

Three Essays on Physician Pricing

by

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(ABSTRACT)

This dissertation focuses on three different aspects of physician pricing. The first is the use of the assumption in formal modeling that physicians have the same type of costs for different types of patients. The second aspect of physician pricing investigated here is physicians' ability to change the name of a service in response to a fee cap without actually changing the price of the service. The third aspect investigated in this dissertation is the effect of posting physician prices on patient-initiated demand for physician services. All three of these aspects have potential implications for the discussion on health care reform.

In Chapter One, I examine physician price response to fee ceilings set by third party payers. I use the realistic assumptions that physician's have the same cost function for all their patients and physicians have increasing marginal cost. Using these assumptions, I find that, in theory, a third party payer that uses fixed fees benefits from including every physician in the community.

In chapter two, I use the medical claims data from a Fortune 500 firm (Firm) to evaluate physician pricing response to the Firm's institution of fee ceilings. I find that physicians who are constrained by the fee ceiling systematically record a more expensive

office visit code than physicians who were not constrained by the fee ceiling. This result has implications for private insurers as well as government programs that fix physician fees.

In chapter three I use a model of patient-initiated demand under uncertainty to examine the effect of posting physician prices on the demand for physician services. I find that requiring physicians with monopoly power to post all or some of their prices has no effect on the total patient cost associated with physician consultations, including the cost of untreated disease. If physicians compete in a Bertrand fashion, then requiring a physician to post the prices of all types of consultations results in lower total patient cost than posting only some prices.

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Introduction: Three Essays on Physician Pricing

In the health economics literature, research on physician pricing and patient demand is sparse. Understanding the response of physicians to payment rules is essential to any policy of health care reform that includes altering physician pricing behavior. Although a large body of work exists on the response of medical providers to Medicare programs, many of these works focus on hospital utilization and not on physician pricing behavior. In an effort to understand the response of physicians to payment rules, this dissertation focuses on three different aspects of physician pricing. The first is the use of the assumption in formal modeling that physicians have the same type of costs for different types of patients. The second aspect of physician pricing investigated here is physicians' ability to change the name of a service in response to a fee cap without actually changing the price of the service. The third aspect investigated in this dissertation is the effect of posting physician prices on patient-initiated demand for physician services. All three of these aspects have potential implications for the discussion on health care reform.

In Chapter one, physician price response to fee ceilings set by third party payers is examined. Much of the literature on physician pricing in response to fee ceilings focuses on physicians' response to Medicare pricing rules. The Medicare program is the single most extensive, legislated regulation of physician fees and the subject of frequent policy discussion and congressional debate. The introduction of managed care programs such as preferred-provider programs (PPO's) broadens the

application of economic theory beyond Medicare to the private market for physician services. The most common market structure assumption is one of monopolistic competition.¹ Using the assumption that physicians are able to price discriminate between managed care patients (including Medicare patients) and privately insured patients, all of these works employ the assumption that either costs are fully independent or marginal cost are constant. In chapter one of this dissertation, I use the standard model of monopolistic competition and introduce the more realistic assumption that physician's have the same cost function for all their patients and physicians have increasing marginal cost. Using these new assumptions, I find that, in theory, a third party payer (such as a PPO or Medicare) that uses fixed fees can set the lowest fees by including every physician in the network of preferred providers. These results suggest that fee-setting managed care programs benefit from including every physician in the community. The results also apply to the literature on Medicare and indicate that the Omnibus Budget Reconciliation Act of 1989 which fixes physician reimbursement for Medicare patients may result in more services at lower prices for private as well as Medicare patients.

The passage of the Prospective Payment System (PPS) in 1984 linked hospital payments for Medicare patients directly to the diagnosis of the patient. Studies on hospital responses to this change indicate that, to some extent, hospitals record more

¹See, for example, Satterthwaite (1985), Cromwell and Mitchell (1986), Dranove (1988), Satterthwaite and Dranove (1988) and Pauly and Satterthwaite (1981).

expensive diagnoses to increase revenues from Medicare patients.² Physicians were not directly involved in the PPS and studies on the effect of the PPS on pricing are limited to hospitals' responses. However, the increase in managed care and the increasing concern of private insurers over expenditures on physician services has led some insurers to lower their maximum reimbursement for physician services. In chapter two, I use the medical claims data from a Fortune 500 firm (Firm) to evaluate physician pricing response to the Firm's institution of fee ceilings. I find that physicians who are constrained by the fee ceiling systematically record a more expensive office visit code than physicians who were not constrained by the fee ceiling. This type of behavior among hospitals is referred to as 'upcoding'. My results suggest that physicians also respond to fee ceilings by engaging in upcoding. This result has implications for private insurers as well as government programs that fix physician fees.

Much of the work on physician behavior in the literature assumes that the physician acts as the patient's agent. This assumption is realistic once the patient has made contact with the physician. However, the decision process of patients on when, if ever, to consult a physician is not explored in the current literature. In chapter three I use a model of patient-initiated demand under uncertainty to examine the effect of posting physician prices on the demand for physician services. I find that requiring

²For example, see studies by Carter and Ginsburg (1985) or Carter, Newhouse and Relles (1990).

physicians with monopoly power to post all or some of their prices has no effect on the total patient cost associated with physician consultations, including the cost of untreated disease. If physicians compete in a Bertrand fashion, then requiring a physician to post the prices of all types of consultations results in lower total patient cost than posting only some prices. The results of this work suggest that the intervention of a third party, such as the government, that requires competitive bidding among physicians for patients and requires the posting all prices may be desirable.

Works Cited

Carter, GM and PB Ginsburg, (1985), "The Medicare Case Mix Index Increase: Medical Practice Changes, Aging and DRG Creep," RAND Corporation, R-3292-HCFA, June.

Carter, GM, JP Newhouse and DA Relles, (1990), "How Much Change in the Case Mix Index is DRG Creep?", *Journal of Health Economics*, 9:411-428.

Cromwell, J. and J. Mitchell, (1986), "Physician-Induced Demand for Surgery," *Journal of Health Economics*, 5:293-314.

Dranove, D., (1988), "Pricing by Non-Profit Institutions: The Case of Hospital Cost-Shifting," *Journal of Health Economics*, 7:47-57.

Dranove, D., and M. Satterthwaite, (1988), "Monopolistic Competition When Price and Quality are Not Perfectly Observable," mimeo, Northwestern University.

Dranove, D. and M. Satterthwaite, (1991), "The Implications of Resource-Based Relative Value Scales for Physicians' Fees, Incomes, and Specialty Choices," in HE Frech, ed., Regulating Doctor's Fees: Competition, Benefits, and Controls under Medicare. Washington DC: AEI Press, 52-70.

Pauly, M. and M. Satterthwaite, (1981), "The Pricing of Primary Care Physicians' Services: A Test of the Role of Consumer Information," *Bell Journal of Economics*, 12:488-506.

Satterthwaite, M. (1985), "Competition and Equilibrium as a Driving Force in the Health Services Sector," in RP Inman, ed., Managing the Service Economy: Prospects and Problems. New York: Cambridge University Press, 239-67.

The Effect of a Fee-Setting Preferred-Provider Organization on Physician Pricing

Introduction

An intense interest in health care reform is producing a multitude of plans which will potentially affect the quality and quantity of health care supplied in the United States. Chief among the concerns of policymakers are reforms which decrease national (and in particular, government) expenditures on health care. Currently, the United States spends about 13 percent of its GNP on health care, more than any other country in the world, yet fails to achieve the highest levels of health as measured by some important health indices.¹ If decreasing health care costs is the objective of health care reform, then any policy which either decreases the quantity or the price or both of health care meets this objective. However, implementing any health care reform policy which concentrates on decreasing quantity raises the thorny issue of health care access.

A nation concerned that its 37 million non-elderly, uninsured citizens lack adequate access to health care may well find any government-imposed decrease in the quantity of health care objectionable. Regulations aimed at increasing the patients' cost of care could achieve a desired decrease in quantity but, once again, threatens to deny access to some citizens by increasing insurance rates and pushing the marginal consumer

¹In 1985, the United States ranked 17th in infant mortality which is the most commonly cited health indicator.

off the insured rolls. This assumes, as do many policymakers, that the uninsured lack adequate access to health care.

Decreasing the price of health care offers an alternative approach to lowering health care expenditures. Health care reform undertaken with this objective avoids the overt access problem. Managed competition, in all its various formulations, attempts to lower health care expenditures by decreasing the price of health care while typically assuming that the price effect will dominant any quantity increase. If this assumption proves true, then expenditures decline without a decrease in the quantity of health care consumed and without altering the current distribution of insurance coverage. Access would not change for anyone currently insured and the lowered price increases access, at least to the marginal patient.

Preferred-provider organizations (PPO's) and health maintenance organizations (HMO's) dominate managed competition plans. In their purest form, HMO's wholly integrate the health insurance market with the health care services market. By paying a periodic premium to an HMO, consumers gain full access to the HMO's health care services but forgo any alternative services outside the HMO. PPO's typically contract with private facilities and providers to form a network of 'preferred providers' for PPO enrollees to utilize. PPO providers either accept a fixed fee per service or grant a discount on their customary fee per service. In either case, the PPO-enrolled patient remits some co-payment per service to the provider in addition to a periodic premium paid to the PPO. The PPO provides its enrollees with an incentive to patronize its

network of preferred providers by increasing the patients' co-payment for services rendered by providers outside the PPO network. In contrast with a PPO, HMO enrollees are denied coverage for services received from a non-HMO provider.

PPO's offering reduced remuneration work when providers believe that they will be at least as well off participating in a PPO as not participating. Otherwise, providers would lack any incentive to participate in the PPO. A provider may choose to participate in the PPO and accept a decline in revenue from her PPO patients rather than lose all of her patients who have joined a PPO.

If no provider participates in the PPO then provider revenues are unaffected. However, if one provider chooses to participate in the PPO, then all the non-participating providers will lose their PPO patients to the PPO provider and every non-PPO provider will be strictly worse off.² Once one provider elects to participate, then it is possible that every provider elects to participate in order to avoid losing their PPO patients and to gain some additional PPO patients from providers who chose not to participate. If every provider participates, it is clear that providers would collectively prefer not to participate in a PPO. When all providers participate in a PPO the number of patients for any provider remains unchanged, yet each provider serves their PPO patients at a lower price.

If a PPO is part of a health plan with the objective of reducing health care

²Note that this argument requires that providers have the excess capacity to serve additional patients.

expenditures, then the question of how a PPO affects the price and quantity of health care merits examination. Most work on this issue relies on the ability of providers to discriminate between PPO patients and other types of patients while focusing on the difference in price and/or quality offered by providers to the different types of patients. Jonathan Gruber (1991) employs a model of a PPO which allows hospitals to differentiate between PPO patients and private patients while completely insulating the PPO patients from the private patients by assuming that the cost of providing medical services to these two markets is entirely independent. In his model, providers chose quantity and quality with costs increasing in quality. The quantity and quality chosen in the PPO market has no effect on the nature of costs in the private market. Gruber's model predicts that an increase in the percentage of a community's residents who belong to the PPO will have no effect on the price in the private market. His result is driven by the assumptions of independent cost functions and fixed quality in the private market. Gruber notes that a model in which joint cost functions are considered would most likely show that a change in the size of a PPO would affect the price of services in the private market.

Jacob Glazer and Thomas McGuire (1992) use a model of monopolistic competition with a representative physician and examine the effect of changes in balance billing on the quality and quantity of services. Balance billing refers to the practice of billing a Medicare patient the difference between the Medicare set fee and the physician's customary fee. Prohibiting physicians from balance billing causes Medicare to function as a fee-setting PPO. Physicians face a separate demand from patients who cannot be

balance-billed. Glazer and McGuire allow physicians to choose quality and quality is costly. By normalizing the quality and its cost in the balance-billed market to zero, the authors consider the physician's adjustment of quality in the fixed-fee market. Physicians can alter costs in the fixed-fee market by adjusting the level of quality. This handling of the cost structure results in separate cost functions for the two groups. Constant marginal costs are assumed in both markets and the authors assert that their results also hold with increasing marginal costs, but the model does not assume that changing the quantity of patients served in one market affects the marginal cost of serving patients in the other market. Although the cost structures are different, costs are neither dependent nor super-additive.³ They show that a physician's selection of price and quality depends on the fee set by Medicare. Not surprisingly, for very low levels of Medicare fees, fixed-fee patients are not served and for high enough levels of Medicare fees, physicians do not balance bill. For fee levels between the two extremes, some patients are balanced billed and some patients are served at the fixed fee with a lower level of quality.

For the purpose of this paper, I assume that the average cost of providing service to any patient is dependent on the total number of patients served by that physician. Suppose a physician faces separable demands from PPO and traditionally-insured patients, but cannot separate the cost function for the two groups of patients. Then, costs are dependent and marginal costs are super-additive.⁴ For example, consider the

³The super-additivity property states that $f(x) + f(y) < f(x + y)$.

⁴Super-additivity is unimportant if constant marginal costs are assumed.

physician who has joint and dependent cost functions with increasing marginal costs. The cost to serve the first PPO patient depends on the number of private patients served. The cost to serve the n th PPO patient depends on the number of both private and PPO patients served. With identical cost functions, total cost is a function of the total number of patients and the insurance status of these patients is unimportant with respect to costs.

In practice, it is common for a physician's practice to contain patients with various types of health insurance coverage. A physician's patient mix may include patients with Medicaid, Medicare, Blue Cross-Blue Shield, private indemnity plans and the uninsured. Most physicians use the same office space, utilities, support personnel, medical equipment and supplies to service their entire mix of patients. For example, a physician does not use two different stethoscopes or receptionists, one for Medicare patients and one for PPO patients. Rather, a physician uses a common pool of capital and labor to serve the physician's entire patient population. A joint cost structure captures this nuance of the physician services market. In the short run, any given physician faces increasing marginal costs, if only because of the disutility suffered from increasing the hours worked. In this paper I use a joint, dependent cost structure with increasing marginal cost to describe the physician's services market.

The purpose of this paper is to formally examine the effects of a fee-setting PPO on the price of physicians' services in both the PPO market and the private patient market using a model of monopolistic competition and jointly dependent cost functions. When a long run equilibrium exists, the number of physicians in a community with a

PPO is generally less than in a community without a PPO and the PPO desires to enroll every physician in the community. In some special cases, a long run equilibrium exists such that the number of physicians in a community rises with the presence of a PPO.

The Insurance Market

In this paper medical insurance is assumed to be provided by profit-maximizing insurers: traditional, indemnity insurers and preferred-provider organizations. It is perhaps easiest to model the provision of insurance as a three-stage game. In the first stage, the private insurer and the PPO simultaneously select the insurance rules and set the premium price. By assumption the private insurer pays all of the community's physicians on a fee-for-service basis and under the insurance contract, the employees pay a co-payment and the employers' pay a premium.⁵ Also by assumption, the PPO pays on a fee-for-service basis to PPO physicians up to some defined maximum charged referred to as the price ceiling.⁶ The insurance contract for the PPO includes the employees' co-payments, the employers' premiums, the number of physicians to enroll in the PPO and the price ceiling for PPO physicians. As will be discussed later, the number of PPO physicians and the price ceiling are related. In the second stage,

⁵A co-payment is the amount of a physician's fee that an employee must paid. For purposes of this analysis, the co-payment will be a fixed percentage of a physician's fee.

⁶Typically, most PPO's allow patients to use non-PPO physicians (out-of-network usage), but monetarily punish patients by charging a high co-payment for out-of-network usage. For simplicity in this model, the out-of-network punishment is considered to be 'high enough' to prevent any out-of-network usage.

physicians observe the PPO price ceiling and then simultaneously choose whether to participate in the PPO. In the third stage, employers act as perfect agents for their employees and choose between the private insurer and the PPO based on employee welfare. After that, employees choose whether or not to visit a physician based on the insurance rules of their insurer and the marginal price of physician services.⁷

1. The PPO Structure

The PPO is modeled as a for-profit organization with the objective of providing health insurance services at the lowest cost while ensuring that every patient will be able to find a doctor who will provide services at or below the PPO maximum payment. The assumption that the PPO's objective is to clear the PPO market determines the lowest price ceiling that the PPO can choose.⁸ PPOs are identical in structure and type of services and will be treated as one.⁹ The PPO consists of a network of physicians enrolled to provide health services to PPO patients.

Physicians who participate in the PPO agree to a price ceiling for services

⁷For a discussion of patient-initiated demand for physician services see Peele(1994).

⁸Clearing the PPO market means that every employee who is insured with the PPO can find a physician who will provide services at or below the PPO price ceiling. I use this assumption for simplicity. It can be relaxed without changing the results by introducing a cost to employers, in addition to the PPO premium, which increases as the amount of physician rationing increases.

⁹By assuming that PPOs are identical in structure and treating them as one firm, the implicit assumption is that there is no product differentiation among PPOs and that competition results in the same premium and price ceiling among all the PPOs.

rendered to PPO patients. As previously noted, the PPO selects the price ceiling to ensure that PPO physicians will serve all PPO patients who desire service at the PPO price ceiling.¹⁰ It will be assumed that the PPO offers a price ceiling below the market price for physician services.

Physicians individually, and without collusion, choose whether or not to participate in the PPO network. No bargaining occurs between the PPO and any physician concerning the volume of patients or the price ceiling and physicians receive no guarantee of demand from PPO patients. The PPO does not impose any constraints on any physician's method of operation and physicians are free to continue to accept private (non-PPO) patients. The PPO is free to limit the number of physicians who can participate in the PPO.

The PPO offers to provide medical insurance to employers. The PPO determines the number of employers to insure and operates as an actuarially fair insurer. By definition, the PPO payment rule states that enrolled physicians are paid on a fee-for-service basis with a price ceiling and patients pay a fixed percentage of the physician's fee. There is no deductible. The PPO collects a premium from employers such that

$$i = \mu(P_{\alpha} + \text{administrative costs} - f(P_{\alpha}))$$

where i is the per employee premium paid by the employer, μ is the community risk rating assigned by the government which all insurers must use. P_{α} is the maximum price

¹⁰This assumption implies that the PPO first solves for the number of employers to insure.

the PPO will pay a physician and $f(P_c)$ is the fixed percentage co-payment paid by the patient.

For simplicity, the PPO earns zero economic profits in this model. This would be the case if the PPO were a non-profit organization subject to a break-even constraint or a for-profit forced to earn zero profits by the threat of entry.

2. The Private Insurance Structure

Private insurers will offer to provide medical insurance to any employer. The private insurers choose the premium price. Contracts with employers are secured through competitive bidding and the insurance is actuarially fair. Because private insurers are identical, they will be treated as one insurance firm. Under the private insurance structure, physicians receive payment from the private insurer on a fee-for-service basis without a price ceiling. Patients pay a fixed percentage of a physician's fee and there is no deductible.¹¹ The private insurer charges each insured employer a per employee premium such that

$$i = \mu(P + \text{administrative costs} - f(P))$$

where i is the employer's insurance premium, μ is the community risk rating. P is the fee-for-service price and $f(P)$ is the co-payment paid by the employee.

The Behavior of Employers

All employers provide health insurance all employees. Each employer's objective

¹¹For simplicity, the percentage co-payment is assumed to be the same for both PPO and privately insured patients.

is to choose the insurer that provides the defined, standard package of health insurance benefits and the highest employee welfare. The welfare of each employee is the consumer surplus described by $W = (q(p) - i(p))$ where $q(p)$ is the employee's demand function, p is the price of physicians services and i is the insurance premium. Employers, acting as perfect agents, contract with one insurer, either the PPO or the private insurer. By contracting with an employer, a PPO gains all of the employer's employees as enrolled patients. Likewise, the private insurer gains all the employees of any employer with which it contracts. Because every employer purchases insurance, every employee in the community is insured. Employers must use the community risk rating, even if their work force historically has a different risk factor.

The Structure of the Physician Services Market

1. The Framework of Monopolistic Competition

Monopolistic competition, as described by Chamberlin (1962), is often used to describe the market for physician services. In Chamberlin's construction of monopolistic competition, consumers are assumed to be identical in that their preferences for product characteristics that do not have a natural ordering. A representative consumer purchases a bundle of characteristics from a firm (in this case the physician) and each physician's combination of characteristics constitutes a unique product. Thus, the number of products available equals the number of physicians in the market. The representative consumer recognizes a natural ordering over bundles or combinations of characteristics even though the consumer lacks a natural ordering over any individual characteristic.

For example, the number of chairs in a physician's waiting room is a physician characteristic, but more chairs are not preferred to fewer chairs and vice versa (a consumer needs only one chair). However, a physician who on average has fewer consumers in the waiting room than chairs is preferred to a physician with more consumers in the waiting room than chairs.

It is assumed that the number of physicians is large enough to prevent any individual physician from influencing the market price. In many communities, the primary physician market contains enough physicians to satisfy this assumption, although certain medical specialists may exercise enough market power to influence the market price. For that reason, only the primary physician market will be considered. Monopolistic competition includes the assumption of free entry and exit. Although the high cost of medical school imposes a barrier to becoming a physician, once licensed, physicians can move from one community to another. The fact that an active market exists for used practices suggests that the transaction cost involved in relocation is not high enough to prevent relocation. For the purpose of this discussion, only the pool of licensed physicians will be considered as potential providers, justifying the use of the free entry/exit condition.

2. The Provision of Medical Service by Physicians

Physicians operate independently with identical cost structures and offer the same types of services. PPO physicians are free to choose their patient mix (between PPO and

private patients) while non-PPO physicians serve only private patients.¹² All physicians choose the quantity of patients to serve and are never obligated to serve every patient who requests service.

Services provided by physicians to PPO patients do not differ in quality or form from services to private patients, nor do the costs of providing services differ. Physicians do not accept bribes or side-payments.

Physicians are profit maximizers. In the privately-insured patient market (private market), physicians set price as well as quantity. In the PPO patient market, PPO physicians choose quantity but are limited in their choice of price by the PPO price ceiling. The price ceiling acts as an upper bound on the price PPO physicians charge their PPO patients.

As previously described, physicians selected by the PPO choose whether or not to participate in the PPO. Because physicians are free to select quantity, an invited physician may choose to participate in the PPO, but fail to provide any services to PPO patients. In order to avoid this situation, the following physician participation constraint is imposed: A physician will choose to participate in the PPO if and only if,

$$0 \leq \pi_{\text{PPO}}$$

where π represents profit and the PPO subscript refers to the PPO-insurer patient market in a community with a PPO.

¹²This is the result of the assumption that a patient's punishment for using a non-PPO physician is 'high enough' to prevent any out-of-network usage.

The Benchmark Case: A Community Without a PPO

This section provides a benchmark for examining the effect of a fee-setting PPO on a community by evaluating physician pricing in a community with only private insurers. Consider a community with only private, fee-for-service insurers. Because all private insurers are identical by assumption, all private insurers will be treated as one. There are N physicians and many employed, medically-insured patients. Insurance is provided through each patient's employer. All physicians share equally in the market demand for medical services which arises solely from the insured, private patients.¹³ For simplicity, the demand facing physician i (see Figure 1) is defined as

$$q_{i_o} = \frac{1}{N} [(A+BP) + \frac{\gamma(A+BP)}{P}(p_{i_o} - P)] \quad (1)$$

which can be written as,

$$p_{i_o} = \frac{NP}{\gamma(A+BP)} q_{i_o} + P(1 - \frac{1}{\gamma}) \quad (2)$$

where $\gamma \in [-\infty, -1]$ captures the concept that a physician who prices above the equilibrium price will not lose all of her patients because some patients will continue to demand service for idiosyncratic reasons. Likewise, by pricing below the equilibrium price a

¹³The source of patient demand is ignored, as it is often the case in the literature. This is done for simplicity, but a more satisfying model would consider an employee's decision to seek a physician's services when the patient is uncertain about the seriousness of his symptoms and the physician's ability to alleviate them.

physician fails to capture the entire market. The negative parameter B insures a downward sloping demand curve. The positive constant, A , represents some exogenous demand not related to price and P is the price charged by all physicians other than physician i .¹⁴

Physicians are profit-maximizing providers. The price physician i charges, p_i , is a function of physician i 's demand and the prices of the other physicians in the community. The cost of providing medical services is identical across all physicians. Each physician is assumed to face an identical, increasing and strictly convex marginal cost function. In keeping with monopolistic competition, providers select price by setting marginal revenue equal to marginal cost.

In equilibrium, monopolistic competition results in a market price which is greater than the marginal cost and equal to the average cost. This implies that the average cost curve is above the marginal cost curve, thus it must be the case that either the physician enjoys economies of scale over some portion of production and/or the physician incurs some fixed costs. Either of these conditions will produce the necessary downward sloping portion of a physician's average cost curve. The presence of fixed costs for a physician is easily justifiable in the observable need of the physician to rent capital such as office space and medical instruments and to pay yearly licensure fees.

If p_i is greater than the average cost, then positive profits are realized and there

¹⁴The functional form of the demand curve is borrowed from previous work by Satterthwaite (1985) because of its simplicity.

is an incentive for an additional physician to enter the community. Physicians will enter the community until the entry of one more physician would force the demand curve below the average cost curve, resulting in negative profits. Likewise, pricing below the average cost curve results in negative profits and at least one community physician will exit the community. In equilibrium, profits are zero and price equals average cost.¹⁵

Lemma 1: In equilibrium, in a monopolistically competitive community without a PPO, the optimal quantity of service for a physician with cost, $c(q_{i_0})$, to provide is

$$q_{i_0}^* = \frac{\gamma(A+BP)}{2NP} \left[\frac{\partial c(q_{i_0}^*)}{\partial q_{i_0}^*} - P\left(1 - \frac{1}{\gamma}\right) \right] \quad (3)$$

at the price

$$p_{i_0}^* = \frac{1}{2} \left[c'(q_{i_0}^*) + P\left(1 - \frac{1}{\gamma}\right) \right] \quad (4)$$

Proof: See appendix A.

The comparative statics of the benchmark case are:

$$\frac{\partial q_{i_0}}{\partial N} < 0; \quad \frac{\partial p_{i_0}}{\partial P} > 0; \quad \frac{\partial p_{i_0}}{\partial \gamma} < 0; \quad \frac{\partial p_{i_0}}{\partial N} < 0. \quad (5)$$

These comparative statics reveal that an increase in the number of physicians decreases any one physician's share of the market demand and lowers the revenue

¹⁵It is possible for physicians to have small positive profits in equilibrium in a monopolistically competitive market. This occurs when the entry of an additional physician would rotate the demand curve strictly below the average cost curve. For simplicity in this model, equilibrium profits will be defined as zero.

maximizing price for physician services. A decline in the market price of physician services results in a decrease in any individual physician's price. An increase in demand elasticity will decrease the market price.

As noted by Satterthwaite (1985), when $p_i = P$, the elasticity of demand is equal to γ . For the demand function given in (1), an increase in the number of physicians in the community rotates the demand curve clockwise without changing the price intercept. Likewise, a decrease in demand from a decline in the number of patients also rotates a physician's demand curve clockwise. These two important aspects of the demand curve are crucial to deriving some later results in this paper. Satterthwaite uses this demand function in a search model with constant marginal costs.¹⁶ Because costs are convex, both a decrease in demand and an increase in the number of physicians result in a price decrease.

The Community With a Fee-Setting PPO

1. The Privately-Insured Sector

Consider a community identical to the benchmark community in the previous section except that there is a PPO in addition to the private insurer. The PPO and the private insurer each contract with one or more of the community's employers. There is no change in the total number of employees, thus the total number of patients is unchanged. All employers provide identical health insurance to their employees. A

¹⁶In this case, changes in the number of physicians or the number of patients in the community have no effect on the equilibrium price.

PPO-contracted employer cannot also contract with the private insurer.

PPO insured employees are restricted to using only PPO physicians. The percentage of the community's employees enrolled in the PPO is given by α . Because some of the community's employees $(1-\alpha)$ were are now insured by the PPO and the total number of employees in the community has not changed, the demand each physician, i , faces from privately-insured patients, q_{ip} , is strictly less than the demand any physician faced in the benchmark case without the PPO. This reduced demand curve (see Figure 2) from privately-insured patients is

$$q_{i_p} = (1-\alpha)\left[\frac{1}{N}[(A+BP) + \frac{\gamma(A+BP)}{P}(p_{i_p}-P)]\right] \quad (6)$$

which can be rewritten as the inverse demand function physician i faces from privately-insured patients

$$p_{i_p} = \frac{NP}{\gamma(A+BP)(1-\alpha)}q_{i_p} + P\left(1-\frac{1}{\gamma}\right) \quad (7)$$

By assumption, there is no difference in the cost of providing services between PPO and private patients. Each physician faces a convex, twice differentiable and super-additive cost function. The quantity of private patients served is a function of the quantity of PPO patients served.

Profit maximizing physicians take the number of PPO patients as given and equate marginal cost and marginal revenue to select the price and quantity in the market for

private patients.

Proposition 1: The presence of a PPO that employs a price ceiling lowers the quantity of physician services in the private patient market.

Proof: See Appendix B.

Let the percentage of patients in the community who belong to the PPO be represented by $\alpha \in [0,1]$. The profit maximizing quantity of private patients for each physician, q_{ip}^* , is a function of the quantity of PPO patients, $q_{i\alpha}^*$, served by the physician

$$q_{ip}^*(q_{i\alpha}^*) = \frac{\gamma(A+BP)(1-\alpha)}{2NP} \left(\frac{dc(q_{ip}^*(q_{i\alpha}^*) + q_{i\alpha}^*)}{dq_{ip}^*} - P(1 - \frac{1}{\gamma}) \right) \quad (8)$$

which results the price of services to privately insured patients

$$p_{ip}^* = \frac{1}{2} \left(\frac{dc(q_{ip}^*(q_{i\alpha}^*) + q_{i\alpha}^*)}{dq_{ip}^*} + P(1 - \frac{1}{\gamma}) \right) \quad (9)$$

Comparing the market for privately-insured patients with a PPO (subscript p) and without a PPO (subscript o),

$$p_{ip} < = > p_{io} ; \quad q_{ip}^* < q_{io}^* , \quad \forall \alpha > 0.$$

The quantity change is the result of using a strictly convex cost function. The static results remain the same as the previously described benchmark case. For any individual physician, an increase in the number of physicians in the community decreases that physician's private patient demand. An increase in fixed costs or market price increases

an individual physician's price to private patients. Additionally, an increase in the percentage of patients covered by the PPO has the same effect on the privately-insured sector as increasing the number of physicians in the community: lower quantity.

2. The PPO Patient Sector

Of the community's physicians, n are enrolled in the PPO. Enrolled physicians have demand from their PPO patients in addition to demand from their private patients. If less than all of the physicians in the community are enrolled in the PPO, then those physicians who are enrolled in the PPO have demand from not only their own PPO patients but they equally share the PPO demand from non-enrolled physicians. Recall that α is the percentage of patients enrolled in the PPO. PPO demand is increasing in α . Then the demand facing each PPO physician is α of the market demand present in the benchmark case.

The PPO demand, $q_{i,\alpha}$, for enrolled physicians is

$$q_{i,\alpha} = \alpha \left[\frac{1}{n} [(A + BP_\alpha) + \frac{\gamma(A + BP_\alpha)}{P_\alpha} (p_{i,\alpha} - P_\alpha)] \right] \quad (10)$$

which can be rewritten as

$$p_{i,\alpha} = \frac{nP_\alpha}{\gamma(A + BP_\alpha)\alpha} q_{i,\alpha} + P_\alpha \left(1 - \frac{1}{\gamma}\right) \quad (11)$$

The replacement of P with P_α in the above demand reflects the physician's constraint to price at or below P_α . If all PPO physicians price at P_α , then physician i faces an individual demand curve that is truncated at $p_{i,\alpha} = P_\alpha$ because all PPO physicians

agree to the price ceiling of P_α . Physician i 's individual demand curve now varies from the fractional demand curve only at prices below P_α . When $P_\alpha = p_{i\alpha}$, the elasticity of demand equals $\gamma_\alpha < \gamma < -1$.¹⁷ PPO physicians are free to choose the quantity of private and PPO patients they wish to serve. Again, the two markets are functionally linked by the cost function.

Each physician chooses the quantity of private and PPO patients to service by maximizing profits.

Proposition 2: For profit-maximizing physicians who participate in a fee-setting PPO, the optimal strategy is to select the quantity of PPO patients served, q_α , such that the physician's marginal revenue is equal to marginal cost. For the optimally selected quantity of PPO patients, q_α^* , the physician chooses p_α^* , the optimal price to charge a PPO patient. Because the PPO is a fee-setter, the physician's pricing strategy is constrained by the PPO price ceiling, P_α which causes a kink in the demand curve at the PPO price ceiling.

For $p_\alpha^* \geq P_\alpha$, the physician chooses q_α^* such that

$$P_\alpha = \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_p^*(q_\alpha)} \frac{dq_p^*(q_\alpha)}{dq_\alpha} - \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_\alpha} \quad (12)$$

which is the familiar marginal revenue equals marginal cost condition. The physician prices the quantity q_α^* at the PPO-set price ceiling, P_α .

¹⁷ $\gamma < -1$ by definition.

For $P_\alpha > p_\alpha^*$, the physician chooses the optimal quantity, q_α^*

$$q_{i_\alpha}^* = \frac{\alpha \gamma (A + BP_\alpha)}{2nP_\alpha} \left(\frac{dc(q_{i_\alpha}^*(q_\alpha)) + q_{i_\alpha}^*}{dq_{i_\alpha}} - P_\alpha \left(1 - \frac{1}{\gamma}\right) \right) \quad (13)$$

and prices below the PPO price ceiling at

$$p_{i_\alpha}^* = \frac{1}{2} \left(\frac{dc(q_{i_\alpha}^*(q_\alpha)) + q_{i_\alpha}^*}{dq_{i_\alpha}} + P_\alpha \left(1 - \frac{1}{\gamma}\right) \right) \quad (14)$$

Proof: See appendix C.

The comparative statics of the PPO market are:

$$\frac{\partial q_{i_\alpha}}{\partial \alpha} > 0, \quad \frac{\partial q_{i_\alpha}}{\partial n} < 0, \quad \frac{\partial q_{i_\alpha}}{\partial P_\alpha} < 0, \quad \frac{\partial p_{i_\alpha}}{\partial P_\alpha} > 0, \quad \frac{\partial p_{i_\alpha}}{\partial c(q_{i_\alpha})} \geq 0. \quad (15)$$

The comparative statics of the PPO market are similar to the comparative statics in the benchmark case. An increase in the cost of providing services or an increase in the market price of physician services increases any individual physician's price. Two important results are 1) as the number of physicians participating in the PPO increases, any individual PPO physician faces a decrease in PPO demand and 2) as the percentage of employers insured with the PPO increases, each PPO physician faces an increase in PPO demand.

Market Equilibrium

Equilibrium Price of Physician Services

By assumption, the PPO objective is to clear the PPO market. The PPO achieves this by selecting the price ceiling for physician services such that every PPO patient who requests service at the PPO price ceiling can find a PPO physician to serve them. If an equilibrium exists, then this occurs when $MR=MC$ and $q^*_\alpha \geq (\alpha/n)(A+BP_\alpha)$.

Proposition 3: In equilibrium, the lowest PPO price ceiling that will clear the PPO market occurs when the PPO enrolls every physician in the community.

Proof: By (15), as n increases, the lowest PPO price ceiling which clears any size PPO market decreases. Therefore, the lowest possible price ceiling occurs when $n=N$.

Note that (15) is a consequence of the physician's convex cost function.

Proposition 4: In equilibrium, if both a private and a PPO sector exists then, the private premium equals the PPO premium and the price of physician services is the same to PPO and privately-insured patients.

Proof: Recall that, by assumption, the PPO price ceiling is below the equilibrium benchmark price for physician services. Because individual physicians in the benchmark community set price by using the $MR=MC$ rule, the benchmark community is in equilibrium on the elastic portion of the demand curve. A decrease in price by the PPO results in an increase in total expenditures on physicians services by PPO patients and the PPO premium will be above the benchmark premium. Employers, acting as perfect agents, seek to maximize employee welfare and will choose the PPO over the private insurer as long as the net gain to consumer surplus is positive. Also recall, as the percentage of employers insured with the PPO increases (α increases), the price in the

private market falls resulting in an increase in both the private premium and private consumer welfare. Employers will choose the PPO as long as consumer welfare is greater in the PPO. As the PPO increases in size the minimum price ceiling the PPO can set which will clear the PPO market rises, reducing the consumer's premium and welfare in the PPO.¹⁸ If an equilibrium exists, employers will be distributed between the PPO and the private insurer such that consumer welfare will be the same in both plans and the premiums will be equal.¹⁹ Because the model uses a representative consumer, when consumer welfare is the same and premiums are equal under both the PPO and the private insurer, the price of physician services is the same to both PPO patients and privately-insured patients. □

Equilibrium Quantity of Physician Services

The market equilibria for the model presented here can take several forms with different conclusions about the number of physicians supported in a community with a PPO. The quantity of physician services in a community with a PPO may be greater than but never equal to the quantity of physician services in the benchmark case. Recall that, in equilibrium, γ is the elasticity of demand and the effect of a PPO depends on the

¹⁸This assumes that there is a continuum of employers and that employers are atomistic with respect to the market. For discrete employers, it may be the case that the private and the PPO price never equate. Also, for large employers who are not price takers, but who alter the equilibrium price in the PPO and private markets by their insurance decision, then the integer problem of perfect competition can result in a lack of equilibrium.

¹⁹This does not rule out the possibility that the PPO will take the entire market and there will be no private sector.

elasticity of demand.

Proposition 5: If $\gamma < -1$, $c(q)$ is monotonic and strictly increasing in q and $\ln(c(q))$ is convex in q , then a long run equilibrium exists and the quantity of physician services provided is greater in a community with a PPO than in the benchmark case.

Proof: See Appendix D.

Proposition 6: If $\gamma < -1$, then the quantity of physician services in a community with a PPO never equals the quantity of physician services in the benchmark case.

Proof: From the proof of proposition 5, for $q_o^* = q_\alpha^*$, it must be the case that $(1+\gamma)/\gamma = 1$. For $\gamma < -1$, this is not satisfied. \square

Equilibrium Number of Physicians

By imposing restrictions on the parameters of the demand function and the functional form of the cost function, the number of physicians in a community with a PPO may be greater than, less than or equal to the number of physicians in the benchmark case.

Proposition 7: If $\gamma < -1$, $c(q) = q^x + k$, $x > 1$, $k > 0$ and $A/B \leq (P_\alpha^{*2} - P_o^{*2}) / (P_o^* - P_\alpha^*)$, then a community with a PPO supports fewer physicians than the benchmark case.

Proof: See Appendix D.

Proposition 8: If $\gamma < -1$, $c(q) = q^2 + 1$, $-2.5 > A/B > -3$ and $q_o^* = 1/2$, then a community with a PPO will support more physicians than the benchmark case.

Proof: From the proof of proposition 5, $q_o^* < q_\alpha^* = 1$. For $c(q) = q^2 + 1$, $q_\alpha^* = 1$. Let $q_o^* = 1/2$. By definition, $B < 0$, $P_\alpha^* = c' = 2$ and $P_o^* = AC = 2.5$. From the proof of

proposition 7, for $N_o^* < N_\alpha^*$, it is sufficient to show

$$0 < N_o^* = 2A + 5B < A + 2B = N_\alpha^* \quad (16)$$

$-2.5B < A < -3B$ satisfies (16). \square

Proposition 9: If $\gamma < -1$, $c(q) = q^2 + 1$, $q_o^* = 1/2$ and $(A/B) = -3$, then a community with a PPO will support the same number of physicians as the benchmark case.

Proof: From the proof of proposition 5, $q_o^* < q_\alpha^* = 1$. For $c(q) = q^2 + 1$, $q_\alpha^* = 1$. By definition, $B < 0$ and let $q_o^* = 1/2$. For $N_o^* = N_\alpha^*$ it is sufficient to show

$$0 < N_o^* = 2A + 5B = A + 2B = N_\alpha^* \quad (17)$$

$(A/B) = -3$ satisfies (17). \square

It is clear from propositions 7, 8, and 9 that the model's prediction of the equilibrium number of physicians supported by a community with a fee-setting PPO is dependent on the elasticity of the market demand. Note that for any equilibrium in the benchmark case, $A + BP_o > 0$, which implies $N_o > 0$ and insures that $N_\alpha > 0$.

Equilibrium Size of the PPO

At $q_\alpha^* > (\alpha/n)(A + BP_\alpha)$, a physician is operating on the downward sloping portion of her truncated PPO demand curve. At $q_\alpha^* = (\alpha/n)(A + BP_\alpha)$, a physician is operating at the kink in her truncated PPO demand curve. The lowest PPO price ceiling that clears the PPO market occurs when $MR = MC = P$ and $q_\alpha^* = (\alpha/n)(A + BP_\alpha)$. If an equilibrium exists, then for any PPO price ceiling, P_α , the equilibrium size of the PPO market is N_α . The PPO will enroll firms until α^* employees are insured with the PPO. Of course, this

$$\alpha^* = \frac{q_{\alpha}^* n}{(A + BP_{\alpha})} \quad (18)$$

implies that $(1-\alpha^*)$ employees remain with the private insurer.

Under the assumption that the PPO's objective is to set the lowest PPO price that will clear the PPO market, each PPO physician operates at the kink in their PPO demand and provides the PPO market with,

$$q_{i_{\alpha}}^* = \frac{\alpha}{n}(A + BP_{\alpha}) \quad (19)$$

The PPO price ceiling equals the PPO physicians' marginal costs (which are assumed to be identical across physicians).

Proposition 10: In equilibrium, a physician may have many different combinations of private and PPO patients.

Proof: If physicians have separate cost functions in the PPO and private patient markets, then in equilibrium a physician chooses a patient mix that equates the marginal cost for each type of patient. In the model presented in this paper, the physician has a joint cost structure between PPO and private patients, therefore it is meaningless to equate the marginal costs of each type of patient. As a result of the joint cost structure, there are many equilibria of patient mixes which will result in the sum over all physicians of PPO and private patients equaling the total number of patients in the community. ◻

Welfare and Policy Implications

To evaluate the effectiveness of a fee-setting PPO with regard to a health policy objective of decreasing expenditures on health care services, consider the change in the total quantity of and expenditures for physician services from the benchmark community to the community with the PPO. By definition, the PPO price ceiling is below the equilibrium price in the benchmark case and, as shown in proposition 4, the PPO price ceiling equals the private price, therefore the private price is below the price in the benchmark case. In equilibrium, the market price of health services is strictly lower in the community with a PPO than in the benchmark case. This yields an unambiguous increase in total expenditures on physician services. Further, there is an increase in consumer welfare associated with the presence of a PPO in the community. A policy objective of maintaining and/or increasing access to health care is satisfied.

Consider the effect of a fee-setting PPO on the employers. Recall that employers pay a per employee premium based on the price of the physician services and the probability an employee visits a physician. The price of physician services falls in the presence of the PPO. If the demand for physician services is elastic, and the probability of illness among employees is unaltered, the employer premiums increase.²⁰ The

²⁰Given that only the insurance market has changed, there is no reason to expect any alteration in the probability that an employee will fall ill. If demand is elastic, then a price decrease raises total expenditures. However, an argument can be made that employees will seek more health care in the form of both treatment for illness and preventive care. The increased consumption of preventive care will be converted into a higher level of employee health stock, thus decreasing the future probability

RAND HIS estimates the elasticity of demand for outpatient physician services at -0.3. If the elasticity of demand (γ) is greater than -1, then employers will see a decrease in total expenditures from a price decrease and a decrease in premiums. For the specific cost function used in proposition 8, the equilibrium elasticity of demand is -4/3 suggesting that employer expenditures would be higher in a community with a PPO. This is the result reported by Zwanziger and Auerbach (1991) in a study of a large firm's experience in switching from a traditional fee-for-service policy to a PPO. Not surprisingly, a fee-setting PPO's ability to fulfil a policy objective of reducing expenditures on health services is a function of the elasticity of demand. Employers in this model are concerned with employee welfare, not just with choosing the insurer with the cheapest premium. The cheapest premium would result from employers offering no insurance at all. That we do not observe this uniformly in the work place, suggests that employers might be concerned with employee welfare, not just the cheapest medical insurance premium.²¹

In order to evaluate the effect of a fee-setting PPO on physicians total revenue, compare the total revenues in the benchmark case with the total revenues in a community with a PPO. As described above, the price in a community with a PPO is unambiguously lower than the price in the benchmark case. From proposition 3, every

that an employee falls ill and decreasing the quantity of physician services necessary to treat any future illness.

²¹It might also be the case that employers are concerned with tax breaks, a subject not treated in this model.

physician in the community will participate in the PPO. In equilibrium, the private and the PPO price are the same, but each physician in a community with a PPO serves more patients than physicians in the benchmark case at a price below the price of the benchmark case. The change in a physician's total revenue depends on the elasticity of demand and a fee-setting PPO may increase rather than lower expenditures on physician services. This result is expected for elastic demands. Lastly, consider the effect of a fee-setting PPO on the insurers. In this model, insurers are competitive and actuarially fair and any price or quantity change has no effect on the insurers.

Conclusion

The national interest in containing health care prices while maintaining access to health care has led to the exploration of different types of organizations for the delivery of health services including fee-setting insurers. I have shown that a community with both traditional insurers and a fee-setting PPO may exist in a long run equilibrium and when this is the case that the PPO is most effective in lowering physician prices when every physician in the community participates. This is counter to the popular notion that PPO's should limit the number of participating physicians to some subset of a community's physicians. I also show that when such an equilibrium exists, patients who do not belong to the PPO benefit from a decline in physician prices. Gruber's (1991) work contains an empirical section on hospitals which operate in markets with both private insurers and PPO's. Gruber's results show that when hospitals lower their price to PPO patients, the price to private patients also falls.

The model in this paper uses increasing marginal costs. If physicians have constant marginal costs a fee-setting PPO may not drive down physician prices even if every physician participates in the PPO. The results of this model require both a private and a PPO sector operate simultaneously in a community. In equilibrium, this model predicts not only that physician prices decrease in both the private and PPO sectors, but the quantity of physician services will not fall. This suggests that a policy objective of increased access to physician services may be achieved through a fee-setting PPO. The predictions of the model presented in this paper rely heavily on the elasticity of demand.

An interesting extension of this model could yield slightly different results. Suppose γ is allowed to vary by physician, then in equilibrium physicians charge different prices based on their individual γ . For example, γ could be an educational choice by physicians where physicians choose how much education to obtain and education is costly. This allows physicians to specialize and to price according to their speciality. Depending on how much diversity over prices exist in equilibrium, it can be the case that a fee-setting PPO will choose to exclude some of the highest priced physicians from participating in the PPO.

The model presented in this paper does not address the issue of physicians who can elect to alter quality to manipulate their cost structures. Glazer and McGuire's (1992) work modeling balance-billing in Medicare markets, while closely related to the model presented here, allows physicians to alter quality which is assumed to be costly. Glazer and McGuire find that physicians will vary their quality in response to a fee-

setting insurer such that the fee can never equal the marginal cost. Including a quality choice for physicians in the model presented in this paper may allow a PPO community to support the same number of physicians as the benchmark community by providing a lower level of quality. In formal modeling, quality and quantity are difficult to distinguish. Tirole (1988) notes that if quality is some characteristic that is defined such that more is always better, then an increase in quality and an increase in quantity are the same. For outpatient physician services, if quality is the amount of time that a physician spends with a patient, then an increase in the length of patient visits represents an increase in quality. If physicians choose to lower quality in response to a price ceiling imposed by a third party payer, the expected result would be a recording of lower time value visits (as defined by the Current Procedural Terminology codes). This would be testable in a data set that contained information on visit types for physicians that are subject to price ceilings. In another paper (Peele 1994), I investigate this issue and find that physicians who are constrained by a price ceiling (as compared to physicians who are not constrained) systematically record longer patient visits on medical insurance claims. Thus, rather than decrease quality, these physicians may be increasing quality, at least to the extent that length of visit is correctly recorded and is an adequate proxy for quality.

The result that the number of physicians in a community with a fee-setting PPO is ambiguous (depending on restrictions of demand parameters), but could possibly be tested empirically by examining the physician-population ratio in a community with a fee-

setting PPO.

WORKS CITED

Beath, John and Katsoulacos, Yannis (1991), The Economic Theory of Product Differentiation, Cambridge: Cambridge University Press.

Chamberlin, E.H. (1933), The Theory of Monopolistic Competition, Cambridge, Mass: Harvard University Press.

Dranove, David (1987), "Pricing by Non-Profit Institutions," *Journal of Health Economics*, 7:47-57.

Glazer, Jacob and McGuire, Thomas G. (1993), "Should Physicians be Permitted to 'Balance Bill' Patients?" *Journal of Health Economics*, 12:239-258.

Gruber, Jonathan (1991), "What Do PPOs Do?: Hospital Responses to Private Sector Cost Containment," mimeo, Harvard University.

Manning, Willard G., Joseph P. Newhouse, Naihua Duan, et al.(1988), "Health Insurance and the Demand for Medical Care," Rand Corporation, Santa Monica, CA.

Peele, Pamela B. (1994), "The Response of Physicians to Institutionalized Changes Payment Rules," mimeo, VPI&SU.

Satterwaithe, Mark (1985), "Competition and equilibrium as a driving force in the health services sector," in Managing the Service Economy: Prospects and Problems, ed. Robert P. Inman 239-267. Cambridge: Cambridge University Press.

Tirole, Jean (1988), The Theory of Industrial Organization, Cambridge: MIT Press.

Zwanziger, Jack and Rebecca R. Auerbach, (1991), "Evaluating PPO Performance Using Prior Expenditure Data," *Medical Care*, 29:142-151.

Appendix A

In a model of monopolistic competition, all of the community's physicians equally share in the market demand for physician services. Each physician faces the same cost function and marginal costs are assumed to be monotonic, strictly convex and twice differentiable.

In a market without a PPO (subscript o), each physician i 's total revenue is

$$TR_{i_o} = P\left(1 - \frac{1}{\gamma} + \frac{Nq_{i_o}}{\gamma(A+BP)}\right) q_{i_o} \quad (\text{A1})$$

and marginal revenue is

$$MR_{i_o} = \frac{\partial TR}{\partial q_{i_o}} = P\left(1 - \frac{1}{\gamma} + \frac{2nq_{i_o}}{\gamma(A+BP)}\right) \quad (\text{A2})$$

The revenue maximizing quantity for any physician is

$$q_{i_o} = \frac{(1-\gamma)(A+BP)}{2N} \quad (\text{A3})$$

and the revenue maximizing price is

$$p_{i_o} = \frac{1}{2} P\left(1 - \frac{1}{\gamma}\right) \quad (\text{A4})$$

Each physician faces the same strictly convex cost function

$$C \equiv c(q_{i_o}) \quad (\text{A5})$$

with marginal cost defined as

$$MC_{i_0} = c'(q_{i_0}) \quad (\text{A6})$$

and average cost as

$$AC_{i_0} = \frac{c(q_{i_0})}{q_{i_0}} \quad (\text{A7})$$

Physicians select the price and quantity of services to provide by equating marginal revenue (A2) with marginal cost (A6).

In equilibrium,

$$q_{i_0}^* = \frac{\gamma(A+BP)}{2N} [c'(q_{i_0}^*) - P(1-\frac{1}{\gamma})] \quad (\text{A8})$$

and

$$p_{i_0}^* = \frac{1}{2} [c'(q_{i_0}^*) + P(1-\frac{1}{\gamma})] \quad (\text{A9})$$

□

Appendix B

Proposition 1: The presence of a PPO that employs a price ceiling lowers the quantity of services in the privately-insured patient market.

Proof: In a community with a PPO, profit-maximizing physicians take the number of PPO patients as given and equate marginal cost with marginal revenue to select the price and quantity in the private patient market. By definition, the demand function facing each PPO physician, i , is,

$$q_i = (1 - \alpha) \left[\frac{1}{N} \left[(A + BP) + \frac{\gamma(A + BP)}{P} (p_i - P) \right] \right] \quad (\text{B1})$$

By assumption, for any physician, the cost function is convex, twice differentiable.

$$\text{Cost} = c(q_p, q_\alpha) + q_\alpha \quad (\text{B2})$$

Each physician faces the same total revenue function,

$$\text{Total Revenue} = \frac{NPq_{i_p}^2}{\gamma(A + BP)(1 - \alpha)} + q_{i_p} P \left(1 - \frac{1}{\gamma} \right) \quad (\text{B3})$$

The marginal revenue function is

$$\text{Marginal Revenue} = \frac{2NPq_{i_p}}{\gamma(A + BP)(1 - \alpha)} + P \left(1 - \frac{1}{\gamma} \right) \quad (\text{B4})$$

Equating marginal cost and marginal revenue yields

$$q_{i_p}^* = \frac{\gamma(A+BP)(1-\alpha)}{2NP} \left(\frac{\partial c(q_{i_p}^*(q_{i_o}^*) + q_{i_o}^*)}{\partial q_{i_p}^*} - P(1 - \frac{1}{\gamma}) \right) \quad (B5)$$

and

$$p_{i_p}^* = \frac{1}{2} \left(\frac{\partial c(q_{i_p}^*(q_{i_o}^*) + q_{i_o}^*)}{\partial q_{i_p}^*} + P(1 - \frac{1}{\gamma}) \right) \quad (B6)$$

From Lemma 1, in the benchmark case of a community without a PPO the equilibrium price and quantity are

$$q_{i_o}^* = \frac{\gamma(A+BP)}{2NP} [c'(q_{i_o}^*) - P(1 - \frac{1}{\gamma})] \quad (B7)$$

and

$$p_{i_o}^* = \frac{1}{2} [c'(q_{i_o}^*) + P(1 - \frac{1}{\gamma})] \quad (B8)$$

For any $\alpha > 0$, $q_{i_p}^* < q_{i_o}^*$. □

Appendix C

Proposition 2: For profit-maximizing physicians who participate in a fee-setting PPO, the optimal strategy is to select the quantity of PPO patients served, q_α , such that the physician's marginal revenue is equal to the marginal cost. For the optimally selected quantity of PPO patients, q_α^* , the physician chooses p_α^* , the optimal price to charge a PPO patient. Because the PPO is a fee-setter, the physician's pricing strategy is constrained by the PPO price ceiling, P_α .

For $p_\alpha \geq P_\alpha$, the physician chooses q_α^* such that

$$P_\alpha = \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_p^*(q_\alpha)} \frac{dq_p^*(q_\alpha)}{dq_\alpha} - \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_\alpha} \quad (C1)$$

which is the familiar marginal revenue equals marginal cost condition. The physician optimally prices the quantity q_α^* at the PPO-set price ceiling, P_α .

For $P_\alpha > p_\alpha^*$, the physician chooses the optimal quantity, q_α^*

$$q_i^* = \frac{\alpha\gamma(A + BP_\alpha)}{2nP_\alpha} \frac{dc(q_i^*(q_\alpha) + q_i^*)}{dq_i^*} - P_\alpha \left(1 - \frac{1}{\gamma}\right) \quad (C2)$$

and prices below the PPO price ceiling at

$$p_{i_\alpha}^* = \frac{1}{2} \left(\frac{dc(q_{i_\alpha}^*, (q_{i_\alpha}^*) + q_{i_\alpha}^*)}{dq_{i_\alpha}^*} + P_\alpha \left(1 - \frac{1}{\gamma}\right) \right) \quad (C3)$$

Note that the PPO market will not be served when $P_\alpha < c'(q_{i_\alpha})$.

Proof: For each PPO physician, total revenue from PPO patients is

$$TR_{i_\alpha} = \frac{nP_\alpha}{\gamma(A+BP_\alpha)\alpha} q_{i_\alpha}^2 + q_{i_\alpha} P_\alpha \left(1 - \frac{1}{\gamma}\right) \quad (C4)$$

and marginal revenue from PPO patients is

$$MR_{i_\alpha} = \frac{2nP_\alpha}{\gamma(A+BP_\alpha)\alpha} q_{i_\alpha} + P_\alpha \left(1 - \frac{1}{\gamma}\right) \quad (C5)$$

Each physician chooses the quantity of private and PPO patients to service by maximizing profits. The private price and quantity (q_p^* and p_p^*) is chosen as described in equations (9) and (10), respectively.

For $p_\alpha = P_\alpha$, a physician operates (*no pun intended*) on the truncated portion of the PPO demand curve and the profit function is

$$\pi = p_p^* q_p^*(q_\alpha) + P_\alpha q_\alpha - cost(q_p^*(q_\alpha) + q_\alpha) \quad (C6)$$

Given P_α , the physician chooses q_α^* to maximize profits.

By the envelope theorem,

$$\frac{d\pi}{dq_\alpha} = \frac{\partial(p_p^* q_p^*(q_\alpha))}{\partial q_p^*(q_\alpha)} \frac{dq_p^*(q_\alpha)}{dq_\alpha} + \frac{\partial(P_\alpha q_\alpha)}{\partial q_\alpha} - \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_p^*(q_\alpha)} \frac{dq_p^*(q_\alpha)}{dq_\alpha} - \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_\alpha} \quad (C7)$$

$$\frac{d\pi}{dq_\alpha} = \frac{\partial(P_\alpha q_\alpha)}{\partial q_\alpha} - \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_p^*(q_\alpha)} \frac{dq_p^*(q_\alpha)}{dq_\alpha} - \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_\alpha} \quad (C8)$$

Thus, the physician chooses q_α^* such that

$$P_\alpha = \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_p^*(q_\alpha)} \frac{dq_p^*(q_\alpha)}{dq_\alpha} + \frac{\partial c(q_p^*(q_\alpha) + q_\alpha)}{\partial q_\alpha} \quad (C9)$$

which is the familiar marginal revenue equals marginal cost condition.

For $p_\alpha < P_\alpha$, a physician is operating on the downward sloping portion of the PPO demand curve. Using price (p_α) as expressed in (12), the profit function is

$$\pi = (p_p^* q_p^*(q_\alpha)) + (p_\alpha q_\alpha) - \text{cost}(q_p^*(q_\alpha) + q_\alpha) \quad (C10)$$

Given that all other physicians price at P_α , the profit maximizing quantity for physician i is

$$q_{i_\alpha}^* = \frac{\alpha \gamma (A + BP_\alpha)}{2n P_\alpha} \left(\frac{dc(q_{i_p}^*(q_\alpha) + q_{i_\alpha})}{dq_{i_\alpha}} - P_\alpha \left(1 - \frac{1}{\gamma}\right) \right) \quad (C11)$$

and physician i will charge PPO patients

$$p_{i_a^*} = \frac{1}{2} \left(\frac{\partial c(q_{i_p^*}, (q_{i_a^*}) + q_{i_a^*})}{\partial q_{i_a^*}} + P_\alpha \left(1 - \frac{1}{\gamma}\right) \right) \quad (\text{C12})$$

Note that for $P_\alpha < c'(q_{i_a^*})$, physicians will not serve the PPO market.

Appendix D*

Proposition 5: If $\gamma < -1$, $c(q)$ is monotonic and strictly increasing in q and $\ln(c(q))$ is convex in q then a long run equilibrium exists and the quantity of physician services provided is greater in a community with a PPO than in the benchmark case.

Proof: Consider the demand facing any physician in a community without a PPO (benchmark case),

$$q_i = \frac{1}{N} \left[(A + BP) + \frac{\gamma(A + BP)}{P} (p_i - p) \right] \quad (D1)$$

where i indicates physician i and the subscript o denotes demand in the benchmark community. Let $X = (1/N)(A + BP)$ and rewrite (D1) as

$$q_{i_o} = X(1 - \gamma) + \gamma X \frac{p_i}{P} \quad (D2)$$

By definition total revenue equals $q_i p_i$ which can be expressed as

$$q_i p_i = \left[X(1 - \gamma) + \gamma X \frac{p_i}{P} \right] p_i \quad (D3)$$

Taking the derivative of (D3) yields the marginal revenue function

$$\frac{\partial(q_i p_i)}{\partial p_i} = X(1 - \gamma) + X\gamma 2 \frac{p_i}{P} \quad (D4)$$

Define the cost function as $\text{cost} = c(Q) + k$ where Q represents a physician's demand as defined in (D2) and k is a constant. This can be written as

*Thanks to Hans Haller for suggesting the substitution method used in this appendix.

$$C(Q) = c(Q) + k = (X(1-\gamma) + \gamma X \frac{P_i}{P}) + k \quad (D5)$$

and the marginal cost function is

$$\frac{\partial c(q_{i_0})}{\partial q_{i_0}} \frac{\partial(q_{i_0})}{\partial p_{i_0}} = c'(X(1-\gamma) + \gamma X \frac{P_i}{P}) \gamma X \frac{1}{P} \quad (D6)$$

Profit maximizing physicians set marginal cost equal to marginal revenue which gives

$$X(1-\gamma) + \gamma X 2 \frac{P_i}{P} = c'(X(1-\gamma) + \gamma X \frac{P_i}{P}) \gamma X \frac{1}{P} \quad (D7)$$

and replacing the expression for demand in the cost function with Q and rewriting (D7) yields

$$(1-\gamma) + 2\gamma \frac{P_i}{P} = c'(Q) \frac{\gamma}{P} \quad (D8)$$

By symmetry, $p_i = P$ and (D8) can be rewritten as

$$1 + \gamma = c'(Q) \frac{\gamma}{P} \quad (D9)$$

From the market structure of monopolistic competition, in equilibrium, price equals average cost thus,

$$\frac{1}{P} = \frac{Q}{c(Q)} \quad (D10)$$

Substituting (D10) into (D9) and replacing Q with X as defined earlier,

$$1 + \gamma = \gamma c'(Q) \frac{Q}{c(Q)} = \gamma \frac{c'(Q)}{c(Q)} \frac{1}{N} (A + BP) \quad (D11)$$

Now, consider the demand facing any physician in a community with a PPO. Again, from the market structure of monopolistic competition, price equals average cost in equilibrium. Let the PPO-set price, P_α , be equal to marginal cost such that

$$P_\alpha = c'(Q) = \frac{c(Q)}{Q} \quad (D12)$$

In equilibrium $p_i = P = P_\alpha$, and demand can be expressed as $Q = (1/N_\alpha)(A + BP_\alpha)$.

Substituting this expression for demand into (D12) yields

$$c'(Q) = \frac{c(Q)}{\frac{1}{N_\alpha}(A + BP_\alpha)} \quad (D13)$$

Using (D11) and substituting q^* for $(1/N)(A + BP)$ gives

$$1 + \gamma = \gamma \frac{c'(Q)}{c(Q)} q_o^* \quad (D14)$$

which can be rewritten as

$$q_o^* \frac{d(\ln c(q_o^*))}{dq_o^*} = \frac{1 + \gamma}{\gamma} < 1 \quad (D15)$$

Likewise, (D13) can be rewritten as Because $\ln(c)$ is convex and demand is linear, it

$$q_{\alpha}^* \frac{d(\ln c(q_{\alpha}^*))}{dq_{\alpha}^*} = 1 \quad (D16)$$

follows that $q^*(\ln c(q^*))$ must be strictly increasing in q^* . Comparing (D15) and (D16) reveals that $q_o^* < q_{\alpha}^*$, thus in equilibrium, the quantity of physician services is strictly greater in the community with the PPO. ◻

Proposition 7: If $\gamma < -1$, $c(q) = q^x + k$, $x > 1$, $k > 0$ and $A/B \leq (P_{\alpha}^{*2} - P_o^{*2}) / (P_o^* - P_{\alpha}^*)$, then a community with a PPO will support fewer physicians than the benchmark community.

Proof: To evaluate the equilibrium number of physicians present in the benchmark case, express (D11) in terms of N .

$$N_o^* = \ln(c)'(q_o^*) \frac{\gamma}{1+\gamma} (A + BP^*) \quad (D17)$$

where the subscript o denotes the benchmark community. Now, substitute $(1/N_{\alpha}^*)(A + BP_{\alpha}^*)$ for q_{α}^* in (D16) to get,

$$N_{\alpha}^* = \ln(c)'(q_{\alpha}^*) (A + BP_{\alpha}^*) \quad (D18)$$

where the subscript α denotes a community with a PPO. From monopolistic competition, in equilibrium, price equals average cost and

$$P^* = \frac{c(q^*)}{q^*} = \frac{c(q^*)}{\frac{1}{N}(A + BP^*)} \quad (D19)$$

Substituting q_o^* and P_o^* in (D19) and solving for N

$$N_o^* = \frac{1}{c(q_o^*)} (AP_o^* + BP_o^{*2}) \quad (D20)$$

And, likewise for the community with a PPO

$$N_\alpha^* = \frac{1}{c(q_\alpha^*)} (AP_\alpha^* + BP_\alpha^{*2}) \quad (D21)$$

By assumption $P_\alpha^* < P_o^*$ and from the proof of Proposition 5 that $q_\alpha^* > q_o^*$. Inserting $c(q) = q^x + k$ into (D15) results in $q_o^* < (k/(x-1))^{1/x}$ and into (D16), $q_\alpha^* = (k/(x-1))^{1/x}$. In equilibrium, $P_o^* = AC = (q_o^{*x} + k)/q_o^*$. Let the PPO set $P_\alpha^* = c' = xq_\alpha^{*(x-1)}$. Using these results in (D20) and (D21) provides the basis for comparing the equilibrium number of physicians in a community with a fee-setting PPO and the benchmark case. From (D20),

$$N_o^* = \frac{1}{q_o^x} \left(A \frac{(q_o^x + k)}{q_o} + B \left[\frac{(q_o^x + k)}{q_o} \right]^2 \right) \quad (D22)$$

and from (D21),

$$N_\alpha^* = \frac{1}{q_\alpha^x + k} [Axq_\alpha^{x-1} + B(xq_\alpha^{x-1})^2] \quad (D23)$$

Note from the proof of proposition 5 that $q_o^* < q_\alpha^*$, therefore $c(q_o^*) < c(q_\alpha^*)$ and for $N_o^* > N_\alpha^*$, it is sufficient that $A/B \leq (P_\alpha^{*2} - P_o^{*2}) / (P_o^* - P_\alpha^*)$. ◻

The Response of Physicians to Institutionalized Changes in Payment Rules

Introduction

It has been proposed in the literature that medical providers will alter the quality of services when constrained by reimbursement caps. Theoretical work by Glazer and McGuire (1993) predicts that physicians will lower quality in response to Medicare's binding price ceilings. In support of this, Held et al (1990) finds evidence of substitution of cheaper inputs by providers in response to binding reimbursement caps on renal dialysis. To the extent that quality of health care is related to the number and type of providers, substitution of labor inputs suggest an alteration in quality.

In medical settings such as hospitals, where patients do not expect an identical stream of service (or even the same *type* of provider) from one admission to another, it is possible for providers to lower quality without the patient's knowledge. In settings where the provision of services is by a monopoly provider, such as a dialysis unit, the patient may recognize a decrease in quality, but lack reasonable alternatives to accepting a lower quality of service. But what about non-monopoly providers who supply the same services repeatedly to patients? In this case, providers facing binding reimbursement caps may not be able to lower quality without losing patients to other providers.

Providers restricted from altering the quality of their services when constrained by a price ceiling, either by regulation or by the threat of competition from other providers, would still be expected to respond to price ceilings. The restriction of

payment imposed by Medicare under the Prospective Payment System (PPS) tied hospital payments to the Diagnostic Related Group (DRG) of a patient. In general, the more complicated the DRG, the higher the reimbursement from Medicare to the hospital.

One possible response of hospitals to the pricing restrictions of PPS is the recording of more complicated DRG's for their patients. This reaction to PPS is referred to as 'upcoding' or 'DRG creep'. Hospitals that upcode are simply responding to the incentives associated with the PPS. It would not be surprising to see other types of providers respond in a similar fashion when faced with pricing restrictions.

The amount of upcoding that occurs is difficult to detect. It is possible that hospitals recording more complicated cases are not upcoding, but truly have a more complicated case-mix of patients. It is also possible that hospitals respond to the PPS not by upcoding, but by early discharges of patients in an effort to reduce the length of stay and, hence, the cost of caring for a patient. Hospitals that respond to PPS by prematurely discharging patients may simply re-admit the same patients shortly after their discharge. Patients prematurely discharged and then re-admitted may be sicker and have more complicated DRG's on re-admission. Carter and Ginsburg (1985) estimate that the amount of DRG change related to upcoding is around 6 percent. They also estimate that the amount of upcoding by hospitals associated with the PPS is approximately 3 percent. Using a nationally representative sample of Medicare hospital claims from 1986 and 1987, Carter, Newhouse and Relles (1990) estimate DRG creep to be approximately one-third of the total change in DRG coding (two-thirds was attributed to changes in case-

mix).¹

Both Feldman et al (1981) and Hadley (1979) examined the response of California physicians to the Medicare fee freeze during the Economic Stabilization Program of 1971. Both studies showed that physicians responded by altering the volume and type of service recorded on the Medicare claim, including the type of office visit. Gabel and Rice (1985) suggest that these California physicians may have upcoded their office visits to more intense and expensive codes. Rice (1983) examined Colorado Medicare claims and found that a revision of payment rules in Colorado which constrained physicians' fees resulted in an increase in intensive (and expensive) services. Rice concluded that physicians do alter the type of service provided in response to reimbursement rate changes.

After 1971, Quebec operated under a universal health insurance regime which froze physician fees. Berry et al (1980) examined Quebec physician claims from 1971 to 1975. Berry shows that from 1971 to 1975 standard office exams declined and the more expensive comprehensive office exams increased. This suggest that physicians responded to frozen fees by altering the type of exam recorded on the insurance claim. Berry provides no evidence to suggest that physicians altered the actual type of exam they preformed.

This analysis examines the response of a group of physicians to reimbursement caps imposed by a large firm's medical insurer. It is hypothesized physicians constrained

¹Two-thirds of the DRG change was attributed to hospital changes in case mix.

by a reimbursement cap respond by systematically recording higher-price office visits. Physicians who are pricing near or above the reimbursement cap prior to the institution of the cap are expected to respond to a reimbursement cap by recording more expensive types of office visits. Conversely, physicians pricing well below the insurer's reimbursement cap are not expected to change the types of office visits they record. In an effort to avoid the quality issue, only established outpatient visits are examined.

After controlling for the age, gender and diagnosis mix of the established patients, as well as the presence of more than one source of insurance to the patient, I find that physicians who are constrained by the price ceiling systematically record higher-priced office visits than other physicians.

Methods and Data Source

The database contains first quarter 1991 and first quarter 1992 medical claims data for outpatient physician visits by employees and covered dependents of a Fortune 500 firm (Firm). These data were collected by the Firm's medical insurer. On each medical claim filed, the insurer collected information on the provider's fee, type of service rendered, type of provider, amount paid by other insurers, patient's age, gender, and diagnosis recorded. In 1991, the Firm's insurer paid 80 percent of any physician's reasonable and customary fee. In 1992 physicians were paid only up to a reimbursement cap determined by the insurer to be the 50th percentile of usual and customary charges by area physicians. Patient deductibles did not change. A detailed description of the Firm's insurance plans for 1991 and 1992 is given in the appendix A.

In order to avoid, as much as possible, varying degrees of price elasticity and strategic behavior among employees, only first quarter claims data are used. In most cases, the Firm resets each employee's deductible credit to \$0 on January 1st of each year. Because the employees pay the same deductible of \$325-\$470² in both years, no change in the employees' strategic behavior with regard to the deductible is expected from 1991 to 1992. However, over the course of either year, the responsiveness of any given employee to physician pricing remains a function of the stream of claims already filed by that employee. Specifically, the closer an employee is to fulfilling the deductible requirement, the less price sensitive the employee will become. This hypothesis cannot be tested with data available, but is assumed to be true.

In 1991 each physician received a questionnaire from the Firm requesting information about the physician's office operations (phone number, office hours, types of payment accepted, board certifications, schooling, years in practice, number of procedures done per year and prices). Physicians were informed of the Firm's intention to switch to a fee-ceiling set at the median price for the area. Physicians also were informed that the Firm's employees would have access to information from the questionnaires to aid employees in choosing physicians. Detailed information about which physicians returned the questionnaires is not available, although it would be expected that low-priced physicians and physicians with excess capacity would have a

²Deductible amounts were a step function of salary level. See appendix A for a detailed table.

higher incentive to return the questionnaire than physicians with established and busy practices.

Regardless of the physicians' response to the questionnaire, by sending the questionnaire and payment change information to physicians, physicians were informed of the changes in the payment rules for 1992. Although the actual fee ceilings were not revealed, physicians were informed that the fee ceiling would be the median price for the area. It is assumed that physicians have some indication of their prices in relation to other prices in the community.

The purpose of this study is to examine the response of physicians' prices to changes in payment rules. Physicians may respond to changes in payment rules by altering the quality of service and therefore, the issue of alterations in quality cannot be ignored. In physician services, quality can be quite ambiguous and difficult to quantify.

What exactly constitutes quality and, hence, the ability to perceive an alteration in quality is beyond the scope of this paper. Additionally, it is not clear that quality and quantity can be separated. For service industries, a change in quantity may actually reflect a change in quality. In order to minimize as much as possible the quality issue in the data used here, only established outpatient office visits are considered.

If physicians respond to changes in payment rules by altering the quality of their services, established patients would be in the best position to evaluate that change in quality. For example, only patients with knowledge of a physician's quality before 1992 could assess a change in quality by that physician in 1992. I assume that patients care

about quality and that physicians believe that patients care about quality so physicians have an incentive to maintain quality for established patients. Only established patients are included in the study.

Because patients' search costs are, in theory, lowered by access to information about physicians in their area, better informed patients might be more inclined than uninformed patients to switch physicians in response to decreases in physician quality. Physicians were assumed to be cognitive of patients' increased propensity to switch in response to any dissatisfaction with the physicians' services. Therefore I assume that physicians in the study had some incentive to maintain their standard level of service to employees of the Firm.

A total of 4,504 claims in the 1st quarter of 1991 and 6,698 claims in the 1st quarter of 1992 were made for outpatient visits to licensed physicians by established patients insured by the Firm. The date the patient saw a physician determines the date of the claim regardless of the filing or payment date.³ Because the purpose of the study is to determine physicians' response to a reimbursement cap, physicians for whom claims were filed in only one year are excluded. The sample contains 342 physicians. These physicians recorded the most common type of established outpatient office visit (code 90050 for a 15 minute visit of moderate complexity) in 1991 and any visit type in 1992. After discarding claims lacking pricing information, the final sample contains a total of

³Patients have one year to file a claim. Insurer patients who saw a physician and did not file a claim within one year are not included and the number of these patients is not known.

876 patients over 342 physicians with a total of 1501 claims in 1991 and 1308 claims in 1992.

Measurement and Variables

Established patients. An established outpatient is defined as any patient for whom a physician records an established outpatient office visit (Current Procedural Terminology (CPT) codes of 90030-90080,) on the medical insurance claim.⁴ New patients were excluded because of their inability to perceive a drop in quality or a change in price by their new physician.

Physician type. Physicians were designated as constrained or unconstrained by the reimbursement cap in 1992. Physicians whose average 1991 charge for office visit type 90050 was greater than or equal to 90 percent of the reimbursement cap for 1992 were considered to be constrained by the reimbursement cap. All other physicians were labeled unconstrained for 1992. This definition was used for two reasons. First, the 1991 consumer price index (CPI) for medical services was 8.9 percent. Assuming that the increase in physicians' fees would be about the same as the increase in the CPI, physicians whose 1991 charges were 90 percent of the 1992 reimbursement cap or more are assumed to be constrained by the reimbursement cap in 1992. Second, visit type 90050 was the most frequently recorded visit type in both 1991 and 1992 and information was available on the reimbursement cap for this visit type. Therefore, it provided a

⁴See Table 1 for a brief definition of CPT codes and the distribution of CPT codes by type of physician.

useful index to determine if a physician was constrained by the reimbursement cap in 1992.

Co-insurance. The insurer collected information on medical payments made by other insurers and medically designated, tax-exempt funds. Employees of the Firm are allowed to make an annual payment of pre-tax income to be used exclusively for medical payments. The Firm reports that this is used by fewer than 1 percent of employees. The insurer records only the amount, not the source, of payment made by additional insurance.

Diagnoses. The insurer recorded the primary diagnoses according to the ICD-9-CM codes. These codes are condensed to 17 ICD-9-CM general headings to make the analysis tractable (see Table 9 for details on diagnosis grouping).

Statistical Analysis

Data are patient-generated medical claims from 1991 and 1992. The purpose of the analysis is to detect differences in responses of constrained and unconstrained physicians to reimbursement ceilings. In order to address this question, I first focus on discovering differences between constrained and unconstrained physicians.

Bivariate Analysis and Results

To detect differences in the characteristics of constrained and unconstrained physicians, bivariate analysis using chi-squared statistics is used.⁵ This section provides

⁵See Lardaro (1993) for a technical description of the test.

a look at physicians by type (constrained versus unconstrained) and by year. Only established outpatient office visits were examined. First, I look at all six categories of established patient visits to see if there is some difference in the distribution of office visit codes recorded on the insurance claim by physician type. If constrained physicians recorded offices visits differently than unconstrained physicians in 1992 then that would suggest that something happened to constrained physicians in 1992 that unconstrained physicians didn't experience. There was a significant difference in the distribution of the types of office visits across years for both constrained and unconstrained physicians. Table 2 shows the results for unaggregated visit types. The six visit types were aggregated into the three lowest and the three highest price visit types.

To detect a movement between low-priced and high-priced visits, the type of office visit was grouped into briefer and lower priced visits (CPT codes 90030-50) and longer and higher-priced visits (CPT codes 90060-80). Chi-square statistics reveal a significant difference between constrained and unconstrained physicians with constrained physicians recording significantly more high-priced visits in 1992 (see Table 2).

Table 2 presents the chi-square tests of the hypothesis that patient visits are identical by physician type and year. When the visits are aggregated by price, unconstrained physicians have the same distribution of visit types in 1992 as in 1991. The chi-square statistic reveals that unconstrained physicians did not alter significantly the mix of office visits recorded from 1991 to 1992. The change in the type of office visit recorded for constrained physicians is significant at the 5 percent level even when

the visit types are aggregated into low and high-priced visits.

The fact that constrained physicians, in contrast to unconstrained physicians, recorded more high-priced visits in 1992 suggests that constrained physicians may have responded to the 1992 price ceiling by recording more high-priced visits. However, the bivariate analysis does not take into account the effect of patients' characteristics on physicians' behavior and the type of office visit recorded. The change in the type of visit recorded by constrained physicians may be caused by changes in their patients' characteristics from 1991 to 1992.

Chi-square statistics were done on patient characteristics to determine if the differences in the type of office visits was due to differences in the patient mix of constrained and unconstrained physicians or differences in patient mix between 1991 and 1992.

If constrained physicians experienced a significant change in the age mix of their patients in 1992, then it might be expected that constrained physicians would record different types of office visits in 1992. To determine if the age mix of patients varies significantly with the type of physician (constrained or unconstrained), patients were partitioned into three age categories. Young patients were defined as under 18, middle-aged patients as 18-50 and old patients as over 50. For the two types of physicians (constrained and unconstrained), the age mix of patients did not vary significantly from 1991 to 1992. However, constrained physicians have significantly older populations of established patients than do unconstrained physicians (see Table 4 for the distribution of

patients by age across physicians). Because the data set includes only employed individuals and their dependents, there are very few observations over the age of 60. Hence, Medicare reimbursement is not considered an issue in this dataset.

The older population of constrained physicians may represent a selection bias by older and more affluent patients with higher time values who seek out physicians who provide shorter waiting times at higher prices. It may also be an indication that older patients have more complicated medical problems requiring longer and more expensive office visits. In general, Medicare covers those over 64. Separating the Medicare-aged patients into a separate category did not alter the results. To determine if Medicare-aged patients were affecting the outcomes, I repeat the test for patients assigned as young (0-17 years old), middle (18-64 years old) and old (over 64 years old). The distribution of age mix for constrained and unconstrained physicians is shown in Table 4. Patients over 64 years of age accounted for only 1% of patients for both constrained and unconstrained physicians, confirming the assumption that Medicare patients are not an issue in this dataset. These results are reported in Table 3.

The gender mix of patients did not vary significantly across years for constrained or unconstrained physicians, but it is interesting that constrained physicians had significantly more female patients. This counters the notion that women have lower incomes and lower time values and might be expected to seek lower-priced physicians where they may have longer queues. Keeping in mind that young physicians generally have lower prices, this may represent the fact that women of childbearing age use

physician services more frequently than their male counterparts. Hence women may have longer relationships with their physicians resulting in the use of more established and more expensive physicians. Alternatively, this may represent a selection bias on the part of women for some unidentified characteristic of the constrained physicians.

In both years, there were significant differences in the diagnosis mix of patients between constrained and unconstrained physicians (see Table 3). The diagnosis mix was significantly different from 1991 to 1992, but this was true for both types of physicians (see Table 2). Physicians in this study are not coded by their type of practice. An abundance of general practitioners in the dataset could account for the diverse diagnosis mixes observed.

The distribution of patients with and without additional insurance was significantly different for unconstrained physicians from 1991 to 1992. For the same time period, the mix of patients with and without additional insurance did not vary significantly. However, the number of patients with additional insurance is relatively small and may not be meaningful. There was no significant difference in the distribution of patients with additional insurance between unconstrained and constrained physicians in either year.

Multivariate Regression Analyses

The bivariate analyses suggest that relationships exist between visit types, physician types and patient characteristics. In this section, I explore these relationships simultaneously, rather than in a series of separate bivariate comparisons.

The dependent variable is the type of office visit recorded by the physician which

is defined as low-priced (CPT codes 90030-50) or high-priced (CPT codes 90060-80). The type of office visit is represented by a dummy variable equal to 1 for a high-priced visit and 0 otherwise. Because the dependent variable is binary and the coefficients in linear probability models can be interpreted directly, I initially explore the relationship between visit type and physician type by modelling the type of visit on the physician type using a linear probability model (LPM).

It is hypothesized that physicians who are near or above the 1992 price ceiling in 1991 (constrained physicians) will be affected in 1992 by the presence of the price ceiling. If constrained physicians charge above the price ceiling in 1992, they risk losing patients to physicians who price at or below the price ceiling in 1992. Therefore, it is expected that constrained physicians will change their behavior in 1992 while unconstrained physicians will not. The physician type variable is binary; equal to 1 for constrained physicians and 0 otherwise. Physician type is interacted with year to determine the effect of constrained physicians in 1992 and unconstrained physicians in 1992.

First, the LPM is employed using only paired variables of year and physician type to explain the type of office visit recorded. The model is simply,

$$\text{Prob(High-Priced Visit)} = \alpha_0 + \alpha_1 \text{cons92} + \alpha_2 \text{cons91} + \alpha_3 \text{uncons92},$$

where *cons92* indicates a constrained physician in 1992, *cons91* indicates a constrained physician in 1991 and *uncons92* indicates an unconstrained physician in 1992. The results (shown in Table 5) reveal that constrained physicians in 1992 were 8 percent

more likely to record a high price visit than they were in 1991. This regression also reveals that in 1991 a constrained physician is 5 percent less likely to record a high price visit than an unconstrained physician.

Recall that the bivariate analyses indicated that there were differences in diagnosis mix, age of patients and patient gender. To control for the effects of these patient characteristics on the type of office visit recorded they were included in the LPM. Patient gender is represented by a binary variable equal to 1 for female and 0 for male. Although gender is expected to influence the type of office visit, the direction of the effect is ambiguous. Adult women use more medical services than adult men, although older men use more medical services than older women.⁶ From this documented observation, women might be expected to have long-standing and loyal relationships with their physicians and be less likely to switch physicians because of a price increase. Physicians with established practices tend to charge more for their services as compared to new physicians. If women have long-standing relationships with their physicians then women would be expected to patronize established and higher-priced physicians earlier in their lives than men. It is hypothesized that as women age, they are more likely to see high-price physicians and generate high-priced visits.

Because this study involved employees and their dependents, there are very few observations for claims by patients over 65. Therefore, the increase in usage and subsequent loyalty to physicians by men that might be observed for older men would not

⁶ See Health Care Financing Review (1989).

be expected to be expressed in these data. Although men in this study may not have long-standing and loyal relationships with their physicians, men may be expected to have higher time values because of higher opportunity cost related to their employment. If this is the case, men would be expected to patronize physicians who will see them promptly. To the extent that physicians extract the waiting time of their patients in their fees, men would be expected to have office visits with higher-priced physicians (constrained physicians).

The presence of additional insurance would be expected to decrease an employee's price sensitivity to physician pricing. Additional insurance includes insurance available through a spouse's medical insurance plan as well as government insurance such as Medicare. Because these employees are gainfully employed it is not expected that any of them are receiving Medicaid payments. The actual type of additional insurance available is not known, only the presence of additional insurance is noted in the data set. The presence of multiple insurers could render a reimbursement cap non-binding.

Patient age is expressed as number of years different from the mean age of all patients in the sample. Patient age is expected to have some influence on the type of visit generated. Older employees may be expected to have more complicated medical problems than younger employees resulting in higher-priced visits for older employees.

Patient diagnosis is also expected to have some influence on the type of office visit recorded. Diagnosis is categorized into one of 14 different general headings (see Table 9). Although the direction of the effect is not clear, it is assumed that some

diagnoses may influence the type of office visit generated.

One advantage of using a LPM is that the coefficients on the variables can be interpreted directly. A positive coefficient on physician type, gender or presence of other insurance (COB) reveals the increase in probability that being a constrained physician, a female patient or a patient with additional forms of insurance is associated with a high-priced office visit. A positive coefficient on patient age reveals the increase in the probability of generating a high-priced visit for each year that the patient is above the mean age. Gender is a binary variable with female equal to 1 and male equal to 0. A positive coefficient on gender reveals the increase in probability that a high-priced visit will be generated.

One of the disadvantages of the LPM is the possibility of estimating probabilities greater than 1. Even though the coefficient on the variables in the LPM can be directly interpreted as the change in probability of triggering a high-price visit by a corresponding explanatory variable, using the LPM assumes that the predicted change is constant for each incremental change in the explanatory variable. There is no reason to impose this restriction on the model.

The LPM is used to explore the possible relationships between physician type, patient characteristics and visit type. A logit model is employed to address the magnitude of the relationships uncovered in the LPM. The logit model is simply,

$$\ln[p(\text{HighPriceVisit})/1-p(\text{HighPriceVisit})]=\beta_0+\beta_1\text{cons92}+\beta_2\text{cons91}+\beta_3\text{uncons92}+\phi X$$

The term ϕX represents patient characteristics of age, gender, insurance status and primary diagnosis.

Results of the Multivariate Analyses

Table 6 details the results of the LPM analysis which controls for patient characteristics on the type of visit recorded. Recall that without controlling for patient characteristics, the LPM predicts that a constrained physician is 8 percent more likely to record a high price visit in 1992 than in 1991. The logit model (see Table 8) predicts the same 8 percent increase as the LPM. Using the LPM and controlling for patient characteristics, a constrained physician in 1992 is 7 percent more likely to record a high price visit in 1992 than in 1991. Adding patient characteristics to the LPM does not change the essential conclusion that physicians constrained by a price ceiling respond by recording higher priced visits.

While the LPM indicates that only 1 percent of constrained physicians 8 percent response to a price ceiling is related to changes in patient characteristics, the logit model indicates that 2 percent of the 8 percent response to the price ceiling is attributable to patient characteristic. Table 6 addresses these patient characteristics for the LPM and Table 8 does the same for the logit model. There is very little difference in the results of the logit model compared to the LPM.

In both the logit and the LPM analysis with the patient characteristics, the

coefficient on age is negative and significant. The coefficient value indicates that each additional year a patient's age varies from the mean age (28.87 years) decreases the probability of a high price visit by one tenth of 1 percent. Using the age as a linear variable indicates that the older patient population of constrained physicians was not responsible for triggering a high priced visit. Thus, the expectation that older patients may have more complicated medical problems than younger patients resulting in higher priced visits is not supported. However, the underlying assumption that age is linearly related to the type of visit recorded may not be true.

Consider the nature of the data. Each observation is generated by an office visit claim for an employee or their dependent. These are salaried employees of the Firm and it is assumed that employees are at least 18 years old. However, patients under the age of 18 account for over 40 percent of the total office visits in both 1991 and 1992. For patients under the age of 18, I assume that their parent or guardian and not the minor makes the decision about which physician the minor will use. If this is true, then one would not expect a linear relationship to exist between age and visit type. The relationship of minor patients to visit type should mirror the relationship of their adult parents to visit type. To test this hypothesis, I include age squared as an explanatory variable and find that it is significant at the 10 percent level. This supports the hypothesis that age is not a linear variable.

If the assumption that minors mirror the decisions of their parents is correct, then one might expect the relationship between age and visit type to be a step function with

the step occurring around age 18. To test the importance of minors in the dataset, a dummy variable equal to 1 for patients under 18 years old is included. This variable is significant at the 5 percent level supporting the assumption that minors mirror the decisions of their parents.

The coefficient on gender is not significant. It reveals that a female patient increases the probability of a high-priced visit by only 2%. The result from the chi-square testing shows that women are associated with constrained physicians, but this does not effect the type of office visit recorded.

As expected some diagnoses are significant predictors of the type of office visit recorded. Table 6 details the coefficients on all the diagnosis groups for the LPM and Table 8 does the same for the logit model. Of special interest are the diagnoses that are significant at the 5 percent level. Looking strictly at the results if the LPM, a primary diagnosis of infectious or parasitic disease increases the probability of a high-price office visit by 18 percent. Circulatory disorders increase the probability of a high-price office visit by 10 percent. Genito-urinary disorders increase the probability of high-price visits by 20 percent. A diagnosis of skin or subcutaneous tissue disorder increases the probability of a high-price visit by 10 percent. Ill-defined symptoms increase the probability of a high-price visit by 9 percent while injury or poisoning increases the probability of a high-price visit by 11 percent. Because the diagnosis categories are broadly defined and only the primary diagnosis is known, no explanation is offered on the actual mechanism driving the diagnosis effects on the type of office visit.

Summary

The analysis in this paper provides evidence that physicians who were constrained by a price ceiling responded by systematically recording a higher priced office visit on patients' insurance claims. After controlling for patient characteristics of age, gender, diagnosis and the presence of additional insurance, constrained physicians were 6 to 7 percent more likely to record a high-price office visit than unconstrained physicians. Six out of 14 identified diagnoses were positively and significantly associated with high-price office visits. Because the categorization of diagnoses was broad and only a patient's primary diagnosis was known, it is unclear why some of the diagnoses are significant while others are not. Table 6 and Table 8 detail the LPM and the logit results, respectively with flags on the significant diagnoses.

This study looks only at the pricing behavior of physicians who treated employees of a large firm. Nothing is known about the pricing and office coding behavior of these physicians with their other (non-Firm employees) patients. Theoretical work by Peele (1993) suggests that the price to all of the constrained physicians' patients should be affected by the institution of a price ceiling on some of a physician's patients. Because the pricing behavior seen in this study is a recoding of visit type, it would be interesting to know how, if at all, the constrained physicians in this study altered the coding of visits to their other patients. Unfortunately, information about patients who were not employees of the Firm is not available.

In the context of the literature on provider responses to price ceilings, this study

provides further evidence that the providers do not alter prices, but they do alter coding. However, because the data used here are limited and the market share of the Firm's employees with any given physician in the study is unknown (but presumed to be small), this study only offers supportive evidence of upcoding behavior. This study alone is not adequate to support a definitive conclusion that constrained physicians altered their behavior solely in response to a change in payment rules, but provides additional evidence to support the type of provider upcoding seen in provider responses to fixed payments by Medicare.

WORKS CITED

Berry C, Held PJ, Kehrer B, Marheim L, and Reinhardt U. (1980), "Canadian Physicians' Supply Response to Universal Health Insurance: The First Years in Quebec (preliminary results)", In Gabel JR, Taylor J, Greenspan NT, and Blaxall M, eds., Physicians and Financial Incentives. Washington DC: US Government Printing Office: 57-59.

Carter GM, and Ginsburg PB (1985), "The Medicare Case Mix Index Increase: Medical Practice Changes, Aging and DRG Creep", RAND Corporation, R-3292-HCFA, June.

Carter GM, Newhouse JP and Relles DA (1990), "How Much Change in the Case Mix Index is DRG Creep?", *Journal of Health Economics*, 9:411-428.

Gabel JR and Rice TH, (1985), "Reducing Public Expenditures for Physician Services: The Price of Paying Less", *Journal of Health Policy and Law*, 9:595-609.

Glazer, Jacob and McGuire, Thomas G. (1993), "Should Physicians be Permitted to Balance Bill?", *Journal of Health Economics*, 12:239-258.

Feldman R., Goldfarb R., Rafferty J., and Goldfarb M. (1981), "Physician Choice of Patient Load and Mode of Treatment", *Atlantic Economic Journal*, 9:69-78.

Hadley J. (1979), "Physician Participation in Medicaid: Evidence from California", *Health Services Research*, 14:266-80.

Health Care Financing Review (1989), International Comparison of Health Care

Financing and Delivery: Data and perspectives; 7 (annual supplement).

Held PJ, Garcia JR, Pauly M, and Cain MA (1990), "Price of dialysis, unit staffing and length of dialysis treatments", *American Journal of Kidney Disease*, 15:441-450.

Kennedy, Peter (1992), A Guide to Econometrics, MIT Press, Cambridge.

Lardaro, Leonard (1993), Applied Econometrics, Harper Collins, New York.

Lave, Judith (1990), "The Impact of the Medicare Prospective Payment System and Recommendations for Change", *Yale Journal on Regulation*, 7(2):499-528.

Peele, Pamela B. (1993), "The Effects of a Fee-Setting Preferred-Provider Organization on Physician Pricing", mimeo, VPI&SU.

Rice, T. H. (1983), "The Impact of Changing Medicare Reimbursement Rates on Physician-Induced Demand", *Medical Care*, 21:803-15.

Appendix A: The Fee-Setting Medical Plan

Data Review

Data Source: Large Fortune 500 firm (Firm) with 253 locations in the continental U.S.

Medical Plans Offered by the Firm: In 1991, all salaried personnel were offered a medical plan (Plan91) which provided 80% payment for covered outpatient services given that the Plan91 participant had met the salary-specific deductible. A covered outpatient service is any Plan approved medical service provided to a non-hospitalized patient by an approved provider (which includes all licensed physicians). A deductible is the amount of money that a participant must pay for covered medical services before the Plan will provide any payment for medical expenses. The amount of the deductible an employee pays is different for different salary levels with higher deductibles for higher salary levels. Deductibles were salary-specific in three broad categories (See appendix B for deductibles). Participants accrued deductible credit for out-of-pocket payments on covered services. Participants also had a salary-specific, out-of-pocket limit which was the maximum amount a participant would pay in any given year for covered medical services. Once a participant's out-of-pocket limit was reached, the Plan91 paid 100% of all covered medical expenses (See appendix B for limits). Payments which were credited to the deductible and the participant's 20% co-payment on covered medical services both counted toward the out-of-pocket limit. It was not possible for a participant to reach the out-of-pocket limit by utilizing services not covered by Plan91 such as in vitro fertilization, cosmetic surgery or experimental therapies. In-patient services were

covered at 100% after the deductible was met.

In 1992, the Firm eliminated Plan91 and offered a structurally different medical plan, Plan92. Plan92 imposed a fee schedule for covered services (again, including new and established physician visits) which operated as a price ceiling. Plan92 provided the lesser of 100% payment or the fee schedule for covered outpatient services and hospital room and board, given that the Plan92 participant had met the salary-specific deductible (See appendix B). All covered hospital charges (except room and board) were paid at 65% of the usual and customary charge. However, deductible credit was only granted for amounts up to the fee schedule or the usual and customary charge on covered services. Out-of-pocket limits were unchanged, but only expenditures for covered services up to the fee schedule or usual and customary charge were credited towards a participant's out-of-pocket limit. Certain outpatient physician services such as well-baby visits, routine physicals, vaccinations and immunizations were dropped from the list of covered services and participants could not receive either payment for the service or credit towards their out-of-pocket limit and/or deductible.

Enrollment in the Plans: In 1991 and 1992, there were 22,731 and 23,129 participants in Plan91 and Plan92, respectively. In many of the Firm's 253 locations, salaried employees of the Firm could choose between participating in the Firm's medical plan or joining an HMO. Information is not available about the total number of salaried employees, any change in overall employment or the number of eligible employees who chose not to enroll in any Firm-sponsored medical plan. Some eligible employees and

their dependents may be included in other medical plans by either their spouse, guardian or parent. Based on the observation that the number of Plan participants grew slightly from 1991 to 1992 while other medical coverage options offered by the Firm remained constant, the change in plan structure between 1991 and 1992 does not appear to have discouraged enrollments. Adverse selection cannot be disregarded, but data are not available about employees who switched from the HMO to Plan92 or from Plan91 to the HMO. The Plan data available do not allow assumptions to be made about how the changes in Plan92 affected the decisions of new participants in 1992. Adverse selection is possible.

According to reports supplied by the Firm, for the period from 1991 to 1992, the number of outpatient services per 1000 employees fell by 3.8% while the out-of-pocket payments per person fell 12.4%. These numbers do not reflect the true out-of-pocket payments because only amounts up to the fee schedule for covered expenses are credited by the Firm as patient expenditures. For example, if a physician charges \$100 and the fee schedule is \$75, then only \$75 is credited towards the employee's deductible and only the \$75 counts as an out-of-pocket expense. The additional \$25 paid by the employee is ignored.

Information available to physicians and Plan participants: Plan92 employed a fee schedule which was a schedule that defined the maximum dollar amount payable by the Plan. Plan92's fee schedules were available to all participants and physicians upon request. Information about physicians pricing and practices was also available to Plan

participants. The physician price and practice information was collected by the Firm in each of the Firm's locations via a mailed questionnaire. Physicians were informed that the questionnaire information would be available to Plan92 participants upon request. Physicians were thus informed about changes in the Firm's medical plan and the availability of physician price and practice information. Additionally, Plan92 participants viewed a video on how to access the Firm's physician price and practice information as well as how to inquire about and negotiate fees directly with physicians. The extent to which physicians or participants used physician price and practice information is not known.

Organization of the Data: The data set contains medical claims by salaried personnel and their dependents (participants) for new and established outpatient physician office visits in the 1st quarter (Jan-Mar) of 1991 and 1992. These participants generated 13,301 total claims (8041 claims in 1992 and 5,260 claims in 1991). See Appendix B for a list of variables available in each year.

Physician outpatient services are coded according to the Current Procedural Terminology (CPT) as defined by the American Medical Association (AMA). This is the industry standard. In 1992, the AMA revised the CPT codes. All of the 1991 data and most of the 1992 data are coded in 1991 CPT codes. Data coded using the 1992 CPT was re-coded to correspond to the 1991 CPT codes.

Cleaning of the Data: There are 53 observations in 1992 in which the physician's charge is negative. For 46 of these observations there is an observation that is identical

(including the absolute value of the physician's charge) except that the physician's charge is positive amount instead of a negative one. It is assumed that these negative entries are corrective actions for data entry errors and both the 46 observations with the negative charges and the 46 identical observations with the positive charges were removed from the data set.

There are 7 observations in 1992 for negative physician charges that have no identical observation with an identical positive physician charge. These are also assumed to be data entry errors and these 7 observations were deleted from the data set.

For 1992, there are 119 observations where the physician's charge is zero. These could be either data entry errors or claims filed for free office visits. These 119 observations with zero charges were generated by 100 different physicians and no systematic pattern is discerned involving physicians, patients or their locales. All 119 observations with zero physician charges were removed from the data set.

The Firm's change in plan administrators and data entry facilities between 1991 and 1992 may be a factor. The 1991 data contains no negative or zero amounts for physician charges.

Possible Selection Biases: An observation is generated when a participant files a medical claim for an office visit with a physician. Participants in the Plan can file a claim for reimbursement of medical expenses up to 15 months from the date the expenses were incurred. All participants are subject to a deductible (as previously described). Participants who anticipate annual medical expenditures less than their deductible have

little incentive to file a claim because they can file a claim later in the year if their medical expenses exceed their deductible. The data is only for the 1st quarter of 1991 and 1992. It is not known whether patients have a higher or lower propensity to file claims in the 1st quarter of the year as opposed to any other quarter. It is possible that participants who expect to spend less than the deductible on medical services in the year will not bother to file a claim. The 1st quarter claims include all claims filed within the 15 month deadline. Participants who anticipated low medical expenses and did not bother to file claims will not be included if their expectation was correct and their total annual medical expenditure was less than their deductible.

About Plan Participants who Filed Outpatient Claims: Data for each year were sorted by patient ID. In 1991, there were 5,260 claims by 3,088 patients; in 1992, there were 8,009 claims by 4,620 patients. 953 patients filed claims in both years (2,504 total claims). These 953 patients saw 912 different physicians in 1991 and 1,021 physicians in 1992. Patients saw the same physician for any procedure in 1991 and 1992 1,044 times out of a total of 2,504 claims. 1,460 patients saw a different physician in 1992 than in 1991. Of the 1,460 patients who saw a different physician in 1992, 240 were seen as a new patient in 1992. This does not necessarily imply that 240 patients switched physicians in 1992. It could be the case that patients were referred to another physician (although the year lapse makes this unlikely) or that patients sought a new physician for an unrelated illness or treatment. For example, a patient may see an internist in 1991 and 1992 for periodic hypertension control and see a dermatologist in 1992 for removal

of a skin lesion. This would generate a new patient visit in 1992 that could be misinterpreted as switching physicians along with an established patient visit in 1992. 305 patients saw the same physician for the same procedure a total of 474 times in 1991 and 1992.

Of the 240 patients who filed claims in both years and were seen as a new patient in 1992, 166 different physicians were consulted.

About The Physician Pricing: To examine the change in physician pricing of office visits, the data for each year were sorted by physician ID and procedure. There are multiple observations on some physicians. Each physician's average charge for a given procedure was determined and physicians were selected who had charges in both 1991 and 1992 for the same procedure. There are 515 doctors with charges in both years for any procedure. Table 4 summarizes the change in pricing by physicians for each procedure. Note that a physician may have charges in both years for one or more procedures. Data on individual physicians are too limited to determine if physicians cross-subsidized between procedures.

Physicians for whom a claim for procedure 90050 was filed in 1991 and any procedure claim in 1992 were selected. Procedure 90050 was the single most filed claim. A physician's average price for 90050 in 1991 was determined and compared to the 1992 price ceiling for 90050. Physicians whose 1991 price for 90050 was greater than or equal to 0.9 (price ceiling for 1992) were considered to be constrained physicians. All other physicians were considered to be unconstrained physicians.

Appendix B

Information on Insurance Plans for 1991 and 1992

Deductibles¹

Annual Salary of Employee	Individual Deductible	Family Deductible
Less than \$25,000	\$325	\$650
\$25,000 but less than \$50,000	\$380	\$760
\$50,000 or more	\$470	\$940

Out-of-Pocket Limits (Includes Deductible)¹

Annual Salary of Employee	Individual Limit	Family Limit
Less than \$25,000	\$1,500	\$3,000
\$25,000 but less than \$50,000	\$2,300	\$4,600
\$50,000 or more	\$3,250	\$6,500

Notes:

- 1 No change from 1991 to 1992

Table 1
Information on Constrained and Unconstrained Physicians^a
(Distribution of Visit Types)

	<u>Constrained Physicians</u>		<u>Unconstrained Physicians</u>	
Number of Physicians	85		257	
<u>Visit Types^b</u>	<u>1991</u>	<u>1992</u>	<u>1991</u>	<u>1992</u>
New Patients				
unspecified time	0.7%	0.0%	0.8%	0.7%
10 min visit	2.6%	1.4%	3.6%	2.9%
20 min visit	1.8%	2.4%	2.4%	2.3%
30 min visit	1.1%	2.4%	1.1%	1.7%
45-60 min visit	2.9%	3.8%	0.7%	1.4%
Established Patients (CPT codes)				
5 min visit (90030)	12.4%	5.7%	2.2%	2.2%
10 min visit (90040)	9.9%	14.8%	10.5%	22.6%
15 min visit (90050)	54.0%	47.4%	59.3%	47.0%
20 min visit (90060)	9.9%	11.0%	15.4%	13.7%
25 min visit (90070)	1.5%	6.7%	2.5%	4.1%
40 min visit (90080)	3.3%	4.3%	1.5%	1.5%
Number of claims	<u>274</u>	<u>209</u>	<u>1,227</u>	<u>1,099</u>

Notes:

- ^a Physicians with at least one charge in 1992 for any visit type and at least one charge in 1991 for visit type CPT code = 90050.
- ^b As a percentage of total visit claims filed by patients.

Table 2
 χ^2 Tests for Differences in Established Patients
Constrained and Unconstrained Physicians, 1991 vs 1992
 (p-value in parentheses)

	Constrained Physicians	Unconstrained Physicians
	<u>Between years</u> <u>1991-1992</u>	<u>Between years</u> <u>1991-1992</u>
Patient Characteristics		
Gender	1.987 (0.159)	0.478 (0.489)
Age	0.472 (0.790)	2.979 (0.225)
Other insurance	1.115 (0.291)	3.889 (0.049) ^{***}
Diagnosis mix ¹	30.335 (0.007) ^{**}	26.344 (0.059) [*]
Visit Type ²	4.786 (0.029) ^{**}	0.000 (0.995)

Notes:

- ¹ Missing or obviously incorrect diagnosis codes excluded. These are 12-14% of all diagnoses.
- ² Low priced visits= 90030-50, high priced visits=90060-80
- ^{**} Significant at the 5% level
- ^{*} Significant at the 10% level
- ^a For 1991 only 7 patients had other insurance and in 1992 only 1 patient had other insurance. The number of patients without other insurance was 1220 and 1098 in 1991 and 1992, respectively.

Table 3
 χ^2 Test for Identical Patient characteristics, diagnosis mix and visit type
in 1991 and 1992
Constrained and Unconstrained Physicians
 (p-value in parentheses)

	Year= 1991 Constrained vs Unconstrained Physicians	Year=1992 Constrained vs Unconstrained Physicians
Patient Characteristics		
Gender	7.816 (0.005)**	5.536 (0.019)**
Age	93.016 (0.000)**	72.041 (0.000)**
Other insurance	2.435 (0.119)	1.727 (0.189)
Diagnosis mix	199.765 (0.000)**	70.519 (0.000)**
Visit type ^a	3.341 (.068)*	0.994 (0.319)

Notes:

- a visit codes 90030-50 are low priced visits, codes 90060-80 are high priced visits
- ** significant at the 5% level
- * significant at the 10% level

Table 4
Distribution of Gender and Age of Patient Mix
Constrained and Unconstrained Physicians by Year

	Constrained Physicians		Unconstrained Physicians	
	1991	1992	1991	1992
Female patients	64%	57%	54%	56%
Male patients	36%	43%	46%	44%
Age:				
Grouping 1				
0-17	17%	19%	46%	45%
18-50	45%	42%	35%	38%
> 51	38%	39%	19%	17%
Grouping 2				
0-17	17%	19%	47%	45%
18-64	82%	79%	52%	54%
> 64	1%	1%	1%	1%
	=====		=====	
Total number of patients	274	209	1227	1099

Table 5
Estimated Parameters of Linear Probability Model
Dependent variable: Visit Type¹

	<u>Coefficient</u>	<u>Standard Error</u>	<u>Prob</u>
Unconstrained physician in 1991	0.21212	0.0121	0.0001
Constrained physician in 1992	0.0840	0.0393	0.0326**
Constrained physician in 1991	-0.0514	0.0285	0.0710*
Unconstrained physician in 1992	-0.0001	0.0177	0.9945

Notes

- 1 Low priced visits=CPT codes 90030-50;
High priced visits= CPT codes 90060-80
- ** Significant at the 5% level
- * Significant at the 10% level

Table 6
Estimated Parameters of the Linear Probabilty Model
Dependent variable: Visit Type¹

	Coeffiecent	Standard Error	Prob
Unconstrained Physician in 1991	0.1709	0.0310	0.0001
Constrained Physician in 1992	0.0675	0.0395	0.0882*
Constrained Physician in 1991	-0.0432	0.0299	0.1477
Unconstrained Physician in 1992	0.0026	0.0177	0.8846
Patient Age ^a	-0.0047	0.0011	0.0001**
Patient Age Squared	0.0001	0.0000	0.0547*
Patient < 18	-0.1395	0.0453	0.0021**
Patient Gender	0.0192	0.0167	0.2507
Age x Female	0.0018	0.0008	0.0149**
Other Insurance	-0.0035	0.1287	0.9780
Diagnoses			
Infectious&Parasitic	0.1740	0.0501	0.0005**
Neoplasms	0.0626	0.0570	0.2724
Endocrine	0.0606	0.0500	0.2248
Blood	-0.0580	0.0847	0.4932
Neurologic	0.0277	0.0326	0.3956
Circulatory	0.1150	0.0379	0.0025**
Respiratory	0.0308	0.0272	0.2568
Digestive	0.0229	0.0482	0.6356
Genitourinary	0.2039	0.0412	0.0001**
Skin&Subcuatneous	0.1026	0.0414	0.0133**
Musculoskeletal	0.0326	0.0430	0.4480
Ill-Defined syptoms	0.0879	0.0374	0.0189**
Injury&Poisoning	0.1084	0.0489	0.0268**
Misc	0.0347	0.0854	0.6847

Notes:

- 1 Low-priced visits=CPT codes 90030-90050=0
High-priced visits=CPT codes 90060-90080=1
- a Age=actual age - mean age (28.87 years)
- ** Significant at the 5% level
- * Significant at the 10% level

Table 7
Descriptive Statistics on Constrained and Unconstrained Physicians

	<u>Unconstrained Physicians</u>	<u>Constrained Physicians</u>
Number of Physicians	257	85
Number of Patients	1228	240
Number of Claims Filed	2326	483
Patient Age (standard deviation)	28 yrs (21 yrs)	38 yrs (18 yrs)
% Female Patients	54%	59%
% Patients with additional insurance	0.2%	0.4%

Table 8
Estimated Parameters of Logit Model
Dependent variable: Visit Type¹

	Coeffiecent	Standard Error	Prob
Unconstrained Physician in 1991	-1.1699	1.1633	0.3146
Constrained Physician in 1992	0.2192	0.1245	0.0783*
Constrained Physician in 1991	-0.1491	0.0994	0.1337
Unconstrained Physician in 1992	0.0097	0.0545	0.8583
Patient Age ^a	0.0294	0.0070	0.0000**
Patient Age Squared	-0.0004	0.0002	0.0667*
Patient < 18	-0.4158	0.1389	0.0028**
Patient Gender	0.0670	0.0526	0.2031
Age x Female	-0.0122	0.0048	0.0111**
Other Insurance	-0.0011	0.4023	0.9978
Diagnoses			
Infectious&Parasitic	0.4961	0.1417	0.0005**
Neoplasms	0.2233	0.1827	0.2217
Endocrine	0.2129	0.1611	0.1863
Blood	-0.3118	0.3797	0.4116
Neurologic	0.1046	0.1069	0.3279
Circulatory	0.3790	0.1199	0.0016**
Respiratory	0.1146	0.0917	0.2113
Digestive	0.0834	0.1616	0.6057
Genitourinary	0.5739	0.1193	0.0000**
Skin&Subcuatneous	0.3282	0.1270	0.0098**
Musculoskeletal	0.1213	0.1431	0.3964
Ill-Defined sytoms	0.2866	0.1165	0.0139**
Injury&Poisoning	0.3392	0.1454	0.0197**
Misc	0.1318	0.2638	0.6173

Notes: 1 Low-priced visits=CPT codes 90030-90050=0
 High-priced visits=CPT codes 90060-90080=1
a Age=actual age - mean age (28.87 years)
** Significant at the 5% level
* Significant at the 10% level

Table 9
Differences in Diagnosis Mix for
Unconstrained and Constrained Physicians

Diagnosis Group:	1991		Total	1992		Total
	UNcon ¹	Con ²		UNcon ¹	Con ²	
Infectious and Parasitic	88%	12%	59	87%	13%	31
Neoplasms	38%	62%	37	57%	43%	28
Endocrine	77%	23%	56	77%	23%	35
Blood % related organs	26%	74%	19	83%	17%	6
Neurology Disorders	95%	5%	181	94%	6%	162
Circulatory System	79%	21%	101	83%	17%	102
Respiratory System	90%	10%	382	90%	10%	335
Digestive System	71%	29%	45	87%	13%	53
Genitourinary System	71%	29%	79	71%	29%	82
Skin & Subcutaneous	92%	8%	79	81%	19%	69
Musculoskeletal &Connective	52%	48%	83	75%	25%	65
Ill-Defined symptoms	83%	17%	104	79%	21%	97
Injury&Poisoning	93%	7%	58	63%	37%	38
Misc	85%	15%	13	100%	0%	15

Notes:

- 1 Uncon = unconstrained physician
- 2 Con = constrained physician

Patient-Initiated Demand and Physician Pricing: The Influence of Posting Prices

I. Introduction

In many service markets where firms provide both diagnoses and corrective treatment, firms announce the price of treatments after establishing the diagnosis. Car mechanics, plumbers, electricians, and electronic repair are a few examples of such markets. In most health care markets, physician pricing is not revealed to patients until after the service is rendered. As a result, patients might pay more for care than is necessary.

Patients often face uncertainty about the true nature or seriousness of their symptoms. As a result, some patients with self-limiting illnesses needlessly consult a physician. This constitutes medically unnecessary and inefficient use of physician services. On the other hand, delaying consulting a physician increases the patient's disutility cost suffered due to anxiety. Therefore, medically unnecessary care may not constitute inefficient care.

In this paper, I address the question of whether patient-initiated demand for physician consultations is affected by requiring physicians to reveal all prices ex-ante. Patients consider the total cost of consulting a physician. The total patient costs include the monetary price of the consultation, any anxiety or productivity loss from uncertainty about health status, and the costs of untreated disease. The total patient cost associated

with physician services are examined under two regimes; one in which the physician posts only the price of one type of consultation ex-ante and one in which the physician posts all prices ex-ante. In Section III, a simple model of patient-initiated demand is presented. Using this model, two types of markets are considered. In Section IV and V, each physician is assumed to be a local monopolist while in Section VI and VII, many physicians compete to serve the market for physician services are examined.

Section VIII concludes that, given the assumptions of the model, requiring physicians with local monopolies to post consultations prices does not affect the price. Furthermore, the intervention of a benevolent third party (such as the government) who can assign patients to competing physicians can produce an outcome in which every patient consults the physician regardless of the probability that they are sick. In this case, the cost of unnecessary care is outweighed by the benefits the patients receive from the removal of uncertainty about their health status and the avoidance of untreated disease.

II. The Demand for Physician Consultations

Much of the work on the use of physician services focuses on the physician's choice of frequency and type of service. The physician's role as agent for the patient and the conflict between the physician's objectives and the patient's objectives has been explored extensively in the literature on physician-induced demand.¹ Once a patient

¹For example, see Wilensky and Rossiter (1983), Rossiter and Wilensky (1983), Evans (1974) and Pauly (1982).

initiates contact with a physician, it is usually the physician who generates the patient's demand for additional medical services. However, before a physician can act as a patient's agent, the patient must generate the initial contact with the physician.

In an attempt to determine the magnitude of physician-induced demand, Rossiter and Wilensky (1983) examined the 1977 National Medical Care Expenditure Survey, which questions patients directly about who initiated the contact with the physician. They found that 61 percent of ambulatory visits were initiated by the patient, not the physician. The factors influencing patients' demand for initial consultations also influence the pricing behavior of physicians in setting the price for initial physician consultations.

In this paper, three determinants of patient demand are included in the model of patient-initiated demand. The first determinant of patient-initiated demand is the price of the initial consultation. The lower the price of the initial consultation, the higher the patients' demand. In this paper, only risk-neutral patients are considered and insurance issues are not addressed. Other works in the literature address the issue of the effect of insurance on patient demand for medical services.²

The probability of disease is the second determinant of patient-initiated demand. Patients who believe that the probability that they are ill is low will be less likely, at any given price, to demand a physician's service. Physicians are assumed to know the

²The results of the paper hold in the presence of insurance as long as the downward sloping demand curve is not eliminated. For discussions on the effect insurance on medical demand, see Newhouse (1981), Beck (1974), Feldstein (1973) and Greenspan and Vogel (1980).

prevalence of disease in their communities.

The third determinant of patient-initiated demand is the amount of disutility the patient suffers from either the illness itself or the threat of illness. The literature on health services does not ignore the fact that patients suffer some disutility from uncertainty about the seriousness of their symptoms. I assume that patients vary in the amount of disutility they suffer from disease. Grossman (1972) posits that the positive correlation between education and use of medical care indicates that educated consumers are more efficient in converting medical care into health and hence, have a higher marginal rate of substitution between medical care and health status. To the extent that these consumers value health, one would expect to see a higher demand for medical care by educated consumers. However, when Grossman includes wage rates in his analysis, he finds that education has little affect on the use of medical care. Pauly (1982) suggests that education may be a proxy for permanent income and permanent income may be what is correlated with high use of medical care.

In this paper, I do not specifically address the consumer's income, but the disutility cost a consumer can avoid by consulting a physician can be thought of as including the current wage of the consumer. Consumers with high wage rates have more incentive to consult a physician than consumers with low wages. Factors other than wage and education contribute to the differences in disutility cost across patients. Patient attitudes about illness can vary as well as their propensity to worry.

III. A Model of Patient-Initiated Demand

Consider the market for physician services. I will call the potential consumers of these services patients. Patients choose whether or not to purchase a physician's service and purchase at most one physician consultation.³ The only physician is a local monopolist who maximizes expected profits and who has positive fixed costs and no marginal costs.⁴ There are many patients who are assumed to be risk-neutral, expected cost minimizers. There is no discounting over time by the physician or patients and there are N patients in the community. Patients do not have access to any physician outside the community.

To construct the demand for the patient-initiated physician service, begin by examining the problem facing a single patient. Imagine a non-repeated, one period game with two stages. A patient awakes in stage 1 with some symptom. The patient does not know with certainty whether or not the symptom is a sign of illness. If the symptom is not associated with illness, the patient will be well in stage 2. If the symptom is associated with illness, the patient will be ill in stage 2. Patients may choose to consult a physician in stage 1, stage 2, or never consult the physician. If the patient consults the physician in stage 1, he incurs only the cost of a standard office visit, p_1 , and is healed.⁵ Any patient who waits until stage 2 knows with certainty whether or not he is ill. A

³By construction, this implies that physicians do not treat themselves.

⁴The assumption of a local monopolist will be relaxed later. Constant marginal cost do not change the results of the model.

⁵The physician does not charge to write a prescription, only to examine the patient and make a diagnosis.

patient who waits until stage 2 incurs a patient-specific disutility cost, λ , from the anxiety of his unknown health status.⁶ At the beginning of the game, each patient draws a λ from a uniform distribution on the unit interval. The physician knows the distribution of disutility costs, but only the patient knows his specific disutility cost. In stage 2, only patients who are ill consider consulting the physician. A patient who is ill in stage 2 may choose to either consult the physician in stage 2 or incur a permanent cost from the untreated disease. The cost of the disease is a known amount, γ , which is exogenously given and has a value on the unit interval. The probability that a patient is ill is exogenously given by θ which has a value on the unit interval.⁷ Both the patient and the physician know θ and γ , which are the same for all patients.

A patient who chooses to consult the physician in stage 1 never incurs any disutility or untreated disease cost. A patient who chooses to wait and consult the physician in stage 2 (if sick) incurs the disutility cost of waiting but not the cost of any untreated disease residual. The patient who chooses to never consult the physician, incurs the cost of waiting plus, if sick, the cost of untreated disease.

The physician maximizes expected profits and can observe the distribution of disutility costs $f(\lambda)$, but not each patient's λ . The physician's marginal cost of providing service is zero, but she incurs a fixed cost C . In this model, physicians have no

⁶The disutility cost can be thought of as the patient's anxiety cost created by the uncertainty of illness and/or a productivity loss the patient incurs from illness or the threat of illness.

⁷This assumption implies that all sick patients have the same disease.

incentive to violate the Hippocratic oath and administer unnecessary treatments because physicians are paid only for their diagnostic ability.⁸

IV. The Local Monopolist: Ex-Ante Pricing for Stage 1 and Stage 2

In this section, I examine the patient-initiated demand for physician services under the assumption that the physician must commit ex-ante to a package of prices (p_1, p_2) , where p_1 is the price for a stage 1 consultation and p_2 is the price for a stage 2 consultation. This model addresses only patient-initiated consultations and, logically, begins with an analysis of the patient's decision when the patient observes the ex-ante pricing.⁹ The patient is an expected cost minimizer who makes the decision of when to consult the physician based on the total expected cost. If the patient chooses to consult the physician in stage 1, he pays p_1 whether or not he is ill. Therefore,

$$(1) \quad \text{Expected Cost (S1)} = \theta p_1 + (1-\theta)p_1 = p_1.$$

Likewise, if the patient waits and consults the physician in stage 2, he suffers disutility regardless of whether he is ill, but pays p_2 only if he is ill. Therefore,

$$(2) \quad \text{Expected Cost (S2)} = \theta(p_2 + \lambda) + (1-\theta)\lambda = \theta p_2 + \lambda.$$

Finally, if the patient chooses to never consult the physician,

$$(3) \quad \text{Expected Cost (N)} = \lambda + \theta\gamma.$$

Patients evaluate the total expected cost of consulting the physician in stage 1, stage 2

⁸For models addressing the problem of unnecessary treatments see Emons (1994) or Taylor (1993).

⁹Ex-ante pricing is assumed to be credible. I discuss later what happens if the physician cheats and deviates from her posted prices.

or never. Define *Type 1 patients* as patients who choose to consult the physician in stage 1. For these patients, the total expected cost of consulting the physician in stage 1 is less than or equal to the total expected cost of any other action,

$$(4) \quad p_1 \leq \min \{ \theta p_2 + \lambda, \lambda + \theta \gamma \} = \lambda + \theta \min \{ p_2, \gamma \}.$$

Define *Type 2 patients* as patients who wait and consult the physician in stage 2. These are the patients for whom (4) is not satisfied but the total expected cost of a consultation in stage 2 is less than or equal to the total expected cost of never consulting the physician. For Type 2 patients,

$$(5) \quad \theta p_2 + \lambda \leq \lambda + \theta \gamma \Rightarrow p_2 \leq \gamma.$$

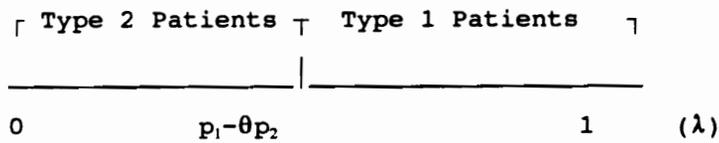
Finally, define *Type 3 patients* as those patients for whom neither (4) nor (5) is satisfied; they never consult the physician.

To determine the physician's optimal prices, consider two arbitrary pricing rules, $p_2 > \gamma$ and $p_2 \leq \gamma$. If the physician chooses $p_2 > \gamma$, she prices herself out of the market in stage 2 (there is no demand for her services in stage 2) and only Type 1 patients demand consultations. If the physician chooses $p_2 \leq \gamma$, both Type 1 and Type 2 patients will demand consultations. The cases described below show the physician's demand and profits under each of the two pricing rules, $p_2 > \gamma$ and $p_2 \leq \gamma$, and show that the optimal prices are $p_1^* = 1/2 + \theta \gamma$ and $p_2^* = \gamma$.

Case A: The Local Monopolist: $p_2 > \gamma$

Suppose $p_2 > \gamma$. Then only Type 1 patients choose to consult the physician and the physician has no demand for consultations in stage 2. Recall that patients make the

consultations. Let $\gamma \leq 1$.¹¹ Type 1 and Type 2 patients are depicted according to their disutility costs as depicted here:



Note that there are no Type III patients since any patient who waits until stage 2 and finds out he is sick will pay up to γ to consult the physician. The demand for consultations in Case B is

$$(10) \quad D_B(p_1, p_2) = (1 - p_1 + \theta p_2)N + (p_1 - \theta p_2)N\theta$$

where $(1 - p_1 + \theta p_2)N$ denotes the demand from Type 1 patients and $(p_1 - \theta p_2)N\theta$ denotes the demand from Type 2 patients. The physician maximizes her expected profits,

$$(11) \quad \text{Expected Profits} = [(1 - p_1 + \theta p_2)p_1 + (p_1 - \theta p_2)\theta p_2]N - C.$$

The first order conditions on p_1 and p_2 are

$$(12) \quad \partial \pi / \partial p_1 = 1 - 2p_1 + 2p_2\theta = 0$$

$$(13) \quad \partial \pi / \partial p_2 = 2\theta p_1 + 2\theta^2 p_2 = 0.$$

Lemma 1: Using the pricing rule $p_2 \leq \gamma$, the prices $p_1^* = 1/2 + \theta\gamma$ and $p_2^* = \gamma$ maximize the physician's expected profits.

Proof: The pricing rule states $p_2 \leq \gamma$. Let $p_2^* = \gamma$, then from (12), $p_1^* = 1/2 + \theta\gamma$. Patients choose to consult the physician in stage 1 if and only if $\lambda \geq p_1 - \theta p_2$. The $\partial \text{profit} / \partial p_2 = p_1 - \theta p_2 \geq 0$, since $p_1 - \theta p_2$ is the proportion of sick patients who wait until

¹¹ For the case in which $\theta\gamma > 1$, the conclusion that the physician should choose $p_2 \leq \gamma$ is not altered.

period 2 to consult the physician. This implies that the problem has a corner solution in which the physician charges her maximum price, $p_2 = \gamma$. When the physician charges $p_2^* = \gamma$, the profit maximizing price to post for stage 1 is $p_1^* = \frac{1}{2} + \theta\gamma$. \square

The intuition here is clear. Any $p_2 < \gamma$ simply leaves money with patients with low disutilities. A low p_2 encourages patients to wait to see the physician and this reduces the number of patients who demand consultations in stage 2 because some $(1-\theta)$ patients will discover that their symptoms are not serious.

Proposition 1: A monopolist physician who is required to post ex-ante prices (p_1, p_2) for stage 1 and stage 2 consultations, respectively, chooses the price package $(p_1^* = \frac{1}{2} + \theta\gamma, p_2^* = \gamma)$.

Proof: From equation (9), if the physician uses the pricing rule $p_2 > \gamma$ and if $\theta\gamma < 1$, expected profits = $N[(1 + \theta\gamma)^2/4] - C$. Only Type 1 patients consult the physician. Then $p_1^* = (1 + \theta\gamma)/2$ and expected profits = $[(1 + \theta\gamma)^2/4] - C/N$. From the proof of Lemma 1, if the physician uses the pricing rule $p_2 \leq \gamma$, her expected profits = $N(\frac{1}{4} + \theta\gamma) - C$. $N(\frac{1}{4} + \theta\gamma) - C > N[(1 + \theta\gamma)^2/4] - C$. The expected profits under the pricing rule $p_2 \leq \gamma$ are greater than the expected profits under the pricing rule $p_2 > \gamma$ thus the physician uses the pricing rule $p_2 \leq \gamma$.¹² From the proof of Lemma 1, the profit maximizing price package under the pricing rule $p_2 \leq \gamma$ is $(p_1^* = \frac{1}{2} + \theta\gamma, p_2^* = \gamma)$. \square

V. The Local Monopolist: Ex-Ante Pricing for Stage 1 Only

¹²If $\theta\gamma \geq 1$, then $p_1^* = \theta\gamma$ and expected profits = $\theta\gamma - C/N$ which are strictly less than the profits under the pricing rule $p_2 \leq \gamma$. Therefore, if $\theta\gamma \geq 1$, the physician makes the same choice of the pricing rule $p_2 \leq \gamma$.

Consider the same physician monopolist as in Section IV except the physician now need only post ex-ante a stage 1 price and is free to set any price she wishes for stage 2. Patients know that the physician is a profit maximizing monopolist and they choose when to consult the physician under the same decision rules as in Section IV.

Theorem 1: Physician prices and total patient costs are identical when a monopolist physician prices stage 1 and stage 2 consultations ex-ante as when a monopolist physician prices stage 1 consultations ex-ante and prices stage 2 consultations ex-post.

Proof: From the proof of Proposition 1, a profit maximizing physician chooses to use the pricing rule $\gamma \leq p_2$ and prices at $(p_1^* = \frac{1}{2} + \theta\gamma, p_2^* = \gamma)$. A physician who does not post p_2 will always charge $p_2^* = \gamma$, since all patients are willing to pay γ for stage 2 consultations and no patient is willing to pay more. Since $p_1^* = \frac{1}{2} + \theta\gamma$ maximizes profits when $p_2 = \gamma$, the physician also chooses $p_1^* = \frac{1}{2} + \theta\gamma$. The patients make identical decisions in both cases and the patients' total costs are the identical. ◻

The Local Monopolist and Posted Pricing: Conclusions

As shown in Sections IV and V, a local monopolist will always choose $p_2^* = \gamma$ for stage 2 consultations. It does not matter whether the physician is required to post stage 1 and stage 2 prices ex-ante or only stage 1 prices ex-ante. This result is quite intuitive. The physician is a local monopolist who knows with certainty the maximum any patient will pay for a stage 2 consultation. Any patient who is ill and waits until stage 2 will always consult the physician if the stage 2 price is less than or equal to the cost of the untreated disease. Therefore, the monopolist always has an incentive to set $p_2^* = \gamma$.

Furthermore, because the posting of prices does not change the physician's pricing behavior, the patients' total expected cost is unaffected by requiring the physician to post prices. It was previously assumed that the physician's ex-ante prices were credible. From Theorem 1, it follows that credibility is not an issue in this model. The profit maximizing physician prices stage 1 consultations at p_1^* and has no incentive to deviate from pricing $p_2^* = \gamma$.

VI. The Bertrand Physician

Consider the same model when some organization (such as a government health alliance) assigns patients to physicians in the community. There is more than one physician ready and able to provide service to the patients in the community. All physicians are identical and once a patient has been assigned to a physician the patient cannot switch physicians.¹³

The organization's objective is to minimize the patients' total cost of physician services. Total patient costs include the total amount spent on physician services, any anxiety from uncertainty about health status (λ), and any permanent residual of untreated disease (γ). Patients are assigned to physicians solely on the basis of minimum total cost. The organization accepts sequential price bids for consultations from physicians until no physician is willing to submit a different bid. The bidding process is sequential and costless. All physicians observe all bids and any physician is free to lower a

¹³This assumption simplifies the analysis of ex-post pricing of stage 2 consultations.

previous bid. If more than one physician submits the lowest bid, then patients are assigned equally to all physicians with the lowest bid.¹⁴

The model now contains an additional stage, stage 0, in which physicians submit bids to the organization and the organization makes the assignment of patients to physicians on the basis of lowest total patient cost. Recall that all physicians are identical and have only a fixed cost. This is still a one period game and the fixed cost is not sunk. As an example, the fixed cost can be thought of as the price of setting up practice in the community. If the physicians are already setup to practice in the community, the fixed cost can represent the price of purchasing some specific software system for recording patient data.

Physicians compete in prices in stage 0. Physicians are not constrained in the number of patients they can service and a single physician can service the entire community.

Lemma 2: With competitive bidding, in equilibrium there is one physician who makes zero economic profits.

Proof: The bidding process is sequential, costless and repeated until no physician wishes to submit another bid. Each physician has an incentive to submit a bid which undercuts the last bid by epsilon and take the entire market. By assumption, this is a one period game and the winning physicians pay their fixed cost after the bidding process ends, therefore the fixed cost is not sunk. Also by assumption, physicians have zero marginal

¹⁴For simplicity, assume there is never an integer problem.

cost and positive fixed costs, therefore no physician has an incentive to bid lower than C/N because expected profits are negative at any price less than C/N . If two physicians submit the same low bid, then assume that they equally share the market demand and the lowest bid for the two physicians is $C/2N$. If this is the case, then either physician has an incentive to submit the bid $C/2N$ minus epsilon until one physician submits the bid C/N . Physicians submit bids, each undercutting the last bid, until the physicians' expected profits are equal to the average fixed cost (C/N). In equilibrium, there is only one physician who bids a price package that yields zero economic profits.□

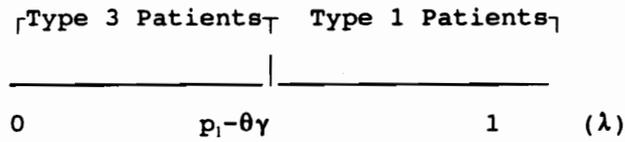
The Bertrand Physician: Ex-Ante Pricing of Stage 1 and Stage 2

Define the Bertrand physician as the physician who successfully makes the lowest bid. This model addresses only patient-initiated demand. The patient's decision process is the same as in the previous section. As a result of the bidding process, the physician operates with zero profits. Consider the same two pricing rules evaluated in the previous section: either the physician prices herself out of the market in stage 2 ($p_2 > \gamma$) or not ($p_2 \leq \gamma$). Case C and Case D examine the Bertrand physician's pricing decisions and patient-initiated demand when the physician must post both stage 1 and stage 2 consultations ex-ante. Case E examines the Bertrand physician's pricing and patient-initiated demand when only stage 1 consultation prices are posted ex-ante.

Case C: The Bertrand Physician: $p_2 > \gamma$

Suppose $p_2 > \gamma$ is true, then only Type 1 patients choose to consult the physician and the physician has no demand for consultations in stage 2. Recall that patients make

the decision of when, if ever, to consult the physician based on their expected cost. A Type 1 patient is defined as one who draws $\lambda \geq p_1 - \theta\gamma$. Each patient draws a λ from the unit interval as depicted here:



There is no demand for consultations in stage 2 and the total demand for physician services in Case C is

$$(14) \quad D_C(p_1) = (1 - p_1 + \theta\gamma)N$$

As a result of the bidding process in stage 0, the physician has zero expected profits and chooses the price of stage 1 consultations in Case C to satisfy

$$(15) \quad \text{Expected Profits} = N(1 - p_1 + \theta\gamma)p_1 - C = 0.$$

The probability that a patient consults the physician in stage 1 is $(1 - p_1 + \theta\gamma)$, C is the physician's fixed cost, and N is the number of patients in the community. From the zero profit condition, it follows that the minimum price solution yields

$$(16) \quad p_1^* = [N + N\theta\gamma - (N^2(1 + \theta\gamma)^2 - 4NC)^{1/2}] / 2N.$$

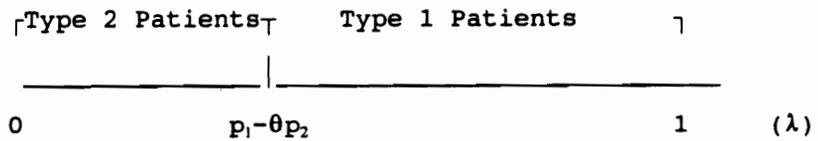
Under the Case C pricing rule, any $p_2^* > \gamma$ satisfies the pricing rule and the total patient cost

$$(17) \quad \text{Total Cost} = \int_0^{p_1 + \theta\gamma} \lambda \, (d\lambda) + \int_0^{p_1 + \theta\gamma} \gamma\theta \, (d\lambda) + \int_{p_1 - \theta\gamma}^1 p_1 \, (d\lambda) \\ = C + N(p_1^2 - (\theta\gamma)^2) / 2 > C.$$

Case D: The Bertrand Physician: $\gamma \geq p_2$

Suppose $\gamma \geq p_2$; then both Type 1 and Type 2 patients demand physician

consultations. Type 1 and Type 2 patients are depicted according to their disutility costs as depicted here:



The demand for consultations in Case D is

$$(18) \quad D_D(p_1, p_2) = (1 - p_1 + \theta p_2)N + (p_1 - \theta p_2)N\theta$$

where $(1 - p_1 + \theta p_2)N$ denotes the demand from Type 1 patients and $(p_1 - \theta p_2)N\theta$ denotes the demand from Type 2 patients. The physician bids ex-ante on the price package (p_1, p_2) which yields zero economic profits. Any price package that satisfies

$$(19) \quad \text{Expected Profits} = N [(1 - p_1 + \theta p_2)p_1 + (p_1 - \theta p_2)\theta p_2] - C = 0$$

produces a low bid and satisfies the organizations objective of lowest price.

The organization cares about minimizing the patient's total cost while the physician cares about successfully making the lowest bid. The lowest successful bid satisfies (19) subject to minimizing total patient cost

$$(20) \quad \text{Total Costs} = N \left\{ \int_0^{p_1 + \theta p_2} (\theta p_2 + \lambda) (d\lambda) + \int_{p_1 + \theta p_2}^1 p_1 (d\lambda) \right\}$$

$$= N[\theta p_2(p_1 - \theta p_2) + (1 - p_1 + \theta p_2)p_1 + (p_1 - \theta p_2)^2/2]$$

Substituting (19) into (20), the physician chooses p_1, p_2 to minimize

$$(21) \quad \text{Total Costs} = C + ((p_1 - \theta p_2)^2/2)N$$

Lemma 3: Given the pricing rule $p_2 \leq \gamma$, the minimum total patient cost under a Bertrand physician is C ; every patient consults the physician in stage 1 and $p_1^* = C/N$.

Proof: From equation (21), when the physician uses the pricing rule $p_2 \leq \gamma$, total patient

costs = $C + ((p_1 - \theta p_2)^2 / 2)N$. By assumption, C and N are strictly positive, therefore total patient costs are minimized when $p_1 = \theta p_2$. If $p_1 = \theta p_2$, then any patient who draws a $\lambda \geq 0$ consults the physician in stage 1. Thus, N patients consult the physician in stage 1 and the p_1 which satisfies the zero profit condition of the Bertrand physician is $p_1^* = C/N$. When $p_1^* = C/N$, the optimal price for stage 2 consultations is $p_2^* = C/(\theta N)$. Substituting p_1^* , p_2^* into (20) yields the minimum total patient cost = C . \square

The intuition behind this result is straightforward. If the Bertrand physician is held to zero profits and prices such that every patient consults the physician in stage 1, then the physician just covers her cost. When every patient consults in stage 1, the minimum price for a stage 1 consultations must be C/N and there is no disutility cost or residual of untreated disease, therefore the total patient cost is $Np_1 = C$.

Lemma 4: Given the pricing rule $p_2 > \gamma$, the minimum total patient cost under a Bertrand physician is C , every patient consults the physician in stage 1 and $p_1^* = C/N$.

Proof: From equation (16), when the physician uses the pricing rule $p_2 > \gamma$, $p_1^* = [N + N\theta\gamma - (N^2(1 + \theta\gamma)^2 - 4NC)^{1/2}] / 2N$ and from equation (15), expected profits = $(1 - p_1 + \theta\gamma)p_1 = C/N$ where $(1 - p_1 + \theta\gamma)$ is the probability a patient consults the physician in stage 1. Consider

(i) Let $p_1^* = [N + N\theta\gamma - (N^2(1 + \theta\gamma)^2 - 4NC)^{1/2}] / 2N$ and substitute p_1^* into $(1 - p_1 + \theta\gamma)$ to get the probability a patient demands a stage 1 consultation, which is $[1 + \theta\gamma + ((1 + \theta\gamma)^2 - 4C/N)^{1/2}] / 2$. Suppose it is the case that not all patients choose to consult the physician in stage 1, then $(1 - p_1 + \theta\gamma) < 1$ and substituting $p_1^* = [N + N\theta\gamma - (N^2(1 + \theta\gamma)^2 - 4NC)^{1/2}] / 2N$ yields

a probability $(1-p_1+\theta\gamma)=[1+\theta\gamma+((1+\theta\gamma)^2-4C/N)^{1/2}]/2 < 1$. The total patient cost in (i) is $N\left\{\int_{p_1+\theta\gamma}^1 p_1(d\lambda) + \int_0^{p_1+\theta\gamma} (\theta\gamma+\lambda)(d\lambda)\right\} = N[(1-p_1+\theta\gamma)p_1 + (p_1-\theta\gamma)\theta\gamma + ((p_1-\theta\gamma)^2/2)]$. Using the zero profit condition, total patient cost $=C+N[(p_1-\theta\gamma)(p_1+\theta\gamma)/2] \geq C$.¹⁵

The physician chooses the pricing rule that yields the lowest total patient cost. The total patient cost in equals $C+N[(p_1-\theta\gamma)(p_1+\theta\gamma)/2] \geq C$. Therefore, the minimum total patient cost, C , occurs under the pricing rule $p_2 > \gamma$. The physician prices $p_1^* = C/N$ and every patient consults the physician in stage 1. ◻

Proposition 2: A Bertrand physician who bids the lowest package of prices and is required to post ex-ante the price package (p_1, p_2) for stage 1 and stage 2 consultations, posts prices such that every patient chooses to consult the physician in stage 1 and $p_1^* = C/N, p_2^* = C/(\theta N)$.

Proof: The proof follows from Lemma 3 and Lemma 4. ◻

VIII. The Bertrand Physician: Ex-Ante Pricing for Stage 1 Only

This section examines the Bertrand physician who is required to post ex-ante only a stage 1 price and is free to price stage 2. Again, two scenarios are considered: $p_2 \leq \gamma$ and $p_2 > \gamma$. Recall that, unlike the local monopolist, the Bertrand physician makes zero economic profits knows that all patients will pay at most γ for a stage 2 consultation.

¹⁵If $\theta\gamma > 1$, then $[1+\theta\gamma+((1+\theta\gamma)^2-4C/N)^{1/2}]/2 \geq 1$, thus every patient consults the physician in stage 1. From the zero profit condition, $p_1^* = C/N$ and the total patient cost is $Np_1^* = N(C/N) = C$ and the physician makes the same choice here as under the pricing rule $p_2 > \gamma$.

It follows that a physician who need not post or commit to a stage 2 price will price stage 2 consultations at $p_2^* = \gamma$. Therefore, the pricing rule of $p_2 > \gamma$ does not apply. Only the pricing rule $p_2 \leq \gamma$ is of interest in examining the Bertrand physician's pricing behavior and the resulting patient-initiated demand when the physician only post Stage 1 consultations ex-ante.

Case E: The Bertrand Physician: $p_2 \leq \gamma$

For the Bertrand physician using the pricing rule $p_2 \leq \gamma$ and pricing stage 2 consultations ex-post, $p_2^* = \gamma$. Patients and the organization are assumed to realize that the physician has monopoly power in stage 2. Total demand for Case E is

$$(22) \quad D_E(p_1, p_2) = (1 - p_1 + \theta p_2)N + (p_1 - \theta p_2)N\theta$$

The physician is held to zero economic profits by the bidding process and chooses p_1^* accordingly:

$$(23) \quad \text{Expected Profits} = N[(p_1 - \theta p_2)\theta p_2 + (1 - p_1 - \theta p_2)p_1] - C = 0.$$

Using $p_2^* = \gamma$, expected profits equal zero when the physician selects

$$(24) \quad p_1^* = \frac{1}{2} + \theta\gamma - [(1 + 4\theta\gamma - 4C/N)^{1/2}]/2.$$

The total patient cost in Case E is

$$(25) \quad \text{Total Costs} = N \left\{ \int_0^{p_1 + \theta p_2} (\theta p_2 + \lambda) (d\lambda) + \int_{p_1 + \theta p_2}^1 p_1 (d\lambda) \right\} \\ = N[\theta p_2(p_1 - \theta p_2) + (1 - p_1 + \theta p_2)p_1 + (p_1 - \theta p_2)^2/2]$$

and substituting $p_2^* = \gamma$ and (24) into (25)

$$(26) \quad \text{Total Costs} = C + (N/2)[\frac{1}{2} - ((1 - 4(C/N) + 4\theta\gamma)^{1/2}/2)]^2.$$

Lemma 5: A Bertrand physician who ex-ante posts only the stage 1 consultation price

results in a minimum total patient cost greater than C for any $\gamma > (C/N - 1/4)/\theta$ and $\gamma \neq C/(\theta N)$.

Proof: From equation (26), total patient cost for a Bertrand physician posting only the stage 1 consultation price is $C + (N/2)[1/2 - ((1 - 4(C/N) + 4\theta\gamma)^{1/2}/2)]^2$. If $(N/2)[1/2 - ((1 - 4(C/N) + 4\theta\gamma)^{1/2}/2)]^2 > 0$ then total patient cost is greater than C . For $\gamma < (C/N - 1/4)/\theta$, the total patient loss is undefined and for $\gamma = C/(\theta N)$ the total patient loss equals C .¹⁶ Therefore for any $\gamma > (C/N - 1/4)/\theta$ and $\gamma \neq C/(\theta N)$, $(N/2)[1/2 - ((1 - 4(C/N) + 4\theta\gamma)^{1/2}/2)]^2 > 0$ and the minimum total patient loss is greater than C . □

The Bertrand Physician and Posted Prices: Conclusions

From Proposition 2, a Bertrand physician who must post both stage 1 and stage 2 prices chooses the price package ($p_1^* = C/N$, $p_2^* = C/(\theta N)$) and every patient consults the physician in stage 1. In contrast, posting only the stage 1 price ex-ante results in the stage 1 price $p_1^* = 1/2 + \theta\gamma - [(1 + 4\theta\gamma - 4C/N)^{1/2}]/2$.

Lemma 6: For $C/N \geq \theta\gamma \geq C/N - 1/4$, posting only the stage 1 consultation price ex-ante results in less demand for stage 1 consultations than the demand that results from posting both stage 1 and stage 2 prices ex-ante. For $\theta\gamma > C/N$, the posting prices does not affect the demand for stage 1 consultations.

Proof: (i) From Proposition 2, demand for stage 1 consultations equals N when both p_1 and p_2 are revealed ex-ante.

¹⁶ If $\gamma < (C/N - 1/4)/\theta$, there is no price at which the physician can make non-negative profits. Therefore, no physician enters the market.

(ii) From equation (24), posting only the stage 1 price ex-ante results in $p_1^* \neq C/N = \frac{1}{2} + \theta\gamma - [(1 + 4\theta\gamma - 4C/N)^{1/2}]/2$ and $p_2^* = \gamma$. Demand for stage 1 consultations is $\text{Demand}(S1) = N(\frac{1}{2} + ((1 + 4\theta\gamma + C/N)^{1/2})/2)$. This is less than N when $C/N \geq \theta\gamma \geq C/N - \frac{1}{4}$. When $\theta\gamma > C/N$, the demand for stage 1 consultations is greater than N . N is the entire market, demand cannot be greater than the entire market, therefore the demand equals the market which is the same result as in (i). ◻

Conclusion

The influence of revealing physician prices on patient-initiated demand was examined in two cases. In the first case, posting prices by a local monopolist does not alter patient-initiated demand, resource use or physician profit. This follows from the fact that the physician has full monopoly power. However, in the case with the Bertrand physician, posting prices influences patient-initiated demand and resource use. Every patient immediately consults the Bertrand physician who posts the price of all types of consultation (immediate and delayed). Although medically unnecessary care is maximized when every patient consults the physician immediately, when the cost of suffering, anxiety and untreated disease is included, this case results in the lowest total patient cost. A Bertrand physician who posts only the price of immediate consultations does not consult more patients and the total patient cost is not lower than the case with all prices posted ex-ante.

By construction, physician profits are zero in the case with the Bertrand physician. Thus a Bertrand physician is indifferent about posting prices for

consultations. In the case with the local monopolist, I have shown that posting prices has no effect on demand or price and thus, the local monopolist is also indifferent about posting prices. However, lowest total patient cost occurs when competition forces physicians to bid for patients (the Bertrand physician) and all prices are posted. Thus, a Bertrand physician who posts prices is preferable for efficient resource use.

The results of the model presented in this paper suggest that requiring physicians to both bid competitively for patients and post all prices results in the most efficient resource use. However, the model of patient-initiated demand presented in the paper makes the assumption that physicians have zero marginal costs and this assumption may not hold in the actual market for physician services.

The zero marginal cost assumption insures that market demand is always met. If the physician is willing to supply the first consultation, then the physician is always willing to supply another consultation at any price greater than or equal to zero. There is always excess supply in this model. Using an assumption of constant marginal costs would not alter the results of the model and excess supply would still exist in equilibrium.

However, using increasing marginal cost should cause several important changes in the results of the model. The bidding process would not necessarily produce only one physician in equilibrium and the lowest bid would be equal to the minimum of a physician's average cost curve. In equilibrium, all physicians price equally and equally share the total market demand. If there are S physicians with F fixed cost and increasing

marginal cost, $c(q)$, then the equilibrium price is $S[F+c(N/S)]/N$. The number of physicians in equilibrium, S^* , will be determined by minimizing $S[F+c(N/S)]/N$ subject to the zero profit condition that the bidding process produces. With increasing marginal cost, excess supply is eliminated and the market for physician consultations would clear.

Works Cited

- Beck, RG, (1974), "The Effects of Co-payment on the Poor," *Journal of Human Resources*, 9:129-42.
- Chamberlin E., (1933), The Theory of Monopolistic Competition, Cambridge, MA: Harvard University Press.
- Emons, Winand, (1994), "Credence Goods and Fraudulent Experts," mimeo, University of Bern.
- Evans, RC, (1974), "Supplier-Induced Demand: Some Empirical Evidence and Implications," in The Economics of Health and Medical Care, Perlman, M., ed. New York: John Wiley and Sons: 1-547.
- Feldstein, MS, (1973), "The Welfare Loss of Excess Health Insurance," *Journal of Political Economy*, 81:251080.
- Greenspan, NR and RJ Vogel, (1980), "Taxation and Its Effect Upon Public and Private Health Insurance and Medical Demand," *Health Care Financing Review*, 4:39-45.
- Grossman, Michael, (1972), The Demand for Health: A Theoretical and Empirical Analysis. New York: Columbia Press.
- Newhouse, JP, et al., (1981), "Some Interim Results from a Controlled Trial of Cost Sharing in Health Insurance," *New England Journal of Medicine*, 305:25:1501-7.
- Pauly, Mark, (1982), "Economic Aspects of Consumer Use", in Issues in Health Economics, Roice Luke and Jeffrey Bauer, eds., Aspen Publications: Rockville, MD.
- Rossiter LF and Wilensky GR, (1983), "A Reexamination of the Use of Physician Services: The Role of Physician-Initiated Demand," *Inquiry*, 20:162-72.
- Taylor, Curtis, (1993), "The Economics of Breakdowns, Checkups, and Cures," mimeo, Texas A&M University.
- Wilensky, GR and LF Rossiter, (1983), "The Relative Importance of Physician-Induced Demand in the Demand for Medical Care," *Milbank Memorial Fund Quarterly*, 61:252-77.

Vita

Pamela Bonifay Peele was born in Pensacola, Florida on December 9, 1953. She graduated summa cum laude from Virginia Western Community College while working as a registered eletrodiagnostic technologist. She graduated magna cum laude from Roanoke College in Salem, Virginia, where she was awarded the outstanding student in economics.

A handwritten signature in black ink, reading "Pamela Bonifay Peele". The signature is written in a cursive style with large, flowing loops and is positioned diagonally across the page.