

# **WORKING PAPER**

## **2004**

Department of Economics  
Tufts University  
Medford, MA 02155  
(617) 627 – 3560  
<http://ase.tufts.edu/econ>

Editorial Manager(tm) for Health Policy  
Manuscript Draft

Manuscript Number:

Title: Competition, Altruism, and Provider Payment

Article Type: Full Length Article (FLA)

Section/Category:

Keywords: Inequity; risk selection; competition; payment incentives

Corresponding Author: Dr. Karen Eggleston Tufts University

First Author: Karen Eggleston

Order of Authors: Karen Eggleston

Abstract: Health care policymakers in many countries seek to use incentives and competition to spur efficiency. One important challenge is to mitigate the sacrifice of social solidarity that such reforms entail, because strong incentives promote risk selection. This paper argues conceptually and presents simulations revealing how competition, altruism, and payment incentives affect efficiency and equity of treatment. The focus is how to prevent or minimize incentives for quality distortions designed to attract profitable and deter unprofitable patients. The primary result is that strong incentives from competition for patients and financial rewards for cost control can exacerbate selection distortions and compromise social solidarity. By contrast, insurer and/or provider altruism, manifest as an innate concern for patient welfare regardless of profits, tends to mitigate selection, allowing society to reap the efficiency benefits of competition and incentives without sacrificing social solidarity

## Competition, Altruism, and Provider Payment

**Abstract.** Health care policymakers in many countries seek to use incentives and competition to spur efficiency. One important challenge is to mitigate the sacrifice of social solidarity that such reforms entail, because strong incentives promote risk selection. This paper argues conceptually and presents simulations revealing how competition, altruism, and payment incentives affect efficiency and equity of treatment. The focus is how to prevent or minimize incentives for quality distortions designed to attract profitable and deter unprofitable patients. The primary result is that strong incentives from competition for patients and financial rewards for cost control can exacerbate selection distortions and compromise social solidarity. By contrast, insurer and/or provider altruism, manifest as an innate concern for patient welfare regardless of profits, tends to mitigate selection, allowing society to reap the efficiency benefits of competition and incentives without sacrificing social solidarity.

Keywords: Inequity; risk selection; competition; payment incentives

## Competition, Altruism, and Provider Payment

### 1. Introduction

Policymakers in many countries seek to improve health sector efficiency and responsiveness by introducing market forces into previously highly regulated health care systems. Countries introducing such competitive reforms include, for example, Belgium, China, Colombia, the Czech Republic, Germany, Ireland, Israel, the Netherlands, Poland, Russia, and Switzerland [1, 2]. Policy debate in the US also focuses on a stronger role for competition, particularly in the Medicare program, and better alignment of incentives with quality goals, including pay-for-performance [3, 4]. Cutler [5] argues that promoting incentives and competition constitutes a current “third wave” of international health policy reform.

Most nations also recognize, however, the many limitations of free-market competition and high-powered financial incentives in the health sector. These limitations arise predominantly because many important dimensions of quality health care are difficult to observe, monitor, and motivate. Provider competition to attract consumers can spur providers to raise quality along dimensions that consumers value. But consumers frequently lack sufficient information and market power to be discriminating purchasers of high quality, low cost services, and policy instruments may be too blunt to address all elements of concern. In this “second best” situation, competition and payment incentives featuring “supply-side cost sharing” [6] give even well-intentioned health plans and providers incentive for socially undesirable behaviors. One such behavior is manipulation of offerings to deter the sick and attract the healthy, variously known as “risk selection,”

“plan manipulation,” “cream skimming,” or “cherry picking” [7, 8]. When health plans compete to avoid the sick rather than provide quality care, the most vulnerable patients may experience access problems, and consumers may be unable to buy insurance against becoming a bad risk in the future or having a child who is a bad risk [7, 9].<sup>1</sup>

This paper uses simulation of an economic model of insurer and provider behavior to illustrate the effects of competition for patients, provider altruism, and payment incentives on the efficiency and equity of health resource allocation. The simulations show that competition can exacerbate selection, especially when insurers or providers are paid by capitation. For any given level of competition, higher supply-side cost sharing induces more selection distortions. By contrast, an insurer or provider’s innate concern for patient welfare, arising through professional norms or otherwise, can reduce selection for any given level of competition or payment incentives, allowing society to reap the efficiency benefits of competition and incentives without sacrificing social solidarity.

The first section below describes the conceptual model. The following sections discuss how competition, provider altruism, and payment incentives affect insurer and provider behavior, and thus equity and efficiency of healthcare delivery.

---

<sup>1</sup> Newhouse defines selection as “actions of economic agents on either side of the market to exploit unpriced risk heterogeneity and break pooling arrangements, with the result that some consumers may not obtain the insurance they desire” [7, p.1236].

## 2. A Conceptual Model

To focus on supplier behavior, and since most industrialized countries provide near-universal coverage with minimal user fees for access to basic services, we assume patients are fully insured.

Frank, Glazer and McGuire [10] (hereafter FGM) illustrate how health insurers (also called health plans) may distort quality of various services to attract profitable enrollees. They model health plan management of care with “shadow prices.” Just as “real prices” lead to lower use, higher shadow prices lead to lower spending.

“The shadow price is a device to capture the myriad strategies a plan uses to ration care, other than demand-side cost sharing (literal prices). Shadow prices can reflect plan decisions about capacity in various service areas....[or] the makeup of networks or payment to providers, including supply-side cost sharing or the stringency of utilization review” [10, p.832].

The simulations of this paper are based on extensions of the FGM model to incorporate (1) provider competition for patients (by varying consumer “travel costs” to competing providers); (2) provider altruism, in terms of professional ethics or genuine concern for patient welfare; and (3) payment incentives (on a continuum from cost reimbursement to capitation).

The participants and the timing of their interactions are as follows. First, a purchaser (government program or employer) designs a health plan payment system. We assume the purchaser contracts with multiple insurers or health plans to serve beneficiaries. Responding to the incentives of the payment system and the

competitiveness of the healthcare market, a health plan manager chooses capacity levels or budgets for each service area, and decides how to contract with providers.

The insurer chooses the contract design knowing that providers will allocate spending across patients according to patient needs, subject to the budget constraint(s) or consistent with cost sharing incentives. The plan administrator may be constrained by providers' preferences for autonomy, since providers may refuse to contract with a plan that overly interferes with clinical decision-making (by imposing high shadow prices).

Heterogeneous consumers choose whether or not to enroll in the plan in light of their expected service needs, the plan's chosen service-specific spending levels, and convenience factors. The purchaser pays the plan the agreed capitation or prospective payments per enrollee, if any. Then some enrollees seek treatment for new or existing medical conditions. The plan's contracted provider (group) chooses treatments, allocating spending across patients according to patient need and the threshold for use embodied in service-specific shadow prices (see discussion in [10, 11]). Providers also allocate their time and attention across services. Finally, reimbursement(s) flow for the portion of payment based on actual patient utilization.

For more detail about the model, please see the appendix.

### **3. Competition**

Many economists and policymakers advocate competition among health care providers to promote efficiency, allowing consumer sovereignty in choosing providers, while simultaneously exerting pressure on providers to deliver quality care at least cost. Unfortunately, provider competition in the health sector is complicated by the limited

ability of consumers and payers to monitor and contract upon various dimensions of quality care.

If patients were homogeneous and needed only one service, the efficiency benefits of competition would be clear. As competition lessens (travel costs  $c$  increase), consumers have fewer viable alternatives, so a health plan can skimp on care without losing too many enrollees to make it profitable. Competition forces insurers and providers to improve quality as a way to attract and retain customers.

The more general multi-service, heterogeneous consumer context illustrates the risks to social solidarity that competition may also create. In the underlying mathematical model, the general comparative statics of shadow prices with respect to competition are ambiguous. Although some shadow prices over some ranges will decrease with competition as above, other shadow prices may increase (decreasing quality) with competition. Competitive pressure will generally increase quality disproportionately for services that attract profitable enrollees, and may give incentive to stint on quality for services valuable to high-cost enrollees.

To illustrate these effects, I simulate plan choice of shadow prices in a model with two services and two patient types. The simulation is based on parameters and functional forms drawn from Keeler, Carter and Newhouse [12]. (See the appendix for details.) Consider service 1 to be care for chronic conditions, and service 2 acute care. Each high-risk enrollee, H, has much higher expected spending on chronic care than a low-risk individual, L. So H disproportionately value spending on service 1 (low  $q_1$ ). Expected use of acute services is identical, so H and L equally value high-quality acute care (low  $q_2$ ). Selection through service-specific quality distortions takes the form of stinting on

chronic care (high  $q_1$ ) to deter H enrollees, while offering generous acute care (low  $q_2$ ) to attract—“cream”—L enrollees. The ratio  $q_1/q_2$  measures quality-distortion selection.<sup>2</sup>

Figure 1 illustrates how competition can exacerbate selection, especially when a health plan or provider group is fully capitated ( $s=1$ ). As competition increases (i.e., travel costs  $c$  decrease), selection increases. For any given level of competition (travel costs), higher supply-side cost sharing induces higher selection.

Figure 1 about here

One way to mitigate selection distortions for any given level of competition is through mandatory high risk pooling (MHRP), outlier payments, or other nonlinear payment schemes [14, 15]. Figure 2 illustrates how MHRP can reduce selection. The simulation assumes cost reimbursement for all expenses of pooled enrollees, and capitation payment for all non-pooled enrollees.

Figure 2 about here

However, such reduction of selection may come at the cost of considerably higher spending, particularly if the pooled patients' expenses are fully reimbursed. This suggests the importance of some supply-side cost sharing to help control excessive spending.

---

<sup>2</sup> One might also want to specify that  $q_1 > q_2$  only qualifies as selection if  $q_1 > 1$ , i.e., the plan stints on the unprofitable service relative to the socially optimal value. I define a selection index (see the appendix) that normalizes quality distortions to between 0 and 1, as suggested in [13].

#### **4. Payment Incentives: Supply-Side Cost sharing**

Supply-side cost sharing refers to cost sharing between the purchaser and insurer or provider. Having the insurer or provider bear part of the cost of care gives insurers and providers incentive to control overall spending, but to do so differentially by service. Stinting disproportionately on the services attractive to expensive consumers discourages their enrollment and hence achieves risk selection. Similarly, overspending on services valuable to profitable consumers lures them to enroll. Call such selection-motivated disparities in spending or shadow prices “quality-distortion selection.” Higher supply-side cost sharing induces more quality-distortion selection (see Figure 1). For example, the simulation in Table 1 in the appendix shows how  $q_1$  (the shadow price for unprofitable chronic care) increases monotonically with  $s$ , but  $q_2$  does not.

Moreover, plan administrators who want to “cherry pick” have methods beyond service-specific quality distortions at their disposal. Although enforcing open enrollment periods can be an inexpensive and effective way to reduce explicit dumping of high risks [16], open enrollment requirements cannot prevent many other possible selection behaviors. These include choice of facility location, selective advertising, size and composition of affiliated providers and other staff, etc. “Explicit dumping” is effort or expense on such activities that plans may undertake explicitly to risk select, apart from service-specific quality distortions.

To examine incentives for explicit and implicit (quality-distortion) selection within the same framework, I integrate into the multi-service model a simple model of explicit dumping, drawing on [13] (also see discussion in [15], chapter 5). The key point is that policymakers could prevent selection if consumers were required to purchase

insurance from a monopoly health plan. However, this way of achieving social solidarity would sacrifice the ethical precept of consumer choice [2] and the efficiency-promoting benefits of competition.<sup>3</sup>

Let  $t$  (between 0 and 1) represent all non-quality-distortion forms of risk selection. Selection  $t$  can be undertaken at increasing and convex cost. Assume that competition--small travel costs  $c$ --makes explicit selection "easier." In other words, a monopolist would face infinite costs of selection because a regulator could easily monitor and proscribe such behavior. Insurers and providers with competitors, however, can use various subtle methods of competition to achieve selection.

Figure 3 about here

In the simulation, for high enough incentive to risk select--such as a profit-maximizing health plan paid with high supply-side cost sharing and no risk adjustment--explicit dumping occurs alongside quality-distortion selection (see Figure 3). Explicit dumping substitutes for exacerbated quality distortions (i.e., becomes a more cost-effective form of risk selection) as  $s$  increases from 0.5 to 1; "total selection" (quality-distortion selection plus explicit dumping) increases substantially as supply-side cost sharing increases to 1. This reminds us of the potentially large selection costs of high supply-side cost sharing, such as capitation.

---

<sup>3</sup> A monopoly profit-maximizing insurer for consumers who are required to buy insurance would want to set all shadow prices to their maximum contractible values (i.e., quality at the minimum contractible level). Except for distortions arising from variation in the lowest contractible quality across services, this would remove service-specific quality distortions, at the expense of uniformly low quality. Once consumers have choice, plans may configure themselves to appeal to desirable consumers.

More generally, different degrees of cost sharing for different services might improve incentives relative to uniform payment. For example, in the simulation detailed in the appendix (see Table 1),  $s=0.5$  (like the US Prospective Payment System) induces some quality distortions:  $q_1(s=0.5)=1.153$  and  $q_2(s=0.5)=0.295$ . Even if overall incentives should remain about  $s=0.5$ , lowering  $s_1$  reduces the incentive to stint on chronic care (service 1) to “dump” unprofitable high-risk consumers, while raising  $s_2$  reduces the incentive to overspend on acute services (service 2) to “cream” profitable low-risk consumers. Raising  $s_2$  has the added benefit of countering the cost increases from more generous spending on chronic care. Simulation shows that the same profit-maximizing plan will choose virtually uniform shadow prices ( $q_1=0.878$  and  $q_2=0.844$ ) when  $s_1=0.25$  and  $s_2=0.75$ .

In practice, varying supply-side cost sharing by service may be too administratively cumbersome to be practical, even if analysts could pinpoint optimal service-specific cost sharing. Purchasers can nevertheless still benefit from the logic of multi-service incentive design. For example, quality assurance measures could be targeted on those services for which capitated providers have greatest incentive to stint on quality. And if capitation results in significant quality-distortion selection (with stinting on services used by less profitable patients and creaming on services used by more profitable patients; see Table 1 in the appendix), then it can be optimal to reduce supply-side cost sharing for both services. Although this move toward mixed payment will sacrifice some cost control, the loss may be more than offset by a reduction in selection distortions.

## 5. Altruism

Clearly, then, competition and financial incentives from plan- or provider-cost-sharing can exacerbate social inequalities through risk selection. What can offset incentives for selection, for any given level of competition and supply-side cost sharing? As distinguished health economist Victor Fuchs noted in his 1996 Presidential address to the American Economics Association, “one of the greatest errors of health policy-makers today is their assumption that market competition or government regulation are the only instruments available to control health care. There is room for, indeed need for, a revitalization of professional norms as a third instrument of control” [17, p.17]. This section focuses on how agency [18]--a plan or provider's innate concern for patient welfare, arising through professional norms or otherwise--can reduce selection.

The model and simulation show that a “good agent” for patients not only chooses higher quality for a given service than a poor agent would, but a good agent also acts to allocate spending more evenly across patients, so that the “neediest” patients receive appropriate treatment despite being unprofitable (see Figure 4).

Figure 4 about here

Moreover, a simple model of provider choice of plan shows that plan altruism can represent the plan's own nonpecuniary objectives *or* a kind of “reduced form” for the constraint on insurer profit-seeking that provider concern for patients brings (results available from author upon request). Thus, both insurer and provider altruism can benefit health policy by upholding solidarity despite competitive pressures for selection.

## **6. Conclusion**

Health care policymakers in many countries seek to use incentives and competition to spur efficiency. One important challenge is to mitigate the sacrifice of social solidarity that such reforms entail, because strong incentives promote risk selection.

This paper argues conceptually and presents simulations revealing how competition, altruism, and payment incentives affect efficiency and equity of treatment. The focus is how to prevent or minimize incentives for quality distortions designed to attract profitable and deter unprofitable patients.

The primary result is that strong incentives from competition for patients and financial rewards for cost control can exacerbate selection distortions and compromise social solidarity. By contrast, insurer and/or provider altruism, manifest as an innate concern for patient welfare regardless of profits, tends to mitigate selection, allowing society to reap the efficiency benefits of competition and incentives without sacrificing social solidarity.

Although I present these results in terms of managed health care in the US, the analysis is applicable to many other countries and sectors. Consider for example the analogy to education. Reformers eager to harness the benefits of strong incentives and competition, for example through vouchers, should beware of selection incentives. Well-intentioned educators, like health plans and providers, may respond to imperfect performance measures by “dumping” the most vulnerable, providing them with worse

quality,<sup>4</sup> or shifting them to “exempt” categories (special education classes exempt from school accountability tests, health care facilities exempt from prospective payment) even when this conflicts with the best interest of student, patient, or society.

---

<sup>4</sup> See for example [19]. Some express concern that schools may shun special education students, like plans shunning the chronically ill, either by distorting quality or explicit dumping. Such selection behaviors are less like in the absence of meaningful school choice (because providing a low-quality special education program does not lead to much lower enrollment) and/or when special education students are exempt from the accountability system (like high-risk patients or outlier cases pooled in a lower-powered payment category).

## References

[1]. van de Ven, W.P.M.M., and R.P. Ellis, 2000. Risk adjustment in competitive health plan markets. In: A.J. Culyer and J.P. Newhouse, eds., *Handbook of Health Economics*, Vol. 1A (Amsterdam: Elsevier North-Holland), 755-845.

[2]. Kornai, J., and K. Eggleston, 2001. *Welfare, Choice and Solidarity in Transition: Reforming the Health Sector in Eastern Europe*. Cambridge, UK: Cambridge University Press.

[3]. Institute of Medicine, Committee on the Quality of Health Care in America, 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. National Academy Press.

[4]. Kowalczyk, L., 2002. For doctors, bonuses for quality, *Boston Globe* November 7, 2002, p.A1.

[5]. Cutler, D.M., 2002. Equality, efficiency, and market fundamentals: The dynamics of international medical-care reform. *Journal of Economic Literature* XL (September 2002), 881-906.

[6]. Ellis, R., and T.G. McGuire, 1990. Optimal payment systems for health services. *Journal of Health Economics* 9, 375-396.

- [7]. Newhouse, J.P., 1996. Reimbursing health plans and health providers: Selection versus efficiency in production. *Journal of Economic Literature* 34, 1236-1263.
- [8]. Cutler, D.M., and R.J. Zeckhauser, 2000. The anatomy of health insurance. In: A.J. Culyer and J.P. Newhouse, eds., *Handbook of Health Economics*, Vol. 1A (Amsterdam: Elsevier North-Holland), 563-643.
- [9]. Feldman, R., and B. Dowd, 2000. Risk segmentation: Goal or problem? *Journal of Health Economics* 19, 499-512.
- [10]. Frank, R. G., J. Glazer, and T. G. McGuire, 2000. Measuring adverse selection in managed health care. *Journal of Health Economics* 19, 829-854.
- [11]. Eggleston, K., 2003. Multitasking and provider payment. Tufts University Economics Department working paper.
- [12]. Keeler, E.B., G. Carter, and J.P. Newhouse, 1998. A model of the impact of reimbursement schemes on health plan choice. *Journal of Health Economics* 17, 297-320.
- [13]. Eggleston, K., 2000. Risk selection and optimal health insurance-provider payment. *Journal of Risk and Insurance* 67(2), 173-196.

[14]. van Barnevald, E., R. van Vliet, and W. van de Ven, 1996. Mandatory high-risk pooling: An approach to reducing incentives for cream skimming. *Inquiry* 33, 133-143.

[15]. Newhouse, J.P., 2002. *Pricing the Priceless: A Health Care Conundrum*. Cambridge, MA: MIT Press.

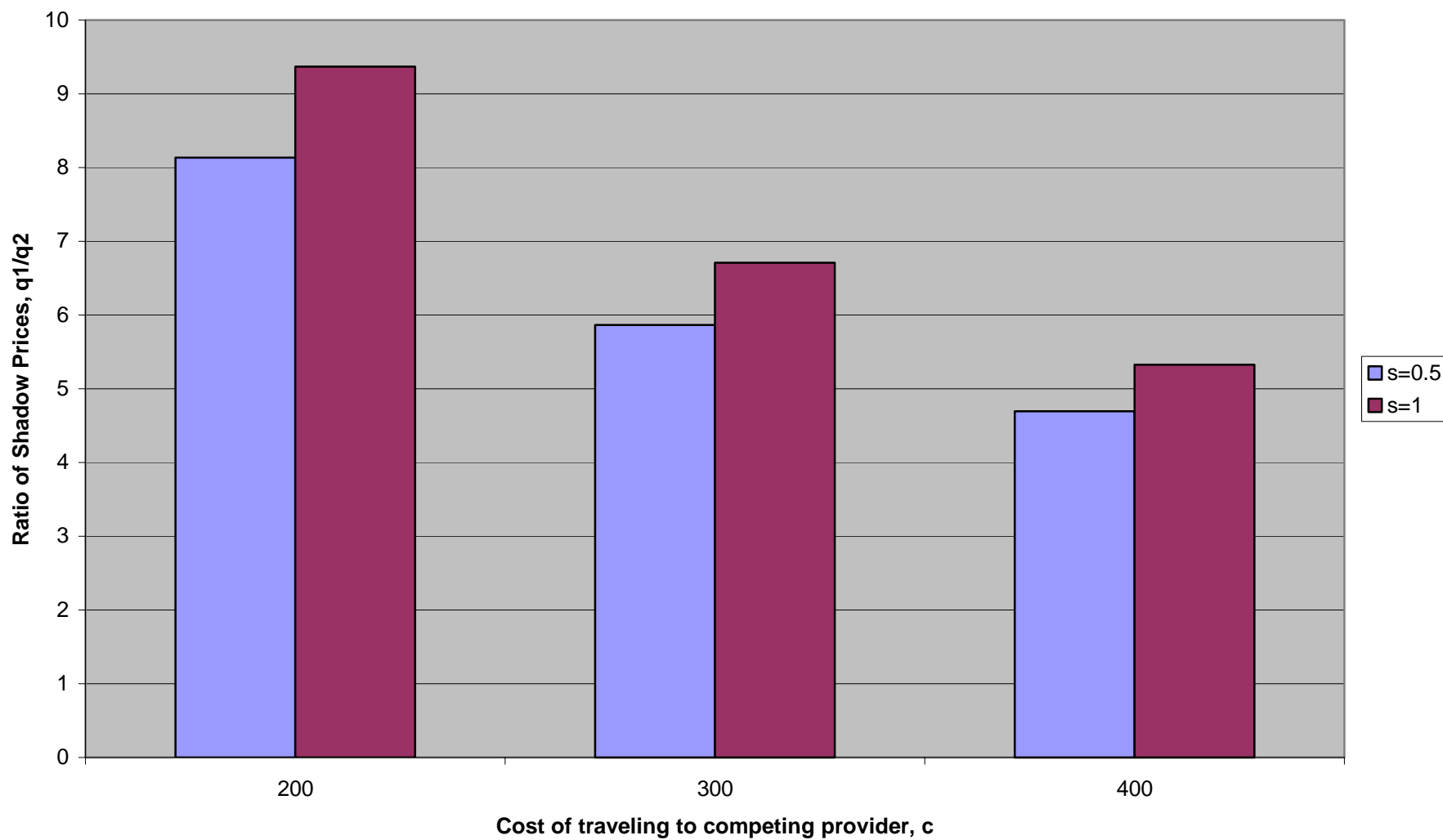
[16]. Glazer, J., and T.G. McGuire, 2002. Setting plan premiums to ensure efficient quality in health care: Minimum variance optimal risk adjustment. *Journal of Public Economics* 84, 153-173.

[17]. Fuchs, V.R., 1996. Economics, values, and health care reform. *American Economic Review* 86: 1-24.

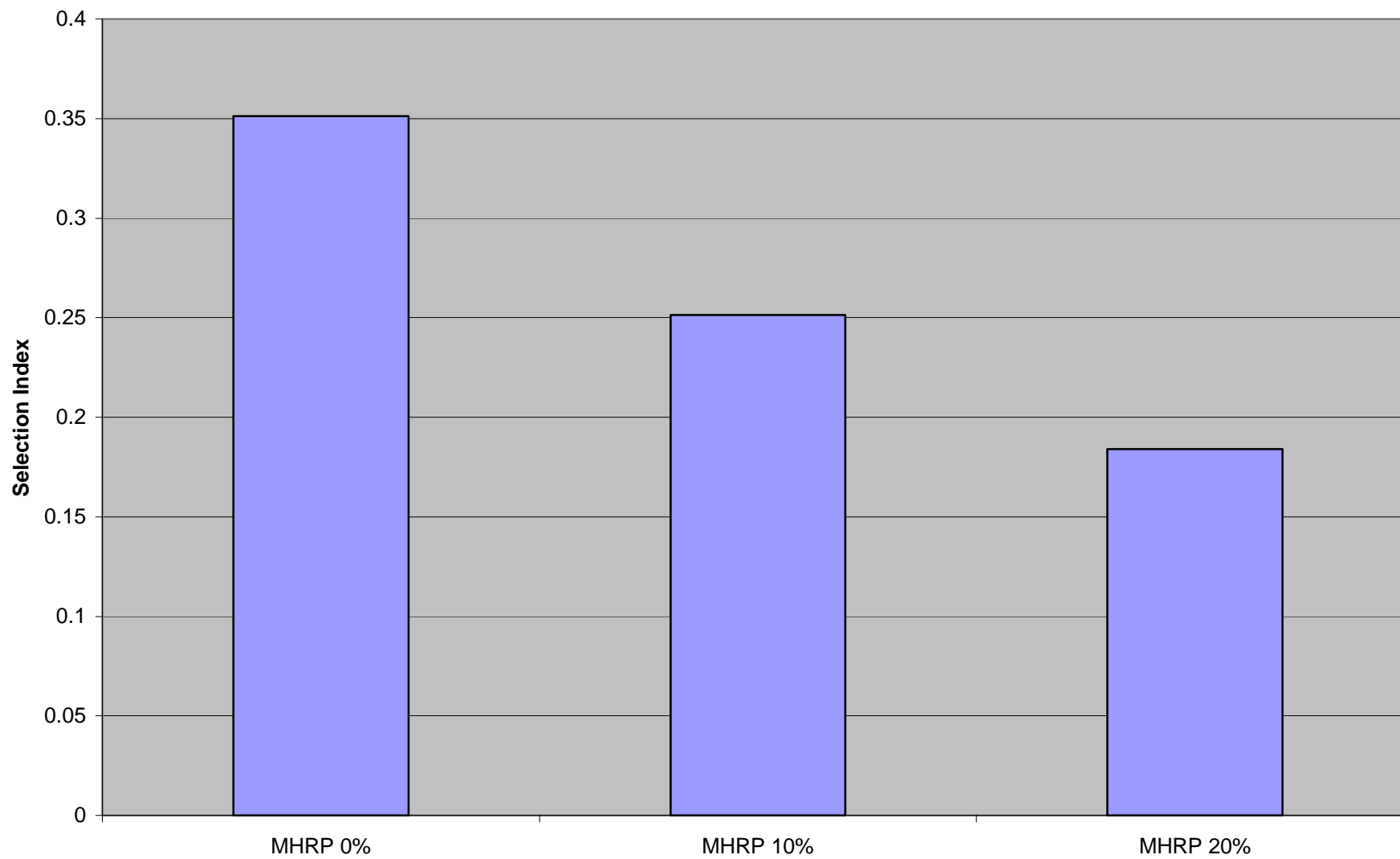
[18]. McGuire, T.G., 2000. Physician Agency. In: A.J. Culyer and J.P. Newhouse, eds., *Handbook of Health Economics*, Vol. 1A (Amsterdam: Elsevier North-Holland), 461-536.

[19]. Figlio, D.N., and L.S. Getzler, 2002. Accountability, ability and disability: Gaming the system. National Bureau of Economic Research working paper 9307.

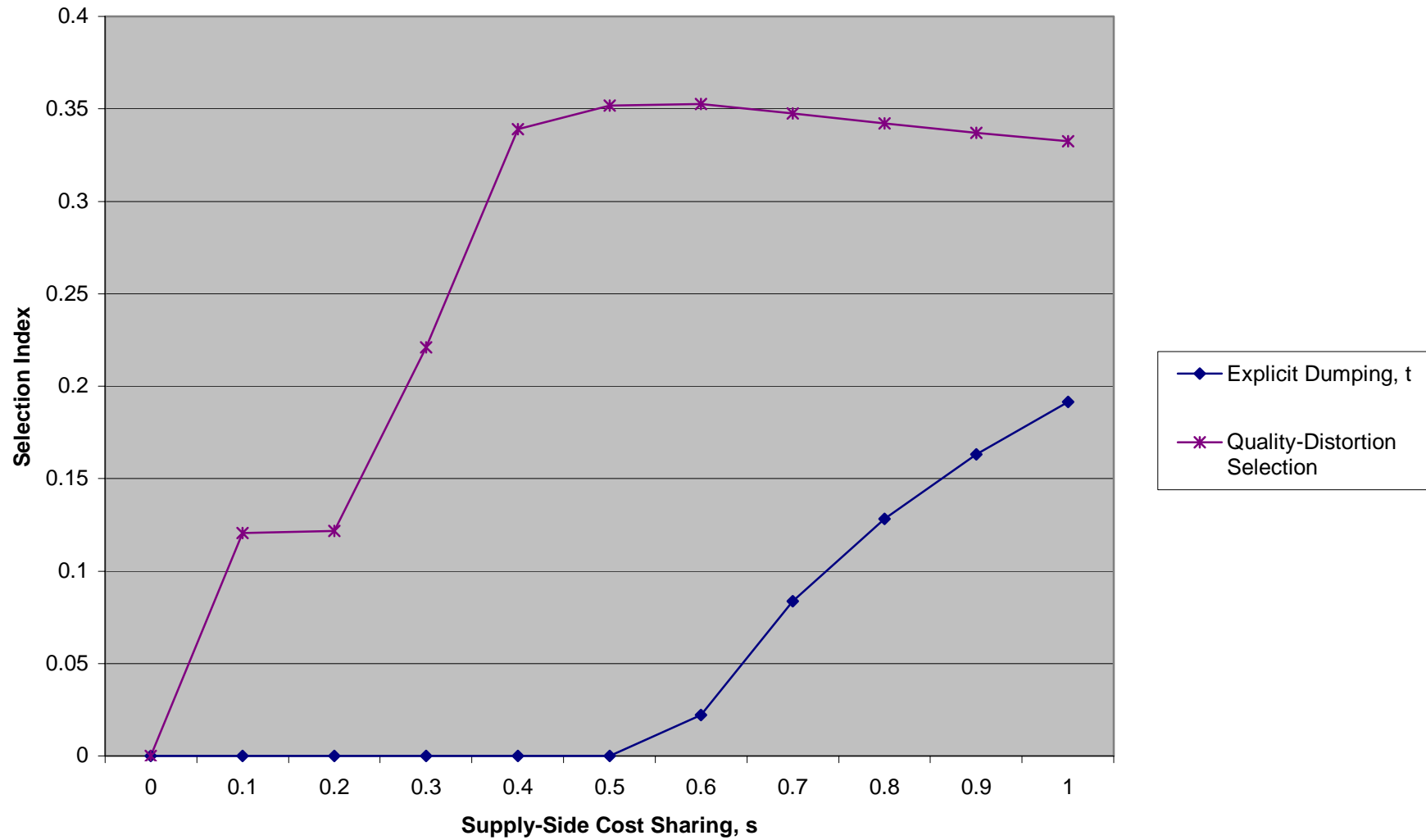
**Figure 1. Competition Can Exacerbate Selection, Especially When Supply-Side Cost Sharing Is High**



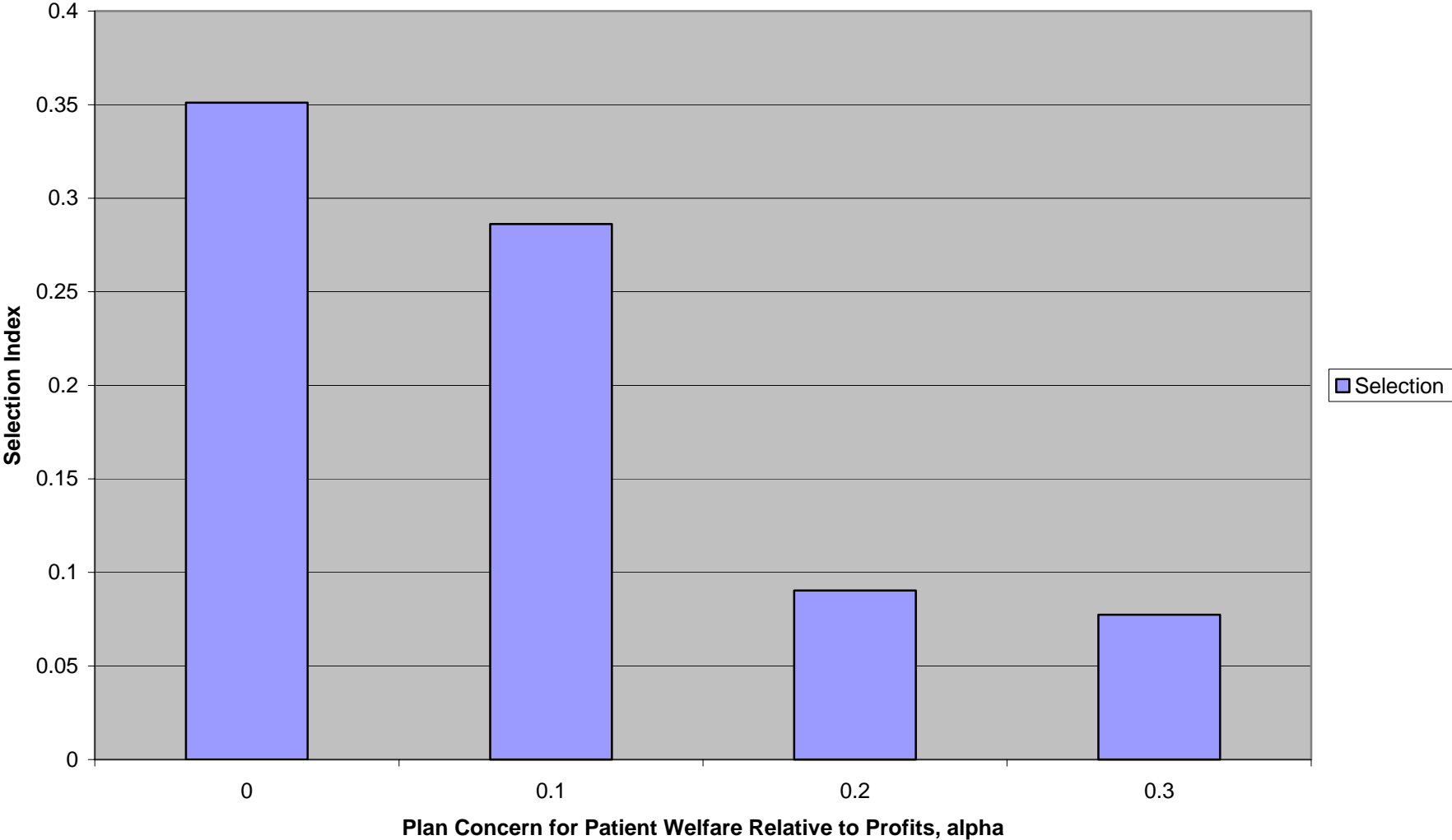
**Figure 2. Mandatory High-Risk Pooling Reduces Selection**



**Figure 3. Selection Increases with Supply-Side Cost Sharing, with Explicit Dumping Substituting for Quality Distortions**



**Figure 4. Plan Agency: Selection-Motivated Quality Distortions Decrease As Plan Concern for Patient Welfare Increases**



## A Appendix: The Simulation Model

This appendix describes the model and simulations from which the conclusions in the main text are drawn. For a more detailed discussion of the underlying economic model, please see [10] and [11].

A health plan provides various health care services (prenatal care, treatment of heart attack patients, mental health services) indexed by  $j$ . Let  $m_j^i$  represent the spending on health service  $j$  provided to individual  $i$ . Assume payment includes two components. First, for each enrollee, the plan receives a fixed pre-payment (capitation)  $r^i$ . The insurer also receives reimbursement  $(1 - s_j) m_j^i$  for each service  $j$ , with  $s_j \in [0, 1]$ .  $s_j > 0$  denotes supply-side cost sharing. Pure cost reimbursement corresponds to  $r = 0$  and  $s = 0$ . A mixed payment system features  $0 < s < 1$ . Capitation or fully prospective payment arise when  $s = 1$ :

Insurers ration care by setting a "shadow price"  $q_j$  for access to care. Just as "real prices" lead to lower use, higher shadow prices lead to lower spending. Patients value spending, so demand increases in  $m$  and decreases in  $q$ .

Denoting patient demand by  $n^i(q)$ , the insurer's expected net revenues  $\frac{1}{4}^i(q)$  are

$$\frac{1}{4}^i(q) = \sum_{j=1}^J n^i(q) \frac{1}{4}^i(q); \quad (1)$$

$$\text{where } \frac{1}{4}^i(q) = r^i - \sum_{j=1}^J s_j m_j^i(q); \quad (2)$$

Consider the simple case of two services,  $j = 1, 2$ , and two consumer types, high-risk  $H$  and low-risk  $L$ , where expected health spending of  $H$  exceeds that of  $L$ :  $m^H > m^L$ . For simplicity assume the two types are distributed identically in the population, so that demand for a health plan consists of  $n^H m^H$  and  $n^L m^L$ . Health plan profit (1) then becomes  $n^H(q) \frac{1}{4}^H(q) + n^L(q) \frac{1}{4}^L(q)$ . To focus on selection incentives remaining under imperfect risk adjustment, assume that prepayment  $r$ , if any, is not risk adjusted. To induce a health plan to provide services, enrollment of some individuals (here,  $L$ ) must be profitable:  $\frac{1}{4}^L(q) > 0$ . For any positive amount of supply-side cost sharing ( $s > 0$ ) without risk adjustment,  $H$  are always less profitable than  $L$ , and depending on the payment system, the plan may incur a net loss for each  $H$  enrolled:  $\frac{1}{4}^L(q) > \frac{1}{4}^H(q) \geq 0$ .

In the two-service, two-type case, the first-order conditions for choice of profit-maximizing shadow prices  $q_1^*$  and  $q_2^*$  are

$$\frac{\partial n^L}{\partial q_1} \frac{1}{4} + \frac{\partial n^H}{\partial q_1} \frac{1}{4} + s_1 \left[ n^H \frac{dm_1^H}{dq_1} + n^L \frac{dm_1^L}{dq_1} \right] = 0 \quad (3)$$

$$\frac{\partial n^L}{\partial q_2} \frac{1}{4} + \frac{\partial n^H}{\partial q_2} \frac{1}{4} + s_2 \left[ n^H \frac{dm_2^H}{dq_2} + n^L \frac{dm_2^L}{dq_2} \right] = 0 \quad (4)$$

Simulations of the two-service, two-enrollee-type model of (3) and (4) build upon the functional forms of Keeler, Carter and Newhouse [12]. Specifically, the simulations assume consumer utility takes the form

$$v^i = \sum_{j=1}^2 a_j m_j + \frac{b_j}{2\mu_j^i} (m_j)^2$$

with  $\mu_1^H = 5$ ;  $\mu_2^H = \mu_1^L = \mu_2^L = 1$ : ( $\mu_j^i$  corresponds to Keeler, Carter and Newhouse's  $D(d)$ ). With providers choosing patient-specific spending according to service-specific shadow prices  $q_j$ , spending on each service becomes

$$m_j = \mu_j^i \frac{a_j q_j}{b}$$

Thus, H enrollees use  $\mu_j^i$  times as much service  $j$  (chronic care) as L enrollees, while use of service 2 (acute services) does not differ across enrollee type. Following Keeler, Carter and Newhouse,  $a = 3$  and  $b = 0.0025$ .

Demand takes the following form (with the cumulative distribution of consumers defined as the cdf for a logistic random variable):

$$F_i(m^i) = \frac{1}{1 + \exp\left(-\frac{1}{c} \sum_j \mu_j^i v_j^i(m^i)\right)}$$

The health plan maximizes (1) taking the competing plan's shadow prices as given. For all simulations except those for Figure 1, the competitor's shadow prices are held fixed at  $q_1 = q_2 = 1$ . For Figure 1, the competitor's shadow prices are fixed at the profit-maximizing response of a plan paid  $s = 1$  competing with a plan that sets  $q_1 = q_2 = 1$ , i.e.,  $q_1 = 1.167$  and  $q_2 = 0.311$ . Travel costs  $c$  are set equal to 100 unless noted otherwise (e.g., in Figure 1).

Prepayment  $r$  to the plan covers the costs that are to be shared at point of service such that if the plan set efficient shadow prices  $q_1 = q_2 = 1$ , it would make a profit of 1000 per enrollee:

$$r = \frac{s_1 (m_1^H + m_1^L) + s_2 (m_2^H + m_2^L)}{2} + 1000$$

where  $m_j^i = m_j^i (q = 1)$  :

To aid in assessing the profit-maximizing shadow prices, I define two indices designed to normalize the range of shadow-price distortions between 0 and 1. The first, distortion index, measures the extent to which shadow prices deviate from social optimality,  $q_1 = q_2 = 1$ :

$$\text{Distortion} = \frac{2}{1 + \exp \left[ \frac{1}{2} \left( (q_1 - 1)^2 + (q_2 - 1)^2 \right) \right]}$$

Note that when  $q_j = 1$  for every service, this distortion index is equal to zero. As shadow prices diverge from 1 in either direction (creaming or stinting or any combination thereof), the distortion index becomes a larger positive number, approaching 1 in the limit. This index therefore normalizes to between 0 and 1 all distortions from  $q_1 = q_2 = 1$ .

The selection index, by contrast, captures the degree to which shadow prices are set differently by service, presumably to achieve risk selection:

$$\text{Selection} = \frac{2}{1 + \exp \left[ \frac{1}{2} (q_1 - q_2)^2 \right]}$$

This selection index appears on the vertical axis of figures 2, 3, and 4. In all cases, selection distortions arise because  $q_1 > q_2$ .

I also report the ratio of  $q_1$  to  $q_2$ , which when it exceeds 1 also represents quality distortions designed to attract L and eschew H enrollees. The range of this ratio reported in the simulations (between 2 and 10, in Table 1 below and Figure 1) is comparable to that found empirically in FGM [10]. In their no risk adjustment, 40% prior use calculated shadow prices (FGM Table 3, p.849), the highest calculated shadow price was for mental health/substance abuse ( $q = 3.73$  relative to the 'other/missing' service category). Taking this as  $q_1$ , and the weighted average of all the shadow prices as  $q_2$ , then  $q_1/q_2 = 4.5$ . If instead one takes as service 2 the service with the lowest shadow price (cancer care,  $q = 0.19$ ), then  $q_1/q_2$  exceeds 20.

To model mandatory high-risk pooling (MHRP) of  $\mu\%$  of enrollees (Figure 2), I assume cost reimbursement ( $s = 0$ ) for the pooled enrollees and calculate profit-maximizing shadow prices for serving the remaining  $(1 - \mu)\%$  of enrollees. The plan exclusively allocates Hs to the pool. Figure 2 assumes fully prospective payment ( $s = 1$ ) for the non-pooled enrollees.

TABLE 1. Simulation of Profit-Maximizing Plan Shadow Prices as Supply-Side Cost Sharing Increases

s	-0.1	0	0.1	0.2	0.3	0.4	0.5	1
q <sub>1</sub>	0	0	0.957	0.994	1.078	1.141	1.153	1.167
q <sub>2</sub>	0	0	0.465	0.499	0.408	0.300	0.295	0.311
q <sub>1</sub> =q <sub>2</sub>	{	{	2.058	1.991	2.645	3.799	3.901	3.757
n <sup>H</sup>	1	1	0.992	0.963	0.523	0.085	0.051	0.026
n <sup>L</sup>	1	1	0.970	0.955	0.936	0.920	0.912	0.897
Distortion	0.762	0.761	0.143	0.125	0.177	0.249	0.254	0.246
Selection	0	0	0.120	0.122	0.221	0.339	0.352	0.351
m <sub>1</sub> <sup>H</sup>	12000	12000	8172	8025	7688	7438	7390	7331
m <sub>1</sub> <sup>L</sup>	2400	2400	1634	1605	1538	1488	1478	1466
m <sub>2</sub> <sup>H</sup> = m <sub>2</sub> <sup>L</sup>	2400	2400	2028	2001	2074	2160	2164	2151

### Explicit Dumping Model

The simulation assumes dumping costs of the form

$$c(t; c) = c \exp \left( -\frac{t}{1 - t} \right)$$

Think of  $t$  as location in plan non-quality characteristic space. Selection shapes the distribution of consumers to whom the plan will most appeal. Specifically, assume  $t$  reduces 'travel cost' to the nearest competitor from  $c$  to  $c(1 - t)$ . 'Perfect' selection ( $t = 1$ ) reduces the travel cost to the competitor to zero.

The plan will only ever find it profit-maximizing to dump high risks H. Although I assume plans' selection activities perfectly target H consumers and do not affect L demand, I also assume that 'perfect' selection {dumping all high risks onto competitors} is prohibitively costly. Then demand from high-risk consumers (i.e., the probability that an H consumer will choose the plan; see [10] and [11]) becomes

$$n^H = \frac{\bar{A} \int_0^1 \frac{u^H v^H(m^H)}{c(1-t)} dt}{c}$$

Note that for  $t = 0$ ,  $n^H = \frac{\bar{A} \int_0^1 \frac{u^H v^H(m^H)}{c} dt}{c}$ . As  $t$  increases, fewer high-risk consumers find it utility-maximizing to enroll in the plan exerting  $t$ . For  $t$  approaching 1, enrollment of H approaches zero.

# WORKING PAPER SERIES 2004

[ase.tufts.edu/econ/papers](http://ase.tufts.edu/econ/papers)

- 2004-01** EGGLESTON, Karen & Winnie Yipp; Hospital Competition under Regulated Prices: Application to Urban Health Sector Reforms in China
- 2004-02** EGGLESTON, Karen & Chee-Ruey Hsieh; Health Care Payment Incentives: A Comparative Analysis of Reforms in Taiwan, Korea and China
- 2004-03** EGGLESTON, Karen; Competition, Altruism, and Provider Payment
- 2004-04** LOURY, Linda; Some Job Contacts are More Equal Than Others: Earnings and Job Information Networks
- 2004-05** LOURY, Linda; Teen Childbearing and Community Religiosity
- 2004-06** LOURY, Linda; Religiosity and High School Misbehavior
- 2004-07** MUKAND, Sharun & Sumon Majumdar; Policy Gambles
- 2004-08** MUKAND, Sharun & Sanjay Jain; Public Opinion and the Dynamics of Reform
- 2004-09** MUKAND, Sharun, Sumon Majumdar & Anandi Mani; Politics, Information and the Urban Bias
- 2004-10** BIANCONI, Marcelo; Aggregate and Idiosyncratic Risk and the Behavior of Individual Preferences under Moral Hazard
- 2004-11** BIANCONI, Marcelo; Transfer Programs and Consumption under Alternative Insurance Schemes and Liquidity Constraints

- 2004-12** BIANCONI, Marcelo; Heterogeneity, Adverse Selection and Valuation with Endogenous Labor Supply
- 2004-13** BIANCONI, Marcelo; The Welfare Gains from Stabilization in a Stochastically Growing Economy with Idiosyncratic Shocks and Flexible Labor Supply
- 2004-14** SHIMSHACK, Jay P. and Michael B. Ward; Enforcement and Environmental Compliance: A Statistical Analysis of the Pulp and Paper Industry
- 2004-15** NORMAN, George and Joel P. Trachtman; The Customary International Law Supergame: Order and Law
- 2004-16** BROWN, Drusilla K. and George Norman; Optimal Intellectual Property Rights Protection and Humanitarian Assistance during and International Health Emergency
- 2004-17** LOURY, Linda; Job Tenure and Personal Contacts: Good Matches or Limited Choices?
- 2004-18** KUTSOATI, Edward and Sharun Mukand; Expectations and the Central Banker: Making Decisions the Market Expects to See?
- 2004-19** RICHARDS, Daniel; Price Discrimination and the Long Boom.
- 2004-20** HARDMAN, Anna and Yannis Ioannides; Income Mixing and Housing in U.S. Cities: Evidence From Neighborhood Clusters of the American Housing Survey.
- 2004-21** HARDMAN, Anna and Yannis Ioannides; Neighbors' Income Distribution: Economic Segregation and Mixing in US Urban Neighborhoods. [revised]
- 2004-22** EGGERS Andrew and Yannis Ioannides; The Role of Output Composition in the Stabilization of the U.S. Output Growth
- 2004-23** SHIMSHACK Jay; Are Mercury Advisories Effective? Information, Education, and Fish Consumption.