistate HMO may or may not bet the Blue Cross affiliate in each state where it operates. The affiliation, therefore, provides some of the benefits of a national HMO network, even if the HMO only operates locally. We have classified the Blue Cross HMOs as non-local; however, the empirical results in the following section remain in tact if the single-state Blue Cross affiliates are classified as local HMOs.

3	1	9	16	7	12
4+	9	14	18	21	12

Table 3 indicates a very striking pattern consistent with differentiation. For example, in the 31 markets with two HMOs operating, 24 consist of one local and one non-local firm but in only 7 are the two firms of the same type. If local and non-local HMOs were, in fact, identical, then the probability of such a pattern in the data would be less than one percent (based on a binomial distribution). Among the 42 markets with three HMOs, 33 contain at least one local and one non-local firm. Again, this would be highly unlikely if local and non-local HMOs were equivalent. This suggests that local and non-local HMOs are differentiated, and such differentiation affects entry decisions. For example, if a market already has one local HMO, it is more likely that the next HMO will be non-local. The reverse is also true – in a market with one non-local HMO, it is likely that the next HMO will be local. The analyses in the following section incorporate this notion of differentiation into the assessment of the competitiveness of local markets for HMO services.

Competitive factors alone do not determine the pattern of entry. Market characteristics also affect the profitability of each type of HMO. Local population is the most natural proxy for market size. We obtain local population measures for 1997 from the U.S. census. Other demographic variables might also influence market demand. We include per capita income, the percent of the population over 65 years of age, and the percent of the population classified as “nonwhite.” To control for differences based upon employer characteristics, we include the fraction of business establishments that are large, defined as those with greater than 100 employees.

Two other market characteristics might also affect HMO costs. As shown by Dranove et

al. (1998), HMOs can reduce their costs relative to other forms of health insurance if they are able to bargain effectively with providers. To capture this effect, we measure the number of hospitals in each market relative to the level one would expect for its size. (This allows us to disentangle hospital effects from sheer market size effects). Finally, each state regulates HMOs in a variety of measures. Using data from the *State by State Guide to Managed Care Law*, we measure two regulations that might drive up entry costs. One regulation requires that the HMO offer a “point of service” plan, which effectively requires the HMO to deal with all providers in the state, not just those with which it has contracts. The other subjects HMOs to state taxation. For our analysis, we create a composite variable that is the sum of two 0/1 dummies reflecting the presence or absence of these laws. Table 4 summarizes our market variables.

Table 4: Variable Definitions

Variable Name	Description
Ln(Population)	Natural logarithm of MSA population (in 1000's) Source: U.S. Census
Per Capita Income	Total income/population Source: U. S. Census
Older Resident Share	Fraction of population 65 years old or older Source: U. S. Census
Extra Hospital	Residual from equation predicting number of hospitals with demographic variables Source: Authors' calculations
Non White Share	(1-fraction of population classified as white) Source: U.S. Census
Big Establishment Share	Fraction of all MSA establishments with 100 or more employees Source: County Business Patterns
State Regulation	Point-of-Service (0/1) + Taxation (0/1) Source: State by State Guide to Managed Care Law

IV. Market Structure and Profitability

The empirical analyses in this paper are designed to examine the competitive consequences of concentrated industry structure in the HMO industry. The frameworks used are among a series of "multiple-agent qualitative-response" models introduced into the industrial organization literature to

evaluate entry strategies and market competition.⁹ In these models, firms' strategies can be represented by discrete decisions (e.g., enter/don't enter a particular market) that are determined by evaluating the profitability of potential alternatives. The goal of the econometrician is to estimate parameters of the profit functions by using data on the firms' observed decisions. Estimation of the profit functions is complicated by the fact that the decisions of competing firms may affect the profitability of the potential alternatives — for example, entry may be less profitable if other firms have also entered the market. A game theoretic behavioral model is therefore used to infer individual firm profitability from an observed market structure outcome, determined by the choices made by interacting agents. We begin by analyzing the relationship between HMO counts and market size using the BR methodology. This method does not address the potential for firm heterogeneity to relax competition among HMOs; to capture these effects we analyze a model where HMOs of different types decide whether to enter the market.

Following BR, we posit a simple yet flexible profit function -- in a symmetric equilibrium in market m , the profit of each firm is given by:

$$\Pi_m = (\text{Variable Profits})_m * (\text{Market Size})_m - (\text{Entry Costs})_m .$$

The effects of competition are incorporated by allowing variable profits to be a function of the number of firms.¹⁰ Specifically, let the profits of each of n symmetric firms operating in market m equal:

$$\Pi_{n,m} = X_m \beta - \mu_n + \varepsilon_m$$

⁹ In addition to the papers cited here, see Berry (1992), Toivanen and Waterson (1999) and Seim (2000). Reiss (1996) provides a discussion of the empirical framework.

¹⁰ It is also possible that incumbent firms could erect more explicit barriers-to-entry, causing entry costs to rise as the number of market participants increases. We will not be able to distinguish between these two explanations in this analysis.

where X_m are exogenous market factors (including market size), μ_n measures the effect of n competitors on per-firm profits, and ε_m is a market-level error term assumed to follow a normal distribution. We assume that firms enter the market if they earn nonnegative profits. Therefore, the probability of observing n firms in equilibrium equals:

$$P(\Pi_n \geq 0 \text{ and } \Pi_{n+1} < 0) = \Phi(\bar{\Pi}_n) - \Phi(\bar{\Pi}_{n+1})$$

where Φ is the cumulative normal density function and $\bar{\Pi}_n = X_m \beta - \mu_n$. We can use ordered probit to estimate this relationship.

To accommodate differentiation among competitors, we employ a model that endogenizes product type choice as well as entry. We permit competitors to choose between two types (e.g., “local” and “non-local”) and posit a separate profit function for competitors of each type. This allows us to determine whether same-type competitors affect profits more than different-type competitors. We include both the number and product types of competitors as arguments in the reduced form profit function. We treat all firms within a given profit type as symmetric.

Given these assumptions, we can specify the profits of a firm with quality type T in market m , where market m contains N_1 firms of type 1 and N_2 firms of type 2:¹¹

$$\pi_{T,m,N_1,N_2} = X_m \beta_T + g(\theta_T; \overrightarrow{N_1}, \overrightarrow{N_2}) + \varepsilon_{Tm}.$$

The first term represents market demand characteristics that affect firm profits (note that the

¹¹ This specification of the profit function was chosen primarily to make the estimation tractable. Following Berry (1992) and Bresnahan and Reiss (1991), it can be interpreted as the log of a demand (market size) term multiplied by a variable profits term that depends on the number (and product types, in this case) of market competitors. There are no firm-specific factors in the profit function. The error term represents unobserved payoffs from operating as a particular type in a given market. It is assumed to be additively separable, independent of the observables (including the number of market competitors), and identical for each firm of the same type in a given market.

effect of X_m varies by type). The $g(\theta_T; \vec{N1}, \vec{N2})$ portion of the profit function captures the effects of competitors, with the vectors $\vec{N1}$ and $\vec{N2}$ representing the number of competing firms of each type. Parameters in the $g(\theta_T; \vec{N1}, \vec{N2})$ function distinguish between the effects of same-type and different-type firms on profits, and capture the incremental effects of additional firms of each type.¹² The parameter vector θ also varies across types, T , so that the competitive effects may differ by type. The unobserved part of profits, ε_{Tm} , is assumed to be different for each product type at a given market.

To proceed, we need to make an assumption about the nature of the entry process. We will start by assuming that there are two possible types of HMOs that could enter a given market — national (S) or local (L). Abstracting from differences among firms of the same type, firms that do enter market m earn $\pi_{Tm}(\vec{N1}, \vec{N2})$, where T is the product type chosen and $\vec{N1}, \vec{N2}$ represents the number and product types of all the competitors that also operate in market m . Firms that do not enter earn zero. Players sequentially make irrevocable decisions about entry before the next firm plays. Firms anticipate that subsequent firms will have the opportunity to make decisions about entry and product type once they have committed to their choice. For this game, a Nash Equilibrium can be represented by an ordered pair (S, L) for which the following inequalities are satisfied:

$$\begin{array}{lll} \pi_S(S-1, L) > 0 & \pi_S(S, L) < 0 & \pi_S(S-1, L) > \pi_L(S-1, L) \\ \pi_L(S, L-1) > 0 & \pi_L(S, L) < 0 & \pi_L(S, L-1) > \pi_S(S, L+1) \end{array}$$

As long as we assume that an additional market participant always decreases profits and that the

¹²Note that this specification measures the same competitive effect for all values of the X-variables. While this does not allow the competitive effects to vary according to values of the demand regressors, it keeps the number of parameters to estimate manageable.

decrease is larger if the market participant is of the same product type, a unique equilibrium exists.¹³

Under our assumptions above, the inequalities corresponding to exactly one of the possible ordered-pair market structure outcomes are satisfied for every possible realization of (ϵ_S, ϵ_L) based on the data for the market in question and values for the profit function parameters.

Assuming a distribution for the error term, a predicted probability for each of the possible outcomes is calculated by integrating $f(\epsilon_S, \epsilon_L)$ over the region of the $\{\epsilon_S, \epsilon_L\}$ space corresponding to that outcome.¹⁴

Since the equilibrium is unique, the sum of the probabilities for all market configurations always equals one. Maximum likelihood selects the profit function parameters that maximize the probability of the observed market configurations across the dataset. The likelihood function is:

$$L = \prod_{m=1}^M \text{Prob}[(S, L)_m^o]$$

where $(S, L)_m^o$ is the observed configuration of firms in market m — its probability is a function of the solution concept, the parameters and the data for market m . For example, if $(S, L)^o = (1,1)$ for market m , the contribution to the likelihood function for market m is $\text{Prob} [(1,1)]$.

¹³ Mazzeo (2000) contains proofs of existence and uniqueness. Note that \vec{N} represents the product types of competing firms (not including itself). For a national firm in market (S, L) , $\vec{N} = (S-1, L)$; for a local firm, $\vec{N} = (S, L-1)$.

¹⁴ In the estimation, markets are constrained to have no fewer than zero and no more than four firms of either product type. The region corresponding to a product-type configuration with zero or four national or local firms operating, therefore, is unbounded on at least one side. The appropriate integration limit is (plus or minus) infinity.

V. Estimation Results

Our first empirical analysis predicts the total number of HMOs that operate in each market, without making distinctions between local and non-local firms. As described above, we start by estimating an ordered probit model with seven categories — markets with six or more HMOs are placed in the same category. The behavioral model underlying the ordered probit suggests that any association between market conditions and a larger number of operating HMOs indicate that HMOs are more profitable under these conditions. The estimated parameters also allow us to calculate entry-threshold ratios, which provide evidence on how additional market concentration affects firm profitability.

Table 5 presents the ordered probit results with seven entry categories — markets with six or more HMOs are placed in the same category. The market level variables are important for explaining the number of HMOs in a market. The coefficient on the log of population, our primary measure of quantity in subsequent analysis, is positive and estimated quite precisely. As per capita income increases, the number of HMOs declines, all else equal, indicating that HMOs are an inferior good. We also find that the number of HMOs is increasing in the share of older residents, in the share of nonwhite population and the share of large employers in the market. These may reflect demand side influences—the relatively lower cost of HMOs may be more attractive to all three groups. The effect of large establishments on the number of HMOs could also reflect cost side explanations if administration costs are lower when the HMO is contracting with fewer employers for the same number of enrollees. Looking further at the cost side, we find that additional hospitals lead to more HMOs, and that regulations hinder entry.

Table 5 — Ordered Probit Results; Dependent Variable = Number of HMOs in the Market

<u>Parameter:</u>	<u>Estimate</u>	<u>Standard Error</u>	<u>z</u>
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Ln (Population)	β_P	0.8276	0.0974	8.500
Per Capita Income	β_I	-0.0001	0.0000	-2.864
Older Resident Share	β_O	7.2323	2.2840	3.166
Extra Hospital	β_{EH}	0.0801	0.0454	1.765
Non White Share	β_{NW}	1.4049	0.5701	2.464
Big Establishment Share	β_{BE}	68.6522	28.5987	2.401
State Regulations	β_R	-0.3060	0.1006	-3.040
Cut1	μ_1	7.0129	1.2113	
Cut2	μ_2	7.6118	1.2083	
Cut3	μ_3	8.4360	1.2187	
Cut4	μ_4	9.0981	1.2320	
Cut5	μ_5	9.5736	1.2421	
Cut6	μ_6	10.0339	1.2500	

Notes: Number of observations =263, LR $\chi^2(7) = 109.78$, Prob > $\chi^2 = 0$, Pseudo R² =0.1254, Log likelihood = -382.74105. See Table 4 for variable definitions and data sources.

The ordered probit estimation generates a set of "cut points," which correspond to the constants that separate adjacent response categories, μ_n . These estimates can be used to examine the relationship between market size and the number of operating firms.¹⁵ As noted previously, if we expect that variable profits are higher in more concentrated markets, then the average quantity per firm should increase as the number of firms increases. Using population as a natural measure of quantity (enrollees), we rewrite the profit function underlying the ordered probit estimation to isolate the market size contribution:

$$\Pi_{n,m} = \beta_P * \ln(\text{population}) + X_m \beta - \mu_n + \varepsilon_m$$

which means that if n firms are observed if:

$$\mu_n < \beta_P * \ln(\text{population}) + X_m \beta < \mu_{n+1}$$

¹⁵ This method for calculating entry threshold ratios is suggested by Abraham, Gaynor and Vogt (1998) in their analysis of local hospital markets.

Holding the other market characteristics constant at their mean levels, we can solve for the minimum population required to support n HMOs:

$$Population = \exp\left\{\frac{\mu_n - \bar{X}\beta}{\beta_p}\right\}.$$

From these, we calculate the predicted minimum average population per firm in a market with n firms, s_n . (This is just the minimum population divided by the number of firms). We refer to this as the *threshold quantity*. We calculate the threshold ratio $\frac{s_{n+1}}{s_n}$. If margins fall as the number of firms increases, we expect a threshold ratio to exceed 1, indicating that the minimum average quantity is increasing with the number of firms.

Table 6 displays the predicted threshold ratios and minimum market quantity based on the estimates of Table 5. Although previous research (e.g. BR) has generally found monotonically declining threshold ratios, the threshold ratio for HMOs has a nonmonotonic relationship with the number of firms. The threshold ratio for two firms is close to one, increases to 1.8 for three firms, and continues to fall thereafter. A threshold ratio of one indicates that the presence of the second firm does not result in lower margins for the monopolist. This result is consistent with several possibilities – the second firm might collude with the first, there could be substantial competition from other forms of insurance (so that neither HMO makes positive profits), or the second firm might be highly differentiated from the first. The threshold ratio for the third firm of 1.8 rules out competition from other forms of insurance. The next analysis explores whether product differentiation can explain this pattern.

Table 6 — Estimated Entry Threshold Ratios Calculated Using Ordered Probit Estimates

Number of Firms	Threshold ratios	Estimated Population
1		6,294
2	1.031	12,977
3	1.805	35,128
4	1.669	78,174
5	1.421	138,868
6	1.453	242,170

To evaluate the effect of product differentiation on competition, we turn back to the empirical framework described in the previous section. We allow for between zero and four firms of each product type in the market — therefore, the dependent variable can take on one of 25 possible values. The profit function to be estimated contains the function $g(\theta_T; \vec{N1}, \vec{N2})$ that captures the effects of competitors and their product types. For each firm type and market configuration, a set of dummy variables is defined, and the corresponding θ -parameters represent the incremental effects of additional competitors.

The reported estimates reflect the following specification of the competitive-effect dummy variables:¹⁶

$$\begin{aligned}
g_{\text{LOCAL}} = & \theta_{LL1} * \text{presence of first local competitor} \\
& + \theta_{LL2} * \text{presence of second local competitor} \\
& + \theta_{LL3} * \text{presence of third local competitor} \\
& + \theta_{LS} * \text{number of nonlocal competitors}
\end{aligned}$$

¹⁶ The goal is to make the specification of the competitive effects through $g(\theta_T; \vec{N})$ as flexible as possible, while maintaining estimation feasibility. For example, in the cases where the data indicate the "number" of competitors, I implicitly assume that the incremental effect of each additional competitor is the same. More flexible parameterizations of these effects did not yield further economic distinctions.

$$\begin{aligned}
g_{\text{NONLOCAL}} &= \theta_{SS1} * \text{presence of first nonlocal competitor} \\
&+ \theta_{SS2} * \text{presence of second nonlocal competitor} \\
&+ \theta_{SS3} * \text{presence of third nonlocal competitor} \\
&+ \theta_{SL} * \text{number of local competitors}
\end{aligned}$$

As in the ordered probit, the appropriate X-variables to include are either correlated with HMO demand or costs in each market. Note that the data for the X-variables are transformed to the log of the actual value for that market divided by the sample mean of that X variable across all the markets in the dataset. Consequently, a value of X equal to the sample mean is transformed to zero, a value above the mean becomes positive and a value below the mean becomes negative.¹⁷ The profit function specification also allows the effects associated with the X-variables to vary by product type. The results are presented in Table 7.

The estimated parameters indicate the relative profits earned by local and non-local HMOs depending on market conditions and the competitors they face. For example, the relative value of the constants indicates that if we hold market characteristics constant, a monopoly national HMO is slightly more profitable than a monopoly local HMO ($C_S = 2.0529$ vs. $C_L = 1.8261$).¹⁸ Factoring in market conditions, however, can change this relationship. For example, suppose that in market m , population is one-tenth the sample mean, there are no state regulations, and the other X-variables are at their sample means. With no competitors, profits earned by a local HMO are on average higher ($\pi_L = 1.8261 + (-2.303) * (0.3994) = 0.906$) than

¹⁷ The transformation is done solely to facilitate estimation of the model. Since the estimation is computationally intensive, it is also preferable to use a smaller number of explanatory variables. Therefore, several of the X-variables used in the ordered probit estimations are dropped for the estimation of the entry and product choice model.

¹⁸ All the figures presented in this section represent predicted payoffs. The comparisons between payoffs to operating as each product type assume that values of the unobservable part of profits for both types are at their mean — zero. Directly evaluating the probability that one type's payoffs are greater than the other's requires the standard errors of the parameters, as well as an assumption about the variance of the local and non-local profit function errors.

for a non-local HMO ($\pi_S = 2.0529 + (-2.303)*(0.5642) = 0.754$).¹⁹

Table 7 — Profit Function Estimates from Equilibrium Product Choice Model

Parameter		Estimate	Standard Error
<u>Effect on Profits for Local HMOs</u>			
Constant	C_L	1.8261	0.1618
Local Competitor #1	θ_{LL1}	-1.0651	0.1035
Local Competitor #2	θ_{LL2}	-0.7410	0.0742
Local Competitor #3	θ_{LL3}	-0.6344	0.0754
# of Non-local Competitors	θ_{LS}	-0.0174	0.0322
Population	β_{L-P}	0.3994	0.0732
Per Capita Income	β_{L-I}	-0.1342	0.4488
Older Resident Share	β_{L-O}	-0.1172	0.2285
Large Establishment Share	β_{L-BE}	0.6032	0.1370
State Regulations	β_{L-R}	-0.0676	0.0837
<u>Effect on Profits for Non-local HMOs</u>			
Constant	C_S	2.0529	0.1666
Non-local Competitor #1	θ_{SS1}	-1.0535	0.1084
Non-local Competitor #2	θ_{SS2}	-0.6433	0.0665
Non-local Competitor #3	θ_{SS3}	-0.5148	0.0638
# of Local Competitors	θ_{SL}	-0.0162	0.0313
Population	β_{S-P}	0.5642	0.0754
Per Capita Income	β_{S-I}	-1.8227	0.4533
Older Resident Share	β_{S-O}	0.8666	0.2494
Large Establishment Share	β_{S-BE}	-0.0884	0.1406
State Regulations	β_{S-R}	-0.2307	0.0871

Most striking, however, are the estimated competitive effects on HMO type, as captured by the θ -parameters. The estimates indicate that the effects of competitors on profitability come almost exclusively from same-type HMOs. For both local and non-local firms, the presence of a same-type competitor cuts baseline profits by more than half ($\theta_{LL1} = -1.0651$; $\theta_{SS1} = -1.0535$), while the presence of competitors of the other product type have a negligible impact on profits. This provides strong evidence that HMOs are differentiated, and that differentiation is a

¹⁹ With population at one-tenth the sample mean, the parameter estimate for population is multiplied by $\ln(0.1) = -2.303$, to compute the predicted payoffs. The transformed value of an X-variable at its sample mean is zero; therefore, the other variables do not contribute to the predicted profits.

profitable strategy. To illustrate, consider a market with average values for the X-variables when a national HMO already operates. Profits for a local firm would be $\pi_L = 1.8261 + (-0.0174) = 1.8087$, while profits for a second non-local firm would be $\pi_S = 2.0529 + (-1.0535) = 0.9994$. The relative difference between the competitive effect of same and different-type firms explains why the presence of a second HMO did not appear to increase competition in the entry threshold analysis. Product differentiation insulates HMOs from lower margins that typically result from reduced competition in homogeneous product markets.

The remaining θ -parameters represent the incremental effects of additional competing firms. These effects become smaller as the market concentration decreases. For example, the effect of the second non-local competitor on profits for non-local HMOs is about two-thirds the effect of the first non-local competitor ($\theta_{SS1} = -1.0535$ vs. $\theta_{SS2} = -0.6433$); the third non-local competitor's effect is smaller still ($\theta_{SS3} = -0.5148$). Non-local profits are reduced by the sum of the coefficients when there are three nonlocal competitors: $-1.0535 + -0.6433 + -0.5148 = -2.2116$. Note that since this sum exceeds (in absolute value) the estimated non-local constant, a fourth non-local HMO firm would not be profitable on average at a market with the sample mean values of the X-variables. Thus, we would not expect to see such a market configuration.

We can present our differentiated firms analysis in a manner similar to our undifferentiated firms analysis. To do so, we again exploit our measure of quantity, population, to form estimates of minimum quantities required to support a given market structure. In theory, threshold measures are not unambiguous when there are several types of firms present because of the interaction effects. However, in our application the two types are essentially distinct and

we can summarize the information by reporting entry thresholds for each type of firm.

Table 8 reports these ratios assuming only one type of firm in the market. This is just a straightforward application of the former insight about minimum average quantity and margins. As before, we solve for the minimum average quantity required to support N firms of type i (i = S, L) by setting the profit for that type equal to zero. Thus for a firm of type T with one own competitor we solve:

$$\Pi_{T2} = \beta_{TP} * \ln(\text{population} / \text{populationmean}) + X_m \beta + C_T + \theta_{T1} = 0 .$$

Assuming the mean level of the market characteristics, we can solve for the minimum population required to support two same type HMOs as:

$$\text{Population} = \exp\left\{\frac{-C_T - \theta_{T1}}{\beta_{TP}}\right\} * \text{populationmean} \quad (1) .$$

Table 8: Threshold Ratios for Local and Non-Local HMOs

Number of Firms	Threshold ratios	Estimated Market Population
Local HMOs:		
1		2505.0
2	7.197	36054.3
3	4.262	230513.1
4	3.672	1128551.7
National HMOs		
1		6371.1
2	3.235	41224.2
3	2.085	128924.1
4	1.868	321072.3

The implied entry thresholds from table 8 confirm that once we account for different types of HMOs the entry thresholds monotonically decline as we expect.

The remaining X-variables indicate factors that contribute to higher relative profitability of the local and non-local firms. For example, population has a positive and significant effect on

profits of both product types, but the relative size of the coefficients indicates that firms in markets with population above the sample mean tend to favor national HMOs, while local HMOs are more profitable in below-average population markets. It is also interesting to note that the proxies that predicted the presence of additional HMOs in the ordered probits break out differently in terms of the profitability of each firm type. The demand variables reflecting the per capita income and share of older residents have statistically significant coefficient estimates in the non-local HMO profit function. On the other hand, the markets with a greater share of large employers attract more local HMOs. This result is somewhat surprising, though our measure of employer size does not necessarily reflect whether employers have a national presence. (For example, a retail chain like the Limited may have many small local establishments, and prefer to purchase from a national HMO.) On the cost side, the presence of state regulations reduces profits for the non-local HMOs.

VI. Conclusions

Recent developments in econometric methodology have allowed economists and policy makers to make reasonable assessments of the competitiveness of markets — even without detailed data on demand, prices or costs. Empirical results from homogenous product industries suggest that competition increases rapidly as market concentration falls. The presence of one or two additional firms results in margins substantially lower than a similarly situated monopolist would earn. Such results can provide guidance, for example, on how closely to scrutinize a merger that will reduce the number of competitors in an industry.

In heterogeneous product industries, however, firms offering similar services may not be direct competitors due to differences in their geographic location, customer base, or other aspects

of their business strategy. This appears to be the case in HMO markets. Local HMOs do not have a substantial competitive effect on HMOs with a national geographic scope, and vice versa. Policy makers ought to explicitly consider within product-type concentration when assessing the competitiveness of markets in this and other differentiated industries.

References

- Abraham, Jean, Martin Gaynor and William B. Vogt (1998), "Entry and Competition in Local Hospital Markets, mimeo.
- Berry, Steven T., (1992), "Estimation of a Model of Entry in the Airline Industry," Econometrica, 60(4), 889-917.
- Bresnahan, Timothy F. and Peter C. Reiss (1991), "Entry and Competition in Concentrated Markets," Journal of Political Economy, 99(5), 977-1009.
- Cory Capps, David Dranove, Shane Greenstein, and Mark Satterthwaite, "The Silent Majority Fallacy of the Elzinga-Hogarty Criteria: A Critique and New Approach to Analyzing Hospital Mergers," Northwestern University working paper, 2001.
- Mazzeo, Michael J. (2000), "Product Choice and Oligopoly Market Structure," mimeo.
- Reiss, Peter C. (1996), "Empirical Models of Discrete Strategic Choices," American Economic Review, 86(2), 421-426.
- Seim, Katja (2000), " Geographic Differentiation and Market Structure: The Video Retail Industry," mimeo.
- Toivanen, Otto and Michael Waterson (1999), "Market Structure and Entry: Where's the Beef?" mimeo.
- Wholey, Douglas, Roger Feldman and Jon B. Christianson (1995), "The Effect of Market Structure on HMO Premiums," Journal of Health Economics, 14, 81-105.