PROFIT INCENTIVES AND THE PERFORMANCE OF OKLAHOMA HOSPITALS

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PREFACE

Models were developed to determine whether significant differences exist between for-profit and nonprofit hospitals in Oklahoma. The models are capable of distinguishing case mix, skill mix, and productive relations differences between the two hospital types. The analysis is the first of its kind to specifically address each of these three issues simultaneously.

All significant endeavors are aided in direct and subtle ways by a variety of individuals. It is my great pleasure here to give thanks to some of these special people for their assistance in this endeavor. Unfortunately, words may not express the depth of appreciation which is owed each person.

My thanks begin with my parents, Joyce and Donald Register. From an early age, my parents instilled in me traits that have served me well in this endeavor and, I am sure, will serve me well throughout my life. Among these are an eagerness to learn and a desire to do the best job I can do, regardless of the task.

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CHAPTER I

INTRODUCTION

Economic theory predicts that economic inefficiencies are most likely to occur when for-profit firms operate in noncompetitive markets and when firms operate on a nonprofit basis. The hospital industry represents the worst of all possible worlds. The industry is composed predominantly of nonprofit firms who operate in a climate where price competition is rare. To make matters worse, the industry is essentially regulated and works under a pricing scheme that encourages excessive capacity, quantities, and qualities of care. Examples of these inefficiencies abound in the literature. It is reported that during one sample year, 30 percent of the hopsitals having closed heart surgery facilities did not engage a single case. The results were not too dissimilar for those hospitals with open heart facilities--20 percent reporting no cases.[1] Excess capacity of this nature is not uncommon and poses a significant problem for the hospital in terms of increased costs as indicated by Berry.[2]

Economic inefficiencies of this nature have prompted numerous proposed remedies. These include private and public rate regulation and review and governmental controls on hospital expansions. Variants of these policy options have been tried with varying degrees of failure.[3] As mentioned, rate review and regulation has been both private and public. The private initiative has primarily come from the large

third-party insurers such as Blue Cross. While this approach has been significant, the public initiative has been greater in scope and detail. Public rate review and regulation has its roots in the Economic Stabilization Program of the Nixon Administration. After this program expired, a number of individual states embarked on review programs patterned after the Nixon program. These programs are referred to as prospective reimbursement (PR) schemes and have as an essential element an external authority who sets, or at least approves, payment rates. Under these schemes, hospitals are normally reimbursed based on a predetermined rate, not on the actual cost of the care provided. There is, then, an incentive for the hospitals to be financially concerned with the quantity, quality, and cost of care provided.

An earlier variant of the public review and regulation of hospital rates is the cost reimbursement scheme. This approach differs from the perspective reimbursement approach in that with cost reimbursement, the hospital is reimbursed in full without regard to a predetermined rate. Theoretically, cost reimbursement is inferior to the perspective reimbursement scheme in that the former does not provide the incentives to contain the cost, quantity, and quality of care that exist in the latter.

Empirically, the impact of PR programs has been, at best, modest. Most of the studies of the impact of PR programs have led to inconclusive results. The most supportive of the programs is a Congressional Budget Office study conducted in 1979 which indicated that mandatory state PR programs have tended to reduce annual hospital expenditures by 3 percent.[4] Further, a number of studies indicate that while the case for perspective reimbursement is strong, empirically the impact

of the two reimbursement schemes is not significantly different. For example, Pauly and Drake report that hospital costs did not appear to significantly differ between states having perspective reimbursement and those having cost reimbursement.[5]

Public controls on hospital expansion date back to 1964 when the State of New York established the first certificate of need (CON) program. The underlying idea in the CON approach is that excessive hospital expansions are the primary contributing factor in the uncontrolled cost increases of hospital care. Consequently, hospital cost increases may be restrained by controlling hospital expansion. The CON approach has been quite popular. By 1979, 47 states had the controls in effect. Further, the National Health Planning Act of 1974 requires all states to implement CON programs by the end of 1980. While these programs differ substantially from state to state, the essential feature is the requirement of state designated agency approval for the entry of new hospitals and the expansion or modernization of hospital plant, equipment, and services.

A similar but voluntary program is in force in Section 1122 of the Social Security Act. Under this program, if prior state agency approval is not granted for an expansion exceeding $100,000, the hospital is subject to loss of reimbursement under Medicare and Medicaid.

Empirical research in this area has concentrated on the impact of the CON programs. In the most complete of these analyses, Salkever and Bice found that while the CON legislation had been successful in limiting the growth in beds, the impact on plant assets per bed has been perverse.[6] The impact of the legislation then, according to the

authors, was to significantly change the composition without changing the quantity of investment.

While these proposed remedies have been attempted, it is ironic that the most promising proposal, the promotion of for-profit hospitals, has received relatively little attention. This proposal is based on the assumption that a hospital's economic performance will be dependent upon the form of ownership that exists. Within the for-profit hospital, there exists an owner or group of owners, who has an exclusive residual claim to the hospital's net income. A reasonable assumption to make concerning their motivation is simply that the owners' desire for the firm to be operated in an economically efficient, profit maximizing manner.[7] To meet this end, the owners retain the services of a manager, who is given operating control of the hospital and charged with running the hospital efficiently. To insure the manager's compliance with their objectives, the owners may assign a partial residual claim to the hospital's net income to the manager. In this way, the hospital manager is provided an incentive to operate the for-profit hospital in an economically efficient manner.

The situation differs within the nonprofit hospital. Under this form of ownership, the owners do not have a residual claim to the hospital's net income. In this case, it may be inappropriate to assume that the owners will be motivated strictly be a desire to maximize the hospital's net income. Further, even if it is assumed that the nonprofit owners are driven by a desire to maximize the hospital's profit, by lacking the power to assign a partial residual claim to the manager, the owners may be unable to insure managerial compliance to this goal. The nonprofit manager does not, then, face the efficiency inducing

incentive faced by the for-profit manager. The predicted result of this ownership arrangement is poor economic performance. Consequently, providing profit incentives should tend to improve the industry's performance.

Numerous authors have considered this possibility and have developed theoretical models which trace the poor performance of this industry to the predominance of nonprofit firms. To cite some examples, Newhouse theorizes that nonprofit hospitals have a bias against lower qualities and quantities of care.[8] Further, Lee has developed a Veblenian model of conspicuous production which attempts to explain why hospitals acquire inputs, seemingly, without regard to the demand for their use.[9] A final example of these models is found in the work of Pauly and Redisch who argue within their physician control model that nonprofit hospitals employ inputs up to the point at which the net income of each physician is maximized.[10]

Empirical studies are in general agreement with the theories of nonprofit hospital behavior. Ogur finds a significant difference in the production functions of nonprofit and for-profit hospitals and concludes that the result is consistent with theoretical assertions concerning the behavior of nonprofit hospitals.[11] Viewing hospital ownership as differences in property rights arrangements, Clarkson shows evidence which supports the general implications of the property rights literature. Specifically, he finds that nonprofit managers select easier tasks, do not use market value information as often, and generally do not perform managerial functions as efficiently as the for-profit managers.[12] Similarly, Davies uses a property rights framework in his examination of the relative efficiency of a public

and private airline. Based on his results, Davies contends that the private firm operates relatively more efficiently.[13] Finally, two studies indicate that, given the current nonprofit nature of the hospital industry, increased competition from for-profit entrants may not necessarily improve overall industry performance. Wilson and Jadlow, in a study of the provision of nuclear medicine services, find that proprietary hospitals are more efficient than nonprofit hospitals but that the presence of more competition is associated with less, not more, efficiency in the supply of such services.[14] The authors do conclude, however, that a shift in the institutional arrangements in the hospital sector in the direction of more profit incentives would likely result in increased overall efficiency. Lastly, in a study of the effects of competition and regulation on hospital bed supply, Joskow's empirical results indicate that higher market concentration reduces quality competition and leads to lower excess bed supply.[15] Policies designed to support the for-profit firms may then lead to inefficient increases on the quantity and quality of care provided.

While the theory underlying the proposed remedy of promoting the for-profit hospitals is quite clear, empirically, we cannot, with much certainty, predict that the presence of for-profit firms will lead to a significant improvement in the performance of the hospital industry. The key to the question is whether the profit incentives that exist within the for-profit hospitals cause these hospitals to be operated in a demonstrably more efficient fashion than the nonprofit hospitals. The major objective of this research is to further consider this question. Specifically, the study will attempt to discover if significant differences exist in the behavior of the two hospital types.

The major distinguishing feature of this work is the consideration of the entire productive relation. As is presented in Chapter III, the research considers the inputs used, outputs produced, and technical relationships between inputs and outputs for the two hospital types. Previous research has tended to be concentrated on only one of these three facets of the productive relation. It should be recognized that the research to follow does not directly address the question of whether for-profit entrants will significantly improve the performance of the industry, but rather considers whether the currently existing for-profit hospitals produce significantly differently than do the existing nonprofit firms. If these differences are found, the task will be to determine if the for-profit hospitals operate more efficiently than do the nonprofits. If it is found that the existing for-profit hospitals operate more efficiently than the nonprofits, then one could reasonably expect the impact of entering for-profits to be positive in terms of overall industry performance. If such is the case, a policy designed to promote the profit incentives that exist within the for-profit hospitals would likely yield net economic benefits.

To accomplish this task, data are examined on 120 short-term, acute-care hospitals in the State of Oklahoma for the years 1978 through 1981. The data are taken from the Oklahoma Health Planning Commission's Annual Hospital Survey which is verified by the staff of the Commission. Included in the hospitals are 14 which, for this study, are classified as for-profit. The for-profit group includes both those hospitals which are owned for profit and those which are not owned but are managed for profit. Taken together, these two hospital types form the population of hospitals that operate in an atmosphere of profit

incentives. The remainder of the hospitals are classified as nonprofit. This group is composed of those hospitals which are both owned and operated on a nonprofit basis. By comparing the behavior of the for-profit and nonprofit groups, a determination may be made as to the economic significance of profit incentives in this industry. But, before this examination is conducted, several theoretical and conceptual steps are developed.

Chapter II of this study serves two primary purposes. First, the theoretical models of the nonprofit firm that have been developed and applied to the hospital industry are discussed. In this discussion, special emphasis is placed on describing the differing motives that may come into play for nonprofit and for-profit managers. Second, the chapter concludes with a summary of the literature applying to the profit-nonprofit issue.

Chapter III develops both the conceptual and statistical framework for the study. Also found in this chapter is a more thorough discussion of the data to be used in the study. Here, special attention is paid to the expectations that are held based on the theoretical discussion of Chapter II.

The results of the empirical tests are presented and discussed in Chapter IV. In this discussion, emphasis will be placed on identifying those results which appear to be in accord with theoretical predictions.

Finally, in Chapter V, the implications of the empirical results are discussed. Further, in this chapter the limitations of the research are noted and directions for future research are suggested.

ENDNOTES

[1]These data are taken from Maw Lin Lee, "A Conspicuous Production Theory of Hospital Behavior," Southern Economic Journal, XXXVIII (1971), pp. 48-58. It should be noted that the idea of efficiency employed here and throughout this work is defined as technical or productive efficiency. No intent exists or attempt will be made to consider the broader idea of economic efficiency as expressed in the conditions of Pareto Optimality.

[2]Ralph E. Berry, "Cost and Efficiency in the Production of Hospital Services," Health and Society, II (1974), pp. 291-313.

[3]For a good summary of these proposals the reader should see, Frank A. Sloan, "Government and the Regulation of Hospital Care," American Economic Review, LXXII (1982), pp. 196-201.

[4]Congressional Budget Office, Controlling Rising Hospital Costs, (Washington, D.C., 1979).

[5]Mark Pauly and David Drake, "The Effect of Third Party Methods of Reimbursement on Hospital Performance," in Herbert Klarman (ed.), Empirical Studies in Health Economics (Baltimore, 1970).

[6]David S. Salkever and Thomas W. Bice, Hospital Certificate of Need Controls: Impact on Investment, Costs, and Use (Washington, D.C., 1979).

[7]Here, and throughout this work, competitive markets are assumed when the relationship between profit maximization and economic efficiency is discussed.

[8]Joseph P. Newhouse, "Toward a Theory of Nonprofit Institutions: An Economic Model of a Hospital," American Economic Review, LX (1970), pp. 64-74.

[9]Lee, pp. 56-58.

[10]Mark Pauly and Michael Redisch, "The Not-For-Profit Hospital as a Physician's Cooperative," American Economic Review, LXIII (1973), pp. 87-99.

[11]Jonathan D. Ogur, "The Nonprofit Firm: A Test of the Theory of the Hospital Industry," Journal of Economics and Business, XXVI (1974), pp. 117-123.

[12]Kenneth W. Clarkson, "Some Implications of Property Rights in Hospital Management," Journal of Law and Economics, LV (1972), pp. 363-384.

[13]David G. Davies, "The Efficiency of Public Versus Private Firms, The Case of Australia's Two Airlines," Journal of Law and Economics, XIV (1971), pp. 149-165.

[14]George W. Wilson and Joseph M. Jadlow, "Competition, Profit Incentives, and Technical Efficiency in the Provision of Nuclear Medicine Services," The Bell Journal of Economics, XIV (1983), pp. 472-482.

[15]Paul L. Joskow, "The Effects of Competition and Regulation on Hospital Bed Supply and the Reservation Quality of the Hospital," The Bell Journal of Economics, XIII (1982), pp. 421-447.

CHAPTER II

THEORETICAL AND EMPIRICAL RELATIONSHIP BETWEEN THE NONPROFIT FIRM AND ECONOMIC INEFFICIENCY

Introduction

When dealing with an industry composed of for-profit firms, it is normal to assume that the behavior of these firms will be motivated by a desire to maximize profits. In their attempt to maximize profits, the firms choose inputs and produce outputs in the most efficient manner. This is the typical situation in an industry operated on a for-profit basis but is by no means the only possibility. Numerous authors have questioned the realism of the profit maximizing hypothesis.[1] The most often listed reason for this distrust of the profit maximizing hypothesis is the modern industrial phenomena of a split between the ownership and the management of the firm. Given this split, it is argued that, while the owners still desire the primary goal of the firm to be one of profit maximization, the manager's motives may diverge from strict accordance to this goal. Various alternatives have been offered in lieu of the hypothesis of profit maximization, including the competing goals of sales, growth, and managerial utility maximization.[2]

Under the sales maximizing strategy, the firm is thought to operate in a fashion designed to maximize output, subject to a profit constraint. The actual formulation of the constraint would differ between firms, but in general, the manager will maximize output,

subject to a level of profits he or she perceives to be the minimum acceptable to the owners. Economically speaking, this behavior implies that resources will be misallocated in that the firm will be producing beyond the level at which profit is maximized. Sales maximization, therefore, leads to an inefficient allocation of resources. Given this inefficiency, why may sales maximization serve as a primary motivating force for the firm? Managers may choose to maximize sales for a number of reasons: (1) they may perceive their own prestige to be determined by the sales of their firms; (2) their income may be a function of their firm's sales; (3) they may desire to increase the market power of their firms; and (4) they may find it easier to acquire investment funds as their sales increase. Whatever the reason, however, if the firm operates on a sales rather than profit maximizing basis, the result is an economically inefficient resource allocation.

The growth maximization hypothesis differs from the sales and managerial utility maximization hypotheses in that it provides a way, other than profit maximization, in which both the desires of the manager and the owner can be satisfied. Specifically, it is argued that both the owners and the managers have utility functions which are dependent upon the size of the firm. The manager, then, acts in a way which maximizes the firm's growth and, therby, jointly maximizes both his or her own and the owners' utility. In this case, the constraints faced by the manager are the fear of corporate takeover and the fear of dismissal. As in the case of sales maximization, to the extent that the manager is capable of increasing output beyond the profit maximizing level, the result will be an inefficient allocation of resources.

Finally, in the model of managerial utility maximization, the manager is thought to maximize his or her own utility, subject to the constraint of profits being at least as great as the perceived minimum acceptable level. Here, as in the sales maximizing model, the manager's goals are thought to diverge from the owners', which remain simply, profit maximization. It is argued that the manager's utility is determined by: (1) job security; (2) the power of discretionary spending; (3) his or her salary; and (4) the size of the staff. In this model, one would expect inefficient managerial spending on emoluments, which would tend to generate costs above the minimum possible if the firm were controlled on a profit maximizing basis.

Theoretically, then, there are a number of reasons why one might choose to depart from the profit maximizing hypothesis when dealing with an industry organized on a for-profit basis. Of primary importance, however, is whether this hypothesis is empirically justified. The work in this area is truly voluminous.[3] A general conclusion can be drawn which suggests that while there are, no doubt, cases in which the profit motive may not be applicable, assuming profit maximization appears to be a good first approximation of the motivation of for-profit firms. In the words of Scherer,

> Deviations, both intended and inadvertent, undoubtedly exist in abundance, but they are kept within more or less narrow bounds by competitive forces, the self-interest of stock owning managers, and the threat of displacement by important outside stockholders and corporate raiders.[4]

Consequently, it appears reasonable to assume that for-profit firms behave in an economically efficient manner due to their adherence to the profit maximizing hypothesis. How does this apply to the hospital industry? It should be recalled that the entire idea of

divergent motives is based on the separation of ownership and management. Further, it is normally argued that the manager's interests are not in complete accord with the owners' who desire profit maximization. In the hospital industry, however, the situation is significantly more dire in that the firms are predominantly nonprofit in nature. Put simply, due to the nonprofit nature of the industry, not only is there a split between the owners and the managers, the goals of the owners should not be thought to necessarily include profit maximization. Finally, while hospitals are not pure monopolists, they are normally rather tight regional oligopolists who rarely engage in price competition. In the hospital industry, the forces Scherer lists as keeping divergences from profit maximization within narrow bounds are either weak or absent. While competitive forces, stockholding managers, and the managerial fear of takeover for inefficient operations no doubt exist within the industry, they are not nearly as potent as they are in a for-profit industry. Given these facts, the behavior of the nonprofit hospital may well diverge from strict profit maximization. To the extent that this occurs, the industry is characterized by economic inefficiency.

The purpose of this chapter is two-fold. First, the various theoretical models of the nonprofit hospital which detail the ways in which the nonprofit hospital may diverge from strict profit maximization will be outlined. Then, the empirical research concerning the relative efficiency of for-profit and nonprofit firms will be reviewed. Taken together, these steps should provide the present research with a theoretical and empirical understanding of the behavior of nonprofit hospitals relative to for-profit hospitals.

The Nonprofit Hospital in Theory

If the motivation of profit maximization is questioned in the nonprofit hospital industry, what determines hospital behavior?[5] Numerous models have been developed; some quite similar to the models discussed above. The earliest, and most commonly used, model is the quantity maximization model.[6] This approach is, in almost every way, identical to the sales maximizing model of Baumol.[7] Specifically, the manager of the hospital is thought to utilize resources so as to maximize the quantity of services offered by the hospital. The constraint faced by the manager is the minimum level of surplus revenues he or she perceives as being acceptable. In the for-profit firm, these surplus revenues (profits) are distributed to the stockholders or held as internal funds. They serve a different purpose in the nonprofit hospital--they allow for the expansion of services, plant, and equipment. Should there exist no desire to expand, output will be maximized subject only to the constraint that the hospital be operated without a loss. Finally, in these models it is normally assumed that the quality of care is given.

Several interesting tangents are offered to the quantity maximization model by Feldstein[8] and Rice.[9] Feldstein adds an aspect of realism to the analysis by assuming that, due to the rather tightly controlled entry conditions of the industry and the lack of information on the part of the consumer, the hospital care markets are essentially monopolistic in nature. The nonprofit hospital manager can then operate in a fashion designed to maximize output without the encumbrances of competition.

Rice attempts to add institutional flavor to the quantity models by suggesting that hospitals provide two types of care: necessary and supplementary care. The key, according to Rice, is that the hospital

will behave in the traditional profit maximizing way in the provision of the supplementary products and then use the profits derived therein to allow for quantity maximization of the provision of the products perceived to be necessities.

Regardless of the individual characteristics of the model, the outcome is the same, economic inefficiency. This inefficiency will take the form of resource misallocation in the direction of the nonprofit hospitals in that they will be operating at a level of output beyond the profit maximizing level.

An alternative to the quantity maximization model is the quality maximization model. The quality model is essentially a Veblenian conspicuous production theory of hospital behavior and is attributed to Lee.[10] For Lee, the hospital's managers are thought to operate so as to maximize their own utility which is a function of their salary, security, and the prestige of their hospital. Of primary importance is the fact that the manager's utility is tied to the status of the hospital. Further, it is assumed that the prestige of the hospital plays a dominant role in the manager's utility function. This model is formalized by assuming that the hospital's status is determined by the range and sophistication of services offered by it, relative to other hospitals. The manager will then operate the hospital in a way designed to maximize the services offered by the hospital, subject to the constraint of some minimum acceptable level of surplus revenues.

The quality maximization model suggests that managers, continuously caught up in the race for status, will tend to acquire quality enhancing inputs, often without regard to the demand for the services provided by those inputs. The result of this model is straightforward. The

hospital will follow a pricing scheme designed to provide the level of surplus revenues required for the purchase and maintenance of quality enhancing inputs. This tendency to purchase inputs without regard to the demand for the services produced by the inputs indicates resource misallocation in the direction of these inputs.

A third approach to the motivation of nonprofit hospital behavior is offered by Newhouse[11] and Feldstein.[12] This approach, referred to as the synthesis approach, basically combines the quantity and quality maximizing models. By positing a utility maximand composed of the two key variables, quality and quantity, the synthesis approach allows the managers a considerably enhanced range of choices.

For Newhouse, the manager is not dissimilar from Lee's manager in that he or she will attempt to maximize the prestige of the hospital.[13] The difference here is that the manager perceives prestige to be a function of the quantity of output as well as the quality of the hospital's inputs. This desire to maximize prestige is reinforced by the medical staff who derive utility from the use of the most advanced inputs and who find it easier to attract new staff members as the quantities of these inputs are increased. Further, the physicians are also quite interested in the quantity of care provided in that they desire beds to be available for their patients should the need arise.[14]

In this model, it is assumed that an increase in the quality of care causes an increase in both the demand for care and the average cost of care. Further, it is assumed that equilibrium occurs where average revenue and average costs are equal. When there is an increase in the quality of care, then, it is impossible to predict whether the quantity of care taken will increase, decrease, or remain unchanged.

The manager is therefore, faced with a productions tradeoff curve between quality and quantity which may initially be of any slope. It is assumed, however, that eventually the curve will attain a negative slope.[15] The task of the manager will be to choose that point of the tradeoff curve which yields the highest level of utility. Graphically, this point of maximum attainable utility will occur where this tradeoff curve is just tangent to the highest attainable indifference curve.

Feldstein's synthesis model differs due to his analysis being an analysis not intended to explain the behavior of the nonprofit firm but rather the sources of cost increases in the industry.[16] A primary difference in the models being that here the demand for care is thought to be independent of the quality of care provided. Essentially, this model suggests that the hospital manager will, given the quantity of care demanded, attempt to maximize the quality of that care. It is important to note that the quantity of care demanded is determined by the interaction of the demand for, and supply of, care.[17] From this model, a tradeoff curve between the quality and quantity of care can be derived. Specifically, given an increase in the supply of patient days, a fall in the equilibrating price will result. This fall requires a corresponding fall in costs so as to avoid a deficit. To reduce costs, the manager is required to reduce the per patient expenditures on inputs, thereby reducing the quality of care.[18] There is, then, a tradeoff between the quality and quantity of care provided.

The economic significance of these synthesis models is clear: output will tend to be carried beyond the level of profit maximization and resources will be misallocated in the direction of prestige enhancing inputs.

A final alternative model of nonprofit hospital behavior is the physician control models of Pauly and Redisch[19] and Buchanan and Lindsay.[20] The key to these models is that they are a reply to institutional phenomena. Specifically, they note that the nonprofit hospital is initiated by two groups, the medical staff and the trustees who are, in effect, equity holders. In this industry, profits, or at least surplus revenues, may be earned, but they accrue to the medical staff not to the equity owners. The physician control models suggest that the hospital is primarily under the control of the medical staff.

In the Pauly and Redisch framework, the medical staff is thought to operate so as to maximize the net surplus revenue, where net surplus revenue represents the residual of revenues which remain after non-physician input costs are paid. In the longer run, the problem facing the medical staff concerns determining the appropriate size of the medical staff. The solution posed suggests that the medical staff will, in an attempt to maximize physician profits, hire new members up to the point at which the addition to physician profits due to the new member is just equal to the cost of hiring the new member.[21] Finally, in the Pauly and Redisch model, it is assumed that the pricing scheme will be one of average cost pricing.[22] A price any higher than average cost will tend to increase total surplus revenues but will tend to drive down the medical staff's net surplus revenues.

The physician control model of Buchanan and Lindsay is a bit different in that it argues that the true power struggle within the nonprofit hospital is between the medical staff and the hospital's managers, not the trustees.[23] The authors indicate that the physicians normally are superior in the battle due to the managers realization

that his or her job security is directly related to their ability to satisfy the medical staff.[24] Again, as in the Pauly and Redisch model, the hospital will be run to satisfy the desires of the physicians. Specifically, the hospital will tend to be inefficient in that the physicians are thought to be little concerned with rising costs, and may in fact, have a cost increasing bias due to their desire to obtain the most sophisticated equipment and excess staff so that their time is most profitably spent.

From an economic standpoint, the physician control models suggest inefficiencies in several ways. First, the physician has an incentive to maintain the most modern facilities and equipment, without regard to the degree of use. Put simply, their profitability is enhanced by the use of these items. Similarly, the physicians have an incentive to maintain excess capacity in order to provide for their own patients should the need arise. Further, the physicians will desire to maintain excessive quantities of skilled support personnel in order to enhance their own productivity. Finally, resources will tend to be misallocated due to the average cost pricing scheme.

Economic Efficiency: The Case of For-Profit and Nonprofit Hospitals

An early test of the relative efficiency of for-profit and nonprofit hospitals was conducted by Ogur.[25] The author correctly points out that economic theory predicts that the nonprofit firm should tend to be less efficient than the for-profit. Specifically, since the nonprofit hospital is not operated on a for-profit basis, it is likely to offer a different mix of services, offer a different quantity of

service, and engage in more within firm consumption than the for-profit.[26] To consider whether the nonprofits do differ from the for-profits in these respects, Ogur estimates a derivative of the for-profit hospitals production function, specifically, the logarithm of the average product of labor. Then, the estimated parameters of this regression are used to predict the value of the average product of labor that would result if the original for-profit firms had been nonprofit. Empirically, it is found that the logarithm of the average product of labor is significantly greater in the for-profit hospitals than in the nonprofit. Ogur suggests that this result is consistent with the above stated theoretical prediction. Specifically, the nonprofit hospital is thought to be producing products of higher quality, treating more severe cases, and engaging in more within firm consumption, all of which would have the tendency of driving the logarithm of the average product of labor below the profit maximizing level.[27]

Kushman and Nuckton consider another aspect of the relative behavior of for-profit and nonprofit hospitals: their responsiveness to changes in demand variables such as population and ability to pay.[28] The authors argue that, theoretically, for-profit hospitals have the most to lose by not responding quickly to demand changes. Put differently, the for-profit manager faces higher costs in ignoring market information than does the nonprofit manager. Using regression analysis, Kushman and Nuckton show that for-profits have been more responsive to changes in both the local population and the local population's ability to pay for hospital care.[29] Further, they report that for-profit hospitals do not appear to significantly increase in numbers as the local population's income rises.

Another group of authors has approached the problem within the property rights framework. Clarkson argues that managers in the non-profit hospital have more latitude to deviate from profit maximization than do their for-profit counterparts.[30] The reason for this increased latitude is that the nonprofit owners differ from the for-profit owner in that the latter view profit maximization as the only legitimate goal of the firm. In such a situation, the for-profit managers' success or failure will be directly related to their ability to maximize the firms profits. This may well not be the case for the managers of nonprofit hospitals. Empirically, Clarkson reports that nonprofit managers tend to select easier managerial tasks, do not use market information as frequently, and generally do not perform managerial functions as efficiently as their for-profit counterparts.[31]

In another study along the property rights line, Baird argues that a significant proportion of the recent rises in hospital costs is attributable to inefficiency brought about by the nonprofit nature of the industry.[32] The argument advanced is that inefficiency is brought about by the fact that no single agent, physician nor manager, can increase their own wealth by improving the hospital's performance. As evidence of this, Baird cites a report of the National Advisory Commission on Health Manpower which suggests that the existing variations in costs between hospitals is too great to be explained by factors such as differences in wages or the quality of care.[33]

Finally, Keating adds that in some 2000 credit unions in 1973, 18 percent of the unions' payrolls were spent on emoluments.[34] Keating explains that this behavior is due to there being an absence of profit

incentives in the industry. To improve industry performance, all that is required is to provide profit incentives to the managers of the nonprofit hospitals.[35]

Several recent studies concentrate on the impact of increased competition on the efficiency of the hospital industry. In the earliest of its type, Joskow incorporates a queuing model to determine the impact of quality competition on the supply of beds.[36] The results indicate that quality competition declines as market concentration increases.[37] Further, it is also found that increased market concentration tends to lead to lower excess capacity. Policies designed to promote entry, given the lack of direct price competition, may lead to uneconomic increases in both the quantity and quality of hospital care provided.[38] In a related study, Wilson and Jadlow consider the relative efficiency of for-profit and nonprofit firms in the provision of nuclear medicine services.[39] The authors find that increased competition in the provision of these services tends to be associated with less economic efficiency. The authors do, however, argue that institutional changes in the direction of more profit incentives would likely improve the performance of this industry.[40]

Finally, a number of researchers have considered the relative efficiency of for-profit and nonprofit firms in industries other than the hospital. For example, Davies considers the case of a public and private airline in Australia.[41] To identify efficiency, Davies calculates several productivity ratios over a 16-year period. Included in these ratios are the tons of freight and mail per employee and the number of passengers per employee. Davies results indicate that, in every case, productivity is greater in the private firm.[42]

In an industry closely related to the hospital industry, Eisenstadt and Kennedy consider the factors which tend to limit inefficiency in the provision of health insurance.[43] Two factors are most significant: competitive market forces and the existence of residual claimants. Unfortunately for the hospital industry, neither are very strong. Specifically, there is a general lack of price competition and residual claimants who have an interest in profit maximization.

To conclude, there are two studies from outside the hospital industry which indicate that for-profit firms need not operate more efficiently in practice than do the nonprofit. Pescatrice and Trapani consider the relative performance of public and private utilities in the U. S.[44] The technique involved is to estimate simultaneously the capital and input demand functions for the two utility types. Then, with this information, relative efficiency is considered by testing for structural differences in the costs of production.[45] The results of the test indicate that the public utilities appear to be more efficient than the private. The remaining study is by Caves and Christensen who consider the provision of rail service in Canada.[46] Using freight ton miles and passenger miles as measures of productivity, Caves and Christensen find that the public railway is consistently more efficient than the private.[47] The authors suggest that the key to productivity is not the property rights arrangement that exist but the degree of price competition that the firm faces.

Summary of the Theoretical and Empirical Research

Numerous theoretical and empirical models have been reviewed in

this chapter. The theoretical models suggest that the behavior of the nonprofit hospital is likely to diverge from strict profit maximization. The direction of the divergence is unclear. The nonprofit manager may desire to maximize the hospital's output or quality of care. Here, he or she would be attempting to maximize the prestige of the hospital. Alternatively, the manager may choose to maximize his or her own utility by increasing the size of the staff or by increasing the funds available for discretionary purposes. But regardless of the direction of the divergence, these theoretical models are consistent in one aspect: each predicts that for-profit hospitals are likely to be more efficient than the nonprofit. The empirical studies reviewed in this chapter are in general support of this hypothesis.

ENDNOTES

[1]For examples of this literature see: K. E. Boulding, "The Theory of the Firm in the Last Ten Years," American Economic Review, XXXII (1942), pp. 791-802; Fritz Machlup, "Marginal Analysis and Empirical Research," American Economic Review, XXXVI (1946), pp. 519-554; and Andreas G. Papandreou, "Some Basic Problems in Theory of the Firm," in B. F. Haley (ed.), A Survey of Contemporary Economics (Homewood, 1952).

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[3]For a review of this literature see: F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago, 1980).

[4]Ibid., p. 41.

[5]For a good review see: Philip Jacobs, "A Survey of Economic Models of Hospitals," Inquiry, XI (1974), pp. 83-97.

[6]See: R. G. Rice, "Analysis of the Hospital as an Economic Organism," Modern Hospital, XXI (1966), pp. 87-91; Paul Feldstein, "Applying Economic Concepts to Hospital Care," Hospital Administration, XIII (1968), pp. 68-89; and Max Brown, "An Economic Analysis of Hospital Operations," Hospital Administration, XV (1970), pp. 60-74.

[7]Baumol.

[8]Feldstein, p. 87.

[9]Rice.

[10]Maw Lin Lee; "A Conspicuous Production Theory of Hospital Behavior," Southern Economic Journal, XXXVIII (1971), pp. 48-58.

[11]Joseph P. Newhouse, "Toward a Theory of Nonprofit Institutions: An Economic Model of a Hospital," American Economic Review, LX (1970), pp. 64-74.

[12]Martin Feldstein, "Hospital Cost Inflation: A Study of Nonprofit Price Dynamics," American Economic Review, LXI (1971), pp. 857-890.

[13]Newhouse, p. 65.

[14]Ibid.

[15]Ibid., p. 68.

[16]Feldstein, p. 870.

[17]Ibid., p. 888.

[18]Ibid., p. 890.

[19]Mark Pauly and Michael Redisch, "The Not-For-Profit Hospital as a Physician's Cooperative," American Economic Review, LXIII (1973), pp. 87-100.

[20]James M. Buchanan and C. M. Lindsay, "Financing of Medical Care in the United States," in Health Services Financing (London, 1970).

[21]Pauly and Redisch, p. 90.

[22]Ibid., p. 89.

[23]Buchanan and Lindsay, p. 60.

[24]Ibid., p. 64.

[25]Jonathan D. Ogur, "The Nonprofit Firm: A Test of the Theory of the Hospital Industry," Journal of Economics and Business, XXVI (1974), pp. 117-123.

[26]Ibid., p. 117.

[27]Ibid., p. 119.

[28]John E. Kushman and Carole F. Nuckton, "Further Evidence on the Relative Performance of Proprietary and Nonprofit Hospitals," Medical Care, XV (1977), pp. 189-203.

[29]Ibid., p. 200.

[30]Kenneth W. Clarkson, "Some Implications of Property Rights in Hospital Management," Journal of Law and Economics, XV (1972), pp. 363-384.

[31]Ibid., p. 375.

[32]Charles W. Baird, "On Profits and Hospitals," Journal of Economic Issues, V (1971), pp. 57-66.

[33]Ibid., p. 60.

[34]Barry P. Keating, "Prescriptions for Efficiency in Nonprofit Hospitals," Applied Economics, XI (1970), pp. 321-332.

[35]Ibid., p. 331.

[36]Paul L. Joskow, "The Effects of Competition and Regulation on Hospital Bed Supply and the Reservation Quality of the Hospital," The Bell Journal of Economics, XI (1980), pp. 421-447.

[37]Ibid., p. 445.

[38]Ibid., p. 446.

[39]Wilson and Jadlow.

[40]Ibid., p. .

[41]David G. Davies, "The Efficiency of Public Versus Private Firms, The Case of Australia's Two Airlines," Journal of Law and Economics, XX (1977), pp. 223-227.

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[44]Donn R. Pescatrice and John M. Trapani, "The Performance and Objectives of Public and Private Utilities Operating in the United States," Journal of Public Economics, XIII (1980), pp. 259-276.

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[46]Douglas W. Caves and Laurits R. Christensen, "The Relative Efficiency of Public and Private Firms in a Competitive Environment: The Case of Canada's Two Railroads," Journal of Political Economy, LXXXVIII (1980), pp. 958-976.

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CHAPTER III

CONCEPTUAL AND STATISTICAL FRAMEWORK

Introduction

In the first chapter of this work, it was argued that one should expect, theoretically, differences in motivation to exist between nonprofit and for-profit hospital managers. This expectation is best understood with an appeal to the idea of property rights.[1] It is thought that the for-profit manager will operate the for-profit hospital in an economically efficient fashion while the nonprofit manager's behavior may diverge from strict profit maximization. The reasons for this divergence in behavior are numerous but all flow from the same essential idea. The nonprofit manager lacks the efficiency inducing profit incentives faced by the for-profit manager. Specifically, in the for-profit hospital, the owner has an exclusive residual claim to the surplus revenues generated by the hospital. In such a situation, the owners' desire for the firm is likely that it be operated in a profit maximizing manner. Further, when the owners appoint a manager for the hospital, the manager's motives will also tend to include profit maximization. The reasoning here is simply that the owners may insure the conformity of the manager's motives with his or her own by extending a partial residual claim to the firm's profits to the manager. Also, the for-profit manager operates under the realization that his or her tenure as manager is dependent upon the performance of

the hospital. Not only may the owners replace the manager, but there exists the ever present danger of corporate takeover. Consequently, the manager of the for-profit hospital faces incentives which should induce profit maximizing behavior.

The situation in the nonprofit hospital differs significantly. At the most general level, it should be noted that the owner of the nonprofit hospital does not hold a residual claim to the hospital's surplus revenues. Given this, the assumption of a profit maximization motive on the part of the nonprofit hospital owner is, at best, questionable. Compounding the problem for the nonprofit hospital is the fact that the efficiency inducing incentives which face the for-profit manager are either weak or nonexistent in the nonprofit firm. Specifically, given that the owners lack a residual claim to the firm's surplus revenues, the manager may not realize a positive economic benefit from operating the hospital in the most efficient manner possible. Further, the fear of corporate takeover is greatly reduced by the nonprofit nature of the hospital. Finally, the last efficiency inducing incentive is the fear of being replaced by the owners of the hospital. Again, however, the strength of this incentive is suspect in the nonprofit firm. Specifically, when the owners' motivation cannot be assumed to be profit maximization, it should not be assumed that the manager's tenure will be determined by his or her ability to maximize the nonprofit hospital's surplus revenues. Therefore, in the nonprofit case, profit maximization should not be assumed in that the efficiency inducing profit incentives that exist in the for-profit hospital are lacking.

If the assumption of profit maximization is relaxed for the nonprofit hospital, what does serve as the motive or motives for the

nonprofit manager? In the second chapter of this work several models of nonprofit hospital behavior were presented, each assuming a different managerial motive. The key to these models is that they each suggest testable hypotheses concerning the ways in which for-profit and nonprofit hospital behavior might differ, due to these differing managerial motivations. In this chapter, the predicted divergences in for-profit and nonprofit behavior are identified. In this way, no single model of nonprofit behavior is assumed to be superior. By considering the predictions of each of the models, in reality, a synthesis model of the nonprofit hospital is constructed.

Once the predicted differences in behavior are enumerated, hypotheses concerning these predictions can be developed. These hypotheses will then serve in the empirical tests which are designed to determine whether significant differences in behavior exist between for-profit and nonprofit hospitals. The second part of this chapter will present an exact specification of the hypotheses to be tested and a thorough development of the methodology to be utilized in the tests.

Finally, at the end of this chapter, a discussion of the data to be employed in the study is presented.

Theoretically Predicted Differences in For-Profit and Nonprofit Hospital Behavior

In the review of the literature presented in Chapter II, three models of the nonprofit hospital were briefly discussed: the quality maximization model, the physician control model, and the quantity maximization model. Each of these models leads to predictions concerning the expected divergences between for-profit and nonprofit hospital

behavior. Consider first the quality maximization model.[2] In this model, as presented by Lee, the manager of the nonprofit hospital is thought to operate the firm so as to maximize his own utility which is assumed to be dependent on the status of the hospital. Of particular importance is the belief that the hospital's status is determined by the range and sophistication of the services offered by the hospital.[3] In order to increase the range and sophistication of services offered, the manager of the nonprofit hospital will purchase inputs often without regard to the demand for the services provided. The only constraint facing the manager is the level of surplus revenues perceived to be minimally acceptable to the owners.

Consequently, within the quality maximization model competition exists between the nonprofit hospitals, but it is in terms of the range of services offered and the sophistication of the procedures involved rather than price competition. Such a model leads to a prediction concerning the relative behavior of for-profit and nonprofit hospitals. Specifically, one should expect to find a significant difference in the mix of cases handled by the two types of hospitals. The direction of this difference should be such that the nonprofits tend to handle a significantly larger proportion of serious cases such as intensive care or intensive cardiac care. The reason for this is simply that these relatively serious cases are those cases which require the use of the most sophisticated, and therefore, prestigious inputs. By treating a significantly more serious mix of cases, then, the nonprofit hospital manager can improve the relative status of the hospital, and thereby, increase his or her own utility.

Given this, one theoretical prediction concerning the relative differences in for-profit and nonprofit hospital behavior is simply that one can reasonably expect significant differences to exist in the mix of cases handled by the two hospital types.

Considering the physician control model, a second theoretical prediction is identified.[4] In this model, it is assumed that the hospital is in the control of the staff of physicians. Given their control, the physicians are thought to operate the nonprofit hospital so as to maximize their own utility. How will this maximization scheme differ from the for-profit case? The differences lie in the fact that the physicians do not have an incentive to hold hospital costs down and may actually have a pro-cost incentive. Specifically, in order to maximize their pecuniary and nonpecuniary income from the hospital, the physicians may desire costly increases in both sophisticated equipment and, more importantly, highly trained supporting personnel. The desire for the most modern, sophisticated equipment is not dissimilar from the prediction of the quality maximization model and bears no further mention. The desire for a larger staff of highly trained supporting personnel is, however, unique. By demanding this highly skilled supporting staff, the physicians are setting in motion forces designed to increase their own productivity.

Given the physician control model, then, one would expect to find significant differences in the mix of labor inputs employed by the for-profit and nonprofit hospitals. Specifically, in the nonprofit hospitals, it is predicted that the mix of labor skills will be more heavily tilted towards the relatively more skilled interns and

registered nurses and away from the less skilled aids, orderlies, and attendants than in the for-profit hospitals.

The final model to be considered is the quantity maximization model.[5] This model assumes that the nonprofit hospital manager will purchase and combine resources so as to maximize the output of the hospital, subject only to the constraint of a level of surplus revenues perceived as being minimally acceptable. Given that this minimally acceptable level of surplus revenues is less than the profit maximizing level, the nonprofit hospital will purchase more inputs and produce a greater output than the for-profit hospital.

Consequently, based on the quantity maximization model, one should expect significant differences to exist in the productive relationships of the two hospital types. It should be noted that this prediction is consistent with the two previously mentioned predictions. Each would indicate differences in the productive relationships of the two hospital types. Should such productive differences be found, an appropriate question to consider is, which of the two hospital types is producing more efficiently?

Based on the theories of nonprofit hospital behavior, three behavioral differences are expected between the nonprofit and for-profit hospitals. First, a reflection of the quality maximization model should be found in the relatively more severe mix of cases dealt with by the nonprofit hospitals. Further, from the physician control model, it is expected that the nonprofit hospitals' mix of labor inputs will be relatively more skilled. Finally, from the quantity maximization model, as well as the other models, it is predicted that the productive

relationships of the nonprofit hospital will differ significantly from those in the for-profit hospital.

Hypotheses and Methodology

The Hypotheses

The theoretical models of nonprofit hospital behavior predict differences in the mix of cases handled, the mix of labor inputs used, and the productive relationships of for-profit and nonprofit hospitals. These predictions can be formalized into testable hypotheses. The first null hypothesis is that the for-profit and nonprofit hospitals treat the same mix of cases. Similarly, the second null hypothesis is that the two hospital types employ an equally skilled mix of labor inputs. Finally, the third null hypothesis is that the for-profit and nonprofit hospitals operate under the same productive relationships. From this last hypothesis, an extension is offered in the form of a fourth null hypothesis: the for-profit and nonprofit hospitals are equally efficient.

The Methodology

Case Mix Hypothesis. Testing the first hypothesis requires consideration of the mix of cases dealt with by each of the hospital types. Much has been written concerning the multi-dimensional nature of hospital output.[6] From this literature, it appears that an acceptable way to measure hospital output is to distribute inpatient days by the type of medical service provided.[7] In the present study, the case mix will represent the proportion of total inpatient days distributed by the following categories of service provided: general medical, CM-GM;

intensive care unit, CM-ICU; intensive cardiac care unit, CM-ICCU; pediatrics, CM-PED; and, obstetrics and gynecology, CM-OBGYN. Given this, the test of the hypothesis will be constructed so as to identify differences that might exist between the case mixes of the two hospital types. The methodology to test this hypothesis is the multivariate analysis of variance (MANOVA).[8] Specifically, a multivariate variable, case mix, will be drawn from each of the two hospital populations. Unlike the simple ANOVA case, the means of these variables are vectors rather than scalars. ANOVA, in this case, would allow a comparison of each case mix variable separately. For example, the ANOVA procedure would identify any differences that exist between CM-GM in the two hospital types, then CM-ICU, and so on. The problem with this approach is that it overlooks the very reason case mix variables are often used in the hospital industry. Specifically, case mix breakdowns are used in that it is believed that significant relationships exist between the various services provided in the hospital. For example, there is a belief that a significant relationship exists between the pediatric services of a hospital and that hospital's general medical offering. To this extent, then, the appropriate test of the hypothesis should consider whether significant differences exist in the case mix variables, not sequentially as in the ANOVA case, but simultaneously. Put differently, the appropriate test is to consider whether the case mixes of the two hospital types taken as a whole, not individually, differ. The MANOVA procedure allows for just this type comparison.

Statistically, the MANOVA, as applied to this hypothesis, is as follows: there exists a vector of five case mix variables, CM-GM,

CM-ICU, CM-ICCU, CM-PED, and CM-OBGYM, arising from two normal populations--for-profit and nonprofit hospitals:

$$X = (X_1, X_2, \ldots, X_5) \sim N(\mu_X, \Sigma)$$

$$Y = (Y_1, Y_2, \ldots, Y_5) \sim N(\mu_Y, \Sigma)$$

The populations are assumed to have the same variance covariance matrices and X and Y are independent random vectors. The hypothesis to be tested is that the two population means are equal:

$$H_0: \ \mu_X = \mu_Y$$

$$H_1: \ \mu_X \neq \mu_Y$$

where μ_X and μ_Y represent the means of the for-profit and nonprofit case vectors, respectively.

To test the hypothesis, a random sample of size n_1 is drawn from the for-profit hospitals and of size n_2 from the nonprofit hospitals:

$$X_i = (X_{i1}, X_{i2}, \ldots, X_{i5}) \qquad i = 1, 2, 3, \ldots, n_1 \tag{1}$$

$$Y_i = (Y_{i1}, Y_{i2}, \ldots, Y_{i5}) \qquad i = 1, 2, 3, \ldots, n_2 \tag{2}$$

Analogous to the ANOVA case, a MANOVA table is constructed as:

Source	Sum-of-Squares	df
Between Groups	H	k-1
Error	R	N-k
Total	T	N-1

where H is a p*p matrix of between groups sum-of-squares for each variable along the main diagonal and between groups cross-products in the off-diagonal elements. R is the residual sum-of-squares and

cross-products p*p matrix, and T is the total sum-of-squares and cross-products p*p matrix. As can be seen, the difference between this procedure and the simple one-way ANOVA is the allowance for the relationships among the variables as depicted in the cross-product terms. The test statistic used to test differences in the group means is Wilks' Lambda (Λ), where:

$$\Lambda = \frac{|R|}{|H|+|R|}$$

for k-1 = 1 (k = 2 groups) and, under the null hypothesis:

$$\frac{1 - \Lambda_{obs}}{\Lambda_{obs}} \frac{(df_R - p + 1)}{p} \sim F\ (p,\ r - p + 1)$$

where r equals N-2 and p is the number of variates. The null hypothesis is rejected for:

$$\frac{1 - \Lambda_{obs}}{\Lambda_{obs}} \frac{(df_R - p + 1)}{p} > F_{tab}\ (p,\ r - p + 1,\ \alpha)$$

A rejection of the null would imply that significant differences exist between the case mixes of the for-profit and nonprofit hospitals. Should the null be rejected, a set of simultaneous confidence intervals may be constructed to allow identification of the mean differences of the case mix variables which led to the rejection.

While, as discussed above, the MANOVA is the appropriate procedure to use in detecting case mix differences, the simple one-way ANOVA may be of some value. This is quickly realized when it is noted that significant differences may exist between individual case mix groupings which go undetected by the MANOVA procedure. The reason for this is that the MANOVA procedure only considers whether the case mix vector

means differ between the for-profit and nonprofit hospitals. With MANOVA, then, a significant difference may exist between the two hospital types in the case mix grouping general medical (CM-GM) but this difference is swamped by the similarity of the other individual groupings. A failure to reject the null hypothesis in the MANOVA procedure may, then, be somewhat misleading. Consequently, should the null in the MANOVA not be rejected, individual univariate one-way ANOVA procedures will be conducted to determine if any significant differences exist between the individual case mix groupings of the two hospital types.

Statistically, the ANOVA, in this case, will be designed to test the hypothesis that the means of the individual case mix groupings (ℓ) are equal, for the for-profit and nonprofit hospitals, x and y, respectively:

$$H_0: \ \mu_{x\ell} = \mu_{y\ell}$$

$$H_1: \ \mu_{x\ell} \neq \mu_{y\ell}$$

where $\mu_{x\ell}$ and $\mu_{y\ell}$ represent the means of the individual case mix groupings (ℓ) for the for-profit and nonprofit hospitals, x and y, respectively.

The appropriate test statistic for the univariate one-way ANOVA is:

$$F = \frac{nS_{\bar{X}}^2}{S_p^2}$$

where $S_{\bar{X}}^2$ = variance of sample means,

S_p^2 = pooled variance,

n = sample size,

and (n-1) and r(n-1) are the appropriate degrees of freedom. The null hypothesis is rejected for:

$$\frac{nS_{\bar{X}}^2}{S_p^2} > F_{tab}\ (n-1,\ r(n-1),\ \alpha)$$

Should any of the null hypotheses be rejected, it may be concluded that a significant difference does exist between that particular case mix grouping in the two hospital types.

Skill Mix Hypothesis. The second hypothesis to be tested is that the for-profit and nonprofit hospitals employ equally skilled mixes of labor inputs. This requires consideration of the distribution of hospital employees by the category of their employment. In this study, the hospital's personnel is distributed by the following skill mix categories: staff physicians, SM-DOC; interns, SM-INT; registered nurses, SM-RN; licensed practical nurses, SM-LPN; aids, orderlies, and attendants, SM-AOA; and other employees, SM-O. Determining whether significant differences exist between the skill mixes of the two hospital types is directly analogous to the case mix hypothesis considered above. The appropriate procedure is again, the MANOVA. This time, rather than drawing samples of the for-profit and nonprofit hospital outputs, samples of the two hospitals labor inputs are drawn. The samples, arising from the two normal populations, yield n_1 and n_2 skill mix variables for the for-profit and nonprofit hospitals:

$$z_j = (z_{j1}, z_{j2}, \ldots, z_{j6}) \qquad j = 1, 2, 3, \ldots, n_1$$

$$w_j = (w_{j1}, w_{j2}, \ldots, w_{j6}) \qquad j = 1, 2, 3, \ldots, n_2$$

The hypothesis to be tested is:

$$H_0: \mu_z = \mu_w$$

$$H_1: \mu_z \neq \mu_w$$

where μ_z and μ_w represent the means of the case mix vectors for the for-profit and nonprofit hospitals, respectively.

Again, the appropriate test statistic is Wilks' Lambda (Λ), and is defined as before. The test rejection criteria is the same as above, in the case mix hypothesis. As was the case for the first hypothesis, if the null is rejected, a set of simultaneous confidence intervals may be constructed to determine which mean differences of the skill mix variables led to the rejection. The procedure is identical to that employed above in the case mix hypothesis.

As was the case in the case mix hypothesis above, failure to reject the null hypothesis being considered in the MANOVA procedure may misleadingly suggest that no significant differences exist between the skill mix categories of the two hospital types. Again, to take this possibility into account, individual univariate one-way ANOVA procedures will be conducted. The hypothesis being tested is that the means of the individual skill mix groupings (g) are equal for the for-profit and nonprofit hospitals, z and w, respectively.

$$H_0: \mu_{zg} = \mu_{wg}$$

$$H_1: \mu_{zg} \neq \mu_{wg}$$

where μ_{zg} and μ_{wg} represent the means of the individual case mix groupings (g) for the for-profit and nonprofit hospitals z and w, respectively.

The appropriate test statistic and rejection criteria are identical to those presented above for the case mix hypothesis and will not be repeated here. A rejection of any of the individual null hypotheses in this section would indicate the existence of significant differences between the two hospital types with regard to that skill mix grouping.

Productive Relations Hypothesis. The third hypothesis to be tested is that the for-profit and nonprofit hospitals operate under the same productive relationships. Testing this hypothesis, in general terms, amounts to determining whether the two hospitals operate under equivalent production functions. An adequate specification of the hospital production function must, then, be specified. This seems to be rather straightforward, but many problems exist in selecting a production function for the hospital industry. Montfort argues that the usual assumptions underlying the theory of production do not hold in the hospital sector.[9] Factors such as inefficient input combinations and nonsubstitutability create problems in interpreting estimates of output parameter values. Also, it is suggested that the Cobb-Douglas and Constant Elasticity of Substitution specifications are not applicable to hospitals, since output elasticities are dependent upon input levels. In order to allow for these changing elasticities, Montfort estimates a Transcendental Logarithmic production function.[10] The author finds that the Translog specification fits the hospital industry better than the Cobb-Douglas or the CES. This result is supported by Hellinger who also finds the Translog to be superior for empirical work in the hospital sector.[11]

The methodology to test the third hypothesis starts with the following form of the Translog production function:

$$\ln Q_{it} = a_0 + a_1 \ln L_{it} + a_2 \ln K_{it} + a_{11} \ln^2 L_{it} + a_{22} \ln^2 K_{it} + a_{12}(\ln L_{it})(\ln K_{it}) + b_0 d + b_1 d \ln L_{it} + b_2 d \ln K_{it} + b_{11} d \ln^2 L_{it} + b_{22} d \ln^2 K_{it} + b_{12} d(\ln L_{it})(\ln K_{it}) \quad (3)$$

where ln = the natural log of the variable in question,

Q = hospital output, inpatient days,

K = capital input, staffed beds,

L = labor input, total personnel,

d = dummy variable representing hospital type (d = 0 for nonprofit and d = 1 for for-profit hospitals),

n_1, n_2 = sample sizes for the nonprofit and for-profit hospitals, respectively,

i = hospital, and

t = year.

The hypothesis to be tested is that the for-profit and nonprofit hospitals operate under the same productive relationships. As formalized here, this amounts to determining whether the coefficients on the dummy variables in equation (3) are simultaneously equal to zero. The logic is simply that, if by adding the for-profit hospitals into the model through the dummy variables, the production function is not significantly altered, then it can be concluded that the for-profit and nonprofit hospitals do, in fact, operate under the same productive conditions. Should the coefficients on the dummy variables be found to simultaneously differ from zero, then the null hypothesis is rejected. This would imply that the two hospital types do not operate under the same productive conditions. The test then is:

H_0: $b_j = 0,\ j = 0, 1, 2, 11, 22, 12.$

H_1: not H_0

The appropriate test statistic for the simultaneous test of several parameters is:[12]

$$\frac{(ESS_R - ESS_{UR}) \div q}{ESS_{UR} \div (N-k)} \sim F\ (q, N-k)$$

where ESS_R = error sum-of-squares of the restricted model,

ESS_{UR} = error sum-of-squares of the unrestricted model,

q = number of restrictions implied by the null, and

$N-k$ = degrees of freedom in the unrestricted model.

The null hypothesis is rejected for:

$$\frac{(ESS_R - ESS_{UR}) \div q}{ESS_{UR} \div (N-k)} > F_{tab}\ (q, N-k, \alpha)$$

The basis of this test is provided by the increase in the error sum-of-squares due to imposing the condition that the null is true. Given that the null is true, imposing the condition will increase the error sum-of-squares by no more than that which can be attributed to sampling fluctuations. Therefore, the test is designed to determine whether the observed increase in the error sum-of-squares is significantly greater than zero. Further, the estimation procedure used is ordinary least squares.

Finally, it should be noted that the specification of equation (3) must be altered if either, or both, of the first two null hypotheses are rejected. Should significant differences exist in the case mixes or skill mixes of the two hospital types, then the implicit assumption of homogeneous output (inpatient days) and homogeneous input (total

personnel) must be rejected. The alternation in equation (3) would take the form of estimating the production function for each of the case mix categories separately, rather than simply summing over the numbers of inpatient days in each case mix grouping. Further, the labor variable would be altered by using the skill mix breakdown, adjusted for the particular case mix in question, rather than simply the total number of personnel. This adjustment is unnecessary, however, if the case mixes and skill mixes of the two hospital types are found not to significantly differ. In such a case, it would be reasonable to sum over the various case and skill mix categories to form the desired output and labor input variables.

By estimating this variant of the Translog production function, then, it can be determined whether the for-profit and nonprofit hospitals operate in the same, or a significantly different, fashion. If a determination is made that the two hospital types do produce in significantly different fashions, then a fourth hypothesis is considered. The fourth hypothesis is that the for-profit and nonprofit hospitals are equally efficient. To formalize this hypothesis one may rewrite the Translog production function of equation (3) in its component nonprofit and for-profit parts. For the nonprofits:

$$\ln Q_{it} = a_0 + a_1 \ln L_{it} + a_2 \ln K_{it} + a_{11} \ln^2 L_{it} + a_{22} \ln^2 K_{it} + a_{12}(\ln L_{it})(\ln K_{it}) = F_1(K_{it}, L_{it}) \quad (4)$$

and for the for-profits:

$$\ln Q_{it} = (a_0 + b_0) + (a_1 + b_1)\ln L_{it} + (a_2 + b_2)\ln K_{it} + (a_{11} + b_{11})\ln^2 L_{it} + (a_{22} + b_{22})\ln^2 K_{it} + (a_{12} + b_{12})(\ln L_{it})(\ln K_{it}) = F_2(K_{it}, L_{it}) \quad (5)$$

Given the two production functions, F_1 and F_2, a test of the hypothesis merely requires determining if, given a set of inputs, one of the production functions yields a greater level of output. Formally, the hypothesis is stated as:

$$H_0: \sum_{i=1}^{n_2} F_2(K_{it}, L_{it}) = \sum_{i=1}^{n_2} F_1(K_{it}, L_{it})$$

$$H_1: \text{not } H_0$$

Intuitively, the test will be to determine whether it makes a significant difference which production technique, the for-profit or nonprofit, is employed, given a set of inputs. To do this, F_2, the production function of the for-profit hospitals, is constrained to be such that the for-profits are producing under the same productive conditions as the nonprofits. In other words, the coefficients on the dummy variables are constrained such that their effect cancels out.[13] The appropriate test statistic and corresponding rejection criteria are the same as given above for the third hypothesis test.

Should the null be rejected, a t test may be performed to determine the direction of the increased efficiency. Again, rewriting equation (3):

$$\ln Q = \ln X + \ln Z \tag{6}$$

where $\ln X$ represents the situation when $d = 0$, and $\ln Z$ is the case when only the for-profits are considered.

The test of efficiency then becomes a question of determining whether the mean of $\ln Z$ is significantly different from zero (greater for for-profit efficiency). The appropriate test statistic is:

$$t = \frac{\ln \bar{Z}}{S}$$

where S represents the standard deviation.

The null hypothesis of equal efficiency is rejected for:

$$\frac{\overline{\ln Z}}{S} > t_{c,\alpha}$$

Should this null be rejected, and the mean of ln Z be found to be significantly greater than zero, it can be concluded that the for-profit hospitals are more efficient than the nonprofits.

Finally, it should be noted that a test of the fourth hypothesis becomes redundant if the third hypothesis is not rejected. This can most easily be seen by recalling that the third null hypothesis suggests that the coefficients on the ownership dummy variables are all simultaneously equal to zero, while the fourth null hypothesis states that a linear combination of the dummies is equal to zero. Clearly, if the third hypothesis is not rejected, then the fourth cannot be, in that the third would imply any linear combination of the dummies must also be equal to zero.

The Data

The data for the research outlined above are taken from the Annual Hospital Survey of the Oklahoma Health Planning Commission. The study will include responses of the 120 short-term, acute-care hospitals in the state for the years 1978, 1979, 1980, and 1981. This data includes each of the variables mentioned above and has been verified by the staff of the Commission. Of importance for the study, 14 of the 120 hospitals are categorized as being owned or managed for-profit. This

is roughly the same proportion of for-profit hospitals in the nation as a whole. Further, the use of actual hospital data, rather than statewide averages as in many studies, allows one to avoid the aggregation problems involved with average data.

Summary

In this chapter, the hypotheses that serve as the basis of the research were developed. From the theoretical models of the nonprofit hospital, predictions concerning the relative behavior of for-profit and nonprofit hospitals are made. Specifically, these models suggest that differences should exist in the mix of cases treated by the two hospital types, the mix of skilled labor employed, and the productive conditions of the two hospital types. These theoretical predictions serve as the hypotheses to be tested.

The results of the tests of the hypotheses will be reported in Chapter IV. The data used in the tests are taken from the Oklahoma Health Planning Commission.

ENDNOTES

[1]For a review of this literature see: Louis De Alessi, "The Economics of Property Rights: A Review of the Evidence," Research in Law and Economics (1980), pp. 1-47.

[2]Consider Lee.

[3]Ibid., p. 49.

[4]Consider Pauly and Redisch or Buchanan and Lindsay.

[5]Consider Rice or Brown.

[6]See Ralph E. Berry, "Product Heterogeneity and Hospital Cost Analysis," Inquiry, VII (1973), pp. 350-363; Maw Lin Lee and Richard Wallace, "Some Problems in Estimating Multi-Cost Production Functions: An Application to Hospitals," Western Economic Journal, (1973), pp. 350-363; and Judith R. Lave and Lester B. Lave, "Hospital Cost Functions," American Economic Review, LX (1970), pp. 379-395.

[7]Theodore D. Klastorin and Carolyn A. Watts, "On the Measurement of Hospital Case Mix," Medical Care, XVIII (1980), pp. 675-685.

[8]For a thorough discussion of the MANOVA procedure see Richard H. Lindeman, Introduction to Bivariate and Multivariate Analysis (Glenview, 1980), pp. 220-244.

[9]Guus P. W. P. van Montfort, "Production Functions for the General Hospital," Social Science Medicine, XV (1981), pp. 87-98.

[10]For a discussion of the Translog function see E. R. Brendt and Laurits R. Christensen, "The Translog Production Function and the Substitution of Equipment, Structures, and Labor in U. S. Manufacturing, 1928-1968," Journal of Econometrics, I (1972), pp. 81-113.

[11]Fred J. Hellinger, "Specification of a Hospital Production Function," Applied Economics, VII (1975), pp. 149-160.

[12]For this test statistic see Robert S. Pindyck and Daniel L. Rubinfeld, Econometric Models and Economic Forecasts (New York, 1981), p. 118.

[13]For this testing procedure see J. Johnston, Econometric Methods (New York, 1972), pp. 155-159, or G. S. Maddala, Econometrics (New York, 1977), pp. 196-201.

CHAPTER IV

EMPIRICAL RESULTS

Introduction

The theoretical models discussed in Chapter II offer several testable hypotheses concerning the relative behavior of for-profit and nonprofit hospitals. These hypotheses were discussed and formally specified in Chapter III. The first null hypothesis is that the two hospital types handle the same mix of cases. From the discussion of Chapter III, one would expect this hypothesis to be rejected, indicating that the two hospital types handle significantly different mixes of cases. Theoretically, the direction of the difference is predicted to be such that the nonprofit hospitals treat proportionately more severe cases in which a higher quantity and quality of care is required.[1]

The second null hypothesis to be tested is that the for-profit and nonprofit hospitals employ an equally skilled mix of labor inputs. Again, the theoretical models of nonprofit hospital behavior indicate that this hypothesis should be rejected.[2] From the physician control models, the direction of the differences in skill mix should be such that the nonprofit hospitals employ a relatively more skilled group of workers.

A third null hypothesis is that the two hospital types produce under identical productive relationships.[3] Should this hypothesis be rejected, as is theoretically expected, an extension to this hypothesis

is considered. The extension is in the form of the fourth hypothesis, which is that the for-profit and nonprofit hospitals are equally efficient. Based on the discussion of each of the models of nonprofit hospital behavior, as well as the general discussion of the idea of property rights, this hypothesis is expected to be rejected.[4]

The purpose of this chapter is to present the results of the empirical tests of these hypotheses.

Tests of the Hypotheses

The Case Mix Hypothesis

The first null hypothesis is that the for-profit and nonprofit hospitals treat the same mix of cases. To consider this hypothesis, a case mix variable is defined as the proportion of inpatient days in each of five possible service categories: general medical, CM-GM; intensive care, CM-ICU; intensive cardiac care, CM-ICCU; pediatrics, CM-PED; and, obstetrics and gynecology, CM-OBGYM. For the samples of for-profit and nonprofit hospitals, then, there will be a case mix vector representing, on average, the proportion of total inpatient days, in each hospital type, that are from each of the five service categories. The null hypothesis to be tested is that the two case mix vectors are the same. Formally stated, the first null hypothesis is:

$$H_0: \ \mu_x = \mu_y$$

$$H_1: \ \mu_x \neq \mu_y$$

where μ_x and μ_y are the means of the nonprofit and for-profit case mix vectors, respectively.

The methodology employed to test this hypothesis is the MANOVA, as outlined in Chapter III. The sample size for the test is 345. The appropriate test statistic for the procedure is Wilks' Lambda (Λ):[5]

$$\Lambda = \frac{|R|}{|H + R|}$$

which, with the proper adjustment, is distributed as an F-statistic with p, and r-p+1 degrees of freedom. The null hypothesis is rejected for:

$$\frac{1 - \Lambda_{obs}}{\Lambda_{obs}} \frac{(df_R - p + 1)}{p} > F_{tab\ (p,\ r-p+1,\ \alpha)}$$

In this case, with 5 and 339 degrees of freedom, the observed F value is:

$$F(5,339) = 1.18$$

while, the critical value of the F distribution at the 5 percent level, by interpolation is:

$$F_{tab\ (p,\ r-p+1,\alpha)} = 2.24.$$

Therefore, the hypothesis of equal case mix means cannot be rejected. Failure to reject the null implies that, contrary to the theoretical prediction, the for-profit and nonprofit hospitals did not treat a significantly dissimilar mix of cases during the sample period. It should be recalled that the nonprofits were expected to treat a case mix heavily skewed to more serious cases, relative to the for-profit hospitals. This expectation was based on the belief that the more serious cases required greater quantities and qualities of care and a

more sophisticated mix of inputs. Consequently, by treating a relatively more severe mix of cases, the nonprofit manager could increase the prestige of the hospital, and thereby, his or her own utility.

To subject this result to closer scrutiny, individual ANOVA procedures were conducted on the case mix groupings. This approach, as discussed in Chapter III, is not directly applicable to the hospital industry due to the assumed relationships among the various case mix groupings. It is possible, however, that significant differences exist between individual case mix groups between the two hospital types, but that this difference is swamped by the general similarity of the case mixes taken as a whole, when the MANOVA procedure is used. To consider this possibility, individual univariate one-way ANOVA procedures were performed. The hypothesis being tested in this procedure is that the means of the individual case mix groupings (ℓ) are equal for the for-profit and nonprofit hospitals, x and y, respectively:

$$H_0: \mu_{x\ell} = \mu_{y\ell}$$

$$H_1: \mu_{x\ell} \neq \mu_{y\ell}$$

An appropriate test statistic is:

$$F = \frac{nS_{\bar{X}}^2}{S_p^2}$$

The null hypothesis is rejected for:

$$\frac{nS_{\bar{X}}^2}{S_p^2} > F_{tab\ (n-1,\ r(n-1),\ \alpha)}$$

The results of the individual ANOVA procedures are presented in Table I.

TABLE I

CASE MIX ANOVA

Variable	Observed F	df
CM-GM	0.49	1,339
CM-ICU	1.15	1,339
CM-ICCU	0.40	1,339
CM-PED	0.37	1,339
CM-OBGYN	3.24	1,339

The critical value of the F distribution at the 5 percent level, by interpolation, is:

$$F_{tab\ (n-1,\ r(n-1),\ \alpha)} = 3.87.$$

Clearly, one is unable to reject any of the null hypotheses concerning the equivalence of the means of the case mix groupings. Consequently, the results of the ANOVA procedure indicate that, even when individual case mix groupings are considered, the for-profit and nonprofit hospitals are indistinguishable. This result is consistent with the result from the MANOVA procedure.

Given the limitations of these tests, the first null hypothesis cannot be rejected. This result indicates that the for-profit and

nonprofit hospitals did not treat significantly different mixes of cases during the sample period.

The Skill Mix Hypothesis

The second null hypothesis to be considered is that the two hospital types employ equally skilled mixes of labor inputs. As a measure of the mix of skills employed by the hospitals the hospital's personnel are distributed by one of six skill mix categories: staff physicians, SM-DOC; interns, SM-INT; registered nurses, SM-RN; licensed practical nurses, SM-LPN; aids, orderlies, and attendants, SM-AOA; and other employees, SM-O. The proportion of employees in each category forms the skill mix vector to be considered in the test of the hypothesis. Specifically, given a sample size of 225, the hypothesis to be tested is that the means of the skill mix vectors are equal. Formally stated the hypothesis is:

$$H_0: \mu_z = \mu_w$$

$$H_1: \mu_z \neq \mu_w$$

where μ_z and μ_w represent the means of the for-profit and nonprofit skill mix vectors, respectively.

The appropriate test statistic and rejection criteria are the same as given above in the test of the first hypothesis and are not repeated here. In this case, the observed F value is:

$$F\ (6,218) = 0.32$$

while the critical value of the F distribution at the 5 percent level, through interpolation is:

$$F_{tab\ (p,\ r-p+1,\ \alpha)} = 2.14.$$

Therefore, the null hypothesis of equal skill mixes cannot be rejected. For the sample period, then, the two hospital types did not employ a significantly different mix of labor inputs. Again, the result is contrary to the theoretical prediction which indicated that the nonprofits should be found to employ a relatively more skilled mix of labor inputs. It was thought that, by employing the more skilled mix of labor, the physicians could increase their own productivity, and thereby, their income.

To consider the possibility that significant differences exist between individual skill mix groupings, but that these differences were swamped by the general similarity of the overall vectors, individual ANOVA procedures were conducted. The hypothesis being considered is that the means of the individual skill mix categories (g) are equal for the for-profit and nonprofit hospitals, z and w, respectively:

$$H_0: \ \mu_{zg} = \mu_{wg}$$

$$H_1: \ \mu_{zg} \neq \mu_{wg}$$

The test statistic and rejection criteria are identical to those given above in the case mix ANOVA procedures. The results of the procedures are presented in Table II.

The critical value of the F distribution, by interpolation, at the 5 percent level is:

$$F_{tab\ (n-1,\ r(n-1),\ \alpha)} = 3.89.$$

Therefore, in no case can the null hypothesis of equal skill mixes between the for-profit and nonprofit hospitals be rejected. The results of this ANOVA procedure indicate that, as was true in regard to the individual case mixes, the two hospital types were indistinguishable with respect to the individual skill mix groupings.

TABLE II

SKILL MIX ANOVA

Variable	Observed F	df
SM-DOC	0.16	1,218
SM-INT	1.07	1,218
SM-RN	0.20	1,218
SM-LPN	1.26	1,218
SM-AOA	0.10	1,218
SM-O	0.30	1,218

Given the limitations of the procedures involved, it is concluded that, contrary to the theoretical prediction, the for-profit and nonprofit hospitals did not employ significantly different mixes of labor inputs during the sample period.

The Productive Relations Hypothesis

Theoretically, it is expected that the for-profit and nonprofit hospitals operate under differing productive relations. The third hypothesis to consider, therefore, is that the two hospital types operate under identical productive conditions. Should this null be

rejected, as is expected, then a fourth hypothesis is considered which indicates that the two hospitals are equally efficient. Failure to reject the third hypothesis, however, would render redundant the fourth hypothesis. Put simply, if the two hospitals do not operate in significantly different fashions, one cannot be more efficient than the other. The third hypothesis is, then, critical to the analysis at hand. Testing the hypothesis that the two hospital types operate under the same productive conditions begins with the following form of the Translog production function:[6]

$$\ln Q_{it} = a_0 + a_1 \ln L_{it} + a_2 \ln K_{it} + a_{11} \ln^2 L_{it} + a_{22} \ln^2 K_{it} + a_{12}(\ln L_{it})(\ln K_{it}) + db_1 \ln L_{it} + db_2 \ln K_{it} + db_{11} \ln^2 L_{it} + db_{22} \ln^2 K_{it} + db_{12}(\ln L_{it})(\ln K_{it})$$

where ln = the natural log of the variable in question,

Q = hospital output, measured in inpatient days,

K = capital input, measured in staffed beds,

L = labor input, measured in total personnel,

d = dummy variable representing hospital type (d = 0 for nonprofit and d = 1 for the for-profit hospitals),

n_1 = 442, and n_2 = 50 for the sample sizes for the nonprofit and for-profit hospitals, respectively,

i = hospital, and

t = year.

The hypothesis to be tested is formalized as:

H_0: $b_j = 0$, j = 0, 1, 2, 11, 22, 12.

H_1: not H_0.

The appropriate test statistic is:[7]

$$\frac{(ESS_R - ESS_{UR}) \div q}{MSE_{UR}} \sim F\ (q,\ N-k)$$

where ESS_R = error sum-of-squares of the restricted model,

ESS_{UR} = error sum-of-squares of the unrestricted model,

$q = 6$, number of restrictions implied by the null, and

MSE_{UR} = mean square error of the unrestricted model.

The null hypothesis is rejected for:

$$\frac{(ESS_R - ESS_{UR}) \div q}{MSE_{UR}} > F_{tab}\ (q,\ N-k,\ \alpha)$$

The results of this regression, where ordinary least squares was the estimation procedure, are given in Table III for the restricted model (d = 0) and Table IV for the unrestricted model (d = 1).

TABLE III

RESTRICTED PRODUCTION FUNCTION, DEPENDENT VARIABLE-NATURAL LOG OF INPATIENT DAYS

Independent Variable	Beta Coefficient	T-Ratio (*-5%; **-1%)
Constant	3.115	10.53**
ln L	0.503	3.16*
ln K	1.236	5.91**
$\ln^2 L$	0.135	3.34**
$\ln^2 K$	0.140	2.36*
ln L * ln K	-0.337	-3.70**
F = 1309.59	R^2 = 0.9307	ESS = 42.5681

TABLE IV

UNRESTRICTED PRODUCTION FUNCTION, DEPENDENT VARIABLE-NATURAL LOG OF INPATIENT DAYS

Independent Variable	Beta Coefficient	T-Ratio (*-5%; **-1%)
Constant	3.095	10.02**
ln L	0.422	2.60*
ln K	1.334	6.28**
$\ln^2 L$	0.142	3.49**
$\ln^2 K$	0.130	2.16*
ln L * ln K	-0.337	-3.56**
d * Constant	1.395	0.95
d * ln L	2.110	2.72*
d * ln K	-3.029	-2.58*
d * $\ln^2 L$	-0.099	-0.039
d * $\ln^2 K$	0.469	1.24
d * ln L * ln K	-0.235	-0.41

F = 601 R^2 = 0.932 ESS = 41.679 MSE = 0.0866

Each of the coefficients reported above have the expected sign and are highly significant. For example, consider the two inputs: labor and capital. In both cases, the coefficient of the relevant natural log is positive and significant beyond the 5 percent level. The other coefficients are equally well-behaved. Further, the model offers a high degree of explanatory power as evidenced by the strong coefficient of determination and significant F value. Specifically, the R^2 of 0.9307 indicates that the regression explains about 93 percent of the variation in the dependent variable. Finally, the critical value of the F distribution, at the 5 percent level, is:

$$f_{c,\alpha} = 2.23.$$

Therefore, with a calculated F value of 1309.59, the null hypothesis of an insignificant R^2 can be rejected.

Of more importance to the third hypothesis is the comparison between this model and the unrestricted model, however.

As Table IV indicates, the unrestricted model is also well behaved, offering a very high degree of explanatory power. In this case, the R^2 of 0.932 indicates that the regression explains approximately 93 percent of the variation in the dependent variable. Further, the null hypothesis of an insignificant R^2 can be rejected since the critical value of the F distribution, at the 5 percent level, is:

$$f_{c,\alpha} = 1.81.$$

Of particular importance for the hypothesis in question are the coefficients on the terms which represent the for-profit hospitals (those with the dummy variables). In general, these terms lack the significance of the other terms suggesting that identifying the for-profits adds little to the explanatory power of the model. The precise test of the hypothesis requires formulating the F statistic described above. In this case, the observed F is:

$$F\ (6,480) = \frac{(42.5681 - 41.6796) \div 6}{0.0866}$$

which gives:

$$F\ (6,480) = 1.709.$$

The critical value of the F distribution, at the 5 percent level is, by interpolation:

$$F_{tab\ (1,\ N-k,\ \alpha)} = 2.12.$$

Therefore, the hypothesis that the for-profit and nonprofit hospitals produce under the same productive relations cannot be rejected for the sample period. The fact that the two hospital types did not produce in a significantly different fashion during the sample period indicates that the fourth hypothesis is redundant. Such a result is contrary to that predicted by the theoretical discussion of Chapter III. In that discussion it was noted that, due to the existence of profit incentives, the for-profit hospitals should be expected to produce in an economically efficient fashion. The reverse was predicted for the nonprofits. Due to the lack of profit incentives, the nonprofit hospital's behavior was predicted to diverge from strict economic efficiency.

A closer viewing of Table IV indicates that, while the F test conducted above suggests no significant difference between for-profit and nonprofit, the fact that the for-profit coefficients on the natural log of labor and capital are significant, suggests that some difference, however slight, may exist. To consider this possibility, the insignificant for-profit coefficients were eliminated from the unrestricted regression. Thus, the regression was the original restricted model plus the two significant for-profit terms, the natural log of labor and capital. Again, however, the hypothesis could not be rejected. When this model was run, the two previously significant for-profit coefficients became insignificant.

As a further test of this result, two additional possibilities were considered. First, to determine if grouping those hospitals which were nonprofit owned but for-profit managed together with those that were both for-profit owned and managed introduced a bias, the test of the hypothesis of equal productive conditions was replicated

for the latter group, alone. In this case, while the coefficients and levels of significance were altered for the restricted and unrestricted models, the result was unchanged. Specifically, no difference was found in the productive relations of the for-profit and nonprofit hospitals when the former included only those which were both for-profit owned and managed. The results of the test are not presented here in that the true question of this study is whether profit incentives make a difference in the behavior of hospitals. Therefore, grouping the two hospital types which operate under profit incentives is the appropriate procedure. Separating the two merely serves as a test of the result obtained when the for-profit owned and managed group was taken together with the nonprofit owned but for-profit managed group. The result obtained suggests that no bias is introduced by this grouping.

Finally, it was necessary to determine if the assumption of homoscedasticity was reasonable, in this case. To consider the possibility of heteroscedasticity, a test of the Goldfeld-Quandt type was conducted.[8] The results of the test were such that the null hypothesis of homoscedasticity could not be rejected.

Realizing the limitations of the procedures involved, it is found that, for the sample period, the for-profit and nonprofit hospitals did not operate under significantly different productive conditions. Given this result, the fourth hypothesis cannot be rejected. Specifically, by finding that the two do not produce differently, it is impossible to reject the hypothesis that they are equally efficient.

Summary

In this chapter, the results of the empirical tests of the hypotheses developed in the previous chapters were presented. The sample chosen included the 120 short-term, acute-care hospitals in the State of Oklahoma for the years 1978 through 1981. The results, in general, indicate that the for-profit and nonprofit hospitals in the sample did not behave in significantly different economic fashions during the period. Specifically, it was not possible to reject any of the four hypotheses presented. It appears that the two hospital types treated the same mix of cases, employed the same mix of employees, and produced under the same productive conditions. The last hypothesis indicates further that the two hospital types were equally efficient. Based on the theoretical discussion of Chapter II, none of these results were expected.

ENDNOTES

[1]See Lee.

[2]See Pauly and Redisch or Buchanan and Lindsay.

[3]See Rice or Brown.

[4]See Di Alessi.

[5]For a discussion of this statistic, see S. Wilks, "Certain Generalizations in the Analysis of Variance," Biometrica, XXIV (1932), pp. 471-494.

[6]See Brendt and Christensen.

[7]See Pindyck and Rubinfeld.

[8]S. M. Goldfeld and Richard E. Quandt, "Some Tests for Homoscedasticity," Journal of the American Statistical Society, LX (1965), pp. 539-547.

CHAPTER V

SUMMARY AND CONCLUSIONS

Introduction

The purpose of this final chapter is twofold. First, the divergent aspects of the preceding chapters are drawn together in an attempt to answer the question posed in Chapter I: Do for-profit hospitals operate in both a different and more efficient manner than the nonprofit hospitals? In this discussion, special emphasis will be placed on identifying the theoretical underpinnings of the assumed deviations from strict profit maximization by the nonprofit hospitals and, therefore, the theoretical basis for the proposed remedy of promoting profit incentives within the industry. Also, in this discussion will be an attempt to reconcile the empirical findings of this study with the theoretical expectations. Second, the chapter concludes by assessing the implications of the study's empirical results for the public regulation of the industry. Finally, the limitations of the present study are enumerated along with proposals for future investigation.

Summary

The hospital industry has exhibited economic inefficiencies of great magnitude in the recent past. The major, and most well-known, symptom of these inefficiencies is the rapidly rising cost of hospital

care. These costs have been rising with great fervor, some 150 percent in the period 1966 to 1982, an increase matched by no other component of the Consumer Price Index.[1] It must be noted that cost increases do not necessarily signal economic inefficiency. In the hospital industry, however, the cost increases do appear to be due to underlying inefficiencies. The most prominent of these are high degrees of excess capacity; plant, equipment, and facility expansion that occurs without regard to economic necessity; and rapid increases in both the quantity and quality of care provided.

Given the poor performance of the industry, numerous remedial proposals have been made. These include private and public rate regulation and review, public controls on hospital expansion, outright governmental control of the industry, and the promotion of profit incentives in the industry. This last proposal serves as the proposal of interest for this study. Specifically, the question was asked, Should the promotion of profit incentives within the hospital industry be expected to significantly improve the performance of the industry?

In Chapter I, the logic of the profit incentive proposal was presented. In short, the proposal is based on the theory of property rights.[2] Consistent with this theory, it was argued that for-profit hospitals should be operated in an economically more efficient manner than nonprofit hospitals. The reason for this is simple: by lacking a residual claim, no individual or group of individuals within the nonprofit hospital can realize an addition to their wealth by insuring that the nonprofit hospital is operated in the most efficient manner possible. In the for-profit hospital, the situation is quite different. Within this firm, the owner is an exclusive residual claimant and may

insure managerial compliance by allocating a partial residual claim to the manager. Further, the for-profit manager must always be on guard against the threat of displacement or corporate takeover. Put simply, the for-profit hospital is likely to be operated more efficiently due to the efficiency inducing incentives that face the for-profit manager. By promoting profit incentives within the industry, then, the industry's performance may be improved.

The lack of these efficiency inducing incentives in the nonprofit hospital is thought to lead the nonprofit hospital into behavior patterns not characterized by strict profit maximization. In Chapter II, the theoretical models of nonprofit hospital behavior were presented and discussed. From this discussion, four testable hypotheses concerning the expected divergences in for-profit and nonprofit hospital behavior were developed.

The first hypothesis is that the two hospital types treated the same mix of cases. This hypothesis is based on the notion that, in an attempt to maximize the prestige of the nonprofit hospital, the manager will cause the hospital to treat proportionately more severe cases requiring the most sophisticated technical inputs.[3]

The second hypothesis is that the two hospital types employ equally skilled mixes of labor inputs. Based on the physician control models, it is thought that the nonprofit hospitals will employ proportionately more highly skilled workers in an attempt to maximize the income of the controlling physicians.[4]

The third hypothesis is that the for-profit and nonprofit hospitals operate under the same productive conditions. Should this hypothesis

be rejected, a fourth hypothesis is considered which states that the two hospital types are equally efficient.

These hypotheses concerning the expected divergences in for-profit and nonprofit hospital behavior are the crux of the study, for if these null hypotheses are rejected, the result would indicate that the promotion of profit incentives in the industry may significantly improve the industry's performance. On the contrary, if it is found that the existing for-profit and nonprofit hospitals do not operate in significantly different fashions, then great confidence should not be placed in the profit incentive promotion proposal. Such a finding would not, however, negate the possibility that new for-profit hospitals might operate more efficiently than the nonprofits in that the result only considers existing for-profits.

In Chapter IV, the results of the empirical tests of the hypotheses were reported and discussed. In each case, the hypothesis of equality between the for-profit and nonprofit hospitals could not be rejected. Specifically, it was found that the two hospital types did not, during the sample period, treat significantly different mixes of cases, employ significantly different mixes of skilled labor inputs, and operate under significantly different productive conditions. This third finding of equivalent productive conditions yields the fourth result: the for-profit hospitals of this sample are not more efficient than their nonprofit counterparts. Consequently, there were no discernible differences in the economic behavior of for-profit and nonprofit hospitals.

Implications

The findings of this study do not augur-well the possibility of significantly improving the performance of the hospital industry by promoting profit incentives. The existence of profit incentives, in the form of residual claimants, does not appear to insure economic efficiency in this industry. Rather than significantly improving the performance of the industry, it appears that the for-profit firms have been entrapped by the same efficiency-robbing behaviors characteristic of the nonprofit hospitals.

This result does not, however, imply that the institution of profit incentives within the industry is unnecessary. The result merely indicates that such incentives, on their own, are not likely to lead to a significant improvement in the performance of the industry. It may well be that profit incentives could serve as an integral part of the successful remedial action. Something in addition to these incentives is, however, required. Identification of this additional source of improved efficiency is beyond the scope of this study, but some speculation may be in order. It seems, from an economic standpoint, the most critical problem faced by the hospital industry is not the nature of the existing property rights arrangements but the lack of competition. Competition, no doubt, exists, but it is normally in the areas of quality and prestige. The key ingredient that is lacking is thorough price competition. The implication being suggested is not that property rights are unimportant, but simply that there may be no reason to expect for-profit firms to operate in an economically efficient fashion when they are faced with little or no direct price competition.[5] To significantly improve the industry's performance,

then, public policy must first act so as to increase the degree of price competition that exists. Given a competitive atmosphere, the promotion of profit incentives may lead to the desired goal of increased efficiency.

Limitations of the Study

As with any study of this nature, the results of this study should be viewed with some degree of criticism. Specifically, the study has three major limitations that should be noted.

First, the study includes only those hospitals in the State of Oklahoma. Immediately, then, it is recognized that the results of this study are only directly applicable to this State. Extending the implications of this study beyond the State of Oklahoma requires the assumption that the hospitals in Oklahoma are similar to those elsewhere. This is, of course, a difficult assumption to make. However, there is some justification for such an assumption if one recalls that the proportion of for-profit hospitals in Oklahoma is roughly the same as the proportion in the nation as a whole.[6] Regardless of this seeming similarity, the results of the present study should not be extended, as being final, to other areas.

A second limitation of this study is that it does not actually consider the behavior of entering for-profit hospitals. In the study, the behavior of nonprofit hospitals is compared to the behavior of the existing for-profit hospitals. Finding that the behavior of these two groups does not significantly differ does not necessarily imply that the behavior of entering for-profit hospitals will be indistinguishable from the nonprofit hospitals. It may well be that entering for-profit

hospitals may behave differently from both the existing for-profit and nonprofit hospitals and, through competition, lead to improved industry performance. To this extent, the results of the study should not be read so as to negate this possibility.

The final significant limitation of this study is that it is assumed, but not proved, that the for-profit hospitals are equally inefficient as the nonprofits. By failing to reject the third hypothesis, it is concluded that the two hospital types are producing with the same degree of efficiency. As discussed above, it is assumed that this result implies that the for-profit hospitals operate as inefficiently as the nonprofit. This is but one possibility. It may be that what is actually being found is that the nonprofit hospitals are operating in an economically efficient manner. This possibility is given little credence in this study, however, for several reasons. First, the existence of economic inefficiency in the industry is well documented. To argue that the nonprofit hospitals are operating in an economically efficient (for-profit) fashion, then, one must assume that the existence of the for-profit hospitals in the sample has already significantly altered the behavior of the nonprofits. The problem with this assumption is that the group of for-profit hospitals only comprise 11 percent of the industry. Assuming that this fraction of the industry could have such a profound impact on the entire industry seems a bit difficult to defend. Regardless, however, the point being made in this limitation of the work remains valid.

Directions for Future Research

In the light of these implications and limitations, several

proposals for future research in the area are offered. First, given the assumed importance of competition in improving the industry's performance, one area of fruitful research might be to consider the impact of competition on the industry's performance. While thorough competition does not exist, there are services offered by hospitals in which price competition plays an important role. The research would first identify those services that appear to be provided in a competitive environment and then to determine if the ownership structure makes a difference in the efficiency of provision of those services. If ownership does not make a difference, then the proposal of promoting profit incentives would not be a desirable policy choice. On the contrary, should it be found that the for-profit hospitals offer the services more efficiently than the nonprofit, then a case could be made for promoting both competition and profit incentives.

A second proposed direction for future research is simply that the approach taken within this study be extended both structurally and geographically. Structurally, the study could be extended to consider hypotheses concerning the relative efficiency of chain versus independently managed hospitals, as well as the for-profit/nonprofit comparison. Geographically, the study could be given greater general relevance by including hospitals from different states, if not all states.

A final extension proposal is to trace the behavior of for-profit entrants through a period of years. One of the limitations of this study is that it merely considers the differences between currently existing hospitals. It may prove valuable to trace the behavior of entering firms. These firms may initially show significant behavioral

differences which later disappear. If this is found, it may lead to a better understanding of the underlying causes of the industry's poor performance and, thereby, suggest potentially successful remedial actions.

ENDNOTES

[1]The statistics used are taken from, Statistical Abstract of the United States, (Washington, D.C., 1983).

[2]See Di Alessi.

[3]See the quality maximization model of Lee.

[4]See the physician control model of Pauly and Redisch or Buchanan and Lindsay.

[5]This is essentially the point made by Caves and Christensen.

[6]In Oklahoma, the percentage of for-profit hospitals is roughly the same as the 11 percent nationwide average. Statistics taken from American Hospital Association Guide Issue (Chicago, 1983).

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VITA 2

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