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MANAGED HEALTH CARE AND PROVIDER INTEGRATION: A THEORY OF BILATERAL MARKET POWER

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ABSTRACT

Recent empirical studies point to the need for a model of bilateral market power between health plans and provider organizations. We develop such a model and use it to analyze the impact on cost and access of alternative contractual relationships between plans and providers. The plans differentiate themselves through distinct, albeit overlapping, provider networks of specialized, complementary inputs (physician groups and hospitals). We analyze subgame perfect strategic pricing equilibria for a range of possible contractual relationships between the upstream providers and the downstream insurers, including different internal organizational structures of vertically integrated health plans, such as group- and staff-model HMOs and PPOs. A decentralized market structure produces inefficiencies from pricing coordination failures. Integration may be able to overcome pricing inefficiencies, with performance affected by the internal organization of vertically integrated health plans. Providers and MCOs do not achieve maximum net revenue when they are monopolies or monopsonies, but rather at an intermediate level of market power.

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1. Introduction

The rise of managed health care organizations has transformed health care delivery and insurance in the US.[1] Managed care encompasses a tremendous variety of structures. Nevertheless, one defining feature is the insurer's restriction of patient choice to a designated network of health care providers. This feature sets the stage for strategic vertical relations to arise between insurers—the managed care organizations (MCOs)—and health care providers.

Empirical evidence certainly supports the view that vertical relations in the health care industry affect the cost of health care services. Cutler, McClellan and Newhouse (2000) examine the treatment of heart disease in MCOs and traditional insurance, and find that the 30 to 40 percent lower expenditures of MCOs are almost overwhelmingly attributable to lower unit prices, rather than differences in treatments or health outcomes. Studying eight medical conditions, Altman, Cutler and Zeckhauser (2000) find that a large fraction of the 40-percent lower expenditures (compared to indemnity insurance) comes from MCOs paying lower prices for the same services. In a study of hospital-physician integration, Cuellar and Gertler (2001) conclude that exclusive arrangements have an important effect on costs.

Major problems arise, however, in drawing general inferences from these empirical studies. Health economics lacks a clearly articulated analysis that identifies how different contractual relationships between health care providers and MCOs affect the cost of health care. There are several challenges to developing such an analysis. First, the strategic relationships between upstream providers and downstream insurers in the health care industry differ markedly from the traditional textbook analyses of vertical relations, which assume, usually for analytical tractability, that there is a monopoly on at least one side of the relationship. Such an assumption is at odds with the facts. Health care providers and MCOs are imperfectly competitive, with both sides able to exercise market power and make strategic decisions on pricing and contractual relations.

[1] Whereas before the 1980s fee-for-service indemnity insurance was predominant, by 1993 almost three-quarters of all insured Americans were enrolled in some form of managed care (Glied 2000), and by 1999 fewer than one in ten Americans with employer-sponsored insurance had traditional indemnity insurance (Dudley and Luft 2001).

A second challenge arises from the distinctive nature of specialization in the health care industry. The service of a particular doctor or hospital, unlike a traditional upstream input such as oil or steel, has unique characteristics. Also, the services of differentiated providers upstream create downstream MCOs that consumers and organized purchasers also perceive to be differentiated. As a result, as Gaynor and Vogt (2000) have aptly observed, what is needed to understand the health care industry is a model of "bilateral oligopoly." Empirical studies confirm the need for such a model. Feldman and Wholey (2001) conclude their study of HMO monopsony power by emphasizing "the need for different models" since "the markets for hospital and physician services may be organized differently [from standard models]"; "it seems plausible to us that the relation between medical groups and HMOs should be modeled as an example of bilateral (two-way) market power" (p.20).

In this paper we develop just such a model of bilateral oligopoly that captures many of the distinctive features of vertical relations in the health care industry. The analysis builds upon and extends the work of Pepall and Norman (2001). We begin by assuming that insurers are organized as managed care organizations (MCOs) and that these competing organizations differentiate themselves by creating distinct, but overlapping, health care provider networks. The degree to which consumers perceive MCOs to be differentiated significantly affects the impact of different contractual arrangements on cost and access to health care. An important feature of our analysis is that we allow this degree of perceived differentiation between MCOs to vary. This allows us to examine the incentives that different health provider groups have explicitly to differentiate their services or their brands from those of their rivals. Our focus on perceived differentiation makes the model readily applicable to analyzing the trend toward expanded consumer and employer choice in health care.

Our approach is very different from earlier work on vertical relations between upstream providers and downstream insurers in the health industry, such as Gal-Or (1999), in that we investigate the important complementary relationship between the upstream health service providers. That is, we allow for alliances of specialized, complementary upstream providers, such as physician groups and hospitals.

Premium competition has long been advocated as a way to increase "value for money" in health care (Enthoven 1993). We show that the outcome of premium competition among MCOs is determined by the vertical relations between the upstream providers and the downstream MCOs and by the degree to which consumers perceive the competing MCOs to be offering differentiated health care services. But this is a two-way street. The contractual relationships that are likely to be adopted by providers and MCOs will themselves be affected by the strength of premium competition. Our primary goal in this paper, therefore, is to investigate this interaction between the contractual relationships between the upstream providers and the downstream insurers and the cost of and access to health care. The contractual relationships that we analyze include horizontal alliances among upstream providers as well as more vertically integrated organizations found in HMO and PPO models. These cases capture many of the features of the diverse organizational forms in health care ranging from loose "virtual integration" (Robinson and Casalino 1996) to centralized vertical integration such as in staff-model HMOs.

The paper is organized as follows. In the next section, we develop the model of competing MCOs with overlapping provider networks. We then analyze strategic pricing equilibria under several alternative market structures, beginning in section 3 with the benchmark case of decentralized, or arms-length, contracting between insurers and providers. Section 4 considers horizontal upstream integration in the form of overlapping physician-hospital alliances and an overall provider consortium while section 5 analyzes partial vertical integration. Under partial vertical integration we allow for differing degrees of autonomy or "power" for providers within the integrated MCO, comparing strong provider autonomy in what we label a Preferred Provider Organization (PPO) with staff- and group-model HMOs. Section 6 provides a comparison of the manner in which the different organizational structures affect access to and cost of health care.

2. The Model: Competing MCOs with Overlapping Provider Networks.[2]

[2] To assist anyone interested in applying the model to other questions in the industrial organization of health care, we have made the underlying *Mathematica* code for solving the model available at http://www.tufts.edu/~gnorman/. We request only that you cite our work when using the model.

The upstream market of health providers consists of two physician groups, $j = 1,2$, and two hospitals, $k = 1', 2'$, each offering services that are compatible with the other group and that are differentiated or specialized.[3] For example, the two physician groups could employ different physicians or could differ in the mix of medical specialties covered. The hospitals could differ in location or could specialize in different kinds of inpatient services. Physicians and hospitals are complementary inputs into health care. Different combinations of them produce differentiated health care services. That is, a particular surgeon working in a particular hospital potentially delivers a different outcome than having the same surgeon working in a different hospital.

In the era of managed care the common form of payment to health service providers is *capitation*, a bundled prepayment per enrollee per time period. Capitation payment is prevalent among some kinds of physicians (e.g., primary care providers) and some regions (e.g., California, Pennsylvania) (Dudley and Luft 2001). In California in 1998, 63 percent of HMOs paid primary care providers through capitation. For hospital services, bundled prepayments often take the form of prospective payment per admission, such as payment based on Diagnosis Related Groups. However, capitation payment of hospitals has been used.[4] In addition, physician-hospital organizations often compete for "global capitation" payment for physician and hospital services. Here we assume capitation payment for all upstream health service providers. However, since we abstract from the incentive effects of alternative payment systems, our results do not depend on this assumption. We show in Appendix A, for example, that the analysis can also encompass fee-for-service and intermediate forms of mixed payment. What does matter is the scope of the services covered by capitation: that is, the degree to which a physician group and hospital *jointly* negotiate a "global" capitation rate or set their fees.

[3] For simplicity of exposition, we label the upstream providers physician groups and hospitals; but the model applies to any combination of complementary specialized inputs—nurses, other physician aids, or even pharmaceuticals and medical equipment—that are combined to produce differentiated downstream health care products.

[4] For example, PacifiCare Health Systems in California asked enrollees to choose a hospital for inpatient care, if needed. PacifiCare then paid the hospital a fixed payment for each enrollee who chose it. In 1998, such hospital capitation arrangements covered over 90 percent of PacifiCare's California enrollees, although many hospitals subsequently withdrew from these arrangements (Dudley and Luft 2001).

The prices, or capitation rates, paid to the upstream health providers are denoted by v_j and v_k, $j \in \{1, 2\}$, $k \in \{1', 2'\}$, with $\mathbf{v} = (v_1, v_2, v_{1'}, v_{2'})$. We assume that the physician services of group j are produced at a constant marginal cost of c_j, and that hospital k produces inpatient services at constant marginal cost c_k. For simplicity we assume that the marginal costs of all the upstream providers are equal, and so can be normalized to zero without loss of generality: $c_j = c_k = 0$, $j \in \{1, 2\}$, $k \in \{1', 2'\}$.

The upstream providers deliver health services for an MCO, which acts as an insurer competing in the downstream market for buyers of health care plans. Figure 1 describes the basic setup. The upstream providers are shown in the circle nodes distinguished by primed and unprimed values: the circle nodes 1' and 2' are the two suppliers of hospital services while 1 and 2 are the two suppliers of physician services. Thus, the downstream sector has four MCOs, shown in the squared nodes, each differentiated by the physician and hospital services it offers. There is an MCO offering the health care services provided by a combination of physician group 1 with hospital 1'; another offering the services provided by physician group 1 and hospital 2'; a third offering the services provided by combining physician group 2 and hospital 1'; and a fourth offering the combination of 2 with 2'.

(Insert Figure 1 here)

To deliver one unit of health care service to an enrollee an MCO requires the input of one unit of physician service and one unit of hospital service. That is, there is a constant returns to scale, fixed proportion production technology in providing health care services. Under capitation the MCO prepays for the services of the health care providers, and so the risk of enrollee illness is shifted from the MCO to the upstream health providers. For simplicity, we assume that the risk factor of each enrollee is the same; that is, each enrollee becomes ill with probability ρ, and requires then one unit of health care service. As long as we assume that enrollee risk is observable, the model could be extended to allow for risk heterogeneity among enrollees. In that case the negotiated capitation rate for health care providers would be risk adjusted to account for differing patients' expected costs. That is, the capitation payment to provider j for enrollee with risk i, v_{ij}, would be individually risk adjusted according to ρ_i . Thus, a health care provider would receive a larger payment for an elderly diabetic than for a healthy 20-year-old.

The assumption of observable risk obviates the problem of adverse selection,[5] allowing us to focus on the strategic pricing issues that arise independently of adverse selection or risk selection in health care markets. Extending this framework to examine interactions with selection, particularly when enrollees value provider choice and valuation of choice is correlated with health cost risk, is left to future research.

The MCOs compete for enrollees in one of two ways. The four plans could constitute the health insurance options offered by a payer, such as a large employer or a government program.[6] Alternatively, the four MCOs could compete for employers who are seeking a single plan to offer to their employees. The plans would then be competing for employer contracts. In either case, the number of enrollees in an MCO depends on its premium, the premiums quoted by the competing MCOs, and the appeal of the MCO's differentiated providers to the enrollees.

Specifically, we assume that the demand for MCO $(j; k)$'s services depends upon the premium that it charges, $p_{(j;k)}$, the premiums charged by other competing plans, $p_{(j';k')}$, and the differentiated health care provider network that it offers. This relationship is represented by the following simple linear function:

$$(1) \qquad q_{(j;k)}(\mathbf{p}) = 1 - p_{(j;k)} - \frac{1}{\beta}\left(p_{(j;k)} - \overline{p}\right) \qquad (j \in \{1,2\}; k \in \{1', 2'\})$$

where $\mathbf{p} = (p_{(1;1')}, p_{(1;2')}, p_{(2;1')}, p_{(2;2')})$ and $\overline{p} = \left(p_{(1;1')} + p_{(1;2')} + p_{(2;1')} + p_{(2;2')}\right)/4$. The parameter β describes how differentiation or specialization of the health care provider network of an MCO affects premium competition among the MCOs. The greater is β, the greater is the perceived degree of

[5] Alternatively we could allow for imperfect observability of risk, but assume that the combination of imperfect risk adjustment and mixed payment reduces selection to a *de minimus* concern.

[6] The payer would require all participating health plans to abide by various rules, which could be designed to mitigate problems such as adverse selection. For example, the plans might be required to offer a standardized benefit package with no pre-existing conditions clauses to all applicants (guaranteed issue and guaranteed renewability);

differentiation, and so the greater is the degree of market power of any one plan. For example, when β is high, enrollees or payers do not switch between plans readily, because the costs of switching—choosing a new provider and the potential discontinuity of care—outweigh the benefit of paying a lower premium. Many rural areas and several increasingly consolidated metropolitan areas seem to fit this description. In the limit when $\beta \to \infty$ there is no competition among the MCOs and each one acts as a monopoly insurer.

By contrast, the smaller is β the greater is the perceived degree of substitutability among the services provided by the MCOs, making it more likely that health care purchasers will "vote with their feet" and switch to lower-premium plans. In other words, a low β means that the market is quite competitive even with just a few competing health plans. Indeed, when $\beta \to 0$ the plans are perceived as perfect substitutes, and the four MCOs face a perfectly competitive market for insurance.

This simple linear demand structure[7] allows us to examine how varying degrees of competitiveness in the health care market affect access, defined here as total enrollment, total premium spending, and the relative profitability of various kinds of provider integration. Given (1), access to health care depends in our analysis on the premiums charged by the competing MCOs. The premiums in turn depend upon how the MCO negotiates the prices of services provided by its upstream network of health care providers.

Formally, we model downstream premium competition and upstream price competition as a two-stage game. In the first stage, each physician group and each hospital decides on the minimum price it will accept from an MCO for a specified bundle of services (e.g., a capitation rate). In the second stage, each MCO sets its premium in light of the prices it must pay for physician and hospital services. We solve for the subgame perfect Nash equilibrium to this two-stage price game.

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meet quality assurance criteria; report quality measures that are used in compiling "quality report cards" for potential enrollees; and accept risk adjustment of premiums and provider payments.

[7] An alternative demand specification popular in the industrial organizational literature is based on Dixit and Stiglitz (1977). They model a representative consumer with a "taste for variety". Consumer preferences for variety in the health care market are, however, closer to the address approach in spatial models of differentiation, and the parameter β captures the degree to which preferences are specialized.

We begin with a benchmark case in which downstream insurers and upstream providers engage in arms-length contracting or decentralized price setting. This case is characterized by inefficiencies arising from coordination failures that might be expected to raise premiums, lower access and lower provider net revenues. In subsequent sections we compare the benchmark case against a number of different organizational forms characterized by varying degrees of horizontal and vertical integration. Our primary interest is in whether integration lowers premium costs for a given quality of care and hence increases access. Extending the model to incorporate additional efficiency benefits from actual coordination of health care processes (e.g., between inpatient and outpatient care) is left to future research.

3. The Benchmark Case of Arms Length Contracting

In the first stage of arms length contracting the physician groups set a capitation rate for their services, v_j, and hospitals choose a capitation rate for inpatient services, v_k. In the second stage, the managed health care plans set premiums to maximize revenues net of the per-enrollee payments owed to contracted providers. The outcome in the second stage is:

$$(2) \qquad p^*_{(j;k)}(\mathbf{v}) = \arg\max\left\{\left(p_{(j;k)} - v_j - v_k\right) q_{(j;k)}(\mathbf{p})\right\} \qquad (j \in \{1,2\}; k \in \{1', 2'\})$$

From the equilibrium premiums[8], $\mathbf{p}^*(\mathbf{v})$, we can identify the derived demand functions that upstream providers face in the first stage of the game. Let $x^*_j(\mathbf{v}), j \in \{1,2\}$ denote the total number of MCO enrollees for which the physician group j is contracted to provide physician services. The demand facing the physician group depends on enrollment in the two health plans with which the physician group contracts. Each hospital k derives its demand function $x^*_k(\mathbf{v}), k \in \{1', 2'\}$ similarly. As a result, each upstream provider's derived demand is:

$$(3) \qquad \begin{aligned} x^*_j(\mathbf{v}) &= q_{(j;1')}\left(\mathbf{p}^*(\mathbf{v})\right) + q_{(j;2')}\left(\mathbf{p}^*(\mathbf{v})\right) \\ x^*_k(\mathbf{v}) &= q_{(1;k)}\left(\mathbf{p}^*(v)\right) + q_{(2;k)}\left(\mathbf{p}^*(v)\right) \end{aligned} \qquad j \in \{1,2\}; k \in \{1', 2'\}$$

Note that the demand for each provider's services depends upon the capitation rates set by the other providers, so that providers compete with one another. As is appropriate to health care, this competition for patients is mediated by the health plan affiliation of the different providers.[9]

In the first stage upstream providers of health care services set capitation rates to maximize net revenue, defined as $\Pi_u = (v_u - \rho c_u) x_u^*(\mathbf{v})$, where $u \in \{1, 2, 1', 2'\}$.[10] A higher capitation rate directly raises revenues but also translates into higher costs for the downstream insurer and thus higher premiums, leading to lower enrollments and lower capitation revenue for upstream providers. In contracting with plans, the upstream providers take account of the impact of their payments on plan enrollment. Recalling that we have set $c_u = 0$ for $u \in \{1, 2, 1', 2'\}$, a provider's net revenue simplifies to:

(4) $$\Pi_u = v_u x_u^*(\mathbf{v}). \qquad u \in \{1, 2, 1', 2'\}$$

Solving the first-order conditions from (3) and (4) gives the capitation rates charged by each physician group and each hospital in the decentralized case:

(5) $$v_u^D = \frac{2\beta(8\beta + 7)}{(48\beta^2 + 46\beta + 3)}. \qquad u \in \{1, 2, 1', 2'\}$$

Substituting (5) into the reaction functions (2) gives the premiums in the decentralized case:

(6) $$p_{(j;k)}^D = \frac{8\beta(40\beta^2 + 49\beta + 12)}{(8\beta + 3)(48\beta^2 + 46\beta + 3)} \qquad j \in \{1,2\};\ k \in \{1', 2'\}$$

As we might have expected, the equilibrium capitation rates and MCO premiums are increasing functions of the perceived degree of differentiation among MCOs. That is, $\partial v_u^D / \partial\beta > 0$ and

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[8] The assumption of Nash equilibrium behavior in premium competition has some empirical support. Studying the small-group (50 or fewer employees) health insurance plan of California, Buchmueller and Town (2000) find that MCO premium-setting is well described by Nash equilibrium behavior.

[9] Providers compete to enroll the payer's beneficiaries (e.g., the employees of the firm that offers this "menu" of four competing health plans). The providers are not directly competing for inclusion within the network of a particular plan. One can think of this model as allowing providers to develop a provider-sponsored health plan if no existing plan offers them a contract.

[10] Although nonprofit ownership is prevalent in health care, evidence suggests that nonprofit behavior frequently resembles net revenue maximization (Sloan 2000). This can be consistent with not-for-profit objectives. For example, a nonprofit provider may wish to use revenues from insured patients to provide uncompensated care to poor and uninsured patients, or to fund public health and community outreach initiatives.

$\partial p^{D}_{(j;k)} \big/ \partial \beta > 0$. As $\beta \rightarrow 0$, payers view the MCOs as being less differentiated. This makes health insurer premium competition *tougher*, squeezing profit margins for both MCOs and their contracting providers. In the limit, if payers view hospitals and physician groups as perfect substitutes, the four MCOs are not differentiated, and payers always choose the cheapest plan. In this case the equilibrium provider fees and premiums converge to marginal cost $\rho c = 0$. In other words, perfect competition results in equilibrium premiums that are actuarially fair.

By contrast, as $\beta \rightarrow \infty$, consumers and payers view MCOs as being increasingly differentiated by virtue of their distinct provider networks. Premium competition in the health insurance market becomes *softer*, allowing MCOs and their contracting providers to charge more generous mark-ups over marginal cost. As a result, in the model equilibrium premiums $p^{*D}_{(j;k)} \rightarrow 5/6$ and equilibrium provider payments $v^{D}_{u} \rightarrow 1/3$.

Intuition might also suggest that providers and insurers enjoy the largest net revenues when $\beta \rightarrow \infty$, i.e., when MCOs are so highly differentiated that they are virtual monopolies. This is not, however, the case. Figure 2 shows that providers and insurers both enjoy highest net revenues at an intermediate level of product differentiation among MCOs. Note also that health care providers enjoy higher net revenues than MCOs, thanks to their market power as suppliers of specialized services.

(Insert Figure 2 near here)

Competing forces lead to the pattern of profitability described in Figure 2. At higher β, softer premium competition among MCOs allows them to charge higher premiums, and physician groups and hospitals share in the higher premiums through higher capitation payments. However, offsetting effects arise from two sources of inefficiency in arms-length contracting. First, there is a *horizontal externality* in the pricing of the capitation services v_i. Hospitals and physician groups do not coordinate when setting their rates. Yet any reduction in payment that a physician group accepts from an MCO also benefits the hospital contracting with that MCO, because lower provider payments allow the MCO to charge a more competitive premium and attract more enrollees. Greater enrollments in turn give the hospital a larger volume of patients and revenues. Of course, this is a two-way street. Hospitals similarly do not take into account the benefits that the MCO's contracted physician group derives from any discount the hospital gives the MCO.

Second, under arms-length contracting there is the *vertical externality* characteristic of most upstream-downstream relations. An upstream provider sets a rate v_i that includes a markup over the provider's opportunity cost. That markup is compounded when the downstream insurer—the MCO—offers a premium $p_{(j;k')}$ that includes a markup over its costs.

The detrimental effect that these externalities have on net revenues of providers and MCOs is greater the higher is β (and so the more differentiated are the MCOs) with the result that the detrimental externalities eventually offset the increased monopoly power that a higher β gives the MCOs.

Our analysis abstracts from efficiency and quality coordination issues arising from separate physician and hospital organizations. As a result, the coordination failures among upstream providers and between the upstream providers and downstream insurers stem entirely from strategic pricing effects. Since we are assuming constant marginal costs for a given quality of care, health care purchasers and therefore consumers benefit whenever provider fees and MCO premiums decline. The analysis therefore suggests that a form of provider alliance or integration that helps to overcome pricing coordination failures might have efficiency benefits above and beyond those associated with economies of scope in outpatient and inpatient delivery.

Note also that the welfare-decreasing coordination failures in this model are *not* attributable to the assumed capitation payment of providers, but arise from any decentralized pricing of the complementary, specialized upstream inputs to health care. That is, given that there are no adverse (or beneficial) incentive effects of provider risk-bearing in our analysis, the same results hold under fee-for-service payment, or indeed under any mixed form of provider payment (see Appendix A).

4. Physician-Hospital Alliances

An alliance between physicians and hospitals is one way that the two upstream providers can coordinate the rates set for their complementary services. For example, a physician group and a hospital can coordinate the discounts that they offer a health plan. To the extent that alliances internalize the horizontal pricing externality under arms-length contracting, alliances should lead to lower cost or lower premiums for a given quality of care. Furthermore the lower premiums should increase access as compared to arms-length contracting. This provides an important offsetting influence to the impact that provider integration is usually feared to have.

We analyze one example of provider alliances, a network of physician-hospital organizations. These kinds of networks are increasingly common in many parts of the US. Cuellar and Gertler (2001) note that "by 1998, 66 percent of hospitals had either acquired or formed a long-term contract with one or more physician organizations" (p.1).[11] The majority of such organizations are non-exclusive (ibid). We therefore assume that alliances are "open"; each physician group j is in separate alliances with each hospital k. Figure 3 illustrates such a market structure: Figure 3(a) shows the alliances to which physician group 1 belongs and 3(b) the alliances to which hospital $1'$ belongs.

(Insert Figure 3 near here)

Even though the MCOs are now purchasing from a physician-hospital alliance, they still must compete with other MCOs for enrollees, and so the second stage subgame – equation (2) - is unchanged. Of course, the outcome of the second stage is affected by changes in provider payments arising from the alliance. Specifically the net revenue of each alliance *(j,k)* is:

$$\text{(7)} \qquad \pi_{(j;k)} = (v_j + v_k) q_{(j;k)}(\mathbf{p}^*(\mathbf{v})) \qquad j \in \{1,2\};\, k \in \{1', 2'\}$$

[11] Through an empirical study of such alliances in three states, Cuellar and Gertler (2001) find that hospitals in markets with high managed care penetration, and with high managed care growth, are predicted to form alliances. Such strategic hospital-physician alliances take many forms, ranging from loose contracting alliances and open physician-hospital organizations to closed physician-hospital organizations and fully integrated models.

We assume that the physician group and hospital share this profit equally—the Nash bargaining solution for this symmetric game between the members of the alliance. Thus, in stage one, physician group j chooses v_j to maximize its group's share of net revenues from its two alliances with hospitals:

$$\Pi_j^A = \frac{1}{2}\sum_{k=1'}^{2'}\left(v_j + v_k\right)q_{(j;k)}\left(\mathbf{p}*\left(\mathbf{v}\right)\right). \qquad (j \in \{1, 2\}) \tag{8}$$

Similarly each hospital chooses v_k to maximize net revenue from membership in its two physician-hospital alliances. The solution to this set of joint maximization problems determines the equilibrium provider capitation rates that a downstream MCO faces when setting its premiums.

Given our symmetry assumptions, these capitation rates are identical for physicians and hospitals, and are given by:

$$v_u^A = \frac{\beta\left(8\beta + 7\right)}{32\beta^2 + 32\beta + 3} \qquad u \in \{1, 2, 1', 2'\} \tag{9}$$

Substituting these provider payments into the reaction functions for downstream insurer premiums gives the Nash equilibrium MCO premiums:

$$p_{(j;k)}^A = \frac{2\beta\left(96\beta^2 + 116\beta + 27\right)}{\left(8\beta + 3\right)\left(32\beta^2 + 32\beta + 3\right)} \qquad (j \in \{1,2\};\, k \in \{1', 2'\}) \tag{10}$$

As before, the Nash equilibrium premiums and provider payments are increasing functions of the perceived degree of differentiation among MCOs. Moreover, as $\beta \to 0, v_u^A, p_{(j;k)}^A \to 0$, just as in the decentralized case. By contrast, as $\beta \to \infty$, the equilibrium provider capitation rates $v_u^A \to 1/4$ and the equilibrium MCO premiums $p_{(j;k)}^A \to 3/4$.

It is easy to show by comparing (5), (6), (9) and (10) that the network of provider alliances leads to lower provider payments and lower MCO premiums than decentralized, arms-length contracting. These lower premiums lead to greater access. The combined effect is that, except under the most competitive conditions (low β) insurance costs are generally higher with the network of alliances than with decentralized rate setting primarily because there are more insured enrollees as compared to the decentralized benchmark: see Figure 7 below. In other words, by coordinating the pricing of complementary medical care services, physician-hospital alliances can benefit payers and consumers, even if facilities are not integrated and no economies of scope are realized in patient care.

The network of physician-hospital alliances considered here removes some but not all of the coordination failures between physician groups, inpatient services and MCOs. The only way to remove all the horizontal and vertical externalities is to have all the physician groups and hospitals fully coordinate their payment rates. For example, when all the upstream providers form a provider *consortium*, they can overcome the pricing coordination failures by charging a two-part tariff that extends their monopoly power to the downstream MCO market.[12] Acting as a monopoly, the consortium maximizes its net revenues by charging a capitation rate that maximizes the MCOs' net revenues, because this strategy permits the consortium to set the highest fixed tariff and appropriate the entire downstream surplus of the MCOs.[13]

Interestingly, a provider consortium can sometimes provide greater access (through lower premiums) than either decentralized pricing or a network of provider alliances. This occurs when payers and consumers do not switch readily among plans (high β): see Figure 7 below. In this situation, and in the absence of a consortium, the upstream providers fight over the high surplus associated with each MCO's relatively captive clientele. The resulting pricing coordination failures lead to higher premiums and less access. Whether the potential efficiency benefit from provider consolidation outweighs the anticompetitive effects of consolidation is an interesting and unresolved question.[14]

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[12] Details of the provider consortium market structure equations are available from the authors upon request, and are included in the *Mathematica* file publicly available at http://www.tufts.edu/~gnorman/.

[13] Unlike the other market structures that we consider, under a provider consortium total enrollment and total premium costs do not vary with the perceived substitutability between health plans, because under this structure the real "power" rests with the monopoly upstream providers, not downstream plans.

[14] The Department of Justice has brought actions against physician-hospital organizations in several cases, alleging that provider integration was anti-competitive. For example, a physician-hospital organization in St. Joseph, Missouri linked 85 percent of the physicians in the county with the monopoly hospital in St. Joseph. In Danbury, Connecticut, the only hospital established a physician-hospital organization with 98 percent of physicians on its staff, members of the Danbury Area IPA. Both of these antitrust cases resemble the case of a full consortium of all providers, and the antitrust concern regarding anticompetitive effects seems justified (Simpson and Coate 1998;

5. Vertical Integration Among Providers and Managed Care Plans

Our model of bilateral market power creates the incentive for providers and MCOs to consider partial vertical integration short of a full consortium. Figure 4 illustrates such a partially vertically integrated health care market. Physician group 1 and hospital 1′ form one integrated MCO [1;1′], and physician group 2 and hospital 2′ form a competing integrated MCO [2;2′]. Throughout our analysis of this case we assume that there is no strategic attempt at vertical foreclosure. Rather, the integrated MCOs allow their providers to accept contracts with other, non-integrated MCOs, which could be managed indemnity plans.[15] However, we should expect to find that the contract terms (i.e., provider capitation rates) are not as favorable for non-integrated MCOs as for the integrated MCOs. Denote then by v_j and v_k the rates paid by non-integrated downstream insurers for health services j and k, and denote by $v_{(i;i')}$ (i = 1, 2) the rates for the services provided internally to the integrated MCOs so that now we have $\mathbf{v} = (v_1, v_2, v_{1'}, v_{2'}, v_{(1;1')}, v_{(2;2')})$.

(Insert Figure 4 near here)

In the second stage of the game, both the integrated and non-integrated MCOs set their premiums $p^*_{(j;k)}$ to satisfy:

(11a) $$p^*_{(i;i')} = \arg\max\left\{q_{(i;i')}(\mathbf{p})\left(p_{(i;i')} - v_{(i;i')}\right)\right\} \qquad (i = 1, 2)$$

(11b) $$p^*_{(i;h')} = \arg\max\left\{q_{(i;h')}(\mathbf{p})\left(p_{(i;h')} - v_i - v_{h'}\right)\right\} \qquad (i, h = 1,2;\ i \neq h)$$

The outcome of the premium setting game in stage 2 depends upon the capitation rates set in stage 1. The capitation rates in turn are determined by how the integrated MCOs are internally organized. We analyze three different internal organizations of integrated MCOs, differing in the degree of provider autonomy that they allow. First, with centralized integration health care providers have no pricing

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Gaynor and Vogt 2000). Consistent with this, Halvorson (1999) reports that "when almost all of the oncology groups in one local market merged into a single group, the [price] of one-hour chemotherapy jumped 51 percent…[and that of] a hospital follow-up visit jumped 20 percent" (p.28). Cuellar and Gertler (2001) find that physician-hospital organizations, particularly closed or exclusive forms, use market power to gain managed care contracts on better terms, with little evidence of cost efficiencies or improved quality of care autonomy, and are paid by the integrated MCO at their opportunity or marginal cost. We call this insurer-dominated MCO a *staff-model HMO*. The second form gives health care providers slightly more autonomy. Providers constitute a separate entity or division within the MCO, and their capitation rates are set to maximize the HMO's total net revenues. We label this a *group-model HMO*. The third organizational variant again treats the providers as a separate division. In this variant, however, the providers have total autonomy to determine what capitation rates to charge to the integrated insurer's own enrollees and what rates to offer other insurers contracting with those providers. The objective of the providers in this case is to maximize their division's net revenues. Although we call this form a Preferred Provider Organization, it is still a vertically integrated MCO, albeit with a relatively provider-dominated internal power structure.

The remainder of this section details the resulting equilibrium premiums and capitation rates for the three different organizational forms. Comparison of the impact of these three forms on cost and access is left to section 6.

1. CENTRALIZED INTEGRATION: A STAFF-MODEL HMO

With a staff-model HMO the insurer employs providers and pays them as employees. We assume that in this case the insurer squeezes the revenues of the health care providers to the bare minimum, with the internal capitation rate set equal to expected marginal cost: $v_{(i;i')} = \rho c = 0$, $i = 1, 2$. However, the providers may also contract with other non-integrated MCOs, receiving a capitation rate v_i, which is set by the HMO. Total net revenue for the HMO is, therefore, total premium revenue, $p^*_{(i;i')}(\mathbf{v})q_{(i;i')}(\mathbf{p}^*(\mathbf{v}))$ plus any revenues from providing services to other plans' enrollees ($v_i q_{(i;h')}(\mathbf{p}^*(\mathbf{v})) + v_{i'} q_{h;i'}(\mathbf{p}^*(\mathbf{v}))$). In reality, the latter term is often negligible for staff-model HMOs, since staff providers primarily treat only HMO enrollees. To allow a "fair" comparison with the two other forms that do allow providers more autonomy, however, we include net revenues from provider outside contracts as part of staff-model HMO total revenues.

[15] We can show that this assumption is innocuous in that "no foreclosure" is a weakly dominant strategy for the

In the first stage of the game, each integrated HMO [$i;i'$] sets the provider payment rates v_i and $v_{i'}$ charged to other insurers to maximize:

$$\Pi_{(i;i')}^{S-HMO} = \left[p_{(i;i')}^{*}(\mathbf{v})q_{(i;i')}(\mathbf{p}*(\mathbf{v}))\right] + \left[v_i q_{(i;h')}(\mathbf{p}*(\mathbf{v})) + v_{i'} q_{h;i'}(\mathbf{p}*(\mathbf{v}))\right] \quad i,\, h = 1,2;\ i \neq h$$

subject to the constraint $v_{(i;i')} = 0$, $i = 1, 2$. The equilibrium premiums for the staff-model HMOs and the non-integrated MCOs, and the capitation rates charged to the non-integrated MCOs are derived in Appendix B.

As in the previous cases, both premiums and provider payments are increasing functions of the degree of perceived differentiation among insurers. When consumers are reluctant to switch between plans, plans can charge higher premiums. Since the integrated HMOs control all providers, market power also allows them to charge higher capitation rates to non-integrated plans contracting with their providers. It follows that the non-integrated plans are at a competitive disadvantage vis-à-vis the integrated HMOs because they must contract with the HMO providers on less favorable contract terms. As a result, their premiums exceed those of the integrated HMOs: $p_{(i;i')}^{S-HMO} < p_{(i;h')}^{MCO}$. As $\beta \to \infty$, the equilibrium provider payment rates $v_j^{S-HMO}, v_k^{S-HMO} \to 1/3$ as in the decentralized case, while the equilibrium premiums $p_{(i;i')}^{S-HMO} \to 1/2;\ p_{(i;h')}^{MCO} \to 5/6$.

A natural question to ask, therefore, is whether the non-integrated MCOs can survive. We can show (see Appendix B) that when downstream insurers are not very differentiated and competition among the non-integrated MCOs and integrated HMOs is intense—i.e., when $\beta \leq 0.0297$—the provider payment rates set by the competing HMOs for contracting with non-integrated insurers are such that the non-integrated insurers cannot in equilibrium attract positive enrollments. In other words, non-integrated insurers experience an instantaneous "premium death spiral" and exit the market. Since the HMOs are not deliberately attempting to foreclose by refusing to allow their providers to contract with other insurers, we

vertically integrated MCOs: details can be obtained from the authors on request.

refer to this outcome as *non-predatory vertical foreclosure*. Such foreclosure arises naturally from the extremely competitive nature of the insurance market at such low values of β.

2. A NONEXCLUSIVE GROUP-MODEL HMO

The major difference between the group-model HMO and the staff-model HMO is that with the group model the providers have the autonomy to set internal payment rates that are no longer constrained to equal marginal cost. Specifically, we assume that the internal hospital and physician group forms an upstream provider group with primary responsibility for delivering health services to the HMO's enrollees for which the HMO pays the providers a capitation rate $v_{(i;i')}$.

The HMO-provider group relationship, however, is not exclusive, so that HMO providers can contract with other insurers to provide physician and inpatient services to their enrollees as well. The providers charge v_j and v_k to the non-integrated plans for their services. The revenues from these contracts accrue to the HMO, which in turn allocates a portion of the total HMO net revenues to the provider group. It follows that with the group-model HMO everyone in the HMO aims to maximize the net revenues of the entire HMO, which consist of the premium revenues from the HMO's own enrollees and the provider payments made by non-integrated plans to the HMO's providers. In other words, with such a non-exclusive group-model HMO, payment rates $v_{(i;i')}$, v_j and v_k are set to maximize the HMO's net revenue:

$$\Pi^{G-HMO}_{(i;i')} = \left[p^*_{(i;i')}(\mathbf{v})q_{(i;i')}(\mathbf{p}*(\mathbf{v}))\right] + \left[v_i q_{(i;h')}(\mathbf{p}*(\mathbf{v})) + v_{i'} q_{(i;\acute{i})}(\mathbf{p}*(\mathbf{v}))\right] \quad i, h = 1,2;\ i \neq h.$$

The equilibrium premiums and capitation rates are again detailed in Appendix B. As with the staff-model HMO, the providers in a group-model HMO charge higher payment rates when contracting out to other insurers than when serving the HMO's own enrollees. With a group model, however, there is a non-monotonic relationship between the internal provider payment rate $v_{(i;i')}$ and the degree of perceived differentiation among the downstream insurers. The provider group payments for serving the HMO's enrollees are low when the HMO faces stiff competition for enrollees (β near zero) and initially those payments increase as premium competition softens. However, for high degrees of HMO market power, provider payments once again decline toward marginal cost: that is, as $\beta \rightarrow \infty, v^{G-HMO}_{(i;i')} \rightarrow 0$. In other words, when the group-model HMO faces very little competition for enrollees, its monopoly position translates into monopsony power. To maximize net revenue its provider group acts much like the on-staff providers of a staff-model HMO. In the more typical case where HMOs face competition in the insurance market, a group-model HMO benefits from keeping some degree of vertical separation between its provider group and insurance administration. Setting an internal capitation rate $v_{(i;i')} > 0$ softens competition in the downstream insurance market, benefiting the HMO even though this introduces a vertical pricing externality (double marginalization) between the providers and the insurance division.

As with the staff-model HMO, we find that when the downstream insurance market is extremely competitive, the non-integrated insurers will exit the market. The threshold perceived degree of differentiation for this to happen with the group-model structure is, however, lower than with the staff-model HMO: $\beta \leq 0.0175$ in the latter case as compared to $\beta \leq 0.0297$ in the former.

3. A Vertically Integrated preferred provider organization

We model a Preferred Provider Organization (PPO) as a vertically integrated health insurer that allows providers to retain significantly more autonomy than under either HMO model. One could also think of this case as a provider-sponsored HMO. The distinction between the PPO and HMO in this context is not, as traditionally understood, the degree of consumer choice among providers (which is similarly restricted in all of our forms). Rather it is the autonomy and "power" of providers vis-à-vis the insurance administration. Among the vertically integrated forms, the PPO embodies maximum provider autonomy.

We assume that the PPO's physician group and hospital act as a divisional profit center, setting the contract terms for the PPO's enrollees and for contracting to serve other insurers' patients, with the aim of maximizing their (the PPO providers') division's net revenues. This implies that in the first stage of the game, the payment rates $v_{(i;i')}$, v_j and v_k are set to maximize provider net revenues:

$$\Pi^{PPO}_{(i;i')} = v_{(i;i')} q_{(i;i')}\left(\mathbf{p}^*(\mathbf{v})\right) + v_i q_{(i;h')}\left(\mathbf{p}^*(\mathbf{v})\right) + v_{i'} q_{(h;i')}\left(\mathbf{p}^*(\mathbf{v})\right) \qquad i, h = 1,2;\ i \neq h$$

We show in Appendix B that providers within the PPO discriminate against other employers of their services by charging higher payment rates: $v_{(i;i')}^{PPO} < v_j^{PPO} + v_k^{PPO}$. Except in the trivial case where β = 0, the PPO never adopts marginal-cost pricing of provider services. For less competitive insurance markets, when payers and enrollees are "sticky" in their health care choices and view different providers as highly differentiated (β → ∞), PPO providers act like monopolists. Provider payments $v_{(i;i')}^{PPO} \rightarrow 1/2$ and rates charged for contracting out to other insurers $v_j^{PPO}, v_k^{PPO} \rightarrow 1/3$.

With the PPO organizational form, the premiums charged are such that non-integrated insurers are never driven from the market, regardless of the degree of competition among MCOs. Nevertheless, the PPOs always enjoy a competitive advantage over non-integrated insurers by virtue of the discounted provider payment rates that they are charged by the provider "division". As β → ∞ we have $p_{(i;i')}^{PPO} \rightarrow 3/4$; $p_{(i;h')}^{MCO} \rightarrow 5/6$.

6. Comparing the Different Organizational Structures

The premiums charged and access to health care that results from competition among managed care organizations are determined by the precise manner in which the MCOs and the health care providers structure their relationships.

Consider first the market structures that we have just analyzed, in which some insurers are vertically integrated with their providers and other insurers negotiate arms-length contracts with providers. A simple relationship characterizes the resulting equilibrium health insurance premiums as illustrated in Figure 5. In every case premiums increase with β, but *relative* premiums are determined by the organizational structure of the integrated HMOs or PPOs. Staff-model HMOs yield the lowest premiums, somewhat higher premiums result from group-model HMOs, and the highest premiums from PPOs. These differences in premiums derive directly from the very different internal and external capitation rates that the integrated MCOs charge. Capitation rates are lowest with the staff-model HMO because the internal capitation rate is set at marginal cost, putting severe constraints on the rates that can be charged to the non-integrated MCOs. They are highest with the PPO where the providers' concern with their divisional net revenues leads them to set relatively high internal, and so external, capitation rates.

(Insert Figure 5 near here)

It follows that net revenues for the non-integrated MCOs are similarly determined by the organizational structure of the integrated MCOs, as can be seen from Figure 6a. Competition from the integrated firms is toughest with the staff-model HMOs precisely because their insurance divisions obtain provider services at marginal cost and softest with the PPOs because the insurance divisions now face relatively high internal capitation rates. As a consequence, the net revenues of non-integrated insurers are lowest when competing with staff-model HMOs and highest when competing with looser PPO-form health plans.

The net revenues of the integrated MCOs also depend on their organizational form, but the relationship is not as straightforward, as can be seen from Figure 6b. Note first that net revenues are subject to the same countervailing forces as the decentralized benchmark and the network alliances. On the one hand a high β confers stronger monopoly power, raising net revenues. On the other hand, high β worsens the revenue-destroying effects of coordination failures that even partial vertical integration only partially corrects.

In comparing the impact of organizational structure on net revenues, note first that the group-model HMO always outperforms the staff-model HMO. This is the direct result of the fact that the only difference between these two forms in our analysis is that with the staff-model HMO the providers are *constrained* to price internally at marginal cost while with the group-model no such constraint is imposed. Removing a constraint on internal pricing will always result in an increase in net revenues.

The relative profitability (net revenues) of PPOs and staff- and group-model HMOs is rather more complicated, being determined by the competitiveness of the health insurance market, i.e., the degree to which payers and/or consumers consider MCOs to be differentiated. Downstream competition is softer with PPOs than with either a staff-model or group-model HMO because PPOs set the highest internal and external capitation rates. On the other hand, the PPO suffers more from coordination failures, in particular double marginalization, than either type of integrated HMO. As we have seen, coordination failures are magnified when β is high. By contrast, when β is low the ability of the PPO to soften downstream competition for enrollees is more important. In competitive markets, PPOs are most profitable, despite the efficiency losses from double marginalization. Premium competition among less differentiated PPOs is softer than for similarly differentiated HMOs, because PPOs face higher provider payment rates.

(Insert Figure 6 near here)

This is consistent with the rise of PPOs and other looser forms of managed care (such as Point Of Service [POS] plans) as managed care penetration increased and health insurance markets became more competitive. The prediction from our analysis that staff-model HMOs are less profitable than group-model HMOs or PPOs is also consistent with several empirical observations about staff-model HMOs. The first managed care plans in the US tended to be of this form, and were predominantly non-profit. Integrated, salary-model physician-hospital organizations, which often accept global capitation contracts and therefore resemble staff-model HMOs, seem to differ in many dimensions from other physician-hospital organizations (Cuellar and Gertler 2001). They are more likely to be non-profit, feature teaching hospitals, integrate independent of the degree of managed care penetration, show quality improvements without charging higher prices, and increase the amount of uncompensated care after integration.

In Figure 7 we compare how the different relations among insurers and health care providers affect access to health care, where access is defined as total enrollment in the downstream market. Arms-length contracting or decentralized pricing delivers lower access because pricing coordination failures under decentralized pricing lead to higher premiums, and so to lower overall enrollment. The pricing coordination failures are more acute at high levels of differentiation among the MCOs, with the result that the gap between access under decentralized pricing and other organizational forms widens as β increases.

More generally, access is always negatively related to β for all the cases that we have considered with the exception of the upstream provider consortium. As a consequence, for $\beta > 0.602$ the consortium provides greater access than any other organization of health care. In the absence of a full provider consortium, the typical ranking of the different organizational cases, in terms of access is, from highest to lowest: Staff-model HMO – Group-model HMO – Physician/Hospital Alliance – PPO – Decentralized.[16]

The clear implication is that access is positively affected by those organizational structures that give some weight to what is happening in the downstream MCO market, such as the two types of HMO or the alliance. These structures, by at least partially internalizing the coordination failures, put downward pressure on capitation rates and so lead to lower premiums and greater access in the downstream MCO market. By contrast, with the decentralized benchmark and the PPO, much more weight is given to the upstream provider market, leading to higher capitation rates and lower downstream access.

(Insert Figure 7 near here)

The impact of organizational structure on access also shows up in a comparison of total health care costs, as illustrated in Figure 8. Since the costs here include only those covered by insurance and ignore costs of the uninsured, low access translates into low total costs. Not surprisingly then, the total monopoly power exercised by a provider consortium leads to this being the most costly organizational form for any value of β. The low total costs of the PPO and of the decentralized benchmark at other than very low values of β arise primarily because the high capitation rates under these two arrangements lead to high premiums that choke off demand. By contrast, the higher total costs of the physician/hospital alliances, the group-model HMO and the staff-model HMO arise primarily because the low capitation rates that these schemes generate translate into low premiums, encouraging enrollment in their health care plans.

(Insert Figure 8 near here)

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[16] There are some exceptions to this ranking in that the alliance outperforms the Group-HMO if $\beta < 0.114$ and the

In summary, the premiums that organized purchasers of health care or their beneficiaries must pay, and the net revenues of insurers and providers differ in interesting but not always straightforward ways across the different market structures that we have considered. This is summarized in Table 1.

Conclusion

Recent empirical studies in health care point to the need for a model of bilateral market power between health plans and provider organizations. This paper has developed a model of bilateral oligopoly that is relevant to the health care industry, and uses it to analyze the impact on cost and access of alternative contractual relationships between MCOs and their providers. In our analysis the health plans differentiate themselves through distinct, albeit overlapping, provider networks of specialized, complementary inputs (physician groups and hospitals). We have identified the subgame perfect strategic pricing equilibria for a range of possible contractual relationships between the upstream providers and the downstream insurers, including a network of provider alliances, a provider consortium, and partial vertical integration with group- or staff-model HMOs or PPOs.

Our analysis shows that premium competition among MCOs depends upon the vertical relations between the upstream providers and the downstream MCOs, and upon the degree to which consumers perceive the competing MCOs to be offering differentiated services. But this is a two-way street. In other words, an immediate implication of our analysis is that we should also find a relationship between competition in the downstream market and the type of organizational structure that health care providers and insurers are likely to adopt. The endogenous determination of market structure is a complicated matter that would take us too far afield here but some brief remarks are in order. Simply put, we should expect to find more decentralized structures when downstream competition is tough – because the insurers are not seen as being highly differentiated. By contrast, more integrated structures are likely to arise when the degree of perceived differentiation is high, and the downstream competition is softer. There is then the related implication, of course, that providers and insurers have an interest in trying to increase the perceived degree of differentiation between them.

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decentralized structure outperforms the PPO for $\beta < 0.072$.

Our results highlight that different contractual relationships do not merely redistribute a fixed surplus among providers, plans and consumers, but that contractual and organizational form affects total surplus. A key insight is that a decentralized market structure, with physicians and hospitals setting independent payment rates, gives rise to inefficiencies from pricing coordination failures. These coordination failures raise premiums, lower access and lower provider and MCO net revenues. Forms of integration that overcome pricing coordination failures can lower premiums and benefit consumers. This is consistent with the empirical literature on managed care. The lower premiums charged by MCOs compared to indemnity insurance stem only partly from favorable selection or differential quality. A large part of the premium differences can be traced to lower MCO payments for hospital and physician services (e.g., Cutler, McClellan and Newhouse 2000).

Another insight of our analysis is that the relationship between market power and net revenues is non-monotonic. Providers and MCOs do not achieve maximum net revenue when they are monopolies or monopsonies, but rather at an intermediate level of market power. Our analysis also predicts that access, cost, and net revenues depends on the internal structure of MCOs, especially the extent to which providers have autonomy in setting payment rates to maximize their own net revenues.

It is clear that much remains to be done in this important area. Because total market access to health coverage and the costs of care differ significantly under different market organizations, bilateral market power is a central issue to consider in the design and enforcement of policies ranging from regulation of managed care to antitrust policy. In addition, as we have noted above, more work is needed to identify what relationships between plans and providers are most likely to emerge in different market settings, and more generally, in making market structure endogenous. Moreover, because perceived differentiation among MCOs affects the revenues of insurers and providers in important ways, there will be incentives for these health care groups to engage in activities that affect differentiation. Finally, extending our framework to examine issues of economies of scope and enrollee selection (particularly when enrollees value provider choice and valuation of choice is correlated with health cost risk) is left to future research.

Appendix A: Fee-for-service and Mixed Payment

In this appendix, we illustrate how the model can easily capture alternative provider payment methods. Consider FFS payment of providers. In the first stage, each physician group negotiates a fee schedule with an MCO characterized by an average fee per service of w_j. Similarly, each hospital negotiates a fee per service (e.g., per diem payment or fee schedule) with an average fee of w_k.

In the second stage, MCOs set premiums to maximize premium revenues net of FFS payments to providers:

(A-1) $$p^*_{(j;k)} = \arg\max\left\{\left(p_{(j;k)} - \rho w_j - \rho w_k\right) q_{(j;k)}(\mathbf{p})\right\} \qquad (j \in \{1,2\}; k \in \{1', 2'\})$$

where $p_{jk} \geq \rho(w_j + w_k)$

The set of equilibrium premiums **p*(w)** from the second stage subgame of price competition among MCOs identifies the derived demand function $x^*_j(\mathbf{w})$ that each physician group j faces in the first stage of the game. Each hospital k derives its input demand function $x^*_j(\mathbf{w})$ similarly. As a result, derived demand is:

(A-2) $$\begin{aligned} x^*_j(\mathbf{w}) &= q_{(j;1')}\left(\mathbf{p}^*(\mathbf{w})\right) + q_{(j;2')}\left(\mathbf{p}^*(\mathbf{w})\right) \\ x^*_k(\mathbf{w}) &= q_{(1;k)}\left(\mathbf{p}^*(\mathbf{w})\right) + q_{(2;k)}\left(\mathbf{p}^*(\mathbf{w})\right) \end{aligned} \qquad (j \in \{1,2\}; k \in \{1', 2'\})$$

In the first stage of the game, providers choose their prices to maximize net revenues in light of the resulting demand for their services:

(A-3) $$\Pi^D_u = \rho(w_u - c_u) x^*_u(\mathbf{w}) \qquad (u \in \{1, 2, 1', 2'\})$$

where $w_u \geq c_u$.

Providers clearly have an incentive to increase the fee per service and the volume of services provided, but they face a trade-off between these two components of net revenue. Higher fees translate into higher costs for the downstream insurer and higher premiums, leading to lower enrollments and lower patient volume for upstream providers. In contracting with MCOs, then, providers may accept discounted fee-for-service payment (lower **w**) in exchange for higher patient volume (higher ρx).[17]

[17] Indeed, discounted FFS continues to be a common form of provider payment under managed care. In 1999, although almost 91 percent of physicians had managed-care contracts, mean practice revenue from capitation represented only 7.4 percent of revenue among all physicians, and 21 percent of practice revenue among physicians with capitation contracts (Dudley and Luft 2001).

Solving the first-order conditions from (A-3) gives the Nash equilibrium fees charged by each physician group and each hospital. We focus on the symmetric case of equal marginal costs, normalized to zero. Then the equilibrium provider fees for physician groups and hospitals paid discounted FFS by MCOs are given by:

(A-4) $$w_u^{*D} = \frac{2\beta(8\beta+7)}{\rho(48\beta^2+46\beta+3)} \qquad (u \in \{1,2,1',2'\})$$

Substituting (A-4) into the reaction functions for downstream MCO premiums gives the Nash equilibrium premiums:

(A-5) $$p_{(j;k)}^{*D} = \frac{8\beta(40\beta^2+49\beta+12)}{(8\beta+3)(48\beta^2+46\beta+3)} \qquad (j \in \{1,2\}; k \in \{1', 2'\})$$

The equilibrium FFS provider fees corresponding to the capitation payments we derive in the paper can be found simply by dividing the capitation rate v by ρ. The intuition is that FFS providers paid a fee exceeding marginal cost seek to maximize volume of services, and a lower incidence of illness (lower ρ) among the enrollees they are contracted to serve lowers volume. Providers offer less of a FFS discount to MCOs that give them lower patient volume, and a larger discount to MCOs bringing in higher volume. Therefore, the provider fee is inversely related to ρ.

A mixed payment system with some weight on capitation payment and a complementary weight on FFS could be used, with the weights varying by provider (e.g., capitation for physician groups [s_j=1] and discounted FFS for hospitals [s_k=0]):

(A-6) $$p_{(j;k)}^{*} = \arg\max\left\{\left(p_{(j;k)} - s_j v_j - s_k v_k - \rho\left[(1-s_j)w_j + (1-s_k)w_k\right]\right)q_{(j;k)}(\mathbf{p})\right\} \qquad (j \in \{1,2\}; k \in \{1', 2'\})$$

Under our assumptions, which abstract from the efficiency impact of alternative provider payment methods, the downstream premiums do not depend on the degree of supply-side cost sharing for physicians, s_j, or hospitals, s_k. MCO premiums, MCO and provider profits, total enrollee costs and access are identical for FFS and capitation payment (and any form of mixed payment). For simplicity, the paper presents the model assuming pure capitation payment ($s_j = s_k = 1$).

Appendix B: Partial Vertical Integration

The partially vertically integrated market structure involves six kinds of provider payment rates. First there are the rates v_j and v_k at which the providers sell their specialized medical services j and k to non-integrated downstream insurers. Then there are the rates $v_{(i;i')}$ (i = 1, 2) for the inpatient and physician services sold internally to the integrated MCOs. In the second stage, both the integrated and non-integrated insurers choose their premiums $p^*_{(j;k)}$.

In the downstream insurance market, the integrated and non-integrated MCOs set premiums according to:

(B-1a) $p^*_{(i;i')} = \arg\max\left\{q_{(i;i')}(\mathbf{p})\left(p_{(i;i')} - v_{(i;i')}\right)\right\}$ (i = 1, 2)

(B-1b) $p^*_{(i;h')} = \arg\max\left\{q_{(i;h')}(\mathbf{p})\left(p_{(i;h')} - v_i - v_{h'}\right)\right\}$ (i, h = 1,2; $i \neq h$)

Each insurer's solution to its maximization problem yields a best response function in premiums from which the equilibrium premiums $\mathbf{p}^*(\mathbf{v}) = \left\{p^*_{(j;k)}(\mathbf{v})\right\}$ can be found, where now $\mathbf{v}$ = ($v_{(1;1')}$, $v_{(2;2')}$, v_1, v_2, $v_{1'}$, $v_{2'}$).[18]

CENTRALIZED INTEGRATION: A STAFF-MODEL HMO

Recall that in the first stage of the game, the HMO [i; i'] chooses provider payment rates v_i and $v_{i'}$ charged to other insurers to maximize the HMO's net revenue:

$$\Pi^{S-HMO}_{(i;i')} = p^*_{(i;i')}(\mathbf{v})q_{(i;i')}(\mathbf{p}^*(\mathbf{v})) + v_i q_{(i;h')}(\mathbf{p}^*(\mathbf{v})) + v_{i'} q_{h;i'}(\mathbf{p}^*(\mathbf{v})) \qquad (i, h = 1,2;\ i \neq h)$$

subject to the constraint $v_{(i;i')} = 0$ (i = 1, 2).

Solving the resulting reaction functions gives the equilibrium provider payments that the HMO will require if other insurers wish to contract with the HMO's hospital and physician group:

(B-2) $$v^{S-HMO}_j = v^{S-HMO}_k = \frac{2\beta(7+8\beta)\left(27+88\beta+64\beta^2\right)}{153+1758\beta+5840\beta^2+7296\beta^3+3072\beta^4} \qquad (j \in \{1,2\};\ k \in \{1', 2'\})$$

Substituting these payment rates into the reaction functions for MCO premiums yields the Nash equilibrium premiums which hold for $\beta > 0.0297$:

(B-3a) $$p^{S-HMO}_{(i;i')} = \frac{4\beta(7+8\beta)\left(15+62\beta+48\beta^2\right)}{153+1758\beta+5840\beta^2+7296\beta^3+3072\beta^4} \qquad (i = 1,2)$$

(B-3b) $$p^{MCO}_{(i;h')} = \frac{8\beta\left(93+463\beta+688\beta^2+320\beta^3\right)}{153+1758\beta+5840\beta^2+7296\beta^3+3072\beta^4} \qquad (i, h = 1,2;\ i \neq h)$$

With non-predatory vertical foreclosure (see discussion in text), eliminating insurers (1;2′) and (2;1′) and solving the reaction functions for HMOs [1;1′] and [2;2′] gives the Nash equilibrium premiums for the two HMOs:

(B-3c) $$p_{(i;i')}^{S-HMO} = \frac{2\beta}{1+4\beta} \qquad \text{for } \beta \leq 0.0297$$

A NONEXCLUSIVE GROUP-MODEL HMO

Under a non-exclusive group-model HMO, payment rates $v_{(i;i')}$, v_j and v_k are also set to maximize the HMO's net revenue:

$$\Pi_{(i;i')}^{G-HMO} = p_{(i;i')}^{*}(\mathbf{v})q_{(i;i')}(\mathbf{p}*(\mathbf{v})) + v_i q_{(i;h')}(\mathbf{p}*(\mathbf{v})) + v_{i'} q_{(i;i')}(\mathbf{p}*(\mathbf{v})) \qquad i,\ h = 1,2;\ i \neq h$$

The only difference from a staff-model HMO is the assumption that payment rates can now differ from marginal cost. The Nash equilibrium provider capitation rates resulting from this internal structure are:

(B4)

$$v_{(i;i')}^{G-HMO} = \frac{4\beta(7+8\beta)(21+16\beta)}{(3+4\beta)(51+896\beta+2304\beta^2+1536\beta^3)};\ v_j^{G-HMO} = v_k^{G-HMO} = \frac{32\beta(7+8\beta)(1+2\beta)}{(51+896\beta+2304\beta^2+1536\beta^3)}$$

The equilibrium premiums resulting from competition among two group-model HMOs and two non-integrated insurers are:

(B-5a) $$p_{(i;i')}^{G-HMO} = \frac{48\beta(7+8\beta)(1+2\beta)}{(51+896\beta+2304\beta^2+1536\beta^3)} \qquad (i = 1, 2)$$

(B-5b) $$p_{(i;h')}^{MCO} = \frac{4\beta(111+408\beta+320\beta^2)}{(51+896\beta+2304\beta^2+1536\beta^3)} \qquad (i, h = 1, 2;\ i \neq h)$$

In the range of $\beta < 0.0175$, when health plans are viewed as almost perfect substitutes, the Nash equilibrium provider payments $v_{(i;i')}$ are:

(B-6) $$v_{(i;i')}^{G-HMO} = \frac{2\beta}{(1+2\beta)(1+12\beta+16\beta^2)} \qquad \text{for } \beta \leq 0.0175 \qquad (i = 1, 2)$$

The Nash equilibrium premiums for the two remaining HMOs become:

(B-7) $$p_{(i;i')}^{G-HMO} = \frac{4\beta(1+2\beta)}{(1+12\beta+16\beta^2)} \qquad \text{for } \beta \leq 0.0175 \qquad (i = 1, 2)$$

[18] See the appendix to Pepall and Norman (2001) for derivation of such an equilibrium.

A VERTICALLY INTEGRATED PREFERRED PROVIDER ORGANIZATION

Recall that for a PPO in the first stage of the game, the payment rates $v_{(i;i')}$, v_j and v_k are set to maximize provider revenues:

$$\Pi^{PPO}_{(i;i')} = v_{(i;i')} q_{(i;i')}\left(\mathbf{p}*(\mathbf{v})\right) + v_i q_{(i;h')}\left(\mathbf{p}*(\mathbf{v})\right) + v_{i'} q_{(h;i')}\left(\mathbf{p}*(\mathbf{v})\right) \qquad (i, h = 1,2;\ i \neq h).$$

Solving the resulting reaction functions gives the Nash equilibrium payment rates:

(B-8) $$v^{PPO}_{(i;i')} = \frac{4\beta(7+8\beta)}{\left(3+60\beta+64\beta^2\right)};\ v^{PPO}_j = v^{PPO}_k = \frac{8\beta(7+8\beta)}{3\left(3+60\beta+64\beta^2\right)} \qquad i = 1,2;\ j=1,2;\ k = 1', 2'$$

Substituting into the insurer reaction functions gives the Nash equilibrium premiums:

(B-9a) $$p^{PPO}_{(i;i')} = \frac{8\beta\left(39+172\beta+144\beta^2\right)}{3(3+8\beta)\left(3+60\beta+64\beta^2\right)} \qquad (i = 1, 2)$$

(B-9b) $$p^{MCO}_{(i;h')} = \frac{4\beta\left(87+380\beta+320\beta^2\right)}{3(3+8\beta)\left(3+60\beta+64\beta^2\right)} \qquad (i, h = 1, 2;\ i \neq h)$$

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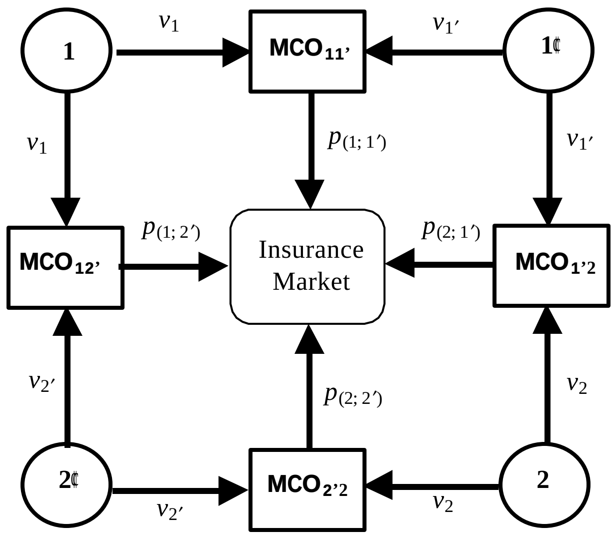


Figure 1: The Upstream and Downstream Market for Health Care Services

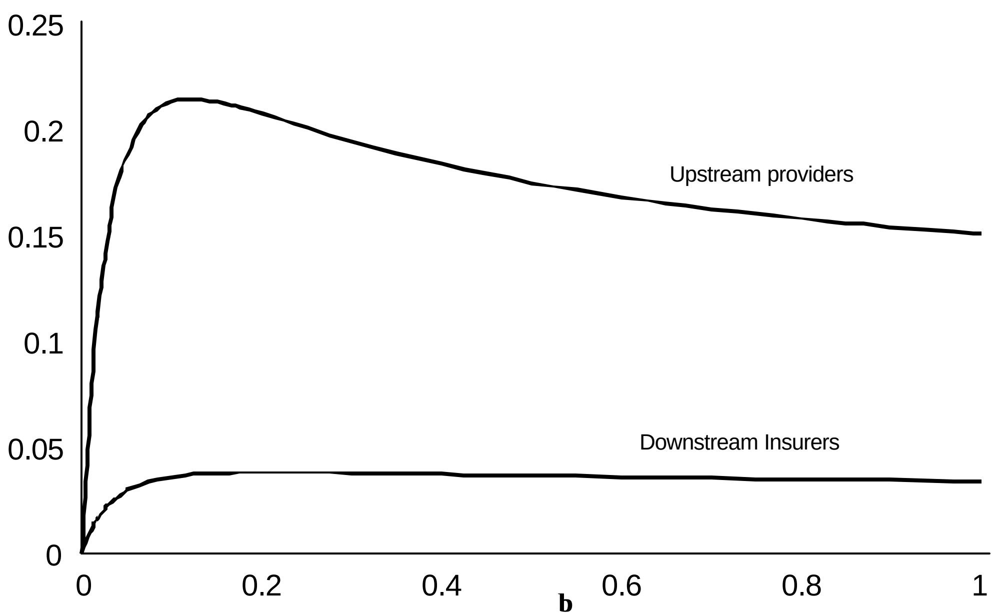
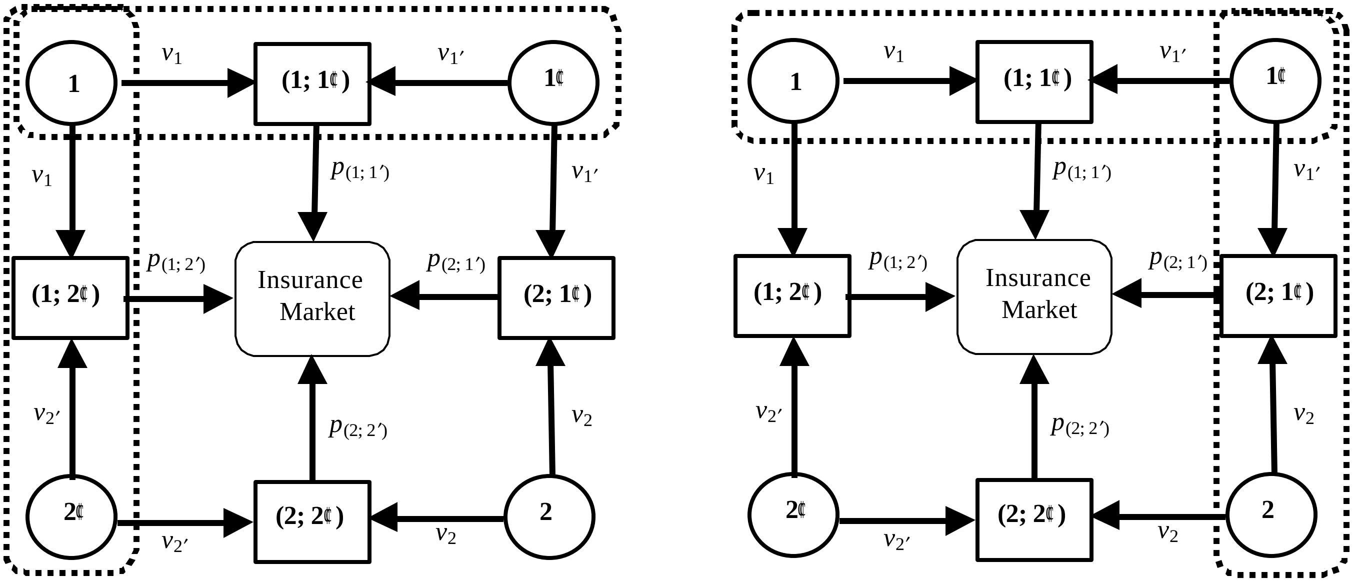


Figure 2: Net Revenues under Arms-Length Contracting



(a) Alliances for Physician Group 1

(b) Alliances for Hospital 1′

Figure 3: Overlapping Provider Alliances: Non-exclusive Physician-Hospital Organizations

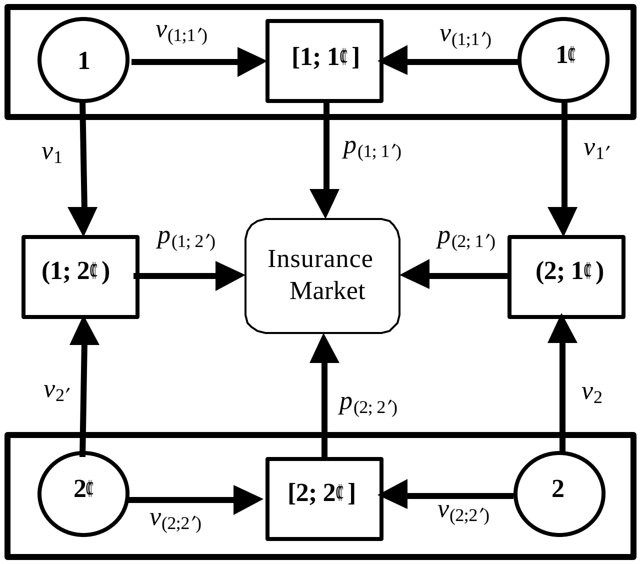
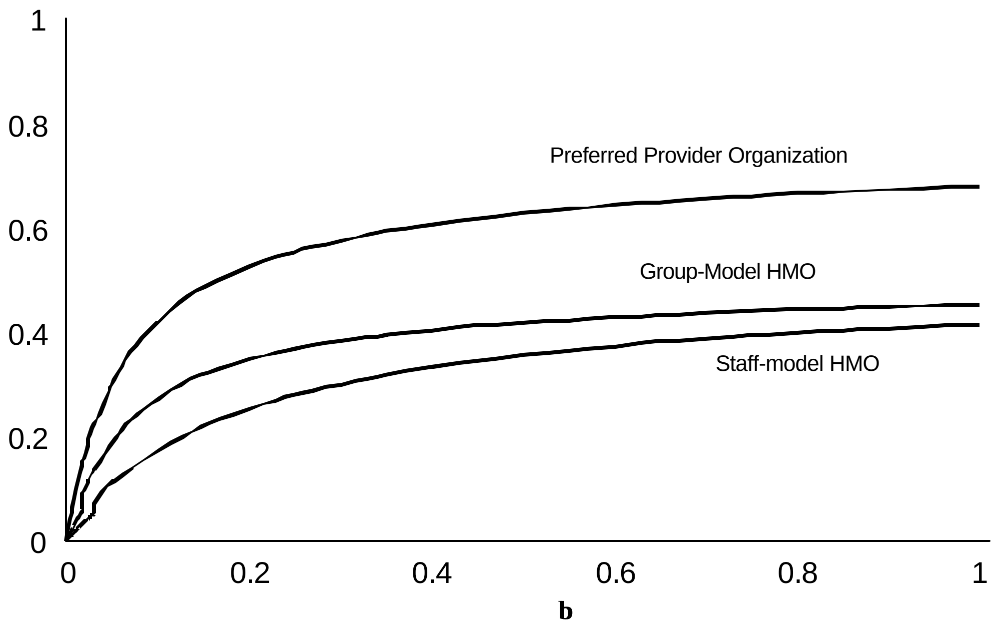
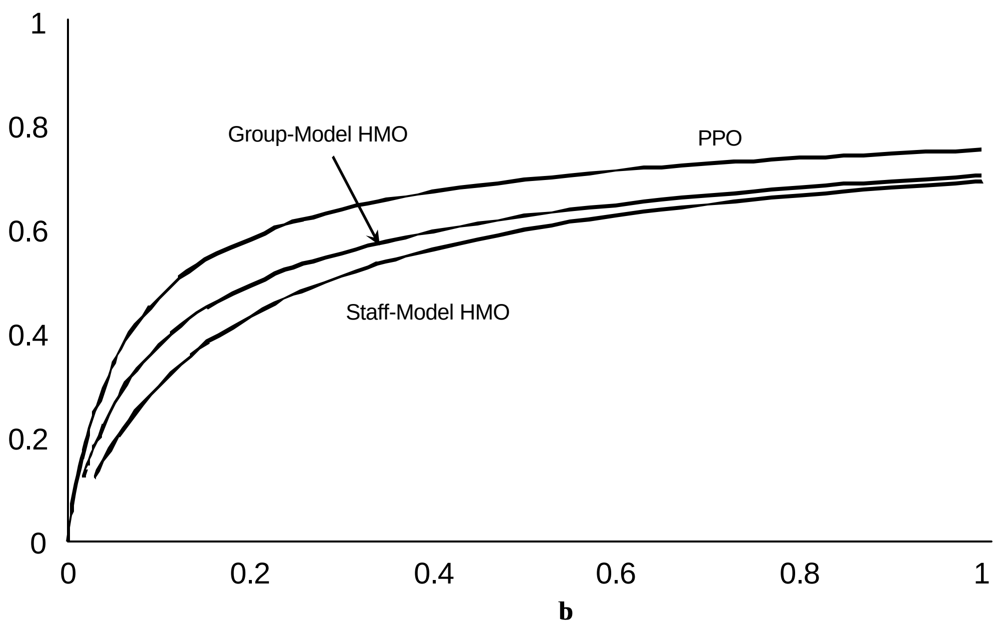


Figure 4: Partial Vertical Integration

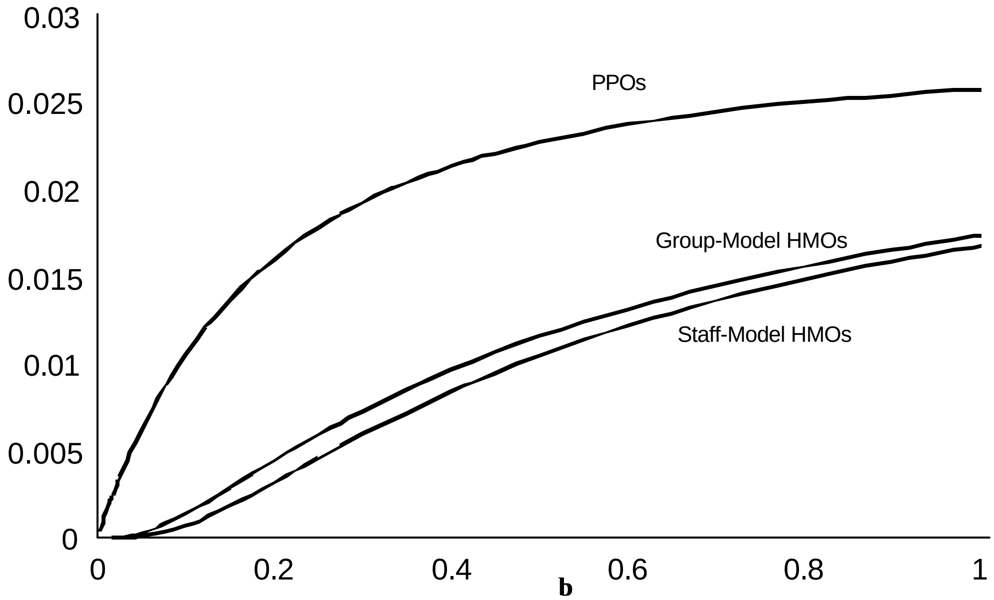


(a) Premiums of Integrated Managed Care Organizations

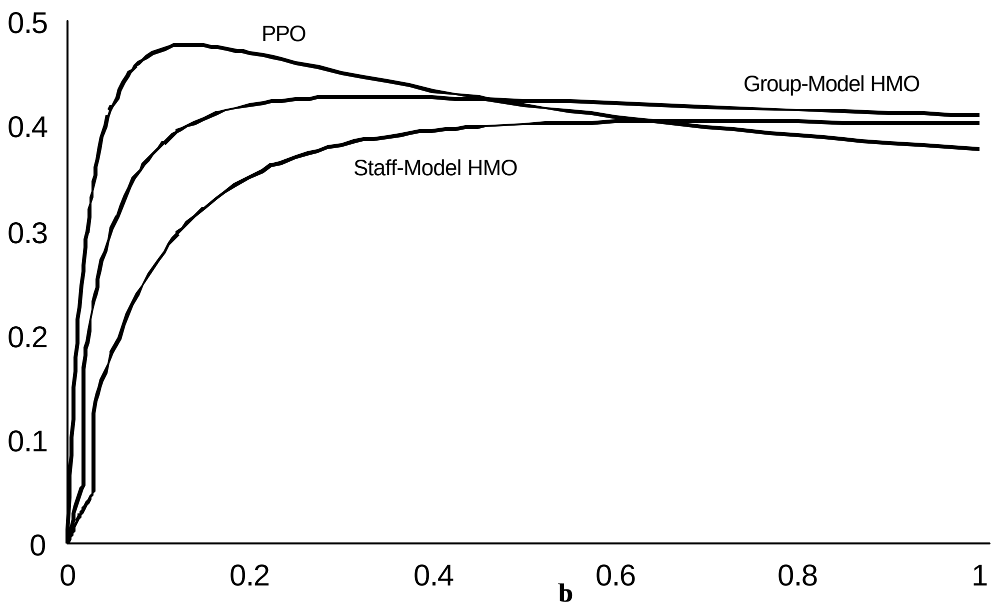


(b) Premiums of Non-Integrated Insurers

Figure 5: Insurance Premiums with Partial Vertical Integration



(a) Net Revenues of Non-Integrated Health Plans



(b) Net Revenues of Integrated Managed Care Organizations

Figure 6: Net Revenues with Partial Vertical Integration

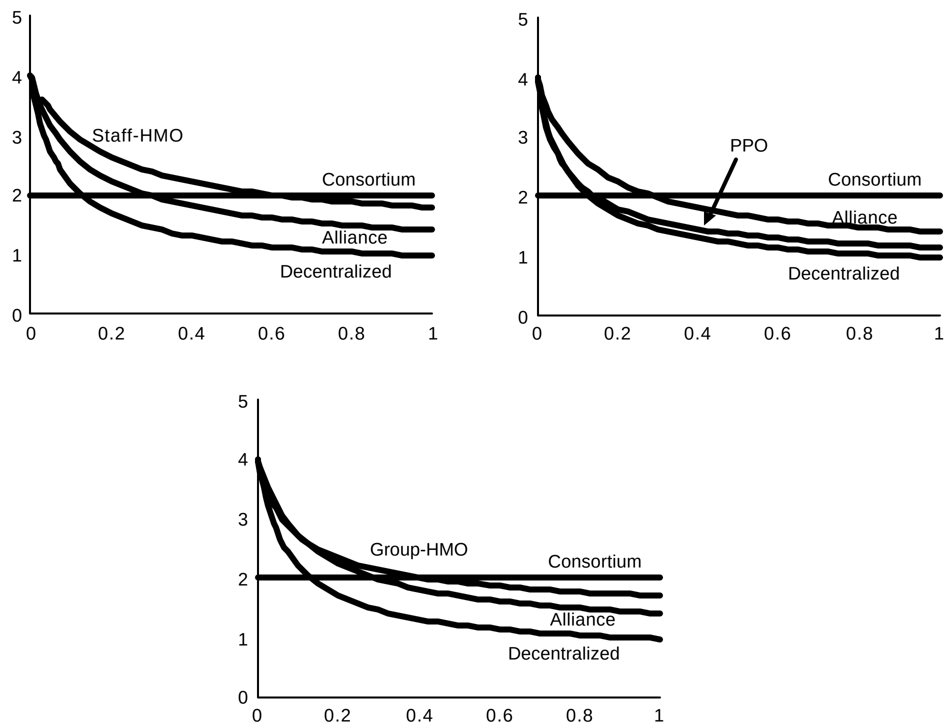


Figure 7: Access (Total Enrollment) under Different Organizational Forms

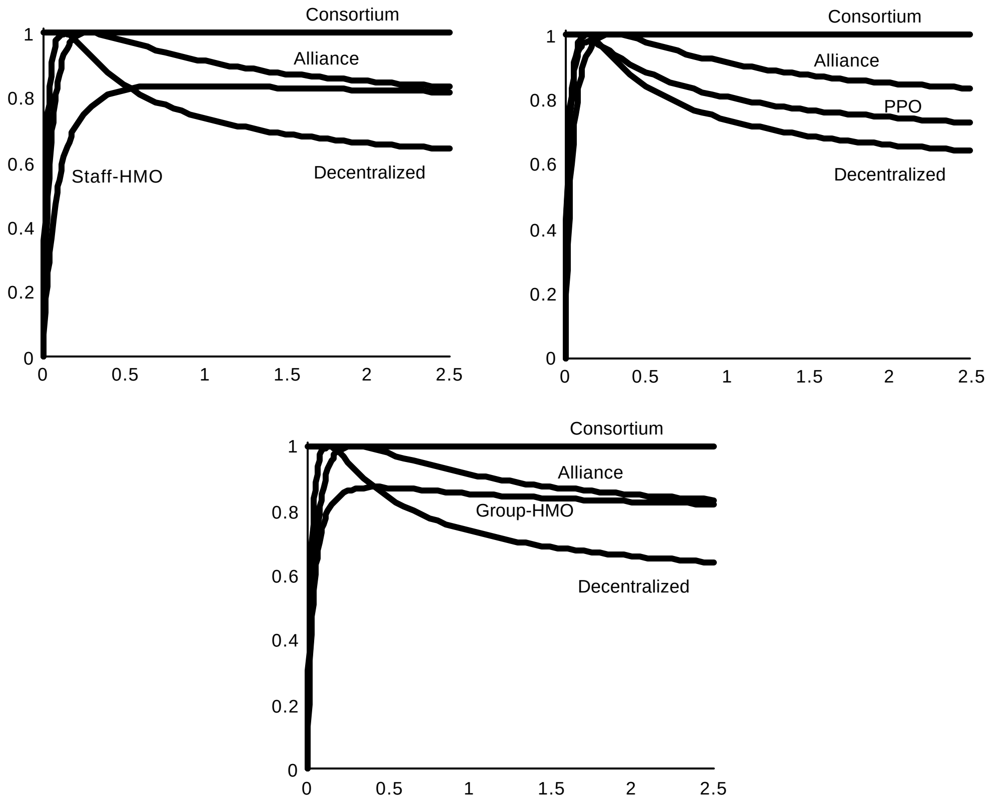


Figure 8: Cost (Total Spending) under Different Organizational Forms

Table 1: Comparison of Premiums, Provider Payments, and Net Revenues

Premiums	
Staff-Model HMOs	$p^{*D} > p^{*A} > p^{*MCO}_{(i;h')} > p^{*S-HMO}_{(i;i')}$ *for* $\beta \leq 0.275$
	$p^{*D} > p^{*MCO}_{(i;h')} > p^{*A} > p^{*S-HMO}_{(i;i')}$ *for* $\beta > 0.275$
Group-Model HMOs	$p^{*D} > p^{*MCO}_{(i;h')} > p^{*A} > p^{*G-HMO}_{(i;i')}$
PPOs	$p^{*MCO}_{(i;h')} > p^{*D} > p^{*PPO}_{(i;i')} > p^{*A}$ *for* $\beta \leq 0.264$
	$p^{*D} > p^{*MCO}_{(i;h')} > p^{*PPO}_{(i;i')} > p^{*A}$ *for* $\beta > 0.264$
Provider Payments	$v^{*D} > v^{*HMO} > v^{*A}$
Net Revenues	
Contracting with Providers	
Provider net revenues	$\boldsymbol{p}^{*D}_{U} > \boldsymbol{p}^{*A}_{U}$ for $\beta \leq 0.551$
	$\boldsymbol{p}^{*A}_{U} > \boldsymbol{p}^{*D}_{U}$ for $0.551 < \beta$
Insurer net revenues	$\boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*D}_{D} > \boldsymbol{p}^{*MCO}_{D}$
Net Revenue of Integrated MCO[1]	*Staff-Model HMO*
	$\boldsymbol{p}^{*D}_{D} > \boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{S-HMO}_{D}$ for $\beta \leq 0.275$
	$\boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*D}_{D} > \boldsymbol{p}^{*S-HMO}_{D}$ for $0.275 < \beta \leq 0.428$
	$\boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*S-HMO}_{D} > \boldsymbol{p}^{*D}_{D}$ for $0.428 < \beta \leq 0.676$
	$\boldsymbol{p}^{*S\_HMO}_{D} > \boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*D}_{D}$ for $0.676 < \beta$
	Group-Model HMO
	$\boldsymbol{p}^{*D}_{D} > \boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*G-HMO}_{D}$ for $\beta \leq 0.275$
	$\boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*D}_{D} > \boldsymbol{p}^{*G-HMO}_{D}$ for $0.275 < \beta \leq 0.294$
	$\boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*G-HMO}_{D} > \boldsymbol{p}^{*D}_{D}$ for $0.294 < \beta \leq 0.369$
	$\boldsymbol{p}^{*G-HMO}_{D} > \boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*D}_{D}$ for $0.369 < \beta$.
	PPO
	$\boldsymbol{p}^{*PPO}_{D} > \boldsymbol{p}^{*D}_{D} > \boldsymbol{p}^{*A}_{D}$ for $\beta \leq 0.275$
	$\boldsymbol{p}^{*PPO}_{D} > \boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*D}_{D}$ for $0.275 < \beta \leq 0.562$
	$\boldsymbol{p}^{*A}_{D} > \boldsymbol{p}^{*PPO}_{D} > \boldsymbol{p}^{*D}_{D}$ for $0.562 < \beta$

Notes: [1] The net revenue of an integrated MCO is the combined net revenue of the MCO insurer and its two upstream providers, i.e., the MCO's physician group and hospital.

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