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Medical Care Output and Productivity in the Nonprofit Sector

Tomas Philipson and Darius Lakdawalla

3.1 Introduction

There is a growing concern about the productivity, or so-called cost-effectiveness, of the health care industry. Health care differs from many other industries in that most production takes place in the nonprofit sector.[1] Little is known about the economic forces which determine productivity in the nonprofit sector, especially compared to that which is known about the for-profit sector. There, productivity analysis is well developed, especially through recent work stressing the endogenous determination of technical change. This paper attempts to analyze the incentives which generate productivity differences between nonprofit and for-profit firms. We are particularly interested in interpreting some empirical differences between nonprofits and for-profits in mixed industries:[2]

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1. For a general discussion of the nonprofit sector see, e.g., Clotfelter (1992), Weisbrod (1977, 1987, 1988), Hansmann (1980), Powell (1987), Rose-Ackerman (1986, 1996) and the references contained therein. For discussions of nonprofit behavior in health care see Newhouse (1970), Pauly and Redisch (1973), Harris (1977), Becker and Sloan (1985), Dranove (1988), Gertler (1989), Gertler and Waldman (1992), and Sloan (2000).

2. See Sloan (2000) or Malani and Philipson (2000) for a review of the evidence. Further work on this subject may be found in Hansmann (1987), James and Rose-Ackerman (1986), Easly and O'Hara (1982), Philipson (2000), and Rudney (1987).

- Controlling for quality and quantity, the output of the nonprofit and for-profit sectors tend to be perfect substitutes in that they are identically priced.
- When both firm types coexist in a single industry, nonprofit firms tend to operate on a larger scale than for-profit firms.
- Nonprofit firms are often observed to use more inputs per unit of output, and have consequently larger average and marginal costs.
- Nonprofits often are more intensive in their investment in research and development (R&D) than for-profits.

These regularities raise some important questions. In the neoclassical analysis of competitive production, more efficient firms tend to be larger than less efficient firms, who tend to be driven out of business. It appears puzzling, therefore, that nonprofits tend to be larger and less efficient, yet they are able to coexist in, if not dominate, industries in which they are allowed to operate. It is particularly puzzling that the nonprofit form of production dominates industries like short-term health care in the United States. It is less puzzling for industries dominated by for-profits, like the U.S. long-term care industry. The prevalence of nonprofit R&D is also striking in the light of many "property rights" theories, which claim that for-profit firms have greater incentives to invest in productivity enhancements.

Our analysis aims at interpreting these regularities in an explicit and internally consistent framework. We discuss the implications for productivity yielded by the theory of nonprofit firms in Lakdawalla and Philipson (1997). The paper is organized as follows: Section 3.2 analyzes the productivity or cost-effectiveness of firms with "profit-deviating" preferences.[3] Building on this analysis, section 3.3 analyzes the productivity differences across the nonprofit and for-profit sectors when both firm types coexist in a mixed industry. We predict that, when both types coexist, nonprofits are larger and less efficient, but nevertheless become more numerous than for-profit firms under competitive conditions. In other words, nonprofits drive out for-profit firms through competition, although they exhibit higher marginal and average costs. This is not inefficient, because we argue that nonprofits can tolerate prices that are lower than marginal and average costs. We can observe direct evidence on such pricing, because in the U.S. nonprofit sector, sales by nonprofits do not cover total costs. For example, tuition revenue for most U.S. universities does not cover faculty salaries. Section 3.4 expands the analysis to consider the endogenous choice of R&D. We predict, contrary to property rights theory, that nonprofit firms invest more in cost-reducing R&D than for-profit firms, holding other factors, such as third-party insurance contracts, constant. Section 3.5 pro-

3. An early analysis of behavior by firms with profit-deviating preferences for the combination of inputs is Becker (1958).

vides some suggestive and aggregate evidence on the productivity differences between the two organizational forms in the short- and long-term care industries.

Both the theory and the evidence differ from the property rights theories of nonprofit firm behavior.[4] Such theories claim that the lack of residual claimants (i.e., the inability of nonprofit firms to retain profits) leads to inefficient behavior. We argue that such theories ignore the endogeneity of nonprofit status. Firms *choose* this status; it is not forced upon them. If nonprofit status is inefficient, it is hard to understand why it would be chosen. We argue that even though nonprofit firms lack residual claimants, their dependence on donations provides the same discipline as the dependence of for-profit firms on investors. We argue that donors are best interpreted as investors who require in-kind, rather than pecuniary, returns.[5] Just as investors have strong incentives to channel funds into firms that will maximize the investors' objectives, donors also have incentives to fund the firms that are most efficient at achieving their objectives, even if those objectives are not restricted to monetary reward. Fundamentally, the property rights theory of nonprofit firms is limited in two respects. First, it assumes that nonprofit status is imposed externally, rather than chosen by the firm. Second, it cannot explain why donors to nonprofit firms cannot discipline the firms as well as investors in for-profit firms.

3.2 Cost-Effectiveness and Profit Maximization

The standard theory of the firm generates the well-known result that a profit-maximizing firm also minimizes costs. This section analyzes the generalization of this implication to producers or donors who do not aim to maximize profits. The main result is that cost-minimization is not preserved when donors have preferences for inputs, although it is preserved when donors have preferences for output alone.[6]

In order to incorporate profit-deviating preferences, we view each firm as a single agent with access to a production technology, and preferences over output y, an $n \times 1$ vector of inputs x, and regular consumption z represented by $U(y, x, z)$. In a for-profit firm, the agent making the decisions is the firm's owner, while in a nonprofit firm, the decision maker is a charitable donor.[7] Let the output y be produced from inputs according to the production function $f(x)$. Each donor is endowed with a level of real con-

4. For a classic exposition of this argument, see Alchian and Demsetz (1972).

5. It is well known that private donations are a small share of capital in many health care industries in the United States, so this distinction applies mainly outside that sector.

6. The analysis also displays that profit-deviating firms may act as if they maximize profits, according to an analogy exploited in Philipson and Posner (2000).

7. We here make no distinction between ownership and control. In this way, our theory resembles the standard theory of the firm but differs from agency explanations for nonprofits (see, e.g., Hansmann 1980).

sumption z_0 and sells output at a unit price p, in terms of the numeraire of consumption. Formally, the firm solves the problem

$$\max_{y,x,z} U(y,x,z),$$

such that

$$y \leq f(x),$$

$$w \circ x + z \leq z_0 + py.$$

Because the constraints will hold with equality, the problem simplifies to

$$\max_{x} U[f(x),x,z_0 + \pi(x)],$$

where $\pi(x) = pf(x) - wz$ denotes profits. The first-order necessary conditions are, for $k = 1, \ldots, n$;

(1) $$\left(\frac{U_y}{U_\pi} + p\right) f_k = w_k - \frac{U_k}{U_\pi}.$$

These first-order conditions can be seen as generalizing classic profit-maximization conditions if we recognize that profit deviators operate according to the "net price" of inputs and outputs, in which the net price includes both the pecuniary price and the nonpecuniary value of inputs and outputs. The nonpecuniary value of output in monetary terms is given by U_y/U_π, the marginal utility of output normalized by the marginal utility of the numeraire good of consumption. The net price of one unit of output is thus $p^* = U_y U_\pi + p$, the nonpecuniary value of one unit of output plus the pecuniary value. Similarly, the net input price will be given by the pecuniary price of an input minus its nonpecuniary value, U_k/U_π. The net price of input k is then $w_k^* = w_k - U_k/U_\pi$. From this point of view, it is apparent that equation (1) generalizes the usual profit-maximization condition for input use

$$p^* f_k = w_k^*.$$

It also generalizes the familiar first-order conditions of the cost-minimization problem, the equality between the ratio of marginal factor products and the ratio of factor prices:

(2) $$\frac{f_k}{f_l} = \frac{w_k^*}{w_l^*}.$$

Firms that do not value inputs ($U_k = 0$ for all k) continue to minimize costs at the pecuniary factor prices w. Put differently, the net price of inputs simply equals the pecuniary price of inputs, so that the firm faces the same relative input prices as a profit maximizer. Then an output-preferring firm will have the same cost function $c(y)$ and conditional input demands $x(w, y)$ as a profit-maximizing firm. The optimal scale of such an output-preferring firm is given by

$$\max_{y} U[y, x(w,y), z_0 + py - c(y)].$$

Using the envelope theorem, the first-order condition for this problem is given by

$$p^* = p + \frac{U_y}{U_\pi} = c_y .$$

An output preferrer behaves exactly like a profit maximizer who faces prices p^*. Since $p^* > p$, an output preferrer produces more than a profit maximizer. This generates an important implication for long-run firm behavior: All firms will charge a long-run price p^* equal to minimum average cost, but output-preferring firms will charge a lower *pecuniary* price p than profit maximizers; therefore, free entry of such firms will drive the long-run pecuniary price *below* minimum average cost.

Alternatively, if the firm values inputs, cost minimization relative to the prices w need not result, because w^* may not be a scalar multiple of w. At a given level of output, an input-preferring firm may have incentives to use more of the inputs it prefers, relative to the cost-minimizing levels of input use. To illustrate, consider the case of linear preferences:

$$U(y,x,z) = \alpha_y y + \alpha \circ x + z.$$

The scalar α_y represents the constant marginal utility of output, and the vector α represents the marginal utilities of the various inputs. The firm behaves as if it faces the vector of input prices $w^* = w - \alpha$. If w^* is not a scalar multiple of w, the firm will act as if it faces different relative input prices and thus have a cost function c^* which differs from the minimum cost function c.

It is frequently argued that nonprofit firms do not behave efficiently, because they tend to operate at a larger scale and at greater input cost than for-profit firms. We have argued that such behavior is optimal when one recognizes that profit maximization is not the objective of the firm. Holding constant the output price, a firm which values outputs is of larger scale than one which does not. Moreover, holding output price and the level of output constant, a firm which values inputs uses more inputs. Therefore, the level of inputs per unit of output is higher for both input- and output-preferring firms.

3.3 Productivity Differences in Mixed Industries

In this section, we analyze the endogenous decision to enter for-profit and nonprofit status, in the context of a long-run competitive model, and the differences in productivity across profit status implied by this analysis. Since nonprofit status is chosen by profit-deviating firms, the predictions about the differences between such firms and profit maximizers will translate into predictions about the differences between nonprofit and for-profit firms. In the mixed industry equilibrium, the nonprofits are predicted to be larger, use more inputs per output, have larger average costs, but nevertheless drive the leaner for-profits out of business.

3.3.1 Scale Differences under Mixed Production

For simplicity, we will consider the case in which firms only have output preference, because the presence of input-preferring behavior will not substantially alter the predictions about scale differences. Suppose that we can index output preference by some parameter $\alpha_y \in [0, 1]$, where $\alpha_y = 0$ for a firm which does not value output. Denote by $U(y, \pi; \alpha_y)$ the utility firm α_y derives from output y and profits π. Let d indicate the regulatory choice of the firm, where $d = 1$ when a firm chooses to be for-profit and $d = 0$ when it decides to be nonprofit. We denote by $d(\alpha_y, p)$ the preferred status of a producer with preferences α_y when the price of output is p. The nonprofit sector is defined by a nondistribution constraint and lower input costs from tax breaks and donations of capital and labor. More precisely, under nonprofit status, the firm is constrained to have economic profits below a certain regulated level $\pi \leq \pi_R$ (we assume $\pi_R = 0$), but under for-profit status, profits are unconstrained. Cost functions differ across profit status: denoting by $c^d(y)$ the cost function in status d, suppose that $c^0(y) \leq c^1(y)$ and $c_y^0(y) \leq c_y^1(y)$; holding output fixed, both total and marginal costs are lower in the nonprofit sector. This difference in costs represents the tax breaks which favor nonprofit firms: For instance, nonprofits have lower corporate income, property, and benefit taxes. It also reflects the value of donated capital and labor in the nonprofit sector. If nonprofits were to have *higher* costs than for-profit firms, then in our setting no firm would choose to be nonprofit. In such a case, a firm could always do better with the lower costs and unconstrained profits of the for-profit sector. Therefore, mixed production reveals that nonprofit costs are lower.

In addition, mixed production reveals a scarcity of output-preferring firms, because an infinite supply of output-preferring firms would result in a strictly nonprofit industry. The following line of reasoning demonstrates this fact. In the long run, a firm will stay in an industry provided that at the prevailing price, it does at least as well as it would do outside the industry. For simplicity, suppose that a firm earns zero utility if it leaves the industry. When $\alpha_y = 0$, firms have no preference for output, and $U(y, \pi; \alpha_y) = \pi$, so that in the long run, profit maximizers will remain in an industry provided that the price weakly exceeds average costs. This leads to the familiar result that, given free entry, profit maximizers must produce at minimum average cost m in the long run. Profit maximizers remain in an industry provided that $p \geq m$, but competition ensures that $p \leq m$. However, when $p = m$, firms with $\alpha_y > 0$ earn positive utility in spite of their zero profits, because they also value output. Therefore, output-preferring firms will find it optimal to remain in an industry even if $p < m$. Given an infinite supply of such firms, output preferrers will enter until the price falls below m. At this point, all profit maximizers leave the industry, and all firms earn negative economic profits. Because profits are negative, the nonprofit constraint $\pi \leq 0$ fails to bind, and nonprofit status exacts no cost. As a result, all remaining firms become nonprofit.[8] As a result, we will consider the more relevant case in which output-preferring firms are scarce, and there exists an infinite supply of for-profit firms.

Suppose we have only the quantity A of firms with $\alpha_y > 0$, where the share of output-preferring firms with preference $\alpha \leq \alpha_y$ is given by the measure $\mu(\alpha_y)$. We know that any profit-maximizing firms in the industry will choose for-profit status. We can also show that output preferrers will always choose nonprofit status. Specifically, since $p \leq m$, any output preferrers will choose to earn strictly negative profits under for-profit status. If $p < m$, it is obvious that output preferrers must earn negative profits. To see this fact for the case in which $p = m$, observe that profit maximizers earn exactly zero profits in this case. Since output preferrers act as if they have lower cost than profit maximizers, they will produce more output, and thus earn less profit. As a result, they can do strictly better by switching to nonprofit status, because the cost reductions of nonprofit status will allow them to produce more output at a higher level of profit. However, even with scarce output preference, we need not have any profit maximizers, or for-profit firms, in the industry. For firms with strong output preference, the nonpecuniary portion of p^* is positive, so they can charge a pecuniary price below p^*. Therefore, output-preferring firms can survive at long-run prices strictly below m, the minimum average cost of a for-profit firm. Thus, if there are enough output-preferring firms to satisfy market demand at a price below m, no profit maximizers will enter the market. Formally, let $D(p)$ be the market demand function, and $y(p; \alpha_y)$ be the supply function of a firm with preferences α_y. If there exists a price $p' < m$ at which output preferrers can satisfy market demand, then the long-run price cannot rise above p', and profit-maximizers do not enter. No profit maximizers enter if there exists $p' < m$ such that

$$D(p') \leq A \int y(p;\alpha_y) d\mu(\alpha_y).$$

8. For a detailed analysis of optimal profit status choice, see Lakdawalla and Philipson (1997).

If this condition is satisfied, the industry will be strictly nonprofit, and all firms will be output preferrers. Suppose that this condition cannot be satisfied, and that we thus have a mixed industry. In such an industry, all for-profit firms will be strict profit maximizers, and all nonprofit firms will be output preferrers. The results of the previous section then imply that firm scale must be higher in the nonprofit sector, because output preferrers rationally choose to operate at a higher scale, holding the output price constant.[9] In addition, the output-preferring nonprofit firms will produce this output at higher marginal cost, because they face a higher net price p^*.

3.3.2 Cost Differences under Mixed Production

It is well known that in both the short-term care (hospital) industry and the long-term care (nursing home) industry, nonprofit firms use more inputs per unit of output and thus have larger unit costs than for-profit firms. For example, as is shown in the empirical analysis of this paper, the number of full-time equivalent employees per bed-day is larger for nonprofit firms in these industries. This section argues that these empirical patterns do not stem from inefficient behavior by nonprofit firms, but from the differences in preferences between nonprofit and for-profit firms. There are two major reasons for the observed differences in unit costs. We have already seen that output-preferring firms choose nonprofit status, while profit maximizers choose for-profit status. We show that the resulting differences in scale, when not accounted for, may induce larger unit costs among the output-preferring nonprofit firms. Second, we show that input-preferring firms choose nonprofit status over for-profit status, so nonprofit firms will tend to be more input-preferring than for-profit firms. This generates differences in unit costs across nonprofit and for-profit sectors, but these differences reflect efficient behavior by firms with different preferences.

First, we show how differences in scale can generate differences in unit cost across the nonprofit and for-profit sectors. Suppose that one defines the observed productive efficiency as simply the observed average or marginal *monetary* costs as is the norm in empirical studies on productivity differences. Scale differences across nonprofit and for-profit sectors may generate differences in average or marginal monetary costs which do not provide information about differences in productive efficiency. Therefore, comparing average monetary costs without considering scale may lead to misleading observations about productive efficiency. Recall from the previous section that for-profit firms will always be profit maximizers. The presence of profit maximizers implies in turn that the long-run output price must be equal to minimum average monetary cost m, because the for-profit firms needed to fill the residual demand (unmet by the scarce output

9. The larger scale of nonprofits is not naturally interpreted by theories of nonprofits as cooperatives (e.g., Pauly and Redisch 1973), because they predict smaller labor forces than profit maximizers given that labor shares the residual gain.

preferrers) will produce at price m, the price at which their average costs are minimized. Recall that the nonprofit firms are output-preferring firms. Such firms will produce strictly greater output than the for-profit firms. Specifically, they will set marginal cost equal to the net output price p^*. Because the output-preferring nonprofit firms face higher *net* output prices p^*, they will produce at higher marginal cost. Of course, the relation between average cost across sectors is technically ambiguous after tax, but before-tax cost differences should remain. However, the higher marginal cost of nonprofit firms will tend to drive up average costs as well. In any event, provided that the cost reductions are not very large in magnitude, average costs will also be higher in the nonprofit sector. This difference in costs follows as an implication of efficient behavior under output preference and does not provide evidence of differences in productive efficiency across the two sectors.

Second, the existence of input-preferring firms could also generate differences in average monetary costs which do not reflect inefficient behavior by nonprofit firms. Consider the case of two inputs x_1 and x_2, and a level of input preference over the input x_1 indexed by $\alpha \in [0, 1]$, where firms with $\alpha = 0$ have no preference for using x_1. Again suppose that we have an infinite supply of profit-maximizing entrants with $\alpha = 0$. We thus know that $p \leq m$. We also know that at any price p, the input-preferring firms will produce more than the profit maximizers. If $p = m$, the profit maximizers would earn zero profits. Since the input-preferring firms produce more than profit maximizers, at this price they must earn negative profits. Clearly, if $p < m$, the input preferrers must earn negative economic profits, because price lies below minimum average cost. Under these circumstances, all input-preferring firms will optimally choose nonprofit status, because they would earn negative profits under for-profit status anyway. All profit maximizers will optimally choose for-profit status, because they have nothing valuable to gain by accepting a constraint on profits. As a result, all nonprofit firms have stronger preferences for x_1 than all for-profit firms. We know that, holding the cost function constant, input preferences cause firms to use more inputs at a given level of output, because they face different relative net input prices. Therefore, provided that the cost reductions afforded by nonprofit status are not so large as to offset the force of input preferences, *nonprofit firms will have higher average costs, but not as a result of productive inefficiency.*

3.4 Research and Development by Nonprofit Firms

In the short-term care industry, a large amount of research and development is conducted by nonprofit teaching hospitals.[10] The property rights

10. We thank George Zanjani for providing us with a simpler derivation of the argument of this section than considered originally.

theory of nonprofit firm behavior seems inconsistent with the predominance of nonprofit firms in R&D, because it argues that nonprofit firms have weaker incentives to control costs. This section argues that profit-deviating firms often have stronger incentives to reduce the marginal cost of output through R&D than do profit maximizers.

We restrict our attention to R&D, which reduces the cost of producing extra quantity, although we discuss the straightforward application of our reasoning to a case in which R&D aims at increasing quality. Consider the case in which the firm maximizes a weighted sum of output and profits and has no input preferences:

$$U(y,\pi) = \alpha y + (1 - \alpha)\pi.$$

The extension to general preferences is straightforward, but algebraically tedious. Suppose that each firm may choose to attain a level of technology θ in its cost function $c(y, \theta)$ where θ reduces the marginal cost of output; $c_{y\theta} \leq 0$. Profits *gross* of investments in R&D are then defined as

$$\pi(y,\theta) \equiv py - c(y,\theta).$$

This implies that cost reduction raises gross profits more the larger the level of output; $\pi_{y\theta} > 0$. Attaining the level of technology θ requires a research budget of $r(\theta)$ units of real consumption. In this setting, the firm solves

$$\max_{y,\theta} \alpha y + (1 - \alpha)[\pi(y,\theta) - r(\theta)].$$

The first-order conditions are

$$\pi_y = -\frac{\alpha}{1 - \alpha},$$

$$\pi_\theta = r_\theta.$$

Absent output preference α, the first condition reduces to the standard profit-maximizing condition. The second condition equates the marginal increase in gross profits with the marginal cost of extra research. The second condition defines an implicit relationship between technology and output preference $\theta(\alpha)$ in which the benefit rises with output, because larger firms enjoy a larger reduction in costs for a given amount of R&D. Since output-preferring firms are larger than profit-maximizing ones, implicit differentiation yields the result that a larger output preference expands R&D:[11]

11. Define by D the determinant of the Hessian matrix. The second-order condition then implies that $D > 0$. Differentiating the first-order conditions yields $\partial\theta/\partial\alpha = [(1 - \pi_y)(1 - \alpha)\pi_{y\theta}]/D$. Since $\pi_y \leq 0$ at the optimal output choice, and $\pi_{y\theta} > 0$, the result follows.

$$\frac{d\theta}{d\alpha} \geq 0.$$

This effect depends entirely on the reduction of marginal costs. Because marginal costs represent the price of output relative to profits on the margin, reductions in this relative price are more valuable to firms with a stronger relative preference for output. Holding the cost function constant, output-preferring firms have a stronger incentive to invest in R&D because it reduces costs more. Thus, contrary to property rights arguments, nonprofit firms have a stronger incentive to invest in R&D than for-profit firms. Of course, nonprofit firms also have lower costs than for-profit firms if they are given tax breaks on inputs. This provides a competing incentive against R&D expenditure. Provided that the cost reductions of nonprofit status are not too large, nonprofit firms will undertake more R&D spending than for-profit firms.

Although we have not explicitly considered quality enhancements in this paper, investments in quality-enhancing R&D would operate similarly.[12] Firms with stronger relative preferences for quality over profits would tend to invest more in quality-enhancing R&D than other firms. Quality-preferring firms would have a stronger incentive to adopt nonprofit status, because their profits would be lower than those of profit maximizers (because they would forgo profits in the interest of raising quality), and because the cost reductions of nonprofit status may help them finance higher quality output.

3.5 Empirical Analysis of Productivity Differences in Long-Term Care

This section provides an illustrative discussion of some broad patterns on the productivity differences between nonprofits and for-profits in the U.S. long-term care industry. We will be concerned primarily with addressing the claim that nonprofit firms use more inputs per unit of output in their larger scaled production. We argued above that output preferrers will have higher unconditional input demands, while input preferrers will have higher conditional input demands. We consider differences in input demands between for-profit and nonprofit nursing homes. Using the nursing home–level data from the 1995 National Nursing Home Survey (NNHS), we estimate conditional input demand as a function of proxies for market price p, output level y, and relative wages w. Specifically, we estimate the following cross-sectional specification[13] of conditional input demand, for all facilities

12. For an early study on quality-preferring behavior by nonprofit firms, see Newhouse (1970).

13. Unfortunately, there exist no panel surveys of nursing homes. Such surveys would be useful if profit status were correlated with input use for other reasons that did not vary over

Table 3.1 **Summary Statistics for Nursing Home Ownership and Input Intensity (1995)**

	Mean	Std Dev	Min	Max
FTE employees	128.81	109.49	1	1,049
FTE registered nurses	11.10	13.14	0	144
FTE nurses' aides	50.41	43.19	0	469
FTE doctors	0.65	2.95	0	82
Nursing home beds[a]	132.74	52.53	25	200
Medicaid per diem ($)	93.88	81.51	24	1,887
Services provided[b]	0.76	0.11	0.05	1
City[c]	0.69	0.46	0	1
For-profit[d]	0.66	0.48	0	1

Notes: Data are from 1995 National Nursing Home Survey (U.S. Department of Health and Human Services 1995). FTE = full-time equivalent.

[a]NNHS categorizes homes into one of four bed size categories: 0–49 beds, 50–99 beds, 100–199 beds, and 200+ beds. Beds variable constructed by assigning to each home the midpoint value of its size category, or in the case of the 200+ category, the minimum value.

[b]Index of services, constructed by NNHS.

[c]Dummy variable equal to 1 if facility is located in a standard metropolitan statistical area.

[d]Dummy variable equal to 1 if facility is for-profit.

$$\ln(x_i) = \beta_1 + \beta_2 \ln(p_i) + \beta_3 \ln(w_i) + \beta_4 \ln(y_i) + \varepsilon_i.$$

The data used are summarized in table 3.1. We measure usage of four inputs: full-time equivalent registered nurses (RNs), full-time equivalent nurses' aides, all full-time equivalent employees, and full-time equivalent doctors. To measure market price, we use the Medicaid per diem payment received by the nursing home. To measure *quantity* of output, we use the number of beds present in the nursing home;[14] and to measure *quality* of output we use an index of services provided, which is constructed within the NNHS. As a proxy for relative wages, we use a dummy for location within a standard metropolitan statistical area. Due to urban amenities, relative wages (relative to the urban price level) should be lower in cities, that input usage should be higher.

Table 3.2 reports the type of finding discussed on the differences in conditional input demand functions between nonprofit and for-profit homes. Controlling for output price, input price, and output level, nonprofit nursing homes use approximately 30 percent more RNs, 23 percent more

time. Indeed, we are not aware of any data sets on the effect of profit status conversion on productivity.

14. Although the NNHS does not directly report bed size for each facility, it does place each facility into one of four size categories: 1–49 beds, 50–99 beds, 100–199 beds, and 200 beds or more. We construct a measure of bed size by assigning to each home in the first three categories the number of beds equal to the midpoint of the category. For example, the homes in the first category are assigned the value of 25 beds. To homes with more than 200 beds we assign the value of 200.

Table 3.2 **Effect of Nursing Home Ownership on Input Intensity (1995)**

	Log FTE RNs		Log FTE Aides[a]		Log FTE Employees		Log FTE Doctors	
	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Constant	−5.82[a]	−7.96	−1.77*	−5.53	−1.51*	−4.753	−1.81*	−1.684
Log nursing home beds	0.75*	17.35	0.94*	27.76	0.94*	31.482	0.20**	1.786
Log medicaid per diem	0.79*	4.55	0.24*	3.25	0.35*	5.031	0.38**	1.782
Services provided	0.98*	4.16	0.05	0.38	0.21**	1.844	−0.44	−0.617
City	0.24*	4.87	0.07*	2.19	0.11*	3.866	0.06	0.535
For-profit	−0.28*	−6.28	−0.23*	−7.48	−0.25*	−9.041	−0.10	−0.865
R^2	0.44		0.55		0.63		0.02	
No. of observations	1,195		1,180		1,202		152	

Note: All *t*-statistics are robust to heteroskedasticity.

[a]Aides are nurses' aides.

*Significantly different from zero with 95% confidence.

**Significantly different from zero with 90% confidence.

nurses' aides, and 25 percent more employees. All these coefficients are statistically significant at the 5 percent level. The coefficient for doctors is negative, but insignificant. The standard errors on all the coefficients rise dramatically in the regression for doctors, because we lose almost 90 percent of the sample. This relates to a finding reported by Borjas, Frech, and Ginsburg (1983), who did not find significant wage rate differences between nonprofit and for-profit nursing homes. This result is consistent with input preference among nonprofit nursing homes. Substantially similar results were obtained for the unconditional input demand equation, in which the output measures were excluded. This would also be consistent with output preference. Further simple analysis was consistent with output preference: Regression of total beds on profit status revealed that nonprofit homes have, on average, 6.5 more beds than for-profit homes,[15] and that this difference is statistically significant at the 5 percent level.

These findings relate to previous studies on the differential input use across the two regulatory forms. Table 3.3 shows the estimated specifications of Borjas, Frech, and Ginsburg (1983), which they use to advance the property rights theory of nursing homes. They advance the claim that nonprofit firms dissipate profits by paying abnormally high wages to workers. On the surface, the theory behind this regression is flawed. If workers in nonprofit nursing homes really received rents for identical labor, there would be long queues of people waiting to work in nonprofit nursing homes, and there could not be an equilibrium in the labor market. This theoretical objection aside, Borjas et al. do not even find evidence of a wage differential. Table 3.3 reports the results of regressing the wages of nurses on the individual characteristics of the nurses, a set of regional and geographical dummies, and the ownership status of the nursing home. Controlling for observable characteristics, there is found to be no statistically significant difference between the wages paid by secular nonprofit homes and those paid by for-profit homes. In fact, church-run nonprofit homes pay a *lower* wage than for-profit homes, perhaps due to the availability of workers who wish to serve the church for nonpecuniary reasons. The only evidence Borjas et al. point to comes from government-run nursing homes, which apparently do pay a wage which is about 6–7 percent higher than the for-profit wage. We will not dwell too long on this finding, because we have not attempted to model government-run homes, which would be subject to various political economic considerations. At any rate, it is possible that governments impose unobservable quality standards on employees and reward them accordingly. While wage rates for a homogeneous unit of labor cannot differ across firms in an equilibrium, firms may use inputs more or less intensively, depending on their preferences.

15. Since the average for-profit home has about 130 beds, this roughly translates into a 5 percent difference in output.

Table 3.3 **Effect of Nursing Home Ownership on Wage Rates for Nurses (1973–74)**

		Log Wage Rate	
	Mean[a]	Coefficient	t-Statistic
Constant	n.a.	−0.036	−0.40
Years of education	11.84	0.055*	7.46
Years of nursing education	1.71	0.174*	61.25
Experience	22.23	0.013*	11.77
Experience squared	669.04	0.000*	−8.55
Firm experience	2.08	0.007*	4.99
Nursing experience	0.78	0.005	1.59
Hospital experience	1.12	0.008*	5.23
Nondegree training[b]	0.47	0.077*	9.46
White male	0.07	0.414*	26.28
Black male	0.01	0.128*	3.21
Black female	0.14	−0.015	−1.23
Northeast region	0.28	0.073*	5.76
North central region	0.33	−0.022**	−1.79
Southern region	0.23	0.083*	−6.37
SMSA[c]	0.64	0.119*	14.02
Church-run nonprofit	0.07	−0.039*	−2.52
Nonchurch nonprofit	0.12	0.016	1.29
Government-owned	0.15	0.066*	5.68
R^2		0.44	
No. of observations		11,542	

Source: Borjas, Frech, and Ginsburg (1983), table 2.

Note: Data are from 1973–74 National Nursing Home Survey. n.a. = not applicable. t-Statistics are robust to heteroskedasticity.

[a]Refers to mean of independent variable.

[b]Received in the past year.

[c]Equal to 1 if nursing home located in a standard metropolitan statistical area.

*Significantly different from zero with 95% confidence.

**Significantly different from zero with 90% confidence.

In tables 3.4 and 3.5, we reproduce the results of other authors whose analyses of hospitals are broadly consistent with our findings for nursing homes. In table 3.4, we report the results of Sloan and Steinwald (1980), who study input intensity across nonprofit and for-profit hospitals. Sloan and Steinwald find that the number of full-time equivalent registered nurses per hospital bed is roughly 25 percent higher in nonprofit hospitals, while the number of full-time equivalent nonnursing employees is roughly 12 percent higher. No significant effect was found for licensed practical nurses, who might be viewed as cheaper substitutes for physicians. Since the dependent variable is normalized by the number of beds, they do not include output as a regressor and thus do not strictly estimate a conditional input demand function. However, they do control for the wage di-

Table 3.4 Effect of Hospital Ownership on Input Intensity (1969–75)

	Log FTE RNs per Bed		Log FTE LPNs per Bed[a]		Log Other FTEs per Bed	
	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Log wage[b]	−0.40**	−1.82	−0.72**	−1.80	0.31**	1.82
Medicaid eligibility[c]	0.04*	3.00	−0.04**	−1.74	0.01	1.37
Medicare eligibility[d]	−0.16*	−3.64	0.03	0.37	0.01	0.26
For-profit	−0.24*	−4.90	−0.03	−0.32	−0.12*	−3.33
Government-run	−0.06	−1.49	0.03	0.41	0.03	1.22
Medical school[e]	0.04	1.38	0.05	0.86	0.12*	5.00
Nursing school[f]	−0.01	−0.34	−0.13*	−2.20	−0.01	−0.44
R^2	0.18		0.12		0.18	
No. of observations	6,016		6,016		6,016	

Source: Sloan and Steinwald (1980), table 8.1.

Note: A variety of included regressors not of interest here are not reported. All regressions control for a hospital-specific fixed effect. *t*-Statistics are robust to heteroskedasticity.

[a]LPNs are licensed practical nurses.

[b]Wages for the class of employees in dependent variable.

[c]Statewide proportion of population eligible for Medicaid.

[d]Statewide proportion of population eligible for Medicare.

[e]Dummy variable indicating presence of medical school.

[f]Dummy variable indicating presence of nursing school.

*Significantly different from zero with 95% confidence.

**Significantly different from zero with 90% confidence.

rectly, and they control for market price using the proportion of people covered by Medicare or Medicaid. Therefore, their results also support the conclusion that holding output fixed, nonprofit hospitals use more RNs and more nonnursing staff.

In table 3.5, we reproduce the results of Gentry and Penrod (1998), who analyze the output of hospitals across profit status. Table 3.5 displays some aggregate patterns consistent with evidence that nonprofit hospitals have more beds and discharges, as well as longer durations of care than for-profit hospitals. In addition, they are more likely to have emergency rooms and delivery rooms. On this level of aggregation it appears that, for a variety of output measures, nonprofit hospitals produce more than for-profit hospitals. Since nonprofit hospitals also have more employees, it is clear that they have higher unconditional input demands than for-profit hospitals. Finally, we can see that nonprofits are more likely to have teaching programs than for-profits, programs which are strong indicators of R&D expenditure. This is consistent with our prediction that output-preferring nonprofit institutions are more likely to invest in R&D.

Table 3.5 **Effect of Hospital Ownership on Output (1995)**

	Nonprofit	For-Profit	Public
Median bed size[a]	170	138	70
Median discharges (yearly)[a]	4,975	3,609	1,233
Median length of stay (days)[a]	5.51	5.11	5.46
Median number of employees[a]	520	330	161
Percent with emergency room	97.8	93.2	99
Percent with delivery room	74.7	62.7	72.8
Percent with teaching program	29.2	12.7	9.1

Source: Gentry and Penrod (1998).

Note: Based on a sample of 4,996 general short-term hospitals from HCFA's public use file of 1995 Medicare Cost Reports.

[a]For these variables, the Kruskal-Wallis test of equivalent distribution across ownership types was rejected at a 0.01 level.

3.6 Conclusion

Although the nonprofit sector is responsible for a majority of the production of health care in many countries, little is known about the economic forces contributing to productivity differences between the nonprofit and for-profit sectors. In this paper we argued that some puzzling empirical regularities may be understood using the analysis of endogenous nonprofit status choice studied in Lakdawalla and Philipson (1997). We contrasted our arguments to the well-known claim that nonprofits are made inefficient by their lack of well-defined property rights. Most importantly, the property rights theory cannot explain why firms would voluntarily choose an inferior arrangement of property rights in the first place.

The analysis here suggests that one should be more cautious in interpreting differences in productivity, because the efficient behavior of a firm will depend on its objectives. We argued that firms which choose nonprofit status are as efficient as those which choose for-profit status even though they utilize more inputs per unit of output produced. Furthermore, we predicted that nonprofits would invest more in cost-reducing R&D than for-profits, contrary to the qualitative arguments of property rights theory. In addition, we argued that although these productivity differences lead them to have higher average costs, nonprofit firms will drive out for-profit firms in competitive markets. These predictions were consistent with the empirical finding reported from the long-term care industry showing that nonprofit nursing homes use 23 to 30 percent more labor inputs (full-time equivalents) than for-profit homes of the same size. It is also consistent with earlier empirical findings that in mixed industries, nonprofit firms tend to be larger and more R&D intensive but less efficient than for-profit firms, while at the same time they tend to be more numerous than their for-profit counterparts.

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Comment Richard G. Frank

The paper by Tomas Philipson and Darius Lakdawalla extends a long line of research on the behavior of nonprofit organizations in the health care sector. This paper focuses on the objective function of nonprofit health care providers and their allocative and productive efficiency. These are concerns that have challenged and vexed economists for over thirty years (Frank and Salkever 1994). The paper also takes up two other topics: (1) cost and productivity differences among health care providers under mixed for-profit and nonprofit production; and (2) research and development by nonprofit firms. The empirical analysis focuses primarily on ownership, organizational preferences, and efficiency. I will briefly summarize the theoretical models proposed by Philipson and Lakdawalla, point out the main implication stemming from the models, and review the empirical strategy adopted for exploring behaviors of nonprofit nursing homes and hospitals.

The Basic Model

The point of departure for the theoretical analysis is a competitive model where free entry holds and firms are price takers. A general objective function for the health care provider is set out: $U = U(y, x, \pi)$. It consists of three arguments, output (y), inputs (x), and profit (π). The firms pursue their objectives subject to a production constraint and a break-even constraint. Because nonprofit organizations receive charitable donations, production costs can exceed revenues from sales.

Analysis of the model yields several implications:

- If the firm is not an "input preferrer" ($Ux = 0$), it pursues cost minimization. This is true of both profit-maximizing for-profit organizations ($Ux = Uy = 0$) and output-preferring nonprofits ($Uy > 0$).

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- If the firm "prefers inputs" ($Ux > 0$), it will not be allocatively efficient.
- Nonprofit firms of all types will use more inputs than for-profit firms. Only input preferrers will have higher conditional input demands than for-profits.
- Output preferring firms will have higher marginal costs and higher output than for-profit firms.
- The availability of donations and tax breaks will tend to drive out for-profit firms.

Philipson and Lakdawalla use this model as a guide for interpreting statistical analysis of the behavior of nursing homes and hospitals.

Evidence

The empirical analysis presented by Philipson and Lakdawalla focuses on the analysis of input demand functions. They present new results for a national sample of nursing homes and review the analyses of others for the hospital sector. There are two important refutable propositions that Philipson and Lakdawalla are seeking to test as a means of assessing the theory they have advanced. The first is that the estimated input demand functions are consistent with cost minimization: that is, the demand curves are downward-sloping. This would be inconsistent with the input-preferrer formulation. Second, holding constant quality and output quantity, nonprofit firms would use more inputs. This offers another test of the input-preferrer formulation.

Some previous research has provided evidence that nonprofit health care providers do not allocate inputs in a fashion consistent with cost minimization. Goldman and Grossman (1988) estimated production functions for community health centers and tested whether the ratio of marginal products was equal to the ratio of factor payments. They rejected the presence of that cost-minimizing equilibrium condition in that market. Frank and Taube (1987) took a similar approach to studying the behavior of ambulatory mental health care providers. They too rejected the proposition that those providers were hiring inputs in a manner consistent with cost minimization. This previous work argues against the profit-maximization and output-preferring nonprofit formulations.

Philipson and Lakdawalla's empirical work is aimed directly at the input demand function for nursing homes. In general the literature has tended to formulate input demand models in the health sector either as technical input demand functions which are derived by assuming cost minimization and no other behavior, or as a behavioral input demand function where profit maximization or some other objective is assumed. In the former case, for a two-input production process the Cobb-Douglas estimating equation might take the form

$$x = A w_1^{\alpha} w_2^{\beta} Q^{\gamma},$$

where A is a constant incorporating Hicks-neutral technical change, w_1 and w_2 are input prices and Q is the quality-adjusted output. In the latter case the model might take the form

$$x = Aw_1^{\alpha}w_2^{\beta}p,$$

where p is the output price for the profit-maximizing firm. Under these types of formulations ownership is specified in the context of the Hicks-neutral technical change term. Hence $A = a_0 + a_1\text{Profit}$ (where Profit is an ownership dummy variable). The specification used by Philipson and Lakdawalla is something of a hybrid. They estimate a model of the form

$$x = Aw^{\alpha}p^{\beta}Q^{\theta}.$$

They estimate models for four types of labor inputs of nursing homes: registered nurses, nurses' aides, all employees, and physicians. Separate equations are estimates for each input. On the right-hand side of the regression models are nursing home beds (as a proxy for quantity given nearly full occupancy), Medicaid per diem reimbursement (a measure of supply price), an index of the range of services provided by the nursing home (as an indicator of quality), a dummy variable indicating whether a nursing home is located in a city (as an indicator of relatively low wages for nursing home staff), and an ownership dummy variable.

The results reported show that holding constant beds, reimbursement, location, and the services index, for-profit nursing homes demand significantly lower quantities of all labor inputs except physicians. The magnitude of the response varies from about 24 percent for aides to 32 percent for registered nurses. These estimates are supportive of the input-preferrer hypothesis. Two factors cast some uncertainty on this result. First, there is evidence suggesting that nonprofit nursing homes tend to be of higher quality than their for-profit counterparts. Weisbrod and Schlesinger (1986) analyze complaint data from the state of Wisconsin and find evidence showing lower rates of complaints by customers of nonprofit homes. Gertler and Waldman (1991) also find evidence suggesting that nonprofit homes are of higher quality. If higher quality is correlated with levels of staffing, as one could plausibly conjecture, then the results obtained by Philipson and Lakdawalla may be sensitive to their ability to measure quality. This is not just a problem for Philipson and Lakdawalla, but one which plagues most empirical work on cost and production in health care. The services index is the sole measure of quality in the model. The construction of the variable is not well specified. While it is plausible that the range of services is correlated with quality, it is not directly linked to common notions of quality. Thus the degree to which the estimated coefficient for the ownership dummy reflects the structure of firm preferences versus differences in quality remains somewhat uncertain.

The second source of uncertainty is that if the input-preferrer formulation holds, then one would expect to reject cost minimization, which is weakly tested by assessing the shape of the input demand functions. The evidence for nursing homes is consistent with a downward-sloping demand curve if one accepts the proposition that city location offers amenities, which implies that "relative wages (relative to urban price level) should be lower in cities." There are other explanations for what a city location dummy might represent, and it may be premature to place such a strong interpretation on the positive coefficient estimate for that variable. The finding is further complicated when Philipson and Lakdawalla consider econometric results from hospital markets that provide evidence of downward-sloping input demand curves and higher levels of input demand by nonprofits (conditional on beds).

Concluding Comment

The paper by Philipson and Lakdawalla offers a theoretical discussion which provides some new ways to interpret differences in observed patterns of behavior by for-profit and nonprofit health care providers. It also suggests reasons why health care markets might so often have mixes of for-profit and nonprofit firms. The authors offer some refutable propositions and provide some evidence offering support for the input-preferrer structure of preferences among nonprofit nursing homes. Unfortunately, the empirical work offered by Philipson and Lakdawalla is plagued with difficulties in measuring quality, which have often frustrated empirical analyses of health care providers. The objective function of nonprofit nursing homes (and health care providers generally) remains uncertain and continues to pose a challenge to economists interested in the productivity of different institutional forms in the health sector.

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