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Modeling Internal Decision Making Process: An Explanation of Conflicting Empirical Results on Behavior of Nonprofit and For-Profit Hospitals

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Abstract

This paper develops multiobjective models of hospital decision making that incorporate the internal decision process in both a for-profit and a nonprofit hospital. Predicted output and quality for a nonprofit hospital differ from those for a for-profit hospital under some conditions but converge under others. Convergence may be the result of a complex internal decision structure with decision control primarily by physicians; similar objectives across different organizational forms; or differing constraints. The mechanisms underlying these outcomes provide explanations for conflicting results in empirical studies of nonprofit and for-profit hospitals and provide a different rationale for convergence than nonprofit response to competition from for-profit hospitals. Understanding the source of convergence is important for policies directed toward the tax treatment of nonprofit hospitals.

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1 Introduction

The prevalence of for-profit hospitals has increased in the United States over the past few decades. The emergence of for-profit hospitals that often compete in markets with not-for-profit hospitals has generated vigorous academic and policy debates about the implications of the distinct legal and organizational for-profit and nonprofit forms on hospital behavior. Differences in monetary and nonpecuniary incentives for administrators and physicians, in tax treatment and access to capital markets, and in governance should lead to observable differences in revenues and costs as well as the quantity, quality and mix of services provided by for-profit and non-profit hospitals. Alternatively, competition from for-profit hospitals in the same markets as non-profit hospitals coupled with persistent cost-containment efforts of public and private insurers, may result in non-profit hospitals behaving similarly to for-profit hospitals despite differences in organizational form. This notion of convergence in the hospital industry has called into question the tax benefits that non-profit hospitals enjoy on the grounds that non-profit hospitals are indistinguishable from for-profit hospitals and fail to provide community benefits at a level sufficient to justify the subsidies.

The ongoing debate about whether for-profit hospitals behave differently from nonprofit hospitals has given rise to a substantial empirical literature seeking to inform the debate. Schlesinger and Gray (2006) and Rosenau (2003) comprehensively reviewed the empirical evidence on the performance differences between for-profit and nonprofit hospitals. Performance is evaluated along several dimensions including economic measures like cost per admission, revenue or charge per admission and technical efficiency and non-pecuniary measures like quality, provision of care to indigent patients and trustworthiness of organizational practices. Both reviews conclude that ownership-related differences in hospital behavior and outcomes is mixed. Schlesinger and Gray reviewed 162 empirical studies comparing nonprofit and for-profit hospitals and nursing homes along the dimensions of economic performance, quality of care and indigent patients' access to care.[1] In terms of economic performance, 18 studies found no significant differences between for-profit and nonprofit hospitals; 10 studies found an advantage for profit-making hospitals; and 30 found an advantage for nonprofit hospitals. 21 studies reported no significant differences between for-profit and nonprofit hospitals in terms of quality care while 4 studies found higher quality of care in for-profit hospitals and 19 studies found higher quality of care in nonprofit hospitals. Rosenau synthesized the results of approximately 75 peer reviewed studies published between 1985 and 2001 along quality, cost, access and charity care dimensions.[2] In terms of cost, 23 studies found nonprofit hospitals to be superior, 5 studies found for-profit hospitals to be superior and 9 studies were inconclusive. 12 studies found that nonprofit hospitals provided higher quality care, 3 studies found quality of care

[1] Measures of economic performance were administrative overhead, cost per admission, measures of technical efficiency and revenue or charge per admission. Measures of quality of care were in-facility mortality rates, post-discharge mortality rates, adverse outcomes other than mortality, process measures of quality, regulatory violations, malpractice suits, functional improvement during admission, and consumer satisfaction. Measures of accessibility for indigent patients were locating in low-income areas, treating uninsured patients, treating Medicaid patients, facility practices affecting indigent care and providing unprofitable services.

[2] There is overlap in the studies reviewed by Schlesinger and Gray and Rosenau.

to be higher in for-profit hospitals and 9 studies found no differences in quality.

The finding that evidence of ownership-related differences in cost, quality, profits, pricing policies, technical efficiency, access to care and service offerings vary greatly across empirical studies is not surprising since the studies themselves vary in terms of data used and statistical methods. The empirical approach taken in the majority of the studies is to estimate a reduced-form model of hospital characteristics that typically includes an indicator variable for ownership status as a control variable. Some studies motivate the empirical analysis with a discussion of the underlying internal organization and characteristics of hospitals and the regulatory and market environment, but rarely develop formal models that generate empirically testable predictions. Typically, the theoretical basis for the empirical findings is implicitly understood as comparable organizations with no decision process clearly delineated. From a policy perspective, the failure of the many empirical studies to consistently predict differences between nonprofit and for-profit behavior is troubling because, at the end of the day, policy debates regarding the optimal organizational structure of the health care delivery system remain relatively uninformed. John Colombo succinctly characterized what can be learned from this substantial empirical literature in a congressional hearing:

> "Empirical studies on quality of care, costs of care and free care for the poor show decidedly mixed results,with some studies finding in favor of nonprofits and others finding in favor of for-profits. These studies certainly do not prove that nonprofit form is better than for-profit form; at best, all we can conclude is that nonprofits in some markets in some measures outperform for-profits, and that in other markets on other measures, for-profits outperform nonprofits."[3]

In this paper, we argue that an explicit theoretical basis for understanding the interactions between ownership form and hospital behavior can explain mixed empirical findings. A structural model of the internal organization of a hospital should shed light on the mechanisms that generate ownership-based differences or similarities in hospital behavior. The notion that the complex internal organization of the hospital is critically important for driving observed outcomes on cost, quantity and types of services provided was advanced in the 1970s by Pauly and Redisch (1973) and Harris (1977). Pauly and Redisch (1973) are the first to formalize the idea that hospital services are produced with a combination of hospital and physician inputs and that the physicians are the primary decision makers. Harris (1977) described the hospital as two separate firms, each with its own managers, objectives, pricing strategies and constraints. This dual internal organizational structure creates complexity in resource allocation and output decisions. Few studies since then, however, focus on hospital-physician integration and the effect of physician control on hospital decision making. Exceptions to this are empirical studies by Alexander, Morrisey and Shortell (1986), Alexander and Morrisey (1988), Burns, Anderson and Shortell (1990), Morrisey, Alexander and

[3]Taken from written testimony of John Colombo, University of Illinois College of Law, before the HouseWays andMeans Committee, May 26, 2005, http://waysandmeans.house.gov/hearings.asp?formmode=view&id=2713 (accessed February 4, 2009).

Ohsfeldt (1990), Feinglass, Martin and Sen (1991), Burns and Wholey (1992), and Goes and Zhan (1995), Cuellar and Gertler (2006), and Ciliberto and Dranove (2006); and theoretical papers by Custer et al (1990), Dor and Watson (1995), Broadway et al (2004), and Crainich et al (2008).

In this paper, we provide a theoretical basis for comparing for-profit and nonprofit hospital decision behavior and performance. We develop alternative theoretical models of hospital decision making for both a profit making hospital (PMH) and a nonprofit hospital (NPH). These explicitly consider hospital decisions in each type of organization. First, we develop a baseline model of a pure profit maximizing hospital with no agency problem either between administrators and organization principals, or between administrators and physicians. Second, we develop a model of each type of hospital that specifies an internal structure and allows for principal-agent differences. The models developed here assume services at any given level of quality and an imperfectly competitive market for hospital services, so that a hospital has some market power and faces a downward sloping demand for its health care services.

The predicted outcomes of our models differ depending on decision makers. Our models have implications for convergence between for-profit and nonprofit hospitals and shed some light on the mixed empirical results. The findings indicate that convergence, if observed, may result from sources other than competition for consumers as is typically advanced. Our models demonstrate that convergence instead may result from a complex decision structure with decision control primarily by physicians; similar objectives across different organizational forms; or cost constraints unequally applied to nonprofit and for-profit hospitals. This result underscores the importance of understanding the implicit theoretical basis for empirical results, particularly when empirical findings influence tax policies for nonprofit and for-profit hospitals.

Following the development of our models in section 2, we examine the implications for convergence in section 3. We discuss policy implications in section 4 and provide some concluding remarks in section 5.

2 Models of Hospital Decision Making

2.1 Baseline Models

The relations between medical and administrative staffs of hospitals are typically ignored in empirical studies of hospital ownership and decision making. The conceptual basis for this approach is the notion that physicians regard hospitals as their workshops (Pauly and Redisch 1973). Although Pauly and Redisch assumed that physicians maximize income, in this market-based PMH, physicians are the primary customers of hospitals and the financial incentives of both groups are essentially aligned. If the financial incentives are aligned then it is unnecessary to draw a theoretical distinction between the objectives of the medical and administrative staffs. The distinction reduces to differences in objectives and the tax exemption for nonprofit hospitals.

2.1.1 Profit-Making Hospital

We formalize this view in the baseline model of a PMH as a production function of health services. There is no internal organization considered here, which implies that all decision makers act as perfect agents on behalf of owners/shareholders. This baseline model is the standard profit-maximizing model of a firm where the objective is to maximize profit of owners/shareholders:

$$\max \pi_P(x|\overline{q}) = R_P(x) - C_P(x) \tag{1}$$

where x is output, which for hospitals is the quantity of health services provided, $\overline{q}$ is the standard (or basic or minimal) level of quality of services, R_P is total revenue to the hospital from the sale of health services, and C_P is total cost of providing all health care services. The first order condition is

$$R'_P(x) - C'_P(x) = 0 \tag{2}$$

which yields maximum profit π^*_P at the optimal output $x = x_P$, shown in Figure 1.

For all models we assume the usual diminishing marginal revenue, diminishing marginal utility and increasing cost. Thus, for any $R_i(x)$, $R'_{ix}(x) > 0$, $R''_{ix}(x) < 0$, for any $U_j(x)$, $U'_{jx}(x) > 0$, $U''_{jx}(x) < 0$, and for any $U_j(q)$, $U'_{jq}(q) > 0$, $U''_{jq}(q) < 0$, and for any $C_i(x)$, $C'_{ix}(x) > 0$, $C''_{ix}(x) > 0$, where subscript i refers to organizational structures: PMH hospital or owners/shareholders ($i = P$), and NPH hospital or stakeholders/principals ($i = N$); and j refers to decision makers: hospital administrator ($j = A$), hospital physicians or doctors ($j = D$).

2.1.2 Nonprofit Hospital

The baseline model of a nonprofit hospital assumes maximizing quantity of health care services, x, as the objective function, subject to a breakeven constraint, $R_N(x) - C_N(x) \geq 0$.. This NPH baseline model assumes identical revenue and cost functions as a profit making hospital, so that $R_N = R_P = R(x)$, and $C_N = C_p = C(x)$. Thus we initially assume the same quality of service as in the PMH which we denote as $(\overline{q})$, no donations, or at least that any donations are exactly offset by reduced sales revenue, and no tax exemption.[4] The Lagrangian to be maximized is

[4] A number of approaches to modeling the objective of NPH have been advanced, including quantity maximization. The rationale initially applied to the hospital industry stems from Baumol (1967) who argued that large firms with a sufficient market power tend to maximize output subject to a break-even level of profits. Since Baumol, others have argued that it is reasonable to portray NPH as quantity maximizers. Davis (1972) points to the multiproduct nature of hospitals as a reason for quantity maximization. Hospitals offer a wide array of services each with its own price and may engage in cross-subsidization. It is reasonable to assume that hospitals would follow a pricing strategy that increases the number of patients admitted. Newhouse (1970) argues that quantity maximization is consistent with the public's perception about how a non-profit hospital should operate, given their stated objective of providing services to the community regardless of ability to pay. We assume identical services for for-profit and nonprofit hospitals in our baseline models. Some research suggests that no quality differences exist across hospitals, so assuming identical services may be assumed, at least initially. (See for example, Sloan, Picone, Taylor and Chou (2001), McClellan and Staiger (2000), Ettner and Herman (2001) and Gray (1991).) Variable quality, donation revenue, and tax exemption

$$\max L = \max (x|\overline{q}) - \lambda[R(x|\overline{q}) - C(x|\overline{q}) - k] \tag{3}$$

where λ is the Lagrange multiplier. The first order conditions for the Lagrangian are:

$$L'_x = 1 - \lambda(R'_x - C'_x) = 0 \tag{4a}$$

$$L'_\lambda = R(x|\overline{q}) - C(x|\overline{q}) - k = 0 \tag{4b}$$

From (4a), $(R'_x - C'_x) = 1/\lambda$. For $\lambda = 0$, x is maximized when $R_N(x) - C_N(x) = 0$, which fulfills the constraint and yields a level of services $x = x_N > x_P$, shown also in Figure 1. As $\lambda \to \infty$, the nonprofit hospital behaves as a profit maximizer, $(\pi'_x = 0)$ and $x = x_P$

2.2 Multiobjective Optimization Models

The advent of prospective payment for Medicare and selective contracting for Medicare in the early 1980s, and an emphasis on cost containment by private third party payers significantly altered the financial incentives for hospitals. The reduction in reimbursement and increased competition for patients disrupted the tenuous balance between the often conflicting goals of hospital administrators and medical staffs that was largely maintained in an era of abundant resources. In the new era of declining reimbursement and cost containment, cooperation between physicians and hospital management is increasingly important. We consider this issue by specifying an internal organization in which medical and administrative staffs have different objectives in our managerial models of hospital behavior.[5]

The following models initially assume an analytical construct of a hospital that consists of two parties: (1) owner/administrator for a profit making hospital (PMH) or organization/administrator for a nonprofit hospital (NPH) and (2) physicians or doctors (for both PMH and NPH) (Harris, 1977). The administrator is initially assumed to be a perfect agent who acts on behalf of owners/shareholders in the case of the PMH or the organization as a whole or its stakeholders/principals in the case of the NPH. The physicians or doctors are assumed to have a separate objective function.

The objective functions for each party vary by organization type for the owner/administrator but not for the doctors.[6] For a profit making hospital, the objective of the owners/shareholders and therefore the administrator is to maximize profit (π_P). For nonprofit hospitals the objective of

are considered below.

[5]Jelovac and Stadler (2002) consider a similar issue of organizational structure and potential conflict between hospital administrators and medical staffs in contracting with insurers. Their analysis focuses on the efficiency of contracts between insurers and providers under two organizational structures for health services: a centralized structure in which insurers contract jointly with hospitals and physicians; and a decentralized structure in which insurers contract with hospitals and delegate the authority to contract with physicians to hospitals.

[6]The similarity or difference of the physicians' objective function in a PMH or NPH may depend on how quality is defined for each type of organization.

the organization and its stakeholders, and therefore the administrator, is to maximize the quantity of services, x, provided for some given level of quality, $\overline{q}$, defined by the organization.[7]

Formally, the different objectives of administrators and physicians can be modeled as a multiobjective optimization problem using the weighting method, where w_A = weight on the administrative objective and w_D = weight on the physicians' or doctors' objective. We do this below for profit making and non-profit hospitals.

2.2.1 Profit making hospital

The objective of the administrator acting as a perfect agent for owners/shareholders in a profit making hospital is the same as that given in the baseline model, shown now in terms of utility maximization of the administrator:

$$\max U_A = \max \pi_P(x|\overline{q}) = R_P(x) - C_P(x) \tag{5}$$

We assume that physicians get utility from such factors as income, their professional reputation, professional authority in making medical decisions and social standing in the community. These factors are not chosen directly by the physician but are articulated in their choices of quantity of services (x) and quality (q). The objective of the physicians or doctors is given as

$$\max U_D = U_D(\text{income, reputation, authority, social standing}) = U_D(x, q) \tag{6}$$

We initially assume that revenue and cost depend only on the level of services, so that the relevant constraints are

$$\begin{aligned} R(x) - C(x) \geq & \quad 0 \quad or \\ \pi_x - k_1 = & \quad 0 \ and \\ q \geq & \quad \overline{q} \ or \\ q - \overline{q} - k_2 = & \quad 0, \\ k_i \geq & \quad 0, i = 1, 2. \end{aligned}$$

The first order condition for equation (5) yields the profit maximizing level of services, x_P, shown in Figure 1 and now also for the profit function in Figure 2. For doctors, where both the amount of services and quality are explicitly variable, Equation (6) yields a wider range of level of services, x, so that $x_P \leq x \leq x_N$ in Figure 2. The relevant range of the profit function in Figure 2 is therefore

[7] Alternatives approaches for modeling the objectives of a nonprofit hospital include revenue maximization and quality maximization. The motivation for revenue maximization stems from Medicare's prospective payment system that reimburses hospitals according to prospectively determined per case rates. This system creates an incentive to maximize revenues by increasing admissions. We have examined models in which revenue maximization is the objective (available by request) but chose to focus on output maximization in this paper for reasons described in footnote 4.

the segment AB. Over this range, $|\pi'_x| \to \infty$ and $\pi \to 0$. The level of services x that will result in this model depends on the relative preference of doctors for x and q, and the relative weights of the objectives of the administrator and the doctors. The relative preference of doctors indicates the interest of physicians in diverting resources from production of services at a given quality to the increase in the quality of services. The weights of the objectives of the administrators and the doctors indicate the physicians' ability to influence allocation of resources and reflect the potential source of conflict.

The multiobjective problem for this model is illustrated in Figure 3. The objective function for the multiobjective decision problem in a profit making hospital is

$$\max Z(x,q) = [\pi(x|\overline{q}), U_D(x,q)] \tag{7}$$

When weighted, Z becomes a function of the variables and the weights, so that (7) becomes

$\max Z(x,q;w_i) = \pi(x|\overline{q}), U_D(x,q), w_i]$, where $i = A, D = [w_A\pi(x|\overline{q}) + w_D U_D(x,q)]$. Simplifying the objective function, we have:

$$\max Z(x,q,w_i) = [\pi(x|\overline{q}) + wU_D(x,q)] \tag{8}$$

where $w = \frac{w_D}{w_A}$ subject to

$$\begin{aligned} R(x|\overline{q}) - C(x|\overline{q}) &\geq 0 \ \textit{or} \\ R(x|\overline{q}) - C(x|\overline{q}) - k_1 = \pi(x|\overline{q}) - k_1 &= 0 \ \textit{and} \\ q &\geq \overline{q} \ \textit{or} \\ q - \overline{q} - k_2 &= 0, \\ k_i &\geq 0, i = 1, 2. \end{aligned}$$

The corresponding Lagrangian to be maximized is

$$\max L = \max [\pi(x|\overline{q}) + wU_D(x|q)] - \lambda_1[\pi(x|\overline{q}) - k_1] - \lambda_2(q - \overline{q} - k_2) \tag{9}$$

where λ_1 and λ_2 are the Lagrange multipliers.

The first order conditions for the Lagrangian are

$$L'_x = \pi'_x + wU'_{D_x} - \lambda_1\pi'_x = (1-\lambda_1)\pi'_x + wU'_{D_x} = 0 \tag{10a}$$

$$L'_q = wU'_{D_q} - \lambda_2 = 0 \tag{10b}$$

$$L'_{\lambda_1} = \pi(x|\overline{q}) - k_1 = 0 \tag{10c}$$

$$L'_{\lambda_2} = (q - \overline{q}) - k_2 = 0 \tag{10d}$$

Proposition 1 *The profit-maximizing level of output and quality is the same as the baseline profit-maximizing model when the administrator has effective control over resource allocation.*

Proof 1 *If $w = 0$, from (9) $wU_D = 0$, which indicates that the doctors' utility function is irrelevant, that is, the administrator has effective control over resource allocation decisions and maximizes owner/shareholder profits. From (10a) we see that $(1 - \lambda_1)\pi'_x = 0$. For $1 > \lambda_1 \geq 0, \pi'_x = 0$ and $x = x_P$, the profit maximizing output. From (10b) $\lambda_2 = 0$, which implies that the quality constraint facing doctors is irrelevant (as is their objective when $w = 0$), so that quality will be the profit-maximizing level: $q = \overline{q}$.*

This is the same outcome for output as the baseline profit maximizing hospital with the explicit assumption of standard quality level as in the baseline model of 2.1.1.

Proposition 2 *As doctors gain increasing control over resource allocation decisions, the optimal quantity of services and level of quality exceeds the profit-maximizing level.*

Proof 2 *When $w > 0$, as $w \to \infty$, from (9) $w_A \to 0$, and doctors have increasing control over resource allocation decisions. From (10a), $(1-\lambda_1)\pi'_x + wU'_{D_x} = 0$. For $\lambda_1 = 1$ and $w > 0, U'_{D_x} = 0$, so that $x_P \leq x \leq x_N$. For $\lambda_1 = 0, w = -(1 - \lambda_1)\frac{\pi'_x}{U'_{D_x}} = -\frac{\pi'_x}{U'_{D_x}}$, so that as w increases, x increases above x_P for any q. From (10b), $U'_{D_q} = \frac{\lambda_2}{w}$. For $\lambda_2 = 1, U'_{D_q} = \frac{1}{w}$, so that as $w \to \infty, U'_{D_q} \to 0$ and $q > \overline{q}$. For $\lambda_2 = 0, U'_{D_q} = 0$ and $q > \overline{q}$.*

Thus, as leverage shifts increasingly in favor of doctors, both x and q will tend to rise above the profit maximizing level. As before, if doctors strongly prefer to offer higher quality health care services, then the amount of services provided by the hospital could be the efficient level ($x = x_P$), but at a quality level that exhausts the profit, thus diverting profit from owners/shareholders to quality and increased physician utility.

2.2.2 Nonprofit Hospital: variable quality, revenue and cost

The model of a NPH allows for variable quality of service provided (q) and revenue and cost functions that reflect the impact of increasing quality on both revenue (through donations) and cost (of inputs). In addition, this model incorporates the effects of differential tax treatment for nonprofit hospitals. The differential tax treatment effectively reduces cost to the NPH relative to the PMH because the NPH is tax-exempt. The tax-exemption is shown in the profit function for the NPH: $\pi_N = R(x) - (C(x) + T(x))$. If we apply the same revenue ($R(x)$) and cost ($C(x)$) to the PMH and NPH, we see that the NPH's profit function differs from the PMH's profit function only by the amount of tax exemption. The objective function for this multiobjective decision problem is

$$\max Z(x, q, w_i) = [U_A(x, q) + wU_D(x, q)] \tag{11}$$

where $w = \frac{w_D}{w_A}$ subject to

$$\begin{aligned} \pi(x) + T(x) - k_1 &= 0 \\ q \geq \overline{q} \ or & \\ q - \overline{q} - k_2 &= 0 \\ k_i &\geq 0, i = 1, 2 \end{aligned}$$

The corresponding Lagrangian to be maximized is

$$\max L = \max \left[U_A(x,q) + wU_D(x,q)\right] - \lambda_1[\pi(x,q) + T(x) - k_1] - \lambda_2(q - \overline{q} - k_2) \tag{12}$$

The first order conditions for the Lagrangian are

$$L'_x = U'_{A_x} + wU'_{D_x} - \lambda_1(\pi'_x + T'_x) = 0 \tag{13a}$$

$$L'_q = U'_{A_q} + wU'_{D_q} - \lambda_1\pi'_q - \lambda_2 = 0 \tag{13b}$$

$$L'_{\lambda_1} = \pi(x,q) + T(x) - k_1 = 0 \tag{13c}$$

$$L'_{\lambda_2} = (q - \overline{q}) - k_2 = 0 \tag{13d}$$

Proposition 3 *The level of output in a nonprofit hospital will exceed the profit-maximizing level when the administrator has effective control over resource allocation, although it may be less than maximum output at which the NPH breaks even.*

Proof 3 *If $w = 0$, from (13a), $U'_{A_x} = \lambda_1(\pi'_x + T'_x)$. For $\lambda_1 = 0, U'_{A_x} = 0$ for any π'_x or T'_x, so that U_{A_x} is maximized and $x = x_A > x_p$. For $\lambda_1 > 0$, $\frac{U'_{A_x}}{\lambda_1} = \pi'_x + T'_x$. Consider the case where $\lambda_1 = 1$, so that $U'_{A_x} = \pi'_x + T'_x$. For $\pi'_x = 0$, at the baseline profit maximizing output $x_P, U'_{A_x} = T'_x > 0$ necessarily results in $x_A = x_{P_T} > x_P$ when $U'_{A_x} = 0$ and where x_{P_T} is the profit-maximizing output with tax exemption. Utility maximizing output therefore exceeds the optimal level. In general, as $\lambda_1 \to \infty$, $(\pi'_x + T'_x)$ decreases; for any positive marginal tax differential ($T'_x > 0$), π'_x becomes increasingly negative, so output expands but is limited by an upper bound, $x_{N_T} > x_N$, where profit with the tax differential (x_{N_T}) is zero.*

In effect, the differential tax treatment acts as a subsidy that generates higher output either with more profit ($x_A > x_{P_T} > x_P$ and $\pi_N > \pi_P$ at x_A) or a higher breakeven point ($x_{N_T} > x_N$).

Proposition 4 *Under administrative control, quality level is above the standard profit-maximizing level ($\overline{q}$) when both the breakeven and quality constraints are not binding.*

Proof 4 *From (13b), where $w = 0, U'_{A_q} = \lambda_1\pi'_q + \lambda_2$. For $\lambda_1 = 0, U'_{A_q} = \lambda_2$. If at the same time $\lambda_2 = 0$, then $U'_{A_q} = 0$, so that $q_A > \overline{q}$. As $\lambda_2 \to \infty, U'_{A_q} \to \infty$, and $q_A \to \overline{q}$. For $\lambda_1 > 0$ and $\lambda_2 = 0, U'_{A_q} = \lambda_1\pi'_q$, or $\frac{U'_{A_q}}{\pi'_q} = \lambda_1$. For $\lambda_1 = 1, U'_{A_q} = \pi'_q$. When $U'_{A_q} = \pi'_q = 0$, quality is at*

the profit maximizing level, $\overline{q}$. When $U'_{A_q} = \pi'_q < 0$, there is overinvestment in quality relative to the profit maximizing level, so $q_A > \overline{q}$. Quantity of output is traded off for quality of services. As $\lambda_1 \to \infty$ with $\lambda_2 = 0, U'_{A_q} \to \infty$ and $\pi'_q = 0$, which yields $q_A \to \overline{q}$. A binding breakeven constraint limits investment in quality of services.

In this case, the optimal level of quality q_A is greater than the profit maximizing level when the breakeven constraint is not binding. We get the result that there is overinvestment of quality and that the quantity of output may be traded off for quality of service. This is an interesting result because it is consistent with the result in informal models put forth by Feldstein (1971) and Newhouse (1970) where hospitals are modeled as in the control of administrators who choose quantity and quality to maximize utility. Higher quality is more costly to produce. In our model, however, the tax differential may allow for an increase in quality without trading off quantity. In the Feldstein and Newhouse models, if there is a single demand function for hospital services, then administrators always face a trade-off between quantity and quality. If there are multiple demand curves that reflect greater willingness to pay for higher quality services, then over some range, the manager can increase both quantity and quality. Eventually, a trade-off will have to be made.

Proposition 5 *When physicians control resource allocation in the nonprofit hospital, both output and quality will be higher than the profit-maximizing level, even when the breakeven and quality constraints are binding.*

Proof 5 *When $w > 0$, we see the output effect of physician control where from (13a), $U'_{D_x} = \frac{\lambda_1}{w}[\pi'_x + T'_x) - \frac{U'_{A_x}}{w}$. As $w \to \infty$ for any $\lambda_1 > 0, U'_{D_x} \to 0$ and the resulting output will approach the utility maximizing level, that is, $x_D \geq x_{P_t} > x_P$. To consider the effect on quality level, rewriting (13b) yields $U'_{D_q} = \frac{1}{w}(\lambda_1 \pi'_q + \lambda_2 - U'_{A_q})$. For any $\lambda_1 \geq 0$ and any $\lambda_2 \geq 0$, as $w \to \infty, U'_{D_q} \to 0$, and $q_D > \overline{q}$. However, as either (or both) $\lambda_1 \to \infty$ or(and) $\lambda_2 \to \infty$, for any $w > 0, U'_{D_x} \to \infty$, so that $x_D \to x_P$ or(and) $U'_{D_q} \to \infty$, thus $q_D \to \overline{q}$. In this situation the output level would be closer to the profit maximizing level and there is less overinvestment in quality by doctors, although this behavior persists.*

Note also that for $\lambda_1 = 0$ and $\lambda_2 = 0, w = \frac{U'_{Aq}}{U'_{D_q}}$, the marginal rate of substitution of administrators' preferences and physicians' preferences for quality. This indicates that in an unconstrained situation, where output and quality may be at levels beyond the breakeven point, that is, the hospital may operate at a deficit, the combination of level and quality of services will depend on the relative leverage (w) and preferences of the administrator (who represents stakeholders) and the doctors.

The results of the baseline and multiobjective models are summarized in Table 1. In the multiobjective models, when $w = 0$, it holds that the physician's utility function is irrelevant and the administrator has effective control over resource allocation decisions. In this case, the results of the multiobjective model for the profit making hospital revert to the baseline model in Section 2.1.1, ($x_A = x_P$), although this may or may not occur for the non-profit hospital where $x_{N_t} \geq x_A \geq x_P$.

Table 1: Summary of Predicted Outcomes

	Objective(s)		Level of Services(x)		Quality (q)	
Model	Org/Admin	Doctors	Org/Admin	Doctors	Org/Admin	Doctors
Baseline						
PMH	max $\pi(x\|\overline{q})$	$\cdots$	x_P	$\cdots$	$\overline{q}$	$\cdots$
NPH	max $(x\|\overline{q})$	$\cdots$	$x_N \geq x_P$	$\overline{q}$	$\cdots$	
Multiobjective						
PMH	max $\pi(x\|\overline{q})$	max (x,q)	$x_A = x_P$	$x_N \geq x_D \geq x_P$	$q_A = \overline{q}$	$q_D \geq \overline{q}$
NPH	max (x,q)	max (x,q)	$x_{N_t} \geq x_A \geq x_P$	$x_{N_t} \geq x_D \geq x_P$	$q_A \geq \overline{q}$	$q_D \geq \overline{q}$

The interesting case occurs when $w > 0$. Here the physician's utility function is relevant and physicians have increasing control over resource allocation decisions as the weight of their utility function increases, that is, as w_D increases and therefore w increases.

For the multiobjective model of a profit making hospital, the objective of the administrator is to maximize utility which means maximizing profit since the administrator acts as a perfect agent for the owners/shareholders. As leverage shifts increasingly in favor of doctors (so $w > 0$ and increasing), both the level of services, x, and quality, q, tend to rise above the profit maximizing level. If doctors strongly prefer to offer higher quality health care services, then the amount of services provided by the hospital will be the efficient level ($x = x_P$), but at a quality level that exhausts the profit, thus diverting profit from owners/shareholders to quality and increased physician utility.

The multiobjective model of a NPH allows for variable quality of service (q) thus incorporating revenue and cost functions that reflect the impact of increasing quality on both revenue (through donations) and cost (of inputs). In addition, this model incorporates the effects of differential tax treatment for nonprofit hospitals. Even under administrative control, we note an interesting result with respect to the optimal level of quality. Quality of service depends on the extent to which the breakeven and quality constraints are binding. If neither constraint is binding, (λ_1 and $\lambda_2 = 0$), the model indicates overinvestment in quality. In this case, the utility maximizing level of quality q_A exceeds the minimal acceptable level of quality $\overline{q}$. This overinvestment in quality declines if either constraint becomes binding while the other is not. The role of the break-even constraint on the NPH is important. As long as λ_1 is between 0 and 1, there is overinvestment in quality relative to the profit maximizing level: ($q_A > \overline{q}$). However, as the breakeven constraint becomes binding, q_A approaches $\overline{q}$ and $q_A = \overline{q}$ when the breakeven constraint is binding. A binding breakeven constraint, therefore, limits investment in quality of services.

Now consider the situation when $w > 0$ and increasing so that physicians are increasingly in control of resource allocation decisions. With a binding breakeven constraint, the resulting output approaches the utility maximizing level for the physician, that is, $x_D \geq x_{P_t}$, where x_{P_t} is

profit-maximizing output with tax exemption. In the case where doctors are in complete control, output level is unrelated to either profit or tax conditions, but depends only on the preferences of the physicians. In terms of quality, both the breakeven constraint and the quality constraint are increasingly less important in the operation of the hospital and quality would be predicted to be higher than that for profit maximization and for output maximization as physicians increasingly gain control of resource allocation decisions ($q_D > \overline{q}$). However, binding breakeven and quality constraints reduce the ability of physicians to reallocate resources into output and quality. Utility maximizing output, x_D, approaches the profit maximizing level x_P and there is less overinvestment in quality by doctors so that q_D approaches $\overline{q}$.

3 Implications for Convergence

In this section we consider how these predictions bear on the conflicting empirical findings on the convergence of for-profit and nonprofit hospitals with respect to the level and quality of services provided.

Our multiobjective models generate predictions about the amount of services or quality of care provided by a NPH relative to the level provided by a PMH under conditions of viewing a hospital rather than simply as a production function of health care services as an organization with an internal decision structure. In the latter, typically there is no explicit role for the doctors as decision makers.[8] We find that predictions for a NPH may differ from those for a PMH under some conditions, but may be consistent under others. As we have noted, predictions of the multiobjective model of a profit making hospital are identical to those of the baseline model under the condition where the hospital administrator has control of resource allocation decisions and doctors are subject to these administrative decisions. These results derive from the assumption that the administrator of a hospital represents the interests of the shareholders (for a PMH).

The predicted quality level is the same for a PMH and an NPH, $\overline{q}$, only when quality is not of particular interest to either type of organization or decision maker so that standard basic quality is acceptable. The predicted NPH quality level is likely to be greater than the minimum acceptable level of the PMH ($q > \overline{q}$) only if it is an explicit argument in the objective function of any decision maker in any model, either administrator or physician. However, it may be greater even when not explicit to the administrator or if physicians have greater weight in the decision process.

The implications for convergence of the comparative behavioral models can be summarized as follows. A frequent explanation of convergence between nonprofit hospitals and for-profit hospitals is that convergence results from increased competition in the health care services industry, primarily as a result of requirements imposed by managed care. (This view is formalized in the baseline model.) Presumably this competition among the suppliers (hospitals) in this industry would take the form of price competition and lead to the optimal level of health care services, x_P,

[8] It is certainly possible to construct a neoclassical model of a nonprofit hospital as production function where the decision maker is the set of physicians, as Pauly and Redisch (1973) did with their income-maximizing model. We have not done that here.

and quality, $\overline{q}$. Our models show that this result would occur if: (1) nonprofit hospitals operate as strict profit maximizing organizations; (2) nonprofit hospitals have an internal decision structure and the effective decision maker is the administrator who represents stakeholders who themselves have profit maximization as the hospital's objective; or (3) a binding breakeven constraint limits investment in quality of services. The binding breakeven constraint implies that we would expect to observe little difference between for-profit and nonprofit hospitals in markets where there is less opportunity for large profit margins, for example, a relatively competitive market. This result is consistent with some empirical findings that nonprofits behave more like for-profits in less concentrated (more competitive) markets. However, the convergence in behavior is not directly attributed to competition compelling nonprofit hospitals to behave like for-profit hospitals but rather is the result of the internal organizational structure of the hospital.

An alternative explanation is that convergence between nonprofit hospitals and profit maximizing hospitals may be an indication (1) that hospitals, whether nonprofit or for-profit, may not behave as neoclassical profit maximizing organizations, and/or (2) of the effect of physician decision making in a hospital with a complex internal decision structure. The effect of convergence in these circumstances is that the hospital expands in either (or both) the level of services or (and) the quality of those services, that is $x \geq x_P$ and $q \geq \overline{q}$. These results hold across alternative objectives of either shareholders or stakeholders when physicians control resource allocation within the hospital. In this case, the observed output and quality in for-profit and nonprofit hospitals would not differ significantly in an empirical analysis but the mechanisms generating the behavior are different. Most of the empirical studies of hospital ownership do not explicitly recognize the potential tension between administrators and physicians. Failure to control for this important feature of organizational behavior may partially explain the some of the conflicting results. We intend to explore the effect of competing objectives of administrative and medical staffs empirically in future research.

Note that even with competition in the health services industry, convergence will not occur when either (1) nonprofit hospitals do not have profit maximization as their objective or (2) hospitals have a complex internal decision structure, shareholders and nonprofit stakeholders have different objectives, and administrators who represent them have control over resource allocation within hospitals. In these circumstances profit maximizing hospitals will appear to be more allocatively efficient ($x = x_P$ and $q = \overline{q}$) than nonprofit hospitals ($x \geq x_P$ and $q \geq \overline{q}$).

Adding a constraint on cost may result in convergence between nonprofit and profit maximizing hospitals with different objectives only if costs in the NPH are more constrained than costs in the PMH. To see this, compare organizations with identical revenue and cost structures where the cost constraint is applied equally to both. If the cost constraint is designed to result in a situation of zero economic profit for the profit maximizing hospital ($\pi = 0$ at x_P) then this would also be the breakeven level of output for the nonprofit hospital. Clearly this implies convergence in observed level of services provided. This outcome requires that costs of the NPH including tax breaks are the same as costs of the PMH without tax breaks. That is, the NPH, without tax breaks, would

operate at a higher cost at the same output (x_P) than would the PMH without tax breaks. The implication of this is that the NPH is producing health care services x_P either less efficiently than the PMH is, or that the NPH is producing health care services x_P at a higher level of quality than the PMH is. Thus convergence between a nonprofit and for-profit hospital such that the level of services provided by a NPH and a PMH is the same could imply that tax breaks subsidize either increased supply or higher quality of health care services in the NPH. Whether increased supply or higher quality are inefficient depends on the assumptions that some given level of services (x_P) or given quality of health care services ($\overline{q}$) is the socially efficient level, and that the for-profit market operates efficiently.

4 Policy Implications

The question remains as to the social welfare and policy implications of convergence. Our models suggest that convergence, if observed, may result from different sources. It is possible that convergence may be a result of (1) price competition for consumers; (2) a complex decision structure with decision control primarily by physicians; (3) similar objectives across different organizational forms; or (4) cost constraints unequally applied to nonprofit and for-profit hospitals. Typically, convergence is viewed by researchers and policy makers as nonprofits moving in the direction of for-profit hospital behavior. (See, for example, Bloche (1998), Frank and Salkever (2000), Melnick, Keeler and Zwanziger (1999), Potter (2001), and Wilcox-Gok (2002)). For any of these sources of convergence, it is also possible that any convergence that occurs may be a reflection of either for-profit hospitals moving in the direction of nonprofit hospital behavior or the reverse.

If convergence indicates that nonprofit hospitals are becoming more like for-profit hospitals, nonprofit hospitals may then provide a more efficient level of services and quality. Tax policies in place favorable to nonprofit hospitals could be important to this outcome. Convergence may not be possible without these policies because of the greater constraint in raising capital for investment imposed on nonprofit hospitals than on for-profit hospitals as a result of the inability to issue stock. Although debt financing through the issue of bonds is possible, the increased debt results in a greater relative risk for a NPH, which is costly.

However, this form of convergence could imply a decrease in efficiency and social welfare if nonprofit hospitals correct imperfections in the market for health care services, such as information asymmetries and externalities. The differences in nonprofit hospital levels of services and quality that diminish with convergence in this case could have served to correct private market deficiencies. This is a concern of some policy makers (Gentry and Penrod (2000), Philipson (2000), Schlesinger and Gray (2006), Horwitz (2003), Horwitz (2005), Wilcox-Gok (2002)). The favorable tax treatment in this case could subsidize corrective behavior in nonprofit hospitals as they are forced to respond to other market forces, such as price competition.

Our multiobjective models also provide a theoretical explanation for the reverse form of convergence where for-profit hospitals behave more like nonprofit hospitals. In this case, our PMH

multiobjective model predicts a level of services and quality that exceeds the profit-maximizing level when physicians have greater control over resource allocation decisions. Such convergence could reflect the inefficiencies of either an internal structural decision process or possibly of physicians seeking pure reputational effects in either a PMH or a NPH. In this case, favorable tax treatment could function in the same way capital market imperfections do by permitting the misallocation of resources in nonprofit hospitals which would similarly occur in for-profit hospitals at the expense of shareholders. Alternatively, greater than optimal quantity and quality of services could reflect the efficiencies of physicians responding to diverse consumer preferences, for example. Favorable tax treatment could be a source of NPH physician response and promote nonprice competition of for-profit hospitals.

5 Concluding Remarks

The mixed empirical results regarding differences in the behavior and outcome of for-profit and not-for-profit hospitals has sparked a lively debate about the mechanisms underlying the observed behavior. Competition between for-profits and non-profit organizations in the same market is a generally accepted explanation for findings of no differences in the service offerings, quality or cost of for-profit and non-profit hospitals. Non-profit hospitals move towards greater efficiency as a result of the competition between for-profits and non-profits. Our models indicate that this explanation for convergence only holds if we ignore the internal organization of the hospital. The outcomes of our models that incorporate some internal structure of a hospital are illuminating for the issue of convergence. First, as noted above, if objectives of the hospital administrator are primary, then the outcomes for level of services (x_A) for a NPH are likely to differ from the profit maximizing amount of the PMH (x_P), as is the level of quality if quality is not explicitly restricted to the minimum required profit maximizing level ($\overline{q}$). If, on the other hand, the objectives of doctors are primary and they are in effective control of resource decisions in the hospital, there is no difference between the PMH and the NPH for predicted outcomes of either the amount of services provided (x_D) or the quality of those services (q_D), although both may differ from the levels predicted in the competitive baseline model.

Thus we see that the observed convergence of behavior in nonprofit hospitals with that of profit maximizing hospitals may be a result of an internal structure of the organizations that allows for physician control of resources. This is a very different outcome than that predicted by neoclassical models of hospitals, and also is a different rationale for convergence than that of competition forcing nonprofit hospitals to behave like profit maximizing hospitals.

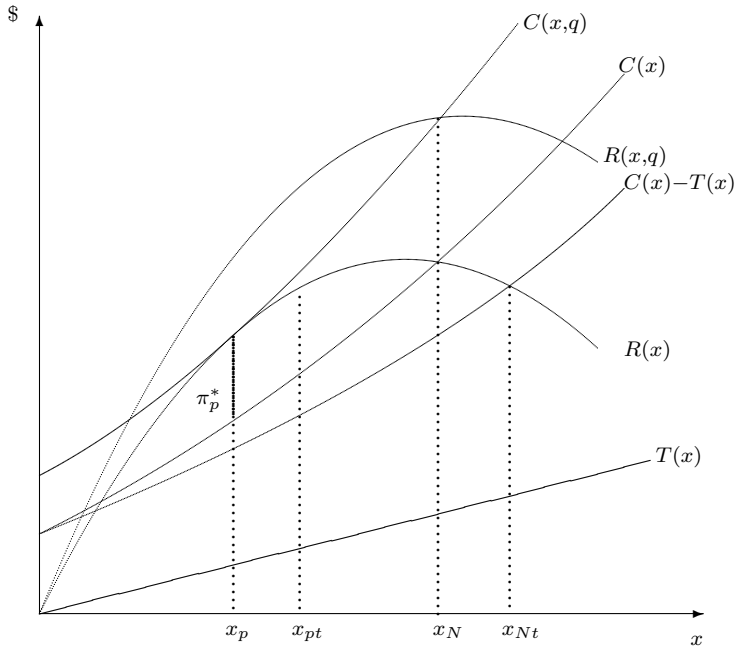

Figure 1: Models of PMH and NPH Under Alternative Assumptions

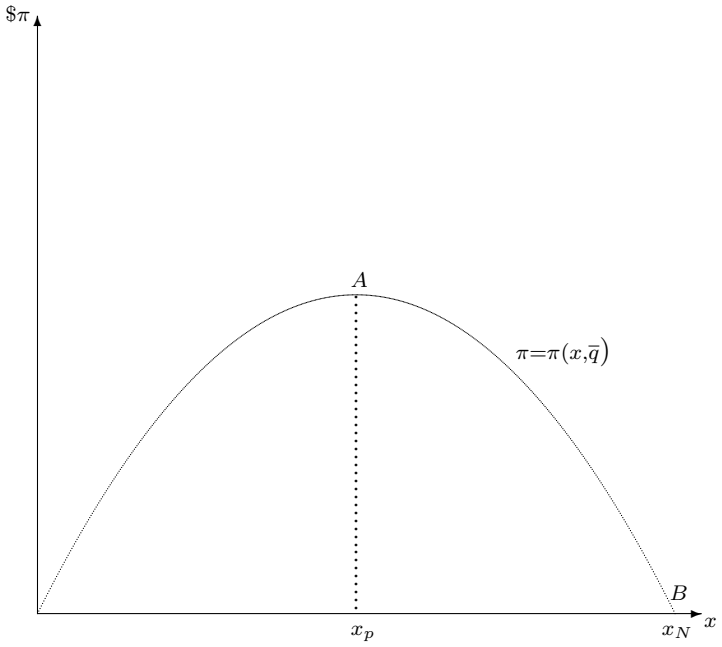

Figure 2: Baseline Models of PMH, NPH

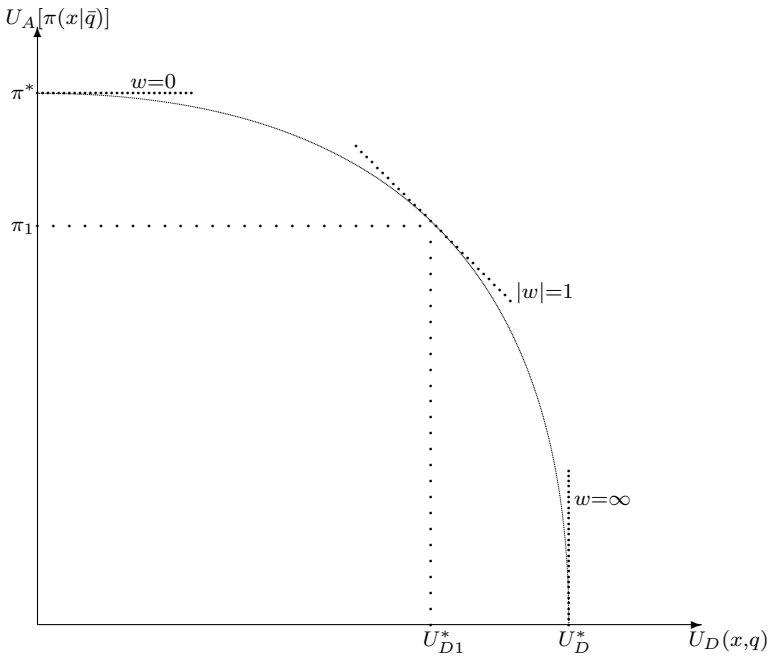

Figure 3: Administrator and Physicians in Objective Space, $w = \frac{w_D}{w_A}$

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