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Testing the appropriateness of nonprofit hospitals' tax exemptions with logistic regression analyses of hospital financial data

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TESTING THE APPROPRIATENESS OF NONPROFIT HOSPITALS' TAX EXEMPTIONS WITH LOGISTIC REGRESSION ANALYSES OF HOSPITAL FINANCIAL DATA

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Degree

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Benjamin P. Foster

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To the Graduate Council:

I am submitting herewith a dissertation written by Benjamin P. Foster entitled "Testing the Appropriateness of Nonprofit Hospitals' Tax Exemptions with Logistic Regression Analyses of Hospital Financial Data." I have examined the final copy this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Business Administration.

Kenneth E. Anderson, Major Professor

We have read this dissertation
and recommend its acceptance:

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ABSTRACT

This study's main objective is to test whether tax-exempt and investor-owned taxable hospitals differ on measures of charity and indigent care provided and profitability. Relieving government burden through the provision of charity and indigent care is frequently cited as justification for nonprofit hospitals' tax exemptions. Also, economic theory suggests that tax-exempt hospitals should require a lower rate of return on equity than taxable hospitals. A secondary objective of this study is to establish a statistical technique that can help governments identify nonprofit hospitals that may not be earning their tax-exemptions.

Analyses are performed on hospital data from Tennessee, Florida, West Virginia, and Arizona. Logistic regression with tax-status as the dependent variable is used to analyze the data and test hypotheses. Several control variables are tested for significance before charity and indigent care and profitability variables are added to logistic models. Results indicate that tax-exempt hospitals provide significantly more charity and indigent care than investor-owned taxable hospitals. Contrary to expectations, results indicate that tax-exempt hospitals are more profitable than taxable hospitals. Models developed exhibit better classification ability than is expected by chance, but classification analyses indicate that some tax-exempt hospitals provide less charity and indigent care than do some investor-owned taxable hospitals.

Findings related to charity and indigent care provided indicate that the current approach taken by governments of selectively re-evaluating nonprofit hospitals' tax-

exemptions rather than revoking exemptions of all nonprofit hospitals may be proper. Results from classification analyses demonstrate that the statistical technique used in this dissertation could help governments identify nonprofit hospitals that warrant having their tax exemptions re-evaluated.

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CHAPTER I

INTRODUCTION

1. Statement of the Problem.

Rising hospital and other health care costs have drawn increasing attention from policymakers in the United States. Hospital expenditures have grown rapidly in the last twenty years, accounting for 4.3% of total U.S. gross national product in 1987. The hospital room component of the consumer price index increased an average of 10.7% annually from 1970 to 1988 [U.S. Bureau of the Census 1990]. Recently, several hospitals have refused to offer some services to patients without adequate health insurance [Ansberry 1988; USGAO 1990, 32-33]. Many people believe that rising costs and lack of adequate accessibility to hospital care warrant a new examination of the U.S. hospital care system.

Policymakers frequently debate what role investor-owned taxable hospitals and tax-exempt hospitals should play in community health care. Currently, most U.S. hospitals are nonprofit, privately-owned tax-exempt entities while smaller percentages of hospitals are either nonprofit, government-owned tax-exempt entities or investor-owned taxable entities. Much attention focuses on tax-exempt nonprofit hospitals because they receive implicit government support through favorable tax treatment. Copeland and Rudney [1990, 1565] estimate that tax-exempt U.S. nonprofit hospitals received tax subsidies totaling $8.5 billion in 1988. Currently, officials at all levels of government are re-evaluating this support, and the question of whether nonprofit hospitals deserve their tax exemptions is a vigorously debated tax policy topic.

Consequently, this dissertation tests whether tax-exempt and taxable hospitals differ on variables that theoretically should distinguish tax-exempt and taxable entities. The dissertation also develops statistical models and techniques to help policymakers evaluate whether tax-exempt hospitals behave in a manner that merits their exemptions.

2. Motivation for the Research.

The current policy debate regarding nonprofit hospitals' tax exemptions and the rapidly changing hospital economic environment warrant another examination of the differences between tax-exempt and taxable hospitals. Three major government policy changes dramatically affected hospital operations in the 1980s. First, the federal government sharply cut all forms of aid to state and local governments, straining public funding for hospitals and health clinics [Abramson and Salamon 1986, xv; Super 1987]. Second, the federal government implemented a Prospective Payment System (PPS) for medicare patients [Kuehl 1986]. Rather than their standard charges, hospitals now collect predetermined payments for Medicare patients based on the illness or injury treated. Shortly after Medicare adopted a PPS, many private insurers adopted similar payment systems. Compared to payment rates in the early 1980s, PPSs resulted in many hospitals earning relatively less revenue per patient. Third, since the mid-1980s, many state governments also limited medicaid payments through PPSs, restrictive cost reimbursement plans, and/or reductions in the number of low income individuals eligible for medicaid.

Reduced federal grants for health care, combined with relatively small per patient revenues from governmental and private insurance plans, financially burdened all types of hospitals [USGAO 1990, 14]. Recently, several hospitals refused to offer some services to patients without adequate health insurance [Ansberry 1988; USGAO 1990, 32-33]. Hospital administrators defend their actions by claiming that recent drops in hospital profits make cost cutting measures imperative. However, Millenson [1990] asserts that when compared to historical rates, hospital profits are not necessarily low. Millenson also points out that hospital associations will not state what profit level is acceptable.

Despite implicit subsidies to tax-exempt hospitals, in the last 20 years investor-owned taxable hospitals gained a considerable market share. Investor-owned hospitals' share of total community hospital beds increased from 6.5% in 1972 to 11% in 1987 [American Hospital Association 1988, 7]. In many markets, tax-exempt hospitals compete directly with investor-owned taxable hospitals. Also, many tax-exempt hospitals expanded beyond their traditional services to compete with taxable entities in other markets [Bennett and DiLorenzo 1989].

Recently, the hospital industry has experienced changes in government funding of medicare and medicaid programs, continued upward pressure on hospital costs, and intense hospital competition. This new economic environment may make research based on old hospital data irrelevant to today's debate and underscores the need for research with current data.

Critics question the propriety of tax exemptions granted to nonprofit hospitals when such hospitals compete directly with taxable entities and are not perceived to provide substantial indigent care. See, for example, Barker 1990; Clark 1980; Copeland and Rudney 1990; Sullivan and Moore 1990; and Herzlinger and Krasker 1987. A few states have proposed funding indigent care programs by taxing nonprofit, exempt hospitals. Barker [1990, 346-347] states that taxing authorities in 20 states have questioned the tax-exempt status of some nonprofit hospitals. Other policymakers, including federal government officials, propose requiring tax-exempt hospitals to provide charity and indigent medical care in return for their tax breaks [Baldwin 1987; Saunders 1987; Sullivan and Moore 1990; USGAO 1990; and Streckfus 1991]. Many hospital administrators also favor some indigent care requirement for tax-exempt hospitals ["Survey ...," 1989].

The current policy debate does have theoretical economic basis. The economic concept of market failure provides theoretical support for tax exemptions to subsidize organizations that provide services government would otherwise provide. Under market failure conditions, if only investor-owned taxable firms provide necessities, government would in some way have to provide these goods and services to impoverished people. Thus, market failure justifies government subsidization through tax exemptions for organizations providing services that government would otherwise provide.

Where tax-exempt and investor-owned taxable entities compete in the same market, the market failure criteria justifies tax exemptions only if tax-exempt entities provide more services that relieve government burden than their investor-owned taxable competition. Medical care for charity and medically indigent patients is the main service tax-exempt hospitals provide that government otherwise would provide. Because both tax-exempt and fully taxable entities compete in the same markets in the hospital industry, testing whether tax-exempt hospitals provide more charity and indigent care than taxable hospitals is possible. Such a test is the main purpose of this study.

Also, some theorists posit that nonprofit tax-exempt hospitals should require a lower return on equity than investor-owned taxable hospitals. If theories concerning hospital groups requiring different rates of return and the market failure rationale for nonprofit hospitals' tax exemptions are valid, a logistic regression model with measures of hospitals' indigent care provided and profitability as independent variables should distinguish tax-exempt from taxable hospitals. Consequently, analyses are accomplished by developing and testing logistic regression models. Also, previous studies have not developed easily interpretable statistical techniques to help governments identify tax-exempt hospitals that do not act in a manner deserving of tax subsidies. This dissertation develops statistical techniques to help policymakers identify tax-exempt hospitals whose exemptions should be re-examined.

3. Overview of Tax Law and Previous Empirical Research Concerning Exemptions.

At the federal level, Internal Revenue Code (IRC) Section 501(c)(3) provides the primary source of law governing tax exemptions for nonprofit hospitals. U.S. Treasury Regulations and Internal Revenue Service Revenue Rulings interpret this Code Section. In most states, exemptions from all types of state and local taxes are based on the organizations' federal tax exemptions under IRC Section 501(c)(3) [Gallagher 1988]. Federal tax law does not currently require nonprofit hospitals to provide charity and indigent care to retain their tax exemptions.

However, Congress now appears interested in requiring that tax-exempt hospitals provide charity and indigent medical care in return for tax subsidies. Also, some state and local tax jurisdictions question whether federal exempt status automatically guarantees state and local tax exemptions. Consequently, state and local courts are rejecting the assumption that nonprofit hospitals are automatically entitled to state and local tax exemptions. Although court rulings do not apply consistent criteria in determining exemption eligibility, many decisions cite issues on which tax-exempt and taxable hospitals should theoretically differ, particularly levels of hospital charity care provided and profitability [Cook v. Rose, 299 S.E.2d 3, 7 (1982) and Utah County v. Intermountain Health Care [709 P.2d 265 (Utah 1985)]. Thus, officials at all levels of government should be interested in a statistical tool that helps determine whether nonprofit hospitals merit their tax exemptions.

Previous empirical research produces conflicting evidence about how ownership and tax status affects hospital performance and also underscores the need for additional research with current data. Using different data sets and statistical methods, researchers examine whether ownership and tax status influences several measures of hospital profits and charity and indigent care provided.

Some studies find that government-owned tax-exempt hospitals provide more charity and indigent care than either privately-owned tax-exempt or investor-owned taxable hospitals [Sloan, Valvona, and Mullner 1986; Sofaer, Rundall, and Zeller 1990; and USGAO 1990]. Other studies find no significant difference in the amount of uncompensated care provided by investor-owned taxable hospitals and tax-exempt hospitals [Sloan and Vracui 1983; Shortell et al. 1986; Herzlinger and Krasker 1987; and Kralewski, Gifford, and Porter 1988]. Most, but not all, studies using data from various sources and time periods generally indicate that investor-owned hospitals are more profitable than tax-exempt hospitals [Watt et al. 1986; Herzlinger and Krasker 1987; Friedman and Shortell 1988; Becker and Sloan 1985; Chang and Tuckman 1987].

4. Research Methods and Results.

Variables

Previous research examines whether tax-exempt and investor-owned taxable hospitals differ by modeling uncompensated care, profitability, etc., as dependent variables. Such research captures the effect of tax-exempt status by using independent dummy variables indicating the hospitals' tax status. This dissertation directly compares tax-exempt (TEs) and investor-owned taxable (IOTs) hospitals by constructing a dichotomous dependent variable based on the tax status of the hospital. This technique allows a more direct way to evaluate individual hospital behavior than previous research.

Several independent variables are included in the analyses. The main independent variable examined is the level of charity and indigent care provided, but profitability is also an independent variable of interest. In this study, net surplus <loss> as a percentage of net patient revenue serves as the main profitability measure. Operating income and cash flow variables are also developed because an ideal profitability measure for individual hospitals is difficult to construct. Difficulty arises because nonprofit hospitals have revenue sources (government contributions for example) not available to investor-owned taxable hospitals, and accounting methods and estimates may vary between organizations.

Because other variables may have a confounding effect, the analyses also include variables that other researchers found to significantly affect hospital performance. Previous research indicates that competition and local economic conditions may affect hospital provision of charity and indigent care [Kralewski, Gifford, and Porter 1988; USGAO 1990]. Accordingly, the analyses include variables that control for competition from other short-term general hospitals and variables that control for local economic conditions. The number of staffed beds is also included as a control variable because some researchers find hospital size affects some performance measures.

Statement of Research Hypotheses

Relief of government burden, or providing charity and indigent (uncompensated) care, provides a theoretical basis for treating tax-exempt hospitals differently than taxable hospitals. Also, theoretical and analytical analyses indicate that tax-exempt and taxable hospitals should differ in profitability. Thus, hypotheses focus on these two independent variables.

The research hypotheses (in null form) are as follows:

H_1: Profitability and uncompensated care variables do not add explanatory power when both are added to a model of hospital tax status that includes significant control variables.

H_2: Tax-exempt hospitals do not provide more uncompensated care than investor-owned taxable hospitals.

H_3: Tax-exempt hospitals do not exhibit lower profit levels than investor-owned taxable hospitals.

Data Set

The main analyses are performed with 1989 Tennessee hospital data tabulated by the Tennessee Department of Health and Environment; 1988 Tennessee hospital data is also analyzed. The analyses include only hospitals classified as short-term general medical and surgical hospitals; no long-term or specialty care hospitals are included. To increase the generalizability of the study, analyses are also performed on 1989 data from short-term general medical and surgical hospitals in Florida, West Virginia, and Arizona.

Logistic Regression Analyses with Tennessee Data

This study uses logistic regression with a categorical dependent variable to analyze the data. The logistic regression analyses compare tax-exempt hospitals to investor-owned taxable hospitals and develop parameter estimates for independent variables. These parameter estimates can be used to calculate the conditional probability of an individual hospital coming from a particular group. This feature is an improvement over a simple classification model because conditional probabilities provide a measure of the degree of error in a misclassification. Also, conditional probabilities provide an interpretable measure to evaluate individual hospital behavior. Modeling charity care as the dependent variable and capturing the affect of tax status with an independent dummy variable does not produce easily interpretable statistical measures of individual hospital performance.

The Statistical Analysis System (SAS), Version 6, is used to perform the logistic regression analyses. The -2 log likelihood statistic serves as a summary measure for models analyzed and Wald chi-square statistics indicate the importance of each independent variable in a model. In logistic regression, Wald chi-square statistics are comparable to t statistics in ordinary least squares regression and test whether independent variables explain significant variation in the dependent variable. Therefore, the -2 log likelihood statistic and Wald chi-square statistics are measures used to test research hypotheses.

Hypotheses tests are performed by analyses of 1989 and 1988 Tennessee hospital data. Wald Chi-square statistics and the change in -2 log likelihood statistics between full and reduced models measure the significance of variables. In all models, the charity and indigent care variable (UNCOMP) and the number of staffed beds (STBEDS) are significant even when the model contains several insignificant control variables. Profitability variables are nearly significant, but their parameter estimates possess signs in the opposite direction of that expected. Tests of significance and the sign of UNCOMP's parameter estimates indicate that tax-exempt hospitals provide more uncompensated care than investor-owned taxable hospitals. However, the signs on profitability variables' parameter estimates indicate that tax-exempt hospitals may be more profitable than investor-owned hospitals. Consequently, research Hypotheses 1 and 2 are rejected while Hypothesis 3 is not.

Additional analyses are performed on Tennessee hospital data. Influence statistics are obtained from several models to search for outliers and influential observations in the data set. Removing influential observations does not dramatically change the parameter estimates or the significance of STBEDS and UNCOMP. Profitability variables become clearly insignificant when one observation is removed, but Hypothesis 3 is still not rejected. Therefore, rejection of Hypotheses 1 and 2 and the inability to reject Hypothesis 3 are not the result of a few influential observations. Also, analyses comparing tax-exempt and investor-owned taxable hospitals is performed on 1988 Tennessee data to determine whether 1989 represents an unusual year. Analyses with 1988 data produce the same results for tests of hypotheses as do analyses with 1989 data.

Classification Ability of Models

The ability of logistic regression models to properly classify tax-exempt and taxable hospitals is examined. Because Hypothesis 3 cannot be rejected, the primary models used to examine classification ability do not include profitability variables. Consequently, a model including independent variables STBEDS and UNCOMP, and a model including UNCOMP alone, are selected for analyses of classification ability. A conditional probability of an observation coming from each group is calculated from the parameter estimates produced by the logistic regression models. Observations are classified into the hospital group for which they exhibit the highest conditional probability. Using this classification criteria, logistic regression parameter estimates produce better classification accuracy than would be expected by chance. A model with UNCOMP alone properly classifies 71.4% of all Tennessee hospitals and 86.9% of tax-exempt hospitals. The model including both UNCOMP and STBEDS properly classifies 72.2% of all Tennessee hospitals and 79.8% of tax-exempt hospitals.

The parameter estimates produced by the logistic regression analyses with 1989 Tennessee hospital data are also used to classify hospitals located in Florida, West Virginia, and Arizona. The model with UNCOMP alone properly classifies 73.8% of Florida hospitals while a model including both UNCOMP and STBEDS properly classifies 72.3%. West Virginia and Arizona have relatively few community hospitals, most of which are tax-exempt. Tennessee parameter estimates exhibit classification ability with West Virginia hospitals, but properly classify a relatively low overall percentage of Arizona hospitals. The poor classification ability for Arizona hospitals indicates that the Tennessee parameter estimates may not be valid for Arizona hospitals.

Logistic Regression Analyses: Florida, West Virginia, and Arizona Data

Logistic regression analyses are also performed on Florida, West Virginia, and Arizona hospital data. The logistic regression models examined include STBEDS (the control variable significant in the Tennessee analyses), UNCOMP, and profitability variables. As with the Tennessee data, UNCOMP is significant in the logistic regression analyses with Florida and West Virginia data. Parameter estimates from the Florida and West Virginia analyses do not classify tax-exempt and taxable hospitals much better than parameter estimates from Tennessee logistic regression analyses classify Florida and West Virginia hospitals. Profitability variables are insignificant in analyses of Florida, West Virginia, and Arizona hospital data. In West Virginia and Arizona, however, the signs on PROFs' parameter estimates are in the expected direction.

In analyses with Arizona data no models or any individual independent variables are significant. Arizona may be too different from Tennessee to obtain similar regression results in both states. Although Tennessee, Florida, and West Virginia are all located in the Southeast, the results with Florida and West Virginia data provide evidence that the results are generalizable beyond Tennessee hospitals. Comparable logistic regression results in three separate states add external validity to the model building process and to the models developed in this study.

Identifying Hospitals for Tax-exemption Re-evaluation

Because the analyses produce models with good classification ability, policy-makers could use this model building process to re-evaluate nonprofit hospitals' tax exemptions. Conditional probabilities produced by models could identify tax-exempt hospitals that warrant further investigation of whether they deserve their tax exemptions. Regulators could simply examine tax-exempt hospitals that exhibit a high conditional probability of being taxable.

Alternatively, a regulator could request a confidence interval for the conditional probability of observations coming from a particular group. With the tax-exempt hospital group as the reference group, SAS can produce, for each observation, a confidence interval of probabilities of that hospital being tax-exempt. Any tax-exempt hospital exhibiting a confidence level upper limit below .50 demonstrates high investor-owned taxable hospital behavior. Use of a statistical tool such as the confidence interval of conditional probability would add objectivity to a regulator's decision to re-evaluate a nonprofit hospital's tax exemption.

5. Contributions.

This study contributes to our knowledge of the comparative performance of nonprofit tax-exempt and investor-owned taxable hospitals by using a different statistical technique than has been used in previous studies. This study uses logistic regression. The logistic function does not assume normality of error terms, unlike other statistical techniques used to analyze hospital performance. Also, when conducting research in an area with a rapidly changing economic environment as in the health care industry, recent data is crucial. Consequently, analyses are performed on 1989 data, the most recent hospital data available.

This study also demonstrates the use of logistic regression diagnostics to examine the effects of influential observations. Version 6 is the first SAS package to produce influence statistics for logistic regression. As in ordinary least squares regression, a single influential observation can sometimes determine, to a large extent, the significance and/or direction of a parameter estimate. Regression diagnostics such as DFBETAs identify which individual observations most influence each parameter estimate. Analyses performed after removing these observations can indicate when statistical results are driven by a few influential observations.

In the past, state and local governments have challenged the tax-exempt status of specific nonprofit hospitals rather than attempting to revoke all hospital tax exemptions. Because models developed in this study exhibit significant classification ability, these models could assist policymakers in re-evaluating nonprofit hospitals' tax exemptions. Also, logistic models can be used to calculate the conditional probability of an observation coming from a particular group. This conditional probability provides an interpretable measure to help evaluate individual hospital behavior. Conditional probabilities produced by logistic regression models could help identify which tax-exempt hospitals should have their exemptions re-evaluated.

Logistic regression conditional probability estimates should not be the only criteria used to determine whether a nonprofit hospital deserves tax exemptions.

Rather, the statistical method developed in this study can provide a starting point to identify hospitals that should have their exempt status re-evaluated. Hospital administrators' knowledge that such a technique is in use may encourage them to provide additional charity and indigent care.

CHAPTER II

LITERATURE REVIEW

The first section of this chapter evaluates the traditional and theoretical rationales for tax exemptions. The literature review presents evidence that many traditional and theoretical rationales for granting tax exemptions do not readily apply to nonprofit hospitals. The second section examines the legal requirements for nonprofit hospitals' tax exemptions. Currently, the form of hospital organization appears to be the most important criterion for exemption. The third section reviews previous, and sometimes conflicting, empirical studies that have compared investor-owned taxable hospitals and tax-exempt hospitals. This chapter concludes by summarizing the literature review and examining the need for additional research.

1. Traditional and Theoretical Rationales for Exemptions: Discussion and Criticisms.

Traditional and Theoretical Rationales for Exemptions

Warren, Krattenmaker, and Snyder (WK&S) [1971] and Quigley and Schmenner (Q&S) [1975] undertook in-depth historical and legal analyses of property tax exemptions. The two main historical rationales for exemptions are that (1) unproductive property should not be taxed and (2) the government would otherwise have to provide services if tax-exempt organizations are not subsidized. As WK&S [1971] point out, the first rationale is no longer valid because much property granted tax exemptions today could be considered productive.

Relief of Government Burden. The economic concept of market failure provides theoretical support for the second traditional rationale. Government intervention in the market economy is typically rationalized by the market mechanism's failure to allocate resources efficiently and equitably [Boadway and Wildasin 1984, 56]. Under market failure conditions, if only investor-owned taxable firms provided necessities, government would in some way have to provide these goods and services to impoverished people because they could not afford to purchase such goods. Thus, under market failure, government assistance through subsidies becomes necessary. Tax exemptions are a form of government subsidy and are justified for organizations providing services that government would otherwise have to provide. Schramm [1988] suggests that hospital care is such a service.

Critics of tax exemptions point to investor-owned taxable competition in hospital markets as evidence that the private market can provide for community needs. However, taxable hospitals may provide less services that relieve government burden than their tax-exempt competitors. If so, the market failure criteria may justify tax exemptions despite investor-owned taxable competition. Herzlinger and Krasker [1987] (H&K) examined this issue by comparing 1977 and 1981 performance of investor-owned taxable and tax-exempt hospital chains. H&K found little difference in prices charged or care provided for uninsured and indigent patients when comparing investor-owned taxable and tax-exempt hospitals. H&K assert that tax-exempt hospitals

> do more to maximize the welfare of the physicians who are their main consumers. These hospitals make large numbers of staff and beds available to the physicians, and they finance these benefits through social subsidies, tax exemptions, and delays in replacing plant and equipment. ...For-profit hospitals, in contrast, produce better results for society and require virtually no societal investment to keep them afloat [1987, 93].

H&K's is not the only study to question the societal benefit from tax-exempt hospitals. The third section of this chapter presents a summary of previous research involving this question.

Ability to Raise Capital. Another rationale for exemptions is they alleviate the disadvantage tax-exempt organizations face in raising equity. Foster [1987] notes that because tax-exempt organizations can not issue common stock, they must generate equity internally or attract equity capital through donations. However, tax exemptions assist retained earnings growth by reducing expenses. Exemptions also help raise capital because donations to tax-exempt entities are deductible on donors' income tax returns [Silvers and Kauer 1986].

Pauly [1986] graphically and analytically examines theoretical market conditions under which tax-exempt hospitals should finance equity from retained earnings. Only in limited circumstances would increasing capital through retained earnings be more efficient than a tax-exempt hospital either borrowing funds or raising donations. Pauly asserts that allowing a tax-exempt hospital to charge prices high enough to generate and reinvest profits is similar to collecting a tax from current hospital patients. After the desired funds are raised, tax-exempt hospitals' prices should drop and net revenues should fall back to zero. Thus, this rationale should not be used to justify perpetual tax exemptions for hospitals [Pauly 1986, 10-11].

Organizations Not Seeking Profits. Bittker and Rahdert (B&R) [1976] assert that federal income tax exemptions for charitable organizations represent neither a special privilege nor a hidden subsidy. B&R say such exemptions apply established income tax law to organizations that do not seek profits [1976, 307]. B&R [308-310] base this assertion on the difficulty of arriving at a taxable income measure for charitable organizations based on standard tax law. Do gifts and bequests received by charitable organizations represent taxable income, or do they qualify under Internal Revenue Code (IRC) Section 102, which excludes gifts and bequests from gross income? Also, if gifts and bequests are used to increase the organization's endowment, should they be excluded from gross income under IRC Section 118 as contributions to capital? The IRS has successfully asserted that expenses not incurred while pursuing a profit may not be deducted as IRC Section 162 business expenses. Applying this rule to a charitable organization that provided relief for the poor could deny a deduction for costs of providing the care [B&R, 309-310].

B&R found no satisfactory solution to the problem but suggested that, if charitable organizations were taxed, defining the charitable activity of an organization as its "business" was one method to calculate a the organization's taxable income. Thus, nonprofit organizations could be allowed deductions for expenses related to achieving their charitable objectives. B&R believe, however, that treating charitable activity as a "business" is self-contradictory [312].

B&R's rationale for income tax exemptions, that charitable organizations do not seek profits, does not readily apply to modern hospital operations. Hansmann [1981] asserts that the difficulty to determine nonprofit organizations' taxable income can not justify all federal income tax exemptions.

> At present, many tax exempt nonprofits--including perhaps most nonprofit hospitals, HMOs [Health Maintenance Organizations], and nursing homes--arguably serve no significant function beyond selling, on a commercial basis, services of a kind and quality that are also provided by profit seeking firms. This raises a serious question as to whether tax exemptions should be withdrawn from most or all nonprofit firms in such industries [Hansmann 1989, 634].

Historical Precedence. Hansmann [1980] credits historical factors rather than theoretical reasons for the proliferation of tax-exempt hospitals.

> In the nineteenth century, hospitals were almost exclusively charitable institutions for the poor and thus were donative institutions. In the twentieth century, however, changes in medical science and in the availability of insurance plans took hospitals almost entirely out of the business of charity and put them on a paying basis [867].

Hansmann speculates that, despite changes, doctors working in hospitals recognized that nonprofit hospitals' tax-exempt status was beneficial to them. Thus, doctors have an interest in continuing the organizational structure hospitals have enjoyed since the nineteenth century.

General Criticisms of Tax Exemptions

Hansmann [1981, 71] and Copeland and Rudney (C&R) [1990, 1571] point out that hospitals' federal income tax exemptions are inequitable. Because the amount of income tax subsidy depends on earnings, wealthy hospitals benefit most while unprofitable hospitals in rural and poor urban areas may receive no benefit [C&R

1990, 1572]. WK&S [1971] criticize property tax exemptions because ambiguous legislative laws governing eligibility are applied in an inconsistent manner by property tax assessors and the courts. Columbo [1990, 471-472] notes that federal income tax exemptions are also awarded in an inconsistent manner. Traditional nonprofit hospitals get virtually automatic exemptions while HMOs and non-traditional health care providers rarely receive tax exemptions.

Also, most theorists question whether tax exemptions are the most efficient way for government to promote desired activities. Schuck [1986, 81] points out problems with implicit subsidies such as tax exemptions.

> Implicit subsidies, almost by definition, elude careful scrutiny of the policy choices underlying them. Indeed, they are often kept implicit for precisely that reason.

WK&S [1971] and Q&S [1975, 293] advocate repealing property tax exemptions and replacing tax subsidies with cash grants from the legislature where constitutionally possible. In this way, only activities worthy of support would be targeted for government subsidies. If governments switch to a direct subsidy approach to support hospitals, the model building process developed in this research project could assist governments in identifying deserving hospitals.

Congress retreated from blanket tax exemptions for nonprofit entities by enacting the unrelated business income tax (UBIT) in 1950. IRC Sections 511-514 specify that income from a trade or activity not substantially related to an organization's exempt purpose shall be subject to the UBIT. Hansmann [1989, 621-622] points out that even though the UBIT raises little revenue, it protects the corporate income tax base. However, the UBIT may be ineffective at preventing tax-exempt entities from encroaching into markets served by taxable entities.

Bennett and DiLorenzo [1989, 73-98] discus how tax-exempt hospitals expanded beyond traditional hospital services into markets traditionally served by investor-owned taxable entities. Bennett and DiLorenzo present a convincing case that tax-exempt hospitals use their tax advantages to compete unfairly. In an empirical test, Hansmann [1987] compared tax-exempt entities' market shares in cities and states with different tax rates. Hansmann found evidence that large tax subsidies offer tax-exempt entities an advantage in establishing market share. At a theoretical level, Hansmann [1981] and Pauly [1987b] suggest that tax preferences for nonprofit firms may cause excessive use of the nonprofit form of organization. Chang and Tuckman [1990], however, found that property tax rates had no affect on the market share of tax-exempt hospitals in Tennessee.

Perceptions of unfair competition led to increased criticism of tax-exempt organizations during the 1980s. In February 1987, the United States General Accounting Office (USGAO) issued a report specifically on competition between taxable businesses and tax-exempt organizations. The USGAO [1987, 2] report notes that tax-exempt entities increased significantly over the years in numbers, types of activities, and resources. The small business community claims that tax-exempt organizations "are destroying the very fabric and strength of the domestic economy by taking unfair advantage of public policy" [Gomes and Owens 1988, 8-9]. Small business concerns may be an important factor in future public policy debates of whether nonprofit hospitals merit tax exemptions. In the past, doctors and hospital administrators exerted political pressure to retain hospitals' tax exemptions. Currently, the small business community, another political force, is exerting pressure to re-examine nonprofit hospitals' tax exemptions.

Evaluation of Theoretical Support for Nonprofit Hospital Tax Exemptions and Rationale for Dissertation

Most traditional and theoretical arguments for tax exemptions do not appear strongly valid for modern hospitals. The market failure argument has validity but rests on the assumption that tax-exempt hospitals provide services government otherwise provides. Thus, Guggenheimer [1988, p. 64] states that exemptions should depend on whether tax-exempt organizations provide a substantive contribution to the community, not just on their nonprofit form. The main service tax-exempt hospitals provide that government would otherwise provide is medical care for charity and medically indigent patients.

Because the hospital industry has both tax-exempt and fully taxed entities competing in the same markets, testing whether these hospital groups differ on the theoretical bases for tax exemptions is possible. Such a test is the main purpose of this study. Finding that tax-exempt hospitals provide significantly more charity and indigent care than investor-owned taxable hospitals would provide empirical evidence that exempt hospitals deserve their tax subsidies. Lower profits in tax-exempt hospitals than in investor-owned taxable hospitals would provide evidence that profits are not as important to tax-exempt entities.

2. Legal Requirements for Hospital Tax Exemptions.

At the federal level, IRC Section 501(c)(3) provides the primary source of law governing tax exemptions for nonprofit hospitals. In most states, exemptions from all types of state and local taxes are based on organizations' federal tax exemptions under IRC Section 501(c)(3) [Gallagher 1988]. Recently, however, some state and local tax jurisdictions have questioned whether federal exempt status automatically guarantees state and local tax exemptions.

Internal Revenue Service (IRS) Requirements

Nonprofit hospitals are granted federal income tax exemptions under the statutory provisions of IRC Section 501(a). IRC Section 501(a) provides income tax exemptions to organizations described in IRC Section 501(c). Hospitals are included in the category of organizations described in IRC Section 501(c)(3) as those **organized** and **operated** exclusively for charitable purposes.

Treasury regulations, which interpret tax code provisions, describe how the organizational and operational requirements of IRC Section 501(c)(3) may be met [Reg. Section 1.501(c)(3)-1]. An entity meets the organizational test if its articles of organization limit its activities to one or more exempt purposes [Reg. Section 1.501(c)(3)-1(b)(1)(i)]. Reg. Section 1.501(c)(3)-1(c)(1) specifies that an organization will be regarded as operated exclusively for exempt purposes only if it engages primarily in activities that accomplish exempt purposes. Also, an organization does not meet the organizational or operational tests unless it serves a public rather than a private interest [Reg. Section 1.501(c)(3)-1(d)(1)].

Nonprofit hospitals are generally granted tax exemptions because they claim to operate for charitable purposes. Reg. Section 1.501(c)(3)-1(d) describes and defines charitable purposes qualifying under IRC Section 501(c)(3). Reg. Section 1.501(c)(3)-1(d)(2) states that the IRC does not narrowly define the term "charitable" but uses the term in its generally accepted legal sense.

Revenue Ruling (Rev. Rul.) 56-185, 1956-1 CB 202, established standards a hospital must meet to qualify as an exempt public organization. One standard required the entity to be organized as a nonprofit charitable organization for the purpose of operating a hospital for the care of the sick. Another standard required tax-exempt hospitals operate to the extent of their "financial ability" for those not able to pay for services rendered and not operate exclusively for patients who are able to pay. Therefore, this standard required tax-exempt hospitals to accept patients in need of hospital care who cannot pay for the services.

In 1969, the IRS modified the second requirement above, the "financial ability" standard of providing charity care. Rev. Rul. 69-545, 1969-2 CB 117, noted that the general law of charity considers promotion of health a charitable purpose.

> A nonprofit organization whose purpose and activity are providing hospital care is promoting health and may, therefore, qualify as organized and operated in furtherance of a charitable purpose.

Consequently, Rev. Rul. 69-545 developed what is known as the "community benefit" standard and gives examples of a hospital qualifying and a hospital not qualifying for the exemption. The ruling states that a hospital operating an emergency room open to all persons in the community able to pay is promoting the health of a class of persons broad enough to benefit the community. Thus, after 1969, the operation of an open emergency room was interpreted as necessary for exempt status. However, Rev. Rul. 83-157, 1983-2 CB 94, modified Rev. Rul. 69-545 by stating that operation of an open emergency room is just one of several factors considered when determining whether a hospital provides benefit to the community. Under Rev. Rul. 83-157, a hospital can qualify for exemption without operating an emergency room when a state health agency determines that operating an emergency room unnecessarily duplicates services in the geographical area.

Thus, at the federal level current tax law does not require nonprofit hospitals to provide charity and indigent care to retain their tax exemptions. In response to a growing lack of medical care for indigent individuals, some federal officials are attempting to tie current tax subsidies to indigent care provided. Congressmen have introduced legislation linking nonprofit hospitals' ability to issue tax-exempt bonds to their charitable behavior [Barker 1990, 347-349]. Also, the House Select Committee on Aging requested a U.S. General Accounting Office report on the role of tax-exempt hospitals in delivering care to the medically indigent [USGAO 1990]. James McGovern, Assistant Chief Counsel of the IRS, testified before the Committee on June 28, 1990 about the legal history of tax exemptions for nonprofit hospitals.

To retain exemptions, Congressional legislation pending in May 1991 would require tax-exempt hospitals to operate "an emergency room open to all, regardless of ability to pay" and would require a stated amount of charity care [Streckfus 1991, 415].

Certainly, Congress and the IRS have begun to re-examine federal tax policy toward tax-exempt hospitals. In return for tax subsidies, Congress wants to require tax-exempt hospitals to provide charity medical care that will relieve government burden. Relief of government burden is a theoretical justification for tax exemptions.

Judicial Decisions - State and Local Tax Exemptions

Recently, despite federal income tax exemptions, state and local authorities have challenged exempt hospitals' state and local tax exemptions. Although court rulings do not apply consistent criteria in determining exemption eligibility, some issues are common to most cases. Most decisions cited issues on which tax-exempt and taxable hospitals should theoretically differ, levels of hospital charity care provided, and profitability. The West Virginia Supreme Court stated that charity care is "probably the single most important element necessary for a finding that a hospital is charitable under West Virginia property tax law" [Cook v. Rose, 299 S.E.2d 3, 7 (1982)].

Two other state court decisions merit discussion. The Utah Supreme Court produced a controversial landmark decision in Utah County v. Intermountain Health Care [709 P.2d 265 (Utah 1985)]. This decision was among the first to reject the assumption that nonprofit hospitals are automatically entitled to state and local tax exemptions [279]. An entity was entitled to an exemption under the Utah constitution only if it met the definition of a charity or its property was used exclusively for charitable purposes [269].

Thus, the court opinion in Utah County v. Intermountain Health Care was organized around the definition of "charity." Charity was defined essentially as a gift to the community, which in turn was defined as "a substantial imbalance in the exchange between the charity and the recipient of its services or in the lessening of a government burden through the charity's operation" [269]. The court specified six factors that must be considered in testing whether a particular institution provides a gift to the community.

> (1) whether the stated purpose of the entity is to provide a significant service to others without immediate expectation of material reward; (2) whether the entity is supported, and to what extent, by donations and gifts; (3) whether the recipients of the "charity" are required to pay for the assistance received, in whole or in part; (4) whether the income received from all sources (gifts, donations, and payment from recipients) produces a "profit" to the entity in the sense that the income exceeds operating and long-term maintenance expenses; (5) whether the beneficiaries of the "charity" are restricted or unrestricted and, if restricted, whether the restriction bears a reasonable relationship to the entity's charitable objectives; and (6) whether dividends or some other form of financial benefit, or assets upon dissolution, are available to private interests, and whether the entity is organized and operated so that any commercial activities are subordinate or incidental to charitable ones [269-270].

Even though Intermountain Health Care hospitals met criteria (1) and (6), the ruling denied exemptions because the hospitals failed other criteria [272-277]. In particular, hospital operations were not significantly supported by donations and gifts. Also, the hospitals did not provide substantial amounts of charity care--less than 1% of gross revenues between 1978 and 1980. In the court's opinion, the tax-exempt nonprofit hospitals had not distinguished themselves from investor-owned for-profit hospitals.

> If nonprofit hospitals, which charge fully for their services, were to be made tax exempt under the "burden" theory, for-profit hospitals logically ought to be treated in the same manner since both provide the public with the same service [278].

In a case with similar facts, the Vermont Supreme Court ruled that a nonprofit hospital was entitled to tax exemptions under Vermont law. In Medical Center Hospital of Vermont v. City of Burlington [566 A.2d 1352 (Vt. 1989)], the court held that the key to exemptions was whether the hospital offered care to all patients, regardless of their ability to pay [8]. MCHV did offer care to all, thereby securing its right to tax exemptions. The Vermont Supreme Court also indicated that basing the exemption on a set percentage of free care would be unworkable [6-7]. Henry and Phillips (H&P) [1990, 80] note that by not following the Intermountain Health Care decision, the court applied the particular laws of Vermont to the case. The court noted that different states had different exemption requirements, and no Vermont case law required an institution to provide free care to be considered charitable. Thus, the MCHV case may provide support for tax exemptions of nonprofit hospitals only in states with laws similar to Vermont.

Court opinions in Utah County v. Intermountain Health Care and Medical Center Hospital of Vermont v. City of Burlington illustrate growing differences between hospital tax-exemption criteria between state and federal law. Both Utah and Vermont require hospitals to offer care to all patients in return for state and local tax exemptions. However, federal exemption requirements under Revenue

Rulings 69-545 and 83-157 only require tax-exempt hospitals to offer care to a broad class of individuals in the community, not necessarily any charity care.

Congressional interest and court deliberations center on whether tax-exempt hospitals provide care to individuals not able to pay. Thus, officials at all levels of government should be interested in a statistical tool that helps determine whether nonprofit hospitals merit their tax exemptions. Developing a statistical modeling process to identify tax-exempt hospitals that perform more like their investor-owned taxable counterparts than charitable organizations is a goal of this research study.

3. Previous Studies Comparing Investor-owned Taxable and Tax-exempt Hospital Performance.

Many previous studies examined U.S. hospital performance. Using different data sets and statistical methods, researchers examined what factors influence several measures of hospital performance, such as profits, costs and charges, uncompensated services provided by hospitals, and access to care for indigent patients. Previous research produced conflicting conclusions about how ownership affects hospital performance. Hospital ownership groups include (1) investor-owned taxable hospitals and (2) two groups of tax-exempt hospitals, privately-owned and government-owned.

Table 1 provides a summary of recent studies comparing uncompensated care and access to care provided by investor-owned taxable hospitals and nonprofit tax-exempt hospitals. (Uncompensated care usually is defined as hospital charity care and bad debt writeoffs as a percentage of gross charges.) Conflicting research findings are evident in Table 1. Some studies find that government-owned tax-

TABLE 1

Studies Comparing Access to Care and Uncompensated Care
Provided by Investor-owned Taxable and Nonprofit Tax-exempt Hospitals.

Author	Sample	Findings
Sloan and Vracui (1983)	1980 data from FL hospitals with <400 beds.	UNCOMP care adjustments not sig. different between TE and IOT hospitals.
Brown and Klosterman (1986)	FL hospitals acquired by other hospital chains, 1979-1982.	Hospitals acquired by IOTs reduced medicaid, bad debt, and charity adjustments, where these adjustments were already relatively low.
Shortell et al. (1986)	National survey of 574 system and 867 community hospitals.	No sig. diff. in UNCOMP care provided by TE and IOT hospital chains.
Sloan, Valvona, and Mullner (1986)	AHA survey of hospitals, 1978-82.	UNCOMP care sig. higher for GOTEs than POTEs or IOTs. No sig. diff. between POTEs and IOTs.
Herzlinger and Krasker (1987)	14 hospital chains (90% of IOT and 68% of TE U.S. hospital beds), 1977 and 1981.	TEs do not provide sig. more access to care for uninsured and indigent patients than IOTs.
Chang and Tuckman (1988)	Short-term TN hospitals, 1982-85.	UNCOMP care higher for GOTEs and POTEs than IOTs.
Kralewski, Gifford, and Porter (1988)	Six matched pairs of TEs and IOTs, 1984-85 information.	Only one match where TE provided sig. more UNCOMP care than IOT. Local market conditions more important factor than ownership.
Sofaer, Rundall, and Zeller (1990)	CA hospitals, 1981-86.	GOTEs provided significantly more UNCOMP care than IOTs or POTEs.
U.S. General Accounting Office (1990)	Hospitals in five states.	Uncompensated care varied within states and hospital groups. Such care was concentrated in urban GOTEs and teaching institutions.

Legend:

Hospital types: TE = Nonprofit tax-exempt
POTE = Privately-owned tax-exempt
IOT = Investor-owned taxable
GOTE = Government-owned tax-exempt

UNCOMP = Uncompensated (bad debt and charity) care
Sig. = Significant
Diff. = Difference
AHA = American Hospital Association

exempt hospitals provide more uncompensated care than either privately-owned tax-exempt or investor-owned taxable hospitals [Sloan, Valvona, and Mullner 1986; Sofaer, Rundall, and Zeller 1990; and USGAO 1990]. Other studies find no significant difference in the amount of uncompensated care provided by investor-owned taxable hospitals and tax-exempt hospitals [Sloan and Vracui 1983; Shortell et al. 1986; Herzlinger and Krasker 1987; and Kralewski, Gifford, and Porter 1988].

Table 2 summarizes some recent studies comparing the profits of tax-exempt and investor-owned taxable hospitals. Several studies using data from various sources and time periods indicate that investor-owned hospitals are more profitable than tax-exempt hospitals [Watt et al. 1986; Herzlinger and Krasker 1987; and Friedman and Shortell 1988]. However, Becker and Sloan [1985] and Chang and Tuckman [1987] conclude that ownership-type does not significantly impact hospital profitability.

Previous research has not presented conclusive evidence that tax-exempt and investor-owned taxable hospitals achieve different profit levels or provide differing amounts of uncompensated care. However, tax-exempt hospitals can still make valuable societal contributions by operating more efficiently, with lower costs, and by charging lower prices than investor-owned taxable hospitals. However, previous research results on hospital efficiency, costs, and charges have been contradictory and appear to depend on the data set and particular research design used. Table 3 summarizes recent research comparing the efficiency, costs, and charges of different hospital ownership groups. Measures of hospital efficiency, costs, and charges are

TABLE 2

Studies Comparing Profits of Investor-owned Taxable and Nonprofit Tax-exempt Hospitals.

Author	Sample	Findings
Becker and Sloan (1985)	2,231 U.S. community hospitals.	Ownership does not have a large impact on hospital profitability.
Register and and Sharp (1985)	Oklahoma hospitals 1978-1981.	Little evidence of profit skimming by using cheaper inputs or picking most profitable patient mix by IOT hospitals.
Register and Sharp (1986)	AHA statistics 1970-1980.	Some evidence of skimming by IOT hosp. by offering fewer costly services. Skimming declined over time.
Brown and Klosterman (1986)	FL hospitals acquired by other hospital chains, 1979-1982.	Hospitals acquired by IOTs had sig. lower profit margins before acquisition, but margin generally increased after acquisition.
Watt et al. (1986)	4,491 Medicare-certified, general hospitals, 1980.	IOT chains have sig. higher profits than freestanding TE hospitals.
Herzlinger and Krasker (1987)	14 hospital chains (90% of IOT and 68% of TE U.S. hospital beds), 1977 and 1981.	IOTs earn a sig. better return on investment than TEs.
Chang and Tuckman (1987)	133 short-term TN hospitals, 1982-84.	Profit margins of GOTEs, POTEs, and IOTs are not sig. different.
Chang and Tuckman (1988)	Short-term TN hospitals, 1982-85.	Surplus as a percentage of gross charges highest for IOTs and lowest for GOTEs.
Friedman and Shortell (1988)	300 U.S. hospitals, 1983 and 1985.	IOTs sig. more profitable, but less sig. when measure after tax profits.

Legend:

Hospital types: TE = Nonprofit tax-exempt; POTE = Privately-owned tax-exempt; IOT = Investor-owned taxable; GOTE = Government-owned tax-exempt

Diff. = Difference; Sig. = Significant; AHA = American Hospital Association

TABLE 3

Studies Comparing Efficiency, Costs, and Charges of Investor-owned Taxable and Nonprofit Tax-exempt Hospitals.

Author	Sample	Findings
Sloan and Vracui (1983)	1980 data from FL hospitals with <400 beds.	IOT chain hospitals have lower net operating expenses and IOTs have higher revenues per patient day.
Brown and Klosterman (1986)	FL hospitals acquired by other hospital chains, 1979-1982.	Hospitals acquired by IOTs raised charges where the charges were already relatively high.
Coelen (1986)	Community hospitals from 50 states, 1974-1981.	IOTs had sig. higher costs, markups, and growth in admissions.
Chang and Tuckman (1986)	153 short-term TN hospitals, 1981.	POTEs have lowest marginal cost for an extra day of care, but the highest marginal cost for an extra empty bed.
Chang and Tuckman (1987)	133 short-term TN hospitals, 1982-84.	Both POTEs and IOTs charge sig. more than GOTEs, but not sig. diff. from each other. POTEs have sig. higher costs than GOTEs.
Herzlinger and Krasker (1987)	14 hospital chains (90% of IOT and 68% of TE U.S. hospital beds), 1977 and 1981.	IOTs have sig. higher operating expenses. IOTs do not charge sig. higher prices.
Friedman and Shortell (1988)	300 U.S. hospitals, 1983 and 1985.	No sig. diff. in costs of IOTs and TEs.
Register, Sharp, and Stevens (1988)	1984 AHA survey.	IOTs sig. higher costs than TEs, but not too dissimilar.
Bruning and Register (1989)	AHA survey, of 7000 U.S. hospitals, 1985.	Ownership type was indistinguishable as far as technical efficiency is concerned.
Lawrence (1989)	AHA survey.	IOTs had sig. higher operating costs than TEs.

Legend:

Hospital types: TE = Nonprofit tax-exempt; IOT = Investor-owned taxable; POTE = Privately-owned tax-exempt; GOTE = Government-owned tax-exempt

Diff. = Difference; Sig. = Significant; AHA = American Hospital Association not included in this study due to conflicting empirical research findings and lack of a clear theoretical link between these items and hospital tax exemptions.

4. Summary of Previous Literature and Need for Additional Research.

Existing literature presents evidence that many traditional and theoretical rationales for granting tax exemptions do not readily apply to tax-exempt hospitals. However, market failure and relief of government burden provides theoretical justification for hospital tax-exemptions if these hospitals provide services that government would otherwise provide. Tax-exempt hospital provision of substantial charity and indigent medical care would satisfy the market failure criteria.

In current tax law, hospital organizational form is the most important criteria for exemption. However, all levels of government are re-evaluating whether nonprofit hospitals deserve their tax exemptions. Government officials frequently mention levels of charity care provided and profitability when hospital tax exemptions are re-examined or changes to current tax laws are proposed.

Previous empirical research reviewed for this study presents conflicting results when comparing uncompensated care provided and profitability of different hospital groups. Other authors also conclude that the effect of ownership on hospital performance is inconclusive. In 1986, the Institute of Medicine issued a report, For-Profit Enterprise in Health Care, which resulted from a comprehensive survey of research findings. The report concludes [91] that evidence available in 1986 was not "sufficient to justify a recommendation that investor-owned health care organizations be either opposed or supported by public policy."

Previous conflicting research conclusions demonstrate that additional research using current data and different research methods may assist policymakers when reconsidering nonprofit hospitals' tax exemptions. With recent data, this study tests whether hospital groups provide different levels of uncompensated care and exhibit different profit levels. In the past, researchers generally modeled hospital uncompensated care, costs, and profits as dependent variables while capturing the affect of ownership-type by using independent dummy variables. This study models hospital ownership-type as the dependent variable and uses variables on which tax-exempt and taxable hospitals theoretically should differ as independent variables. Modeling hospital ownership-type as the dependent variable produces interpretable statistical measures to evaluate the behavior of individual hospitals.

CHAPTER III

RESEARCH METHODS

The primary statistical analysis technique used in this study is logistic regression. An indicator variable (OWN), based on the hospital's ownership-type and tax status serves as the dependent variable. Analyses include an independent variable, uncompensated care (UNCOMP), which can provide theoretical justification for nonprofit hospitals' tax exemptions. The analyses also include several proxies for profitability as independent variables because some theorists believe that tax-exempt and taxable hospitals require different levels of profitability to survive. The logistic regression model tests whether tax-exempt hospitals act differently on these measures than investor-owned taxable hospitals. A number of other independent variables are included in the analyses to control for other factors that might affect hospital performance. Table 4 presents definitions of all variables included in the analyses. The main analyses are performed on 1989 data from community hospitals in Tennessee.

This chapter describes the research hypotheses and the research methods used to test the hypotheses and includes (1) a statement of research hypotheses; (2) a description of the dependent variable; (3) a description of independent variables; (4) a description of the sample of Tennessee hospitals and hospitals from other states; (5) a description of the statistical method applied to analyze the data and test the research hypotheses; (6) a discussion of further analyses, evaluation of the models'

TABLE 4

Definitions of Variables Included in Logistic Regression Analyses.

Variable	Definition
<u>Dependent Variable</u>	
OWN* =	0 if a government-owned tax-exempt hospital, and 1 if a privately-owned tax-exempt hospital
OWN =	0 if a nonprofit tax-exempt hospital, and 1 if an investor-owned taxable hospital
<u>Independent Variables of Interest</u>	
UNCOMP =	(Bad debt + Charity + Indigent care adjustments) / Gross charges
PROF =	Net surplus <loss> / Net patient revenue
CASHFLOW =	(Net surplus <loss> + depreciation) / Net patient revenue
OPERATING INCOME =	(Net surplus <loss> - contributions + taxes) / Net patient revenue
CASHFLOW OPERATIONS =	(Net surplus <loss> - contributions + taxes + depreciation) / Net patient revenue
<u>Independent Control Variables</u>	
COMPT =	number of STGHs in the same county
GOTECOMP =	0 if no other government-owned, tax-exempt STGHs in the same county 1 if other government-owned, tax-exempt STGHs are located in the same county
POTECOMP =	0 if no other privately-owned, tax-exempt STGHs in the same county 1 if other privately-owned, tax-exempt STGHs are located in the same county
POP =	population of county in which hospital is located
LOGPOP =	natural log of population [ln(POP)]
POPDEN =	population density of county in which hospital is located
PCINC =	county residents' per capita income for county in which hospital is located
STBEDS =	number of staffed beds at hospital
LOGBEDS =	natural log of staffed beds [ln(STBEDS)]

Legend: STGH = Short-term General Hospital classification ability, and analyses with data from other states, and (7) a brief summary.

1. Statement of Research Hypotheses.

Relief of government burden provides a theoretical basis for treating tax-exempt hospitals differently than taxable hospitals. Hospital provision of uncompensated care can relieve government burden. Theoretical, graphical, and analytical analyses performed by various researchers also indicate that tax-exempt and taxable hospitals should differ in profitability. Thus, the hypotheses focus on these two variables.

The research hypotheses (in null form) are as follows:

H_1: Profitability and uncompensated care variables do not add explanatory power when both are added to a model of hospital tax status that includes significant control variables.

H_2: Tax-exempt hospitals do not provide more uncompensated care than investor-owned taxable hospitals.

H_3: Tax-exempt hospitals do not exhibit lower profit levels than investor-owned taxable hospitals.

(Research hypotheses are stated in terms of statistical models in the fifth section of this chapter.)

2. Dependent Variable.

To compare groups of hospitals, the ownership and tax status of each hospital serves as the dependent variable. A theoretical basis for tax exemptions exists if exempt hospitals provide services that relieve government burden. Uncompensated health care is one of these services. However, nonprofit hospitals do not deserve tax-exemptions unless they provide more uncompensated care than their taxable counterparts.

The first logistic regression performed in this study tests whether government-owned and privately-owned tax-exempt hospitals can be treated as one group. In these tests, each observation is coded as:

$$OWN^{*} = \begin{cases} 0 \text{ if a government-owned tax-exempt hospital and} \\ 1 \text{ if a privately-owned tax-exempt hospital.} \end{cases}$$

As discussed in Chapter IV, results from these preliminary tests indicate that the two tax-exempt hospital groups can be combined. Consequently, this dissertation directly compares tax-exempt (TEs) and investor-owned taxable (IOTs) hospitals by constructing a dichotomous dependent variable based on the tax status of the hospital. For the main analyses, each observation is coded as:

$$OWN = \begin{cases} 0 \text{ if a nonprofit tax-exempt hospital and} \\ 1 \text{ if an investor-owned taxable hospital.} \end{cases}$$

Past researchers examined the issue of whether tax-exempt hospitals provide more uncompensated care than taxable hospitals by modeling uncompensated care as the dependent variable. These researchers captured the effect of tax-exempt status by using independent dummy variables. In this dissertation, logistic regression is used to analyze the effect of various independent variables on the probability of a hospital being tax-exempt or investor-owned and taxable. The conditional probability of an observation coming from a particular group is calculated based on the values of the independent variables.

3. Independent Variables.

Several independent variables are included in the analyses. The two main independent variables of interest are the level of uncompensated care provided and profitability. Because other factors may have a confounding effect, the analyses also include several variables that other researchers found to significantly affect hospital performance.

Uncompensated Care - UNCOMP

As discussed in Chapter II, the main theoretical support for nonprofit hospitals' tax exemptions rests on the market failure concept and the government burden resulting from market failure. When hospitals care for charity and indigent patients, they provide services that relieve government burden caused by failure in the health care market. As illustrated in Figure 1, charity and indigent care charges as well as other adjustments are deducted from a hospital's gross revenues to arrive at net revenues. Tennessee's joint annual report of hospitals (JARH) requires hospitals to report gross revenue adjustments, which include three somewhat ambiguous categories: indigent care, charity care, and bad debts. The Tennessee Department of Health and Environment's (TDHE's) definitions of these categories (paraphrased) are:

Gross Charges	xxxxxx
Less: Revenue Adjustments	- xxxxxx
Net Operating Revenues	= xxxxxx
Less: Operating Expenses and Depreciation	- xxxxxx
Net Operating Income <Loss>	= xxxxxx
Add <Subtract>: Other Revenue or Expenses	+- xxxxxx
Net Surplus <Loss>	= xxxxxx

(a) General Hospital Accounting Model

Gross Charges	$8,134,383
Less: Revenue Adjustments*	2,405,801
Net Revenues	5,728,582
Add: All Other Revenues	163,451
Total Net Revenue	5,892,033
Less: Total Expenses	5,744,117
Net Surplus <Loss>	$ 147,916
*Revenue Adjustments include the following:	
Medicaid	$ 355,465
Medicare	807,043
Other governmental	13,691
Bad debts	658,079
Charity	359,270
Medically Indigent	89,818
All other adjustments®	122,435
Total	$2,405,801

®Other adjustments include contractual adjustments to gross charges required by other third-party payors such as private insurance companies.

(b) Example Hospital Accounting Model, Hawkins County Memorial As Reported in 1988 TN JARH. The model followed on the Tennessee JARH is slightly different from the above general model.

Figure 1. Hospital Accounting Models.

(1) Charity care: Care provided to medically needy patients for which the hospital does not usually expect payment.
(2) Medically indigent: A patient who can afford the basics of life but has no means to pay all incurred medical bills is medically indigent.
(3) Bad debts: Uncollectible charges that the hospital directly billed patients who should reasonably be expected to pay.

Applying these definitions to actual unpaid accounts requires subjective decisions. Therefore, consistent bad debt, charity care, and indigent care categorization across hospitals is unlikely. The 1986 comprehensive study by the Institute of Medicine [188] states that the most widely used measure of uncompensated care is the percentage of revenue accounted for by bad debts, charity care, and indigent care. Consequently, total bad debts, charity care, and indigent care as a percentage of gross charges is used as the main independent variable in this study. Standardizing uncompensated care by gross charges produces comparable measures across hospitals because bad debts, charity care, and indigent care adjustment amounts are included in gross revenues. Thus,

$$\text{UNCOMP} = \frac{\text{Bad debt + Charity + Indigent care adjustments}}{\text{Gross charges}}.$$

Profitability Variables

Profitability is used as an independent variable for several reasons. First, Bittker and Rahdert [1976] state that tax exemptions can be rationalized by applying established income tax law to charitable organizations that do not seek a profit. Second, if a nonprofit organization does seek profits, profitability can indicate the extent of benefits the organization receives from income tax exemptions. Third, some economists believe that nonprofit tax-exempt and investor-owned taxable hospitals require different rates of return on equity. Profitability variables are used as proxies for return on equity.

Pauly [1986, 1987a] graphically and analytically demonstrates that to attract equity capital, in most economic situations, investor-owned taxable hospitals require a higher after-tax rate of return on equity than tax-exempt hospitals. Silvers and Kauer [1986] agree with Pauly by asserting that tax-exempt hospitals require a lower rate of return than investor-owned entities because donors of capital to exempt hospitals receive income tax deductions. Conrad [1986, 18], however, states that donors to tax-exempt hospitals forego other available investments and thus require a return on equity equal to the market rate of return on equity earned by investor-owned hospitals. Even though not all economists agree, Pauly and Silvers and Kauer provide economic theory to support including profitability as a variable of interest in this dissertation.

Measures of equity for individual hospitals are not available in the data sets used in this study. Consequently, return on equity cannot be calculated. Instead, profitability measures are constructed as proxies for return on equity. In this study, net surplus <loss> as a percentage of net patient revenue serves as the main profitability measure. (Figure 1 illustrates hospital reporting practices.) The net surplus or <loss> measure for hospitals is similar to net income or <loss> in normal business entities. Taking net surplus <loss> as a percentage of net patient revenue standardizes the profitability variable across different size hospitals. Gross charges are not used as the standardizing factor because net patient revenues represent the best measure of actual hospital revenues from operations. Thus,

$$\text{PROF} = \frac{\text{Net surplus } \langle \text{loss} \rangle}{\text{Net patient revenue}} .$$

Due to hospital accounting methods and unique tax-exempt hospital revenue sources, a single proper measure of individual hospital profitability is difficult to construct. Consequently, this study examines the sensitivity of how profitability is defined by including three other measures of profitability standardized by net patient revenue. Current depreciation is added back to net surplus or loss to approximate actual cash flow. A before-tax operating income measure is developed by adding taxes paid and subtracting from surplus or loss any private contributions or revenue from government. Also, by adding depreciation to this operating income measure, cash flow from operations is approximated. Therefore,

$$\text{CASHFLOW} = \frac{\text{Net surplus } \langle \text{loss} \rangle + \text{depreciation}}{\text{Net patient revenue}} ,$$

$$\text{OPERATING INCOME} = \frac{\text{Net surplus } \langle \text{loss} \rangle - \text{contributions} + \text{taxes}}{\text{Net patient revenue}} ,$$

and,

$$\text{CASHFLOW OPERATIONS} = \frac{\text{Operating income} + \text{depreciation}}{\text{Net patient revenue}} .$$

Repeating the analyses with profitability variables above standardized by total net revenue examines sensitivity to the scaling factor.

Control Variables

Previous research found several significant variables when modeling hospital performance. This study also includes these variables because they may confound or adjust the effect of independent variables of interest. The control variables included in the logistic regression model building process are defined in Table 4.

Local market conditions may affect hospital provision of uncompensated care [Kralewski, Gifford, and Porter, 1988; USGAO, 1990]. In particular, the presence of other hospitals in the same area may affect hospital behavior. The USGAO [35] concluded that investor-owned taxable and privately-owned tax-exempt hospitals provide less uncompensated care when a government-owned tax-exempt hospital serves the same market. Shortell et al. [1986] found that hospitals facing competition provide less charity care than sole community hospitals. Also, competition may require tax-exempt hospitals to emulate investor-owned taxable entities [Robinette 1985].

Accordingly, the analyses include a variable for the number of other short-term general hospitals (STGH) located in the same county. (STGHs are those classified as short-term general medical and surgical hospitals. Federally-owned hospitals, long-term care, and specialty hospitals are excluded because they do not provide services comparable to a typical community hospital.) Dummy variables are included for the presence of a government-owned tax-exempt STGH and for the presence of a privately-owned tax-exempt STGH in the same county. Hospital competitors within the same county are reported in the Tennessee Department of

Health and Environment's compilation of the Joint Annual Report of Hospitals (JARH).

In addition to the STGH competition variables, the analyses include other variables to control for local market conditions. To control for a hospital's potential market, analyses include variables for population, the natural log transformation of population, and population density in the county where the hospital is located. (To avoid redundancy in the independent variables, the models investigated do not include both population and natural log of population at the same time.) Per capita income in a hospital's county is also included because higher income residents should require less uncompensated care. The Tennessee Statistical Abstract 1990 [University of Tennessee, Knoxville] provides county population, population density, and per capita income figures.

Chang and Tuckman [1988] found that hospital size, as measured by the number of operating beds, affects hospital profits. Thus, size variables are also included in this study. The number of staffed beds reported in the JARH and the log of staffed beds are included as control variables in the logistic regression analyses. (Again, to avoid redundant independent variables, the models investigated do not include both the number of staffed beds and the log of staffed beds at the same time.)

Previous researchers treat individual hospitals as independent observations. Ownership of many hospitals by the same entity or hospital chain raises concerns about independence of the observations. One way to correct for systematic variation is to include a dummy variable for membership in a particular hospital chain. Approximately 80% of investor-owned taxable, and over 46% of privately-owned tax-exempt Tennessee STGHs belong to several different multi-hospital systems. (Appendix A lists Tennessee hospitals by tax status, ownership-type, and hospital system membership.)

This study develops models of hospital tax status. One way to validate models developed is to evaluate their ability to classify hospital observations by tax status. Because multi-hospital organizations own either solely taxable hospitals or solely tax-exempt hospitals, including dummy variables for membership in a particular hospital chain would artificially inflate the probabilities of correct classification. Consequently, the analyses do not include variables to control for multi-hospital system membership.

4. Data Set.

Tennessee Hospitals

This study employs financial data from individual hospitals in Tennessee. Each hospital in Tennessee must file a Joint Annual Report of Hospitals (JARH) with the Tennessee Department of Health and Environment (TDHE). The JARH contains information necessary for the analyses including revenues, expenses, and charity and indigent care amounts. The TDHE creates a data base of JARH information from all Tennessee hospitals each year, and this information is publicly available. The analyses only include hospitals classified as short-term general medical and surgical hospitals. Federally-owned hospitals, long-term care, and specialty hospitals are excluded because they do not provide services comparable to a typical community hospital. (Appendix A lists Tennessee hospitals included in the analyses.)

Florida, West Virginia, and Arizona Hospitals

Research with data from a single state can contribute significantly to our knowledge of a particular subject. Table 5 lists recently published studies using information from a single state or just a few states. However, analyses are also performed on data from short-term general medical and surgical hospitals in Florida, West Virginia, and Arizona. The Florida Health Care Cost Containment Board, West Virginia Health Care Cost Review Authority, and Arizona Department of Health Services provided financial information for hospitals in these states.

The following table lists the number of investor-owned taxable (IOT) and tax-exempt (TE) short-term general hospitals (STGHs) reporting to states included in the analyses. The last line of the table presents the number of IOT and TE STGHs responding to the American Hospital Association's 1989 survey of members and should be indicative of the relative numbers of IOTs and TEs nationwide. (By ownership and tax-status, Appendix B lists Florida, West Virginia, and Arizona hospitals included in the analyses.)

TABLE 5

Studies Using Specific State Data.

Author and Year	Data Set Used
Studies Using Hospital Data	
Sloan and Vracui (1983)	1980 data from Florida hospitals.
Register and Sharp (1985)	Oklahoma hospitals, 1978-81.
Chang and Tuckman (1986)	153 short-term Tennessee hospitals, 1981.
Chang and Tuckman (1988)	Short-term Tennessee hospitals, 1982-85.
Chang and Tuckman (1990)	Short-term Tennessee hospitals, 1982-85.
Sofaer, Rundell, and Zeller (1990)	California hospitals, 1981-86.
U.S. General Accounting Office (1990)	Iowa, Michigan, New York, California, and Florida hospitals.
Other Studies with Tennessee Data	
Fox and Campbell (1984)	Tennessee sales tax data, 1975-82.
Fox (1986)	Data on retail activity in three Tennessee counties bordering other states.
Fox and Murray (1990)	Tax rates, new branch plant and new business locations in all Tennessee counties, 1980-1986.

	Taxable Hospitals		Tax-exempt Hospitals	
	Number	Percentage	Number	Percentage
Tennessee	49	36.8	84	63.2
Florida	92	41.8	118	53.6
West Virginia	10	18.2	45	81.8
Arizona	9	14.8	52	85.2
Nationally	769	14.0	4,728	86.0

Tennessee and Florida have a larger number of hospitals and a larger percentage of taxable hospitals than West Virginia and Arizona. West Virginia and Arizona have percentages of taxable hospitals close to the national percentage of taxable hospitals. Florida is included to validate results from Tennessee data with data from another state that has a comparable number of hospitals and a similar percentage of taxable hospitals. Including West Virginia and Arizona in the analyses allows a comparison of Tennessee results to results from states that have a small number of hospitals and a low percentage of taxable hospitals.

5. Statistical Analyses.

General Discussion of Logistic Regression

Logistic regression is used because of its advantages over other statistical techniques when analyzing data with a categorical dependent variable. For example, ordinary least squares (OLS) regression can be used with a categorical (dichotomous) dependent variable and is based on the following general linear model:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p + \epsilon. \quad (1)$$

However, Neter, Wasserman, and Kutner (NW&K) [1985, 361] state that when the dependent variable is categorical, "both theoretical and empirical considerations suggest...[that] the shape of the response function will frequently be curvilinear." Also, Hosmer and Lemeshow (H&L) [1989, 7] point out that, with a categorical dependent variable, the OLS regression error term (ϵ) is not normally distributed nor is the variance constant across levels of the independent variables. Thus, a categorical dependent variable leads to violations of crucial linearity and normality assumptions concerning the OLS regression model.

NW&K note that dichotomous dependent variables are frequently modeled with the logistic response function. Multiple discriminant analysis (MDA) is another statistical technique used in past categorical classification studies. However, Press and Wilson (P&W) [1978] point out that normality is an important assumption in MDA. P&W compare the performance of MDA and logistic regression with two nonnormal data sets and conclude that logistic regression with maximum likelihood estimation outperforms MDA. Logistic regression does not assume a normal error term distribution; moreover, techniques used in OLS regression analysis such as comparisons of full and reduced models also apply to logistic regression [H&L, 7]. Because of these advantages over other statistical techniques, logistic regression is used for the analyses in this study.

In logistic regression, the mean response is a probability. The model is fitted through an iterative process that can be used to calculate the conditional probabilities of each outcome category given the independent variables and the fitted model. H&L describe the process as follows.

If $\mathbf{x} = (x_1, x_2, ..., x_p)$ is a vector of independent variables and Y is the dependent variable, the logistic regression model is:

$$g(Y) = \ln [P(Y=0|\mathbf{x}) / P(Y=1|\mathbf{x})] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_p x_p + \epsilon. \quad (2)$$

The function g is called the logit and is the natural log of the probability of Y = 0 given **x**, divided by the probability of Y = 1 given **x**. β_j is the parameter for the jth independent variable. Computerized statistical packages compute maximum likelihood estimates of the parameters using an iterative algorithm. For each β_j, a Wald chi-square statistic is computed that can be used to test the contribution of each variable to the model.

Conditional probabilities of an observation coming from a particular response category are calculated from (2) as follows:

$$P(Y = 0|\mathbf{x}) = \frac{\exp[g(Y)]}{1 + \exp[g(Y)]} \quad (3)$$

and,

$$P(Y = 1|\mathbf{x}) = \frac{1}{1 + \exp[g(Y)]}, \quad (4)$$

where exp[g(Y)] is the exponential function evaluated at g(Y). Thus, logistic regression produces an estimated probability of an observation coming from each category based on the corresponding values of the independent variables. The resultant conditional probability provides a measure of the degree of error in a misclassification and is an improvement over a simple classification model.

Hypotheses Stated in Terms of the Logistic Model

Relief of government burden, or uncompensated care, provides a theoretical basis for treating tax-exempt hospitals differently than taxable hospitals. Theoretical and analytical analyses indicate that tax-exempt and taxable hospitals may differ in profitability. Thus, the hypotheses in this study focus on the effect of these two variables on the logistic model. For example, one model is in the following form: $g(Y) = \ln [P(OWN=0|x) / P(OWN=1|x)] =$

$$\beta_0 + \beta_1 UNCOMP + \beta_2 PROF + \Sigma\beta_i CONTROL_i + \epsilon. \qquad (5)$$

Recall that OWN = 0 if the hospital is tax-exempt and OWN = 1 if the hospital is an investor-owned taxable entity. UNCOMP and PROF are variables of interest described in the independent variables section above. CONTROL is a general expression for various control variables (also described in the independent variables section) which enter into the analyses.

For convenience, research hypotheses are restated here (in null form):

H_1: Profitability and uncompensated care variables do not add explanatory power when both are added to a model of hospital tax status that includes significant control variables.

(H_1: $\beta_1 = \beta_2 = 0$)

H_2: Tax-exempt hospitals do not provide more uncompensated care than investor-owned taxable hospitals.

(H_2: $\beta_1 \leq 0$)

H_3: Tax-exempt hospitals do not exhibit lower profit levels than investor-owned taxable hospitals.

(H_3: $\beta_2 \geq 0$)

Rejecting H_2 requires a positive sign on UNCOMP's beta coefficient while rejecting H_3 requires a negative sign on a profitability variable's beta coefficient. Rejection of all three hypotheses is expected.

Statistical Tests of Hypotheses

Several statistical packages perform logistic regression; this study uses the LOGISTIC procedure in the Statistical Analysis System (SAS), Version 6. Logistic regression procedures produce a -2 log likelihood statistic as a summary measure for models analyzed. In multivariate logistic regression, the -2 log likelihood statistic can test the null hypothesis that all p explanatory variables in the model are zero. The statistic follows a chi-square distribution with p degrees of freedom [H&L, 31]. Wald chi-square statistics are also common logistic regression statistics; a Wald chi-square is produced for each independent variable in a model. In logistic regression, Wald chi-square statistics are comparable to t statistics in OLS regression, testing whether independent variables explain significant variation in the dependent variable. Thus, the -2 log likelihood statistic and Wald chi-square statistics are measures used to test research hypotheses.

This research project concentrates on a comparison of investor-owned taxable hospitals to tax-exempt hospitals. However, past research indicates that government-owned and privately-owned tax-exempt hospitals may behave differently. Consequently, in preliminary analyses, tax-exempt hospitals are coded differently by ownership. To test whether the two tax-exempt hospital groups behave differently, analyses described next are first performed comparing these two groups. The analyses reveal no significant difference in the variables of interest between the government-owned and privately-owned tax-exempt hospitals. Therefore, the two tax-exempt groups are combined, and primary analyses proceed by comparing tax-exempt hospitals to investor-owned taxable hospitals.

Comparison of tax-exempt and taxable hospitals begins by obtaining summary statistics for each group. The mean, standard deviation, minimum, and maximum observed values for each group are examined. Also, univariate logistic regression with the independent variables of interest is performed on the 1989 Tennessee data. These procedures are conducted as preliminary analyses and test no hypotheses.

The primary analyses include control variables listed in Table 4 to adjust the effects of variables of interest in the models. Control variables could affect the estimation (and perhaps sign) of the effects of both UNCOMP and PROF even though the control variable effects are not of direct interest. Consequently, tests of significance for control variables are conducted in full models. The model building process proceeds by removing at each stage the least significant variable (as measured by the Wald chi-square statistic). This process continues until only significant control variables remain in the model.

A model building process that only involves removing variables with the least significant Wald Chi-square statistics from a full model has possible shortcomings. For instance, deleting the variable with the least significant coefficient from a full model cannot detect situations in which two variables are insignificant individually but significant together. Likewise, beginning with a reduced model and adding the most significant variable does not address this possibility. Hauck and Donner [1977] and Jennings [1986] examine the performance of, and inferences from, Wald Chi-square statistics. Both studies find the Wald Chi-square statistic behaves irregularly, often failing to reject hypotheses when coefficients are significant. Consequently, researchers recommend using a log likelihood test to evaluate coefficients' significance.

As variables are deleted from a full model, the change in models' -2 log likelihood statistic produces a measure frequently used to assess the extra explanatory power of deleted variables. For example, consider the logistic models:

$$g(Y) = \beta_0 + \beta_1 UNCOMP + \beta_2 PROF + \beta_3 COMPT + \epsilon$$

and

$$g(Y) = \beta_0 + \beta_1 UNCOMP + \beta_2 PROF + \epsilon.$$

The first model will have a larger -2 log likelihood statistic than the second, and the difference between these two models' -2 log likelihood statistics indicates the extra explanatory power COMPT adds to the model. This difference follows a chi-square distribution with one degree of freedom. Thus, if the -2 log likelihood difference is greater than 3.84 when one variable is removed from the model, that variable has significant explanatory power at the $\alpha = .05$ significance level.

As mentioned previously, deleting a variable with the least significant Wald chi-square statistic from a model cannot detect situations in which two variables are insignificant individually but significant together. The difference in the -2 log likelihood statistic can identify such situations. Consequently, the -2 log likelihood difference is also evaluated for each variable removed from a model due to an insignificant Wald chi-square statistic.

Hypotheses are tested using 1989 Tennessee hospital data. To examine the direct effects of variables of interest, hospital tax status is modeled with UNCOMP, PROF, CASHFLOW, OPERATING INCOME, and CASHFLOW OPERATIONS each alone in five univariate logistic regressions. However, research hypotheses are tested in models including all significant control variables. H_1 is tested by comparing the -2 log likelihood statistic for a model including only significant control variables to the -2 log likelihood ratio of a model including those control variables, UNCOMP, and the most significant profitability variable.

The same process is used to test H_2. UNCOMP is added to a model including significant control variables, and then the change in the models' -2 log likelihood statistics is evaluated. H_2 is also tested by adding UNCOMP to a model including significant control variables and the most significant profitability variable. H_3 is tested the same way as H_2 except profitability variables are added to a model including significant control variables. H_3 is also evaluated by adding each profitability variable to a model including significant control variables and UNCOMP. Then, the change in each models' -2 log likelihood statistic is evaluated. Hypotheses 2 and 3 are also tested by evaluating the significance of Wald chi-square statistics for UNCOMP's and each profitability variable's coefficient.

The following models summarize how hypotheses are tested.

$$g(Y) = \beta_0 + \Sigma\beta_i CONTROL_i + \epsilon \quad (6)$$

$$g(Y) = \beta_0 + \Sigma\beta_i CONTROL_i + \beta_1 UNCOMP + \beta_2 PROF + \epsilon \quad (7)$$

$$g(Y) = \beta_0 + \Sigma\beta_i CONTROL_i + \beta_1 UNCOMP + \epsilon \quad (8)$$

$$g(Y) = \beta_0 + \Sigma\beta_i CONTROL_i + \beta_1 PROF + \epsilon \quad (9)$$

H_1 is tested by evaluating the -2 log likelihood difference between equation (7) and (6). H_2 is tested by evaluating the differences between equations (8) and (6) and equations (7) and (9). H_3 is tested by evaluating the differences between equations (9) and (6) and equations (7) and (8). Tests of H_3 are repeated with CASHFLOW, OPERATING INCOME, and CASHFLOW OPERATIONS replacing PROF.

After the above analyses, influence diagnostics are obtained from models to examine whether any extreme observations unduly affect the results. The DFBETA is a diagnostic statistic of particular interest. The SAS/STAT User's Guide [1990, 1094] describes a DFBETA as "the standardized difference in the parameter estimate due to deleting the corresponding observation, and it can be used to assess the effect of an individual observation on the estimated parameter of the fitted model." For each observation, a DFBETA is produced for the intercept term and each independent variable included in the model. The study includes analyses that identify observations exhibiting large DFBETAs for UNCOMP and PROF. After deleting these observations, logistic regression is performed on the remaining observations. Then, UNCOMP and PROF's parameter estimates from models produced with and without the deleted observations are compared.

The main analyses described in this section are performed only on 1989 Tennessee hospital data. To test whether 1989 data may represent an unusual period, the study performs similar analyses on 1988 Tennessee hospital data.

6. Further Analyses.

Evaluation of Model's Classification Ability

Most extant research modeled hospital profits, charges and costs, uncompensated care provided, or quality of hospital care as dependent variables with independent indicator variables capturing ownership's effect on these variables. Evaluating the behavior of individual tax-exempt hospitals is difficult with this method. The error or difference between predicted dependent variable values and the actual dependent variable values can be used to evaluate individual hospital behavior. However, this difference is not easily interpretable. If this method is used, explaining how tax-exempt hospitals are chosen for re-evaluation would prove a difficult task.

On the other hand, logistic regression can be used to calculate conditional probabilities of hospitals having a particular tax status. Conditional probabilities are calculated using formulas (3) and (4) above, and are obtained from models chosen after the above logistic regression analyses. Predicted conditional probabilities provide an interpretable measure of how a hospital behaves relative to its counterparts. Consequently, the models developed in this study provide a technique to identify tax-exempt hospitals that act like taxable hospitals more so than they act like their tax-exempt counterparts.

In this portion of the study, an observation is considered classified into the hospital group with the highest predicted conditional probability for that observation. Hence, an observation exhibiting a probability larger than .5 of coming from the tax-exempt group is considered classified into the tax-exempt group. The predictive ability of the model is examined through a classification table such as the following:

		Predicted	
		TEs	IOTs
Actual	TEs		
	IOTs		

TEs are tax-exempt hospitals while IOTs are investor-owned taxable hospitals. Correctly classified observations appear on the diagonal of the classification table.

H&L [171] point out that, when this classification technique is used the fitted model performs better on data used to develop the model than on other observations. H&L suggest using a holdout sample to provide external validation of the model. The analyses in this dissertation do not include a holdout sample of Tennessee hospitals because the classification table feature in the SAS LOGISTIC procedure uses a jackknife technique to reduce bias [SAS/STAT User's Guide, 1092]. The jackknife technique involves approximating model parameters with one observation omitted and using these approximated parameters to classify the omitted observation. Because the jackknife technique reduces classification bias, the logistic regression analyses is performed on all 1989 Tennessee hospital data. To provide external validation, however, parameter estimates produced by the logistic regression of 1989 Tennessee hospital data are used to classify hospitals from other states.

Proportions of hospitals properly classified are compared to the proportion properly classified expected by chance. Morris and Nichols [1988, 249] note that when properly classifying both groups is of interest, the proper chance criterion for a dichotomous dependent variable is the "proportional chance criterion, $[p^2 + (1-p)^2]$ where p is the proportion of observations in group 1 and 1-p is the proportion of observations in group 2." To test whether the classification obtained from the logistic models is significantly better than classification expected by chance, the usual test based on the normal approximation will be used. (See, for example, Bhattacharyya and Johnson 1977, 263.) In this case, the test statistic is:

$$Z = \frac{p_1 - p_0}{[p_0(1-p_0)]^{1/2} / n^{1/2}}$$

where: p_1 = the proportion properly classified by the model,
p_0 = the proportion properly classified expected by chance, and
n = the overall sample size.

This Z statistic is used to test the difference between the proportion of Tennessee hospitals properly classified by logistic models and the properly classified proportion expected by chance.

Classification Ability and Logistic Regression Analyses - Other States' Hospitals

To validate the results obtained from Tennessee data, the estimated models are used to predict the tax status of Florida, West Virginia, and Arizona hospitals.

A classification table like that above is constructed for each state. The Z statistic discussed above is used to test whether Tennessee logistic regression parameter estimates classify, better than chance, the tax status of hospitals in other states.

Logistic regression analyses are also performed on Florida, West Virginia, and Arizona hospital data. Logistic regression analyses performed on Florida data include most of the same variables and follow the same process as that described for Tennessee data. However, logistic regression performed on West Virginia and Arizona data include only control variables found to be significant in the Tennessee analyses, along with UNCOMP and PROF. Parameter estimates are obtained from the logistic regression performed with each state's hospitals. The Z statistic discussed above is used to test whether each state's model predicts its respective hospitals better than chance.

7. Summary.

This chapter describes research hypotheses and methods employed to test those hypotheses. The hypotheses, as given above, are that tax-exempt hospitals do not provide more uncompensated care than investor-owned taxable hospitals and that tax-exempt hospitals are not as profitable as taxable hospitals. Tennessee hospital data for 1989 is the main data set used in the analyses, but Florida, West Virginia, and Arizona hospital data are also examined. Logistic regression is the primary statistical method employed to test these hypotheses. Also, the classification ability of logistic regression models is examined. The next chapter reports the results from tests of research hypotheses and other data analyses.

CHAPTER IV

EMPIRICAL RESULTS

This chapter (1) reports empirical results from logistic regression analyses performed with Tennessee government-owned tax-exempt hospitals and privately-owned tax-exempt hospitals; (2) presents the empirical results of logistic regression performed with Tennessee tax-exempt and investor-owned taxable hospitals; (3) discusses the classification ability of the logistic models obtained from Tennessee hospitals as applied to Tennessee hospitals and to hospitals from other states; (4) describes the empirical results obtained from logistic regression performed on hospitals in Florida, West Virginia, and Arizona; and (5) concludes with a brief summary.

1. Government-owned Versus Privately-owned Tax-exempt Hospitals.

The thrust of this research project is to compare investor-owned taxable hospitals to tax-exempt hospitals. However, past research indicates that government-owned and privately-owned tax-exempt hospitals may behave differently. Consequently, tax-exempt hospitals are coded differently by ownership, and logistic regression analyses are first performed with only 1989 Tennessee tax-exempt hospital data. These analyses compare 28 government-owned tax-exempt hospitals to 56 privately-owned tax-exempt hospitals.

The model building process entails beginning with a full model including all (except for transformations) of the control variables. Each full model also includes the uncompensated care variable (UNCOMP) and one of the profitability variables. With all these variables in the model, logistic regression is performed on all Tennessee government-owned and privately-owned tax-exempt hospitals. Next, the output of the analysis is examined to determine the least significant variable as measured by the Wald chi-square statistic. The least significant variable is deleted, and the new reduced model is fitted. The change in the -2 log likelihood statistic from one model to the next is computed to test whether the explanatory power of the overall model drops significantly as variables are removed. This process is repeated until only significant variables remain.

The results reveal that population density (POPDEN) is the only variable that nears significance when comparing the Tennessee tax-exempt hospital groups. Table 6 presents the results of these analyses. For Model 1, which includes only POPDEN, the p-values for POPDEN's Wald Chi-square statistic and the model's -2 log likelihood statistic indicate the explanatory power of the variable. Hauck and Donner (H&D) [1977] demonstrated that the Wald Chi-square statistic frequently fails to reject hypotheses when the coefficient is significant. H&D conclude that the -2 log likelihood statistic yields relatively unbiased hypotheses tests. Consequently, the -2 log likelihood statistic is the preferred measure of variables' significance. This study concentrates on the -2 log likelihood statistic for assessing the contribution of variables to models and for tests of hypotheses.

TABLE 6

Logistic Regression Analyses: Tennessee Government-owned vs. Privately-owned Tax-exempt Hospitals.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likeli-hood Statistic	Prob. > Chi-Square
Model 1					
INTERCEPT	-0.3488	0.2933	1.4140		0.2344
POPDEN	-0.0014	0.0008	2.9269		0.0871
Model 1, 1 df.				3.409	0.0648
Model 2					
INTERCEPT	-0.7978	0.4135	3.7220		0.0537
POPDEN	-0.0017	0.0009	3.5730		0.0587
UNCOMP	0.0523	0.0371	1.9884		0.1585
PROF	0.0273	0.0228	1.4336		0.2312
Model 2, 3 df.				6.647	0.0840
Difference (Model 2 - Model 1), 2 df.				3.238	0.1981
Model 3					
INTERCEPT	-0.8750	0.4486	3.8045		0.0511
POPDEN	-0.0017	0.0009	3.6419		0.0563
UNCOMP	0.0508	0.0370	1.8878		0.1695
CASHFLOW	0.0186	0.0217	0.7363		0.3908
Model 3, 3 df.				5.829	0.1202
Difference (Model 3 - Model 1), 2 df.				2.420	0.29820
Model 4					
INTERCEPT	-0.8047	0.4712	2.9169		0.0877
POPDEN	-0.0017	0.0009	3.5412		0.0599
UNCOMP	0.0580	0.0456	1.6194		0.2032
OP. INCOME	0.0065	0.0178	0.1333		0.7150
Model 4, 3 df.				5.186	0.1587
Difference (Model 4 - Model 1), 2 df.				1.777	0.4113
Model 5					
INTERCEPT	-0.7309	0.5280	1.9164		0.1663
POPDEN	-0.0017	0.0009	3.6389		0.0564
UNCOMP	0.0493	0.0455	1.1785		0.2777
CASHFLOW OP.	0.0008	0.0177	0.0019		0.9655
Model 5, 3 df.				5.052	0.1680
Difference (Model 5 - Model 1), 2 df.				1.643	0.4398

The -2 log likelihood statistic for Model 1 indicates that POPDEN is not significant at the α = .05 level but nears significance. POPDEN's parameter estimate's sign indicates that privately-owned tax-exempt hospitals are more likely to operate in areas of higher population density than government-owned tax-exempt hospitals. POPDEN's sign and near significance are not surprising. Several privately-owned tax-exempt hospitals serve the four most densely populated Tennessee counties while no more than one government-owned hospital operates in any individual Tennessee county.

The variables of interest may together add significant explanatory power to the model even though they are insignificant individually. The change in -2 log likelihood statistics as variables are dropped from a model follows a Chi-square distribution with one degree of freedom for each variable dropped. Therefore, the explanatory power of variables together can be tested by evaluating the change in the -2 log likelihood statistic of a model when variables are dropped. This technique is used to test whether the variables of interest together add significant explanatory power to a model including POPDEN.

Accordingly, Models 2 through 5 in Table 6 include POPDEN, UNCOMP, and one profitability variable. The last items reported for Models 2 through 5 are the differences between the -2 log likelihood statistics for Models 2 through 5 and the -2 log likelihood statistic for Model 1. These differences and their associated p-values indicate that both variables of interest together do not add explanatory power to the model. Therefore, statistical tests reveal that Tennessee government-owned and privately-owned tax-exempt hospitals do not differ significantly on any variables included in the logistic regression analyses, although POPDEN nears significance.

2. Tax-exempt Versus Investor-owned Taxable Hospitals.

Because the two tax-exempt hospital groups do not differ significantly on the variables of interest, all tax-exempt hospitals are re-coded as one group. Then, the analyses proceed by comparing the tax-exempt hospital group (TEs) to the investor-owned taxable hospital group (IOTs). Table 7 presents summary statistics for tax-exempt and investor-owned taxable hospitals in the four states included in the analyses.

Univariate Analyses

To assess which variables may potentially explain variation in a dependent variable, Hosmer and Lemeshow [1989, 83] recommend beginning the model building process "with a careful univariate analysis" of each variable. Accordingly, comparison of Tennessee TEs and IOTs begins with univariate logistic regression analyses with only the variables of interest. Table 8 presents the results of univariate logistic regression with the variables of interest. The sign for UNCOMP's parameter estimate and strongly significant p-values reported in Model 1 indicate that tax-exempt hospitals provide more uncompensated care than investor-owned taxable hospitals. In Model 2 and Model 3, PROF and CASHFLOW are marginally significant. However, all profitability variables' parameter estimates are positive, indicating that tax-exempt hospitals are more profitable than investor-owned hospitals rather

TABLE 7

Summary Statistics for Tax-exempt and Investor-owned Taxable Hospitals in Tennessee, Florida, West Virginia, and Arizona.

Variable	N	Mean	Stand. Deviation	Minimum	Maximum
Tennessee Data					
TEs					
STBEDS	84	198.68	239.47	28.00	1,436.00
UNCOMP	84	8.97	6.60	0.44	51.01
PROF	84	0.91	12.88	-56.45	23.62
CASHFLOW	84	7.04	12.32	-39.10	29.31
OP. INCOME	84	-1.08	17.32	-104.10	23.26
CASHFLOW OP.	84	5.04	16.88	-97.98	28.96
IOTs					
STBEDS	49	104.88	94.38	13.00	622.00
UNCOMP	49	5.53	2.95	0.20	14.32
PROF	49	-4.74	19.14	-86.96	23.68
CASHFLOW	49	2.07	16.85	-60.89	27.60
OP. INCOME	49	-3.54	18.87	-81.52	24.77
CASHFLOW OP.	49	3.26	16.80	-55.45	30.80
Florida Data					
TEs					
STBEDS	117	273.15	229.34	20.00	1,383.00
UNCOMP	117	10.21	7.28	1.70	43.30
PROF	117	0.74	12.96	-106.30	21.30
OP. INCOME	117	-4.99	16.78	-107.40	14.70
IOTs					
STBEDS	93	189.51	100.90	27.00	458.00
UNCOMP	93	4.91	2.88	0.00	20.00
PROF	93	-2.00	12.67	-80.80	18.10
OP. INCOME	93	-1.98	15.18	-80.60	26.60

TABLE 7
(Continued)

Variable	N	Mean	Stand. Deviation	Minimum	Maximum
West Virginia Data					
TEs					
STBEDS	45	171.62	163.83	21.00	962.00
UNCOMP	45	7.39	3.18	1.74	18.29
PROF	45	1.01	10.64	-60.12	11.56
IOTs					
STBEDS	10	94.20	67.93	47.00	275.00
UNCOMP	10	4.82	1.38	2.87	6.96
PROF	10	3.04	6.00	-6.99	17.15
Arizona Data					
TEs					
STBEDS	52	167.42	150.22	22.00	621.00
UNCOMP	52	5.73	4.73	0.00	27.56
PROF	52	-6.24	37.87	-250.55	14.05
IOTs					
STBEDS	9	124.22	90.39	25.00	314.00
UNCOMP	9	4.27	4.88	0.00	16.16
PROF	9	3.05	7.62	-7.73	11.63

Notes:

N is the number of observations in a group.
UNCOMP is presented as a percentage of gross patient charges.
Profitability variables are presented as a percentage of net patient revenues.

TABLE 8

Univariate Logistic Regression Analyses: Tennessee Tax-exempt Versus Investor-owned Taxable Hospitals.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likeli-hood Statistic	Prob. > Chi-Square
<u>Model 1</u>					
INTERCEPT	-1.5460	0.5174	8.9279		0.0028
UNCOMP	0.3064	0.0748	16.7760		0.0001
Model 1, 1 df.				23.418	0.0000
<u>Model 2</u>					
INTERCEPT	0.5757	0.1837	9.8233		0.0017
PROF	0.0233	0.0122	3.6838		0.0549
Model 2, 1 df.				4.000	0.0455
<u>Model 3</u>					
INTERCEPT	0.4230	0.1915	4.8761		0.0272
CASHFLOW	0.0244	0.0129	3.5438		0.0598
Model 3, 1 df.				3.715	0.0539
<u>Model 4</u>					
INTERCEPT	0.5559	0.1818	9.3547		0.0022
OP. INCOME	0.0076	0.0099	0.5786		0.4469
Model 4, 1 df.				0.578	0.4471
<u>Model 5</u>					
INTERCEPT	0.5129	0.1850	7.6898		0.0056
CASHFLOW OP.	0.0062	0.0106	0.3470		0.5558
Model 5, 1 df.				0.345	0.5570

than the reverse as expected. These results are evident from the Tennessee data in Table 7. (Analyses discussed later refer to univariate Models 1 and 2 in Table 8.)

Multivariate Logistic Regression Analyses

Because only one variable is included in a model, univariate analyses do not control for the possibility that other variables may be affecting the results. Consequently, the logistic regression model building process described in Section 1 of this chapter is followed to control for confounding or adjusting variables. In models examined, UNCOMP, STBEDS, and LOGBEDS are significant even when the model includes several insignificant control variables as in the full model reported in Table 9. (Variables are defined in Table 4 of Chapter 3.) POPDEN is not significant despite its near significance in the analyses of the two tax-exempt hospital groups. Tax-exempt hospitals in Tennessee include sole community hospitals in rural areas as well as hospitals in urban areas. Investor-owned taxable hospitals also exhibit such a distribution throughout Tennessee. Therefore, POPDEN's lack of significance in the main analyses is no surprise.

Table 9 presents results of logistic regression analyses with 1989 Tennessee tax-exempt and taxable hospitals. As explained in Section 1 above, the difference in the -2 log likelihood statistics between a full and reduced model follows a Chi-square distribution and can be used to test the explanatory power of variables removed from the full model. The analyses of several models reveal that STBEDS and LOGBEDS are the only significant control variables, exhibiting nearly the same level of significance. LOGBEDS does not add explanatory power beyond STBEDS's

TABLE 9

Multivariate Logistic Regression Analyses: Tennessee Tax-exempt Versus Investor-owned Taxable Hospitals.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likelihood Statistic	Prob. > Chi-Square
Model 1					
INTERCEPT	-0.0088	0.2673	0.0011		0.9739
STBEDS	-0.0040	0.0017	5.7967		0.0161
Model 1, 1 df.				9.063	0.0026
Model 2					
INTERCEPT	-2.2815	0.6111	13.9392		0.0002
STBEDS	0.0047	0.0019	5.9719		0.0145
UNCOMP	0.3199	0.0765	17.4714		0.0001
Model 2, 2 df.				32.978	0.0000
Difference					
(Model 2 - Model 1), 1 df.	(Hypothesis 2)			23.915	0.0000
Model 3					
INTERCEPT	0.0842	0.2753	0.0935		0.7598
STBEDS	0.0034	0.0016	4.4323		0.0353
PROF	0.0151	0.0123	1.5071		0.2196
Model 3, 2 df.				10.644	0.0049
Difference					
(Model 3 - Model 1), 1 df.	(Hypothesis 3)			1.581	0.2086
Model 4					
INTERCEPT	-2.2437	0.6150	13.3093		0.0003
STBEDS	0.0039	0.0019	4.2063		0.0403
UNCOMP	0.3361	0.0788	18.1823		0.0001
PROF	0.0226	0.0130	3.0181		0.0823
Model 4, 3 df.				36.045	0.0000
Difference					
(Model 4 - Model 1), 2 df.	(Hypothesis 1)			26.982	0.0000
(Model 4 - Model 2), 1 df.	(Hypothesis 3)			3.067	0.0799
(Model 4 - Model 3), 1 df.	(Hypothesis 2)			25.401	0.0000

TABLE 9
(Continued)

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likelihood Statistic	Prob. > Chi-Square
Model 5					
INTERCEPT	-2.3836	0.6211	14.7264		0.0001
STBEDS	0.0038	0.0019	4.0178		0.0450
UNCOMP	0.3361	0.0786	18.2414		0.0001
CASHFLOW	0.0236	0.0145	2.6502		0.1035
Model 5, 3 df.				35.669	0.0000
Difference (Model 5 - Model 2), 1 df.	(Hypothesis 3)			2.691	0.1009
Model 6					
INTERCEPT	-2.2653	0.6126	13.6750		0.0002
STBEDS	0.0041	0.0019	4.4931		0.0340
UNCOMP	0.3335	0.0784	18.1180		0.0001
OP. INCOME	0.0171	0.0132	1.6673		0.1966
Model 6, 3 df.				34.638	0.0000
Difference (Model 6 - Model 2), 1 df.	(Hypothesis 3)			1.660	0.1976
Model 7					
INTERCEPT	-2.3636	0.6191	14.5728		0.0001
STBEDS	0.0041	0.0019	4.4039		0.0359
UNCOMP	0.3319	0.0781	18.0618		0.0001
CASHFLOW OP.	0.0164	0.0148	1.2271		0.2680
Model 7, 3 df.				34.209	0.0000
Difference (Model 7 - Model 2), 1 df.	(Hypothesis 3)			1.231	0.2672
Full Model					
INTERCEPT	-2.2811	1.3735	2.7582		0.0968
STBEDS	0.0048	0.0025	3.7879		0.0516
UNCOMP	0.3291	0.0814	16.3284		0.0001
PROF	0.0206	0.0140	2.1477		0.1428
COMPT	-0.1429	0.5028	0.0807		0.7763
PCINC	0.0000	0.0001	0.0298		0.8630
POPDEN	-0.0007	0.0011	0.4015		0.5263
Full Model, 6 df.				36.531	0.0001

contribution to models but, as a transformation, complicates interpretation of the size variable. Therefore, hypotheses are tested using models including STBEDS and variables of interest.

Model 1, Table 9 with only STBEDS as an independent variable is used to test all hypotheses. Hypothesis 1 (null form) is tested by the -2 log likelihood difference between Model 1 and Model 4 which includes STBEDS, UNCOMP, and PROF. This difference (shown with the Model 4 results) of 26.982 follows a Chi-square distribution with two degrees of freedom. The -2 log likelihood difference is highly significant and indicates that the variables of interest together add explanatory power to the model. Thus, Hypothesis 1 is rejected.

Hypothesis 2 (null form) states that tax-exempt hospitals do not provide more uncompensated care than investor-owned hospitals. As measured by p-values on the Wald Chi-square statistics, UNCOMP is the most significant variable in the models included in Table 9. The significance and sign of UNCOMP's parameter estimates indicate that tax-exempt hospitals provide more uncompensated care than investor-owned taxable hospitals.

Evaluating changes in -2 log likelihood statistics provide similar results. The difference in the -2 log likelihood statistics for Model 2 (shown with Model 2 results) including STBEDS and UNCOMP, and Model 1 including only STBEDS is highly significant. Also highly significant is the change in -2 log likelihood statistics (shown with Model 4 results) between Model 4 and Model 3. This change measures the additional explanatory power provided by UNCOMP when it is added to a model that includes STBEDS and PROF. Therefore, Hypothesis 2 is rejected.

Hypothesis 3 (null form) states that tax-exempt hospitals do not exhibit lower profit levels than investor-owned taxable hospitals. The signs of the parameter estimates on the profitability variables in Models 3 through 7 in Table 9 indicate that tax-exempt hospitals are more profitable than investor-owned hospitals. Also, when profitability variables are added to the models, changes in -2 log likelihood statistics are insignificant at an $\alpha = .05$ confidence level. Consequently, Hypothesis 3 can not be rejected. (Possible reasons for this result are discussed in the limitations section of Chapter V.)

As measured by p-values on the Wald Chi-square statistics in Models 4 and 5, PROF and CASHFLOW near significance at the $\alpha = .05$ level but in a direction opposite of that expected. The difference in -2 log likelihood statistics between Models 4 and 2 and between Models 5 and 2 produce similar results. The parameter estimates for profitability variables become less significant as the definition of profitability becomes further removed from net surplus or <loss>. The results therefore demonstrate some sensitivity to how profitability is defined.

To test whether the scaling factor also affects logistic regression results, PROF, CASHFLOW, OPERATING INCOME, and CASHFLOW OPERATIONS are recalculated using total net revenue rather than net patient revenue as the denominator. Results of logistic regression performed with these variables are not shown, but all recalculated profitability variables are less significant than their counterparts reported in Table 9. No recalculated profitability variable is significant nor is the sign on any recalculated profitability variable in the direction expected. However, the results from recalculated profitability variables do indicate some sensitivity to the scaling factor.

Results regarding profitability are unexpected, but not radically different from some past research. (See Table 2, Chapter II.) Rejecting Hypotheses 1 and 2 and the inability to reject Hypothesis 3 can be viewed in a positive manner by policy-makers. Research findings indicate that tax-exempt hospitals can provide significantly more uncompensated care than their taxable counterparts, and remain more profitable as well.

The models developed include few variables. Consequently, as Hosmer and Lemeshow (H&L) suggest, parameter estimates from the chosen models are compared to parameter estimates obtained from a full model including insignificant variables. H&L [88] state that a researcher

> should be concerned about variables whose coefficients have changed markedly in magnitude. This would indicate that one or more of the excluded variables was important in the sense of providing a needed adjustment of the effect of the variable that remained in the model.

Table 8, Model 1 presents the parameter estimate when UNCOMP alone is used to model hospital tax status. A comparison of Table 8 and Table 9 indicates that parameter estimates for UNCOMP vary little when other variables are dropped or added to the model. Preliminary analyses reveal that parameter estimates for UNCOMP vary little from Table 8, Model 1 even when several insignificant control variables are included in a full model. (See the Full Model, Table 9.) Stability in the parameter estimate for UNCOMP provides evidence that no adjusting variables are necessary when interpreting UNCOMP's contribution to a model.

The parameter estimate for PROF in Table 9, Model 4 is similar to that in Table 8, Model 2, but these estimates differ markedly from PROF's parameter estimate in Model 3, Table 9. These results suggest that UNCOMP is a necessary adjusting variable when evaluating PROF's contribution to a model that includes STBEDS. Parameter estimates for PROF also vary little from the Table 9, Model 4 when insignificant control variables are added to that model. (See the Full Model, Table 9.) This indicates that UNCOMP and STBEDS are the only adjusting variables necessary when evaluating PROF's contribution.

Logistic Regression Diagnostics

A standard procedure in regression analysis is to check for influential observations that may strongly affect the results. Version 6 is the first SAS version to produce influence statistics for logistic regression similar to ordinary least squares (OLS) regression influence statistics. For analyses of a dichotomous dependent variable, the SAS LOGISTIC procedure produces several influence diagnostics. (SAS/STAT User's Guide, pp. 1093-1095, discusses these influence statistics.)

Influence statistics are obtained from several models to search for influential observations in the data set. The data is carefully checked for input or other such errors when influence statistics identify a hospital as an influential observation. DFBETAs are influence statistics of particular interest. A DFBETA is a standardized measure of the change in an independent variable's parameter estimate if one observation is omitted from the analysis. DFBETAs for UNCOMP and PROF in Table 9, Model 4 are evaluated to determine whether UNCOMP's significance and the positive sign on PROF's parameter estimate are due to just a few influential observations. Appendix A lists all Tennessee hospitals included in the analyses and their associated DFBETA values for UNCOMP and PROF from Model 4. The larger the DFBETA absolute value, the more influential is the observation.

Table 10 presents Model 4 logistic regression results with all observations included in the analysis and results after one or two most influential observations are deleted from the data set. Carthage General Hospital and Jefferson Memorial Hospital exhibit the largest absolute values for UNCOMP DFBETAs and thus most affect UNCOMP's parameter estimate. In Table 10, the second and third set of results presented are for analyses omitting Carthage General, and then both Carthage General and Jefferson Memorial. When these influential observations are omitted, UNCOMP's parameter estimate increases, becoming more significant in the expected direction. Though not reported, removing three other influential observations (Sequatchie General, Bledsoe County General, and Fentress County General) generates the same effect. Consequently, rejection of Hypothesis 2 is not due to a few influential observations.

Oakwood Memorial Hospital and Baptist Memorial Hospital of Germantown exhibit the largest PROF DFBETA values indicating they most affect PROF's parameter estimate. In Table 10, the fourth and fifth set of results presented are for analyses omitting Oakwood Memorial, and then both Oakwood Memorial and

TABLE 10

Multivariate Logistic Regression Analyses:
Tennessee Tax-exempt Versus Investor-owned Taxable Hospitals with Influential Observations Omitted.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likelihood Statistic	Prob. > Chi-Square
Model 4: All Observations					
INTERCEPT	-2.2437	0.6150	13.3093		0.0003
STBEDS	0.0039	0.0019	4.2063		0.0403
UNCOMP	0.3361	0.0788	18.1823		0.0001
PROF	0.0226	0.0130	3.0181		0.0823
Model 4, 3 df.				36.045	0.0000
Model 4: Omitting Carthage General					
INTERCEPT	-2.4917	0.6441	14.9639		0.0001
STBEDS	0.0036	0.0019	3.7589		0.0525
UNCOMP	0.3865	0.0854	20.4881		0.0001
PROF	0.0256	0.0133	3.7050		0.0543
Model 4, 3 df.				40.129	0.0001
Model 4: Omitting Carthage General and Jefferson Memorial					
INTERCEPT	-2.8108	0.6835	16.9127		0.0001
STBEDS	0.0039	0.0019	4.0636		0.0438
UNCOMP	0.4257	0.0907	22.0081		0.0001
PROF	0.0255	0.0134	3.5845		0.0583
Model 4, 3 df.				43.443	0.0001
Model 4: Omitting Oakwood Memorial					
INTERCEPT	-2.3371	0.6268	13.9015		0.0002
STBEDS	0.0040	0.0019	4.4057		0.0358
UNCOMP	0.3498	0.0809	18.6755		0.0001
PROF	0.0140	0.0147	0.9065		0.3410
Model 4, 3 df.				35.744	0.0001
Model 4: Omitting Oakwood Memorial and Baptist of Germantown					
INTERCEPT	-2.3206	0.6257	13.7539		0.0002
STBEDS	0.0039	0.0019	4.2576		0.0391
UNCOMP	0.3460	0.0806	18.4325		0.0001
PROF	0.0212	0.0163	1.6973		0.1926
Model 4, 3 df.				36.513	0.0001

Baptist of Germantown. When Oakwood Memorial is removed, PROF's parameter estimate declines and the p-value on PROF's Wald Chi-square statistic increases to .3410. (Similar results are found for other profitability variables when Oakwood is removed and the analyses repeated for Models 5 through 7 in Table 9. However, all profitability variables' parameter estimates' signs still remain positive). Omitting Baptist of Germantown along with Oakwood increases PROF's parameter estimate and decreases the Wald Chi-square p-value to .1926. Even though influential observations affect the significance of PROF, the conclusion to not reject Hypothesis 3 is not modified when they are omitted.

Logistic Regression Analyses with 1988 Tennessee Hospital Data

The inability to reject hypothesis 3 leads to the question of whether 1989 data reflects an unusual year. Accordingly, analyses comparing tax-exempt and investor-owned taxable hospitals are also performed on 1988 Tennessee data. Again, STBEDS and LOGBEDS are the only significant control variables. For 1988 data, logistic regression results from several models that include STBEDS, UNCOMP, PROF, and CASHFLOW are presented in Table 11. As with 1989 data, UNCOMP is extremely significant in these models. In fact, the 1988 parameter estimate for UNCOMP is larger than the 1989 UNCOMP parameter estimate. The parameter estimates for profitability variables possess the expected sign in the 1988 analyses but are highly insignificant. These results indicate that 1989 data is not an anomaly; 1988 data produce essentially the same results as does 1989 data.

TABLE 11

Multivariate Logistic Regression Analyses: Tennessee Tax-exempt Versus Investor-owned Taxable Hospitals, 1988 Data.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likelihood Statistic	Prob. > Chi-Square
Model 1					
INTERCEPT	-0.0739	0.2705	0.0747		0.7846
STBEDS	0.0045	0.0017	6.6303		0.0100
Model 1, 1 df.				10.469	0.0003
Model 2					
INTERCEPT	-3.5042	0.7764	20.3711		0.0001
STBEDS	0.0068	0.0023	8.9595		0.0028
UNCOMP	0.4919	0.0995	24.4248		0.0001
Model 2, 2 df.				50.065	0.0000
Difference (Model 2 - Model 1), 1 df.	(Hypothesis 2)			39.596	0.0000
Model 3					
INTERCEPT	-0.0865	0.2755	0.0986		0.7535
STBEDS	0.0046	0.0018	6.4731		0.0110
PROF	-0.0028	0.0107	0.0670		0.7957
Model 3, 2 df.				10.536	0.0052
Difference (Model 3 - Model 1), 1 df.	(Hypothesis 3)			0.067	0.7958
Model 4					
INTERCEPT	-3.5494	0.7856	20.4152		0.0001
STBEDS	0.0071	0.0024	8.9277		0.0028
UNCOMP	0.4947	0.1000	24.4814		0.0001
PROF	-0.0057	0.0121	0.2223		0.6373
Model 4, 3 df.				50.290	0.0000
Difference (Model 4 - Model 1), 2 df.	(Hypothesis 1)			39.821	0.0000
Model 5					
INTERCEPT	-3.5048	0.7769	20.3535		0.0001
STBEDS	0.0068	0.0023	8.5291		0.0035
UNCOMP	0.4924	0.0998	24.3657		0.0001
CASHFLOW	-0.0011	0.0128	0.0070		0.9332
Model 5, 3 df.				50.072	0.0000
Difference (Model 5 - Model 2), 1 df.	(Hypothesis 3)			0.007	0.9332

Summary

Logistic regression analyses are performed with 1989 Tennessee hospital data using various models comparing tax-exempt and investor-owned taxable hospitals. The only significant control variables are proxies for hospital size. The uncompensated care variable is very significant in all models, leading to the rejection of hypotheses 1 and 2. When added to models including STBEDS, all profitability variables are insignificant at the $\alpha = .05$ level with parameter estimates' signs opposite of the expected direction. Therefore, hypothesis 3 can not be rejected. Logistic regression diagnostics are examined to determine whether one or a few influential observations are driving the results; no such evidence is found. Finally, 1988 Tennessee hospital data is also analyzed to determine whether 1989 is an unusual year. The logistic regression results for 1988 data are similar to the results produced by 1989 data.

3. Classification Ability of Models.

Tests of research hypotheses are the main purpose of this dissertation and are accomplished by performing logistic regression analyses on 1989 Tennessee hospital data. Significant parameter estimates on variables included in logistic regression model and the extreme significance of models' -2 log likelihood statistics indicate that the models developed explain significant variation between the two hospital groups. Another goal of this dissertation is to produce a statistical tool to help regulators identify nonprofit hospitals that should have their tax-exemptions re-evaluated. To address this goal, the classification ability of certain models is evaluated.

The classification ability of two logistic regression models is examined. In producing a classification table, the SAS LOGISTIC procedure uses a jackknife technique (discussed in Chapter 3) to reduce bias resulting from classification of the same observations that were used to develop the predictive model. Tennessee, Florida, and West Virginia classification tables that relate to logistic regression models developed with those states respective data are produced with the jackknife technique.

Table 9, Model 4 includes all variables significant at the $\alpha = .10$ level in the 1989 Tennessee logistic regression analyses. However, because the sign of PROF's parameter estimate is in the opposite direction of that expected, PROF's presence in the model would lead to misclassifying tax-exempt hospitals that exhibit low profitability. No court cases or policymakers have cited low profitability as a reason to revoke hospitals' tax exemptions. Also, as discussed in the limitations section of Chapter 5, PROF may be a poor measure of hospital financial performance. Consequently, classification analyses concentrate on models without PROF.

Model 2 from Table 9, which includes STBEDS and UNCOMP as independent variables, is selected for main classification ability analyses. Comparing Model 1 in Table 8 including only UNCOMP, to Model 2 in Table 9 with both UNCOMP and STBEDS as independent variables reveals that UNCOMP's parameter estimate varies little when STBEDS is added to a model. As discussed in the multivariate logistic regression analyses section above, stability of the UNCOMP parameter estimates indicates that STBEDS may not be needed as an adjusting variable. Consequently, classification ability of a model including only UNCOMP as an independent variable is also examined. This model may be more appropriate than a model including STBEDS for these analyses because hospital size is not a theoretical justification for differential tax treatment of hospital groups.

Classification Ability with 1989 Tennessee Hospital Data

Chapter 3 describes how the conditional probability of an observation coming from each group can be calculated from the parameter estimates produced by a logistic regression model. Accordingly, statistical packages calculate the conditional probability of each observation coming from the tax-exempt and taxable groups. Observations are classified into the hospital group for which they exhibit the highest conditional probability. For example, an observation exhibiting a probability larger than .5 of coming from the tax-exempt group is considered classified into the tax-exempt group. Two by two classification tables such as those in Figure 2 present classification results for the three models considered in the analyses.

A model including UNCOMP and STBEDS produces the first classification table for Tennessee hospitals presented in Figure 2. Figure 2 also presents classification results with Tennessee hospitals for a model with UNCOMP alone. The first rows of the 2 X 2 classification tables show the total number of tax-exempt hospitals (TEs) included in the analyses and the number of TEs classified as either TEs or investor-owned taxable hospitals (IOTs). The second rows display the total

1989 Tennessee Hospitals
Model with STBEDS and UNCOMP

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	67	17	84
	IOTs	20	29	49
	Total	87	46	133

1989 Tennessee Hospitals
Model with UNCOMP alone

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	73	11	84
	IOTs	27	22	49
	Total	100	33	133

Figure 2. Classification Tables for Tennessee Hospitals from Logistic Regression Performed on 1989 Tennessee Hospital Data.

number of IOTs included in the analyses and the number of IOTs that are classified as either TEs or IOTs. The first columns in the classification tables present the total number of hospitals classified as TEs and the number classified as TEs that are actually TEs and IOTs. The second columns in the classification tables present the total number of hospitals classified as IOTs and the number classified as IOTs that are actually TEs and IOTs.

Table 12 summarizes classification tables produced with parameter estimates from logistic regression models developed from 1989 Tennessee hospital data. For a specific classification table, the items presented in Table 12 are calculated as follows: (1) adding the diagonal numbers (TEs classified as TEs and IOTs classified as IOTs) and dividing this sum by the total number of hospitals included in the analyses provides the percentage of total hospitals correctly classified; (2) dividing the number of TEs classified as TEs by the total number of TEs supplies the percentage of TEs correctly classified; (3) dividing the number of IOTs classified as IOTs by the total number of IOTs yields the percentage of IOTs correctly classified; (4) dividing the number of predicted TEs that actually are TEs by the total number of predicted TEs produces the percentage of classified TEs which actually are TEs; and (5) dividing the number of predicted IOTs that actually are IOTs by the total number of predicted IOTs generates the percentage of classified IOTs which actually are IOTs.

For example, the results for the first table in Figure 2 are summarized first in Table 12. The summary figures for this table are calculated as follows:

TABLE 12

Classification Results Produced with 1989 Tennessee Parameter Estimates.

	Tennessee	Florida	West Virginia	Arizona
Models with STBEDS and UNCOMP				
Percentage of Total Correctly Classified	72.2	71.9	78.2	59.0
Percentage of TEs Correctly Classified	79.8	90.6	77.8	55.8
Percentage of IOTs Correctly Classified	59.2	48.4	80.0	77.8
Percentage of Classified TEs Which are TEs	77.0	68.8	94.6	93.5
Percentage of Classified IOTS Which are IOTs	63.0	80.4	44.4	23.3
Models with UNCOMP alone				
Percentage of Total Correctly Classified	71.4	73.3	72.7	59.0
Percentage of TEs Correctly Classified	86.9	82.1	77.8	55.8
Percentage of IOTs Correctly Classified	44.9	62.3	50.0	77.8
Percentage of Classified TEs Which are TEs	73.0	73.3	87.5	93.5
Percentage of Classified IOTS Which are IOTs	66.7	73.4	33.3	23.3

Percentage of Total Correctly Classified = [(67 +29) / 133] = 72.2%;
Percentage of TEs Correctly Classified = (67 / 84) = 79.8%;
Percentage of IOTs Correctly Classified = (29 / 49) = 59.2%;
Percentage of Classified TEs Which are TEs = (67 / 87) = 77.0%; and
Percentage of Classified IOTs Which are IOTs = (29 / 46) = 63.0%.

The Tennessee column of Table 12 provides a summary of classification results obtained on 1989 Tennessee hospital data. The model of Tennessee hospitals including both UNCOMP and STBEDS properly classifies 72.2% while the model with UNCOMP alone properly classifies 71.4%. Both models properly classify nearly 80% or more of the tax-exempt hospitals but properly classify a relatively low percentage of investor-owned taxable hospitals.

The proportional chance criterion discussed in Section 6 of Chapter 3 specifies that $[0.632^2 + (1 - 0.632)^2]$ or 53.5% of the hospitals would be properly classified by chance where .632 is the total number of TEs divided by the total number of hospitals (84/133). The Z statistic, also discussed in Section 6 of Chapter 3 tests whether the models classify Tennessee hospitals better than is expected by chance. The model including UNCOMP alone properly classified 71.4% of Tennessee hospitals. The Z statistic for this model is calculated as follows:

$$Z = \frac{p_1 - p_0}{[p_0(1-p_0)]^{1/2} / n^{1/2}} = \frac{.714 - .535}{[.535(1 - .535)]^{1/2} / 133^{1/2}} = 4.14$$

where: p_1 = the proportion properly classified by the model,
p_0 = the proportion properly classified expected by chance, and
n = the overall sample size.

The probability of obtaining a Z statistic of 4.14 or larger by chance is .0001. Consequently, the analyses indicate that the models developed with Tennessee hospital data properly classify hospitals much better than chance. Because most Tennessee hospitals are tax exempt, a person could predict that all Tennessee hospitals are tax-exempt and correctly classify over 63% of the hospitals. Naively assuming that all hospitals are tax exempt is a policy option, but such an assumption does not help address the question of whether tax-exempt hospitals should retain their tax exemptions. The classification tables for Tennessee hospitals indicate that logistic regression parameter estimates produce better classification accuracy than would be expected by assuming all hospitals are tax exempt.

This dissertation addresses the tax policy issue of whether nonprofit hospitals deserve their tax exemptions. Government officials concerned with this question argue that many tax-exempt hospitals behave like their taxable counterparts. However, limited government resources prevent an examination of all hospitals to determine whether each individual hospital deserves its tax-exemptions. Also, hospitals and doctors present a powerful political lobby to fight blanket changes in tax law affecting nonprofit hospitals. Examining a few hospitals to determine whether they are earning their exemptions would conserve government resources and provide an alternative to blanket tax law changes.

Probability estimates based on parameter estimates from logistic regression models provide a statistical tool to choose which tax-exempt hospitals should be examined. Politically, logistic regression models properly classifying a high percentage of tax-exempt hospitals may be a good result. First, the model's accuracy results in a relatively low number of tax-exempt hospitals to be examined, thereby conserving government resources. Second, the accuracy in classifying tax-exempt hospitals should help diffuse doctor and hospital administrator criticism of governments considering revoking misclassified hospitals' tax exemptions. If half of the tax-exempt hospitals are misclassified, critics could have a legitimate argument that the selection method is invalid.

Using Tennessee Parameter Estimates to Classify Other States' Hospitals

Parameter estimates produced by the logistic regression analyses with 1989 Tennessee hospital data are also used to classify hospitals from Florida, West Virginia, and Arizona. Figure 3 presents results for Florida hospitals based on classification attempted with parameter estimates from the Tennessee analyses. The first table in Figure 3 presents the results from a model including parameter estimates for both STBEDS and UNCOMP while the second table in Figure 3 presents the results for Florida hospitals with only UNCOMP's parameter estimate in the model. The Florida column in Table 12 summarizes the results of these classification analyses.

The model with both UNCOMP and STBEDS properly classifies 71.9% of all Florida hospitals while the model including UNCOMP alone properly classifies 73.3%. In fact, both models classify Florida hospitals nearly as accurately as either model classifies Tennessee hospitals. Again, the models are quite accurate at classifying tax-exempt hospitals. The proportional chance criterion specifies that $[0.557^2 + (1 - 0.557)^2]$ or 50.7% of Florida hospitals should be properly classified by

1989 Florida Hospitals
Model with STBEDS and UNCOMP

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	106	11	117
	IOTs	48	45	93
	Total	154	56	210

1989 Florida Hospitals
Model with UNCOMP alone

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	96	21	117
	IOTs	35	58	93
	Total	131	79	210

Figure 3. Classification Tables for Florida Hospitals Using Tennessee Parameter Estimates.

chance (where .557 = 117/210). The proportional Z statistic for the model including UNCOMP and STBEDS is calculated as follows:

$$Z = \frac{.719 - .507}{[.507(1 - .507)]^{1/2} \; / \; 210^{1/2}} = 6.14.$$

The probability of obtaining a Z statistic of 6.14 or larger by chance is .0001. Consequently, the analyses indicate that the models developed with Tennessee hospital data properly classify Florida hospitals much better than chance. A person predicting that all Florida hospitals are tax-exempt would correctly classify only slightly under 56% of the hospitals. The classification tables for Florida hospitals indicate that logistic regression parameter estimates from Tennessee data produce better classification accuracy than would be expected by assuming all hospitals are tax exempt. Comparable classification results for Florida and Tennessee hospitals provide evidence that parameter estimates from the Tennessee logistic regression analyses are generalizable to hospitals other than those used to develop the model.

West Virginia has relatively few hospitals, a large percentage of which are tax-exempt hospitals. Figure 4 presents the results for West Virginia hospitals based on classification attempted with parameter estimates from the Tennessee analyses. The first table in Figure 4 presents the results for West Virginia hospitals using parameter estimates for STBEDS and UNCOMP while the second table presents the results for West Virginia hospitals using only UNCOMP's parameter estimate. The West Virginia column in Table 12 summarizes the results of these classification analyses.

1989 West Virginia Hospitals
Model with STBEDS and UNCOMP

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	35	10	45
	IOTs	2	8	10
	Total	37	18	55

1989 West Virginia Hospitals
Model with UNCOMP alone

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	35	10	45
	IOTs	5	5	10
	Total	40	15	55

1989 Arizona Hospitals
Model with STBEDS and UNCOMP
and Model with UNCOMP alone

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	29	23	52
	IOTs	2	7	9
	Total	31	30	61

Figure 4. Classification Tables for West Virginia and Arizona Hospitals Using Tennessee Parameter Estimates.

Even with West Virginia hospitals, Tennessee parameter estimates exhibit classification ability. The model with UNCOMP alone properly classifies 72.7% of all West Virginia hospitals while the model including both UNCOMP and STBEDS properly classifies 78.2%. For West Virginia hospitals, the model including UNCOMP and STBEDS properly classifies a high percentage of both tax-exempt and taxable hospitals, 77.8 and 80.0 respectively. The proportional chance criterion specifies that $[0.818^2 + (1 - 0.818)^2]$ or 70.2% of West Virginia hospitals should be properly classified by chance (where .818 = 45/55).

The Z statistic for the model including UNCOMP alone is:

$$Z = \frac{.727 - .702}{[.702(1 - .702)]^{1/2} / 55^{1/2}} = 0.41,$$

while the Z statistic for the model including STBEDS and UNCOMP is:

$$Z = \frac{.782 - .702}{[.702(1 - .702)]^{1/2} / 55^{1/2}} = 1.30.$$

The probability of obtaining Z statistics of 0.41 or more and 1.30 or more by chance is .34 and .097, respectively. Consequently, the analyses indicate that a model including STBEDS and UNCOMP developed with Tennessee hospital data properly classifies West Virginia hospitals better than chance at $\alpha = .10$. However, predicting all hospitals are tax exempt would properly classify nearly 82% of West Virginia hospitals. As mentioned before, however, such a prediction would be of little use to policymakers and regulators.

Comparing the West Virginia and Tennessee columns in Table 12 reveals that Tennessee parameter estimates classify West Virginia hospitals more accurately than Tennessee hospitals. This classification ability provides evidence that Tennessee logistic regression results are generalizable to hospitals other than those used to develop the model. Results for West Virginia hospitals using Tennessee parameters also raise the possibility that states with too few hospitals to develop their own models could use models developed in other states to identify hospitals whose tax exemptions should be re-evaluated. However, the Z statistic indicates lack of significance for one Tennessee model and marginal significance for the other model.

The third table in Figure 4 presents the results with Tennessee parameter estimates for models including both STBEDS and UNCOMP, and with UNCOMP alone with Arizona hospitals. (Classification results were the same for both models although some hospitals are classified into different groups by the two models). The Arizona column in Table 12 summarizes the results of these classification analyses. Only 59.0% of all Arizona hospitals are properly classified and only 23.3% of predicted IOTs actually are IOTs. The proportional chance criterion specifies that $[0.852^2 + (1 - 0.852)^2]$ or 74.8% of Arizona hospitals should be properly classified by chance (where .852 = 52/61).

Overall, the classification results indicate that models developed with 1989 Tennessee parameter estimates could provide a useful tool in addressing the public policy issue of whether individual hospitals deserve their tax exemptions. Governments could use hospitals' predicted probabilities produced by the logistic regression parameter estimates as a method of identifying which tax-exempt hospitals should have their exemptions re-evaluated. Although Tennessee, Florida, and West Virginia are all located in the Southeast, the results with Florida and West Virginia data provide evidence that the results are generalizable beyond Tennessee hospitals. However, Tennessee analyses parameter estimates properly classified fewer Arizona hospitals than is expected by chance and were only marginally successful at classifying West Virginia hospitals. Therefore, the method developed here may not work well for states with few total hospitals of which a large percentage are tax-exempt. Also, Arizona may be too different from Tennessee for Tennessee results to apply to Arizona hospitals.

4. Logistic Regression Analyses: Florida, West Virginia, and Arizona Data.

Logistic regression analyses are also performed on Florida, West Virginia, and Arizona hospital data. Logistic regression analyses performed on Florida data follow the same process as that described for Tennessee data. Again, for models that include UNCOMP, the only significant control variable found is STBEDS. STBEDS is the only control variable examined in the West Virginia and Arizona analyses. Consequently, models examined and reported include only STBEDS, UNCOMP, and profitability variables. The classification ability of the models is also examined.

Tables 13 and 14 present results of logistic regression analyses with Florida and West Virginia data, respectively. The results for both states are similar to the Tennessee results. In the Florida analyses, STBEDS and UNCOMP were extremely

TABLE 13

Multivariate Logistic Regression Analyses: Tax-exempt Versus Investor-owned Taxable Hospitals, Florida, 1989 Data.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likeli-hood Statistic	Prob. > Chi-Square
<u>Model 1</u>					
INTERCEPT	-0.4227	0.2455	2.9654		0.0851
STBEDS	0.0029	0.0009	9.5624		0.0020
Model 1, 1 df.				11.510	0.0007
<u>Model 2</u>					
INTERCEPT	-3.3719	0.5591	36.3722		0.0001
STBEDS	0.0048	0.0013	13.8554		0.0002
UNCOMP	0.3831	0.0627	37.3539		0.0001
Model 2, 2 df.				79.990	0.0001
Difference					
(Model 2 - Model 1), 1 df.	(Hypothesis 2)			68.480	0.0001
<u>Model 3</u>					
INTERCEPT	-0.3806	0.2503	2.3131		0.1283
STBEDS	0.0027	0.0010	8.1841		0.0042
PROF	0.0094	0.0120	0.6204		0.4309
Model 3, 2 df.				12.168	0.0023
Difference					
(Model 3 - Model 1), 1 df.	(Hypothesis 3)			0.658	0.4173
<u>Model 4</u>					
INTERCEPT	-3.3491	0.5643	35.2228		0.0001
STBEDS	0.0046	0.0013	12.1977		0.0005
UNCOMP	0.3877	0.0636	37.1623		0.0001
PROF	0.0145	0.0150	0.9361		0.3333
Model 4, 3 df.				80.948	0.0001
Difference					
(Model 4 - Model 1), 2 df.	(Hypothesis 1)			69.438	0.0001
(Model 4 - Model 2), 1 df.	(Hypothesis 3)			0.958	0.3277
<u>Model 5</u>					
INTERCEPT	-3.4050	0.5629	36.5924		0.0001
STBEDS	0.0050	0.0013	13.9792		0.0002
UNCOMP	0.3806	0.0628	36.6965		0.0001
OP. INCOME	-0.0073	0.0126	0.3360		0.5622
Model 5, 3 df.				80.318	0.0001
Difference					
(Model 5 - Model 2), 1 df.	(Hypothesis 3)			0.328	0.5668

TABLE 14

Multivariate Logistic Regression Analyses: Tax-exempt Versus Investor-owned Taxable Hospitals, West Virginia, 1989 Data.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likelihood Statistic	Prob. > Chi-Square
Model 1					
INTERCEPT	0.6375	0.5867	1.1810		0.2772
STBEDS	0.0070	0.0046	2.3299		0.1269
Model 1, 1 df.				3.423	0.0643
Model 2					
INTERCEPT	-1.8219	1.1988	2.3099		0.1285
STBEDS	0.0077	0.0051	2.2767		0.1313
UNCOMP	0.4013	0.1791	5.0170		0.0251
Model 2, 2 df.				10.431	0.0054
Difference					
(Model 2 - Model 1), 1 df.	(Hypothesis 2)			7.008	0.0081
Model 3					
INTERCEPT	0.6713	0.6013	1.2464		0.2642
STBEDS	0.0076	0.0047	2.6213		0.1054
PROF	-0.0484	0.0606	0.6367		0.4249
Model 3, 2 df.				4.327	0.1149
Difference					
(Model 3 - Model 1), 1 df.	(Hypothesis 3)			0.904	0.3417
Model 4					
INTERCEPT	-1.7464	1.2274	2.0245		0.1548
STBEDS	0.0079	0.0052	2.3399		0.1261
UNCOMP	0.3921	0.1816	4.6639		0.0308
PROF	-0.0195	0.0716	0.0739		0.7858
Model 4, 3 df.				10.506	0.0147
Difference					
(Model 4 - Model 1), 2 df.	(Hypothesis 1)			7.083	0.0290
(Model 4 - Model 2), 1 df.	(Hypothesis 3)			0.075	0.7842

significant variables. Also, in the Florida analyses, profitability variables, PROF and OPERATING INCOME, are highly insignificant. In the West Virginia analyses, STBEDS nears significance while UNCOMP is a very significant variable. Again, PROF is highly insignificant. Therefore, logistic regression analyses with Florida and West Virginia hospitals provide the same results for this study's hypotheses tests as does the Tennessee logistic regression. Florida and West Virginia tax-exempt hospitals provide significantly more uncompensated care but are not significantly less profitable than their taxable counterparts.

Figure 5 presents classification tables related to Florida analyses. These classification results are summarized in Table 15. The models properly classify 72.4% and 70.0% of Florida hospitals while the proportional chance criterion specifies that 50.7% of Florida hospitals should be properly classified by chance. For Florida logistic regression classifications, the Z statistic for the model including UNCOMP and STBEDS is 6.29 while Z equals 5.59 for a model with UNCOMP alone. The probability of obtaining Z statistics of 5.59 or higher by chance is .0001. Thus, parameters developed from logistic regression performed on Florida hospital data exhibit significant classification ability.

Figure 6 presents classification tables related to West Virginia analyses. These classification results are also summarized in Table 15. The developed models properly classify 76.4% and 80.0% of West Virginia hospitals while the proportional chance criterion specifies that 70.2% of West Virginia hospitals should be properly classified by chance. For West Virginia logistic regression classifications, the

1989 Florida Hospitals
Model with STBEDS and UNCOMP

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	87	30	117
Actual	IOTs	28	65	93
	Total	115	95	210

1989 Florida Hospitals
Model with UNCOMP alone

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	80	37	117
Actual	IOTs	26	67	93
	Total	106	104	210

Figure 5. Classification Tables for Florida Hospitals from Logistic Regression Performed on Florida Hospital Data.

TABLE 15

Classification Results: Logistic Regression Analyses with Florida and West Virginia Hospital Data.

	Florida	West Virginia
<u>Models with STBEDS and UNCOMP</u>		
Percentage of Total Correctly Classified	72.4	76.4
Percentage of TEs Correctly Classified	74.4	93.3
Percentage of IOTs Correctly Classified	69.9	0.0
Percentage of Classified TEs Which are TEs	75.7	80.8
Percentage of Classified IOTS Which are IOTs	68.4	0.0
<u>Models with UNCOMP alone</u>		
Percentage of Total Correctly Classified	70.0	80.0
Percentage of TEs Correctly Classified	68.4	97.8
Percentage of IOTs Correctly Classified	72.0	0.0
Percentage of Classified TEs Which are TEs	75.5	81.5
Percentage of Classified IOTS Which are IOTs	64.4	0.0

1989 West Virginia Hospitals
Model with STBEDS and UNCOMP

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	42	3	45
	IOTs	10	0	10
	Total	52	3	55

1989 West Virginia Hospitals
Model with UNCOMP alone

		Predicted TEs	Predicted IOTs	Total
Actual	TEs	44	1	45
	IOTs	10	0	10
	Total	54	1	55

Figure 6. Classification Tables for West Virginia Hospitals from Logistic Regression Performed on West Virginia Hospital Data.

proportional Z statistic for the model including UNCOMP and STBEDS is 1.00 while Z equals 1.58 for a model with UNCOMP alone. The probability of obtaining Z statistics of 1.00 or greater, and 1.58 or greater, by chance is .16 and .06, respectively.

Classification accuracy achieved by West Virginia models results from classifying almost all hospitals into the tax-exempt group; neither model properly classifies a single investor-owned taxable hospital. The model that includes UNCOMP and STBEDS and the model that includes UNCOMP alone only classify three TEs as IOTs and one TE as an IOT, respectively. These results would provide limited help to West Virginia regulators in re-evaluating nonprofit hospitals' tax exemptions.

Comparison of Table 15 and Table 12 presents evidence that parameter estimates from Tennessee logistic regression analyses classify Florida and West Virginia hospitals nearly as well as models based on their own state hospital analyses. Comparable logistic regression and classification results in three separate states adds external validity to the logistic regression models developed in this study.

Table 16 reports the results from analyses with Arizona data. Arizona tax-exempt and taxable hospitals do not differ enough on STBEDS, UNCOMP, and PROF for any models or individual variables to be significant. These results corroborate the results from classification analyses with Tennessee regression parameter estimates where Arizona TEs and IOTs could not be identified well. Possibly, the logistic regression results with Arizona hospitals are insignificant because of the small number of observations.

TABLE 16

Multivariate Logistic Regression Analyses: Tax-exempt Versus Investor-owned Taxable Hospitals, Arizona, 1989 Data.

Variable	Parameter Estimate	Standard Error	Wald Chi-Square	-2 Log Likeli-hood Statistic	Prob. > Chi-Square
Model 1					
INTERCEPT	1.3668	0.5534	6.0995		0.0135
STBEDS	0.0027	0.0033	0.6858		0.4076
Model 1, 1 df.				0.820	0.3653
Model 2					
INTERCEPT	0.9932	0.7127	1.9418		0.1635
STBEDS	0.0025	0.0033	0.5743		0.4486
UNCOMP	0.0813	0.1004	0.6554		0.4182
Model 2, 2 df.				1.550	0.4608
Difference					
(Model 2 - Model 1), 1 df.	(Hypothesis 2)			0.730	0.3929
Model 3					
INTERCEPT	1.3162	0.5696	5.3390		0.0209
STBEDS	0.0033	0.0033	0.9857		0.3208
PROF	-0.0466	0.0463	1.0131		0.3142
Model 3, 2 df.				2.625	0.2692
Difference					
(Model 3 - Model 1), 1 df.	(Hypothesis 3)			1.805	0.1791
Model 4					
INTERCEPT	0.9449	0.7489	1.5919		0.2071
STBEDS	0.0031	0.0034	0.8434		0.3584
UNCOMP	0.0791	0.1061	0.5554		0.4561
PROF	-0.0419	0.0427	0.9619		0.3267
Model 4, 3 df.				3.242	0.3559
Difference					
(Model 4 - Model 1), 2 df.	(Hypothesis 1)			2.422	0.2979
(Model 4 - Model 2), 1 df.	(Hypothesis 3)			1.692	0.1933

5. Summary.

Logistic regression analyses on 1989 Tennessee hospital data are used to test research hypotheses. The results reveal that tax-exempt hospitals (TEs) provide more uncompensated care than their taxable counterparts (IOTs), but TEs do not exhibit significantly lower profits than IOTs. Classification analyses with Tennessee hospitals' parameter estimates indicate that results are generalizable beyond the hospitals used to develop the models. Also, logistic regression analyses performed on Florida and West Virginia data produce results similar to those obtained with Tennessee data. Arizona data, however, do not produce results comparable to those of the Tennessee analyses.

CHAPTER V

CONTRIBUTIONS, LIMITATIONS, CONCLUSIONS AND IMPLICATIONS

1. Introduction.

The primary objective of this study is to provide additional insight into the tax policy issue of whether nonprofit hospitals should retain their tax exemptions. The study addresses this issue by comparing levels of charity and indigent care provided, and profitability of tax-exempt and investor-owned taxable hospitals.

This chapter presents a summary of research findings. Next, the contributions and limitations of the study are discussed. The chapter closes with conclusions and implications of the study.

2. Summary of Research Findings.

Relief of government burden is a traditional and an economic rationale for granting tax exemptions and is frequently cited by courts and government policymakers as justification for tax exemptions. Courts and policymakers view hospital provision of charity and indigent (uncompensated) care as a relief of government burden. Uncompensated care provided by exempt hospitals may or may not equal their tax subsidy received. However, if tax-exempt hospitals do not provide more uncompensated care than their taxable counterparts little justification exists for tax exemptions. Consequently, this research project tests whether tax-exempt hospitals provide more uncompensated care than their taxable counterparts.

Main analyses are performed on Tennessee hospital data. Results indicate that tax-exempt hospitals provide significantly more uncompensated care than investor-owned taxable hospitals. Consequently, some justification exists for preferential tax treatment of some nonprofit hospitals. These results conform to the findings of most previous research and *a priori* expectations. Florida, West Virginia, and Arizona hospitals are also included in the study. Analyses with Florida and West Virginia data produce results similar to those obtained from Tennessee data. Analysis of Arizona data, however, does not indicate that tax-exempt hospitals provide significantly more uncompensated care than taxable hospitals.

This study also examines whether taxable hospitals are more profitable than tax-exempt hospitals. Contrary to expectations, results indicate that, in states included in the analyses, tax-exempt hospitals appear more profitable than taxable hospitals. As reported in Table 2, Chapter II, most, but not all, past research found that investor-owned taxable hospitals are more profitable than tax-exempt hospitals. (The limitations section of this chapter discuses possible explanations for this finding.)

Although unexpected, profitability results may be a positive finding. Policymakers can point out that tax-exempt hospitals are more profitable despite providing more uncompensated care than their taxable competitors. However, neither hospital group is very profitable. Investors may not be satisfied in the long term with returns exhibited by taxable hospitals included in this study.

As discussed in the contributions section of this chapter, the classification ability of models developed in this study is a positive finding. Models developed from the Tennessee data predict the tax status of hospitals in Tennessee and Florida better than would be expected by chance. One model predicts the tax status of West Virginia hospitals better than expected by chance. Even though tax-exempt hospitals provide more uncompensated care as a group than taxable hospitals, classification results indicate that not all tax-exempt hospitals provide substantial amounts of uncompensated care. Research findings support the current government policy of challenging individual hospitals' tax exemptions rather than attempting to revoke all nonprofit hospitals' exemptions. Classification results indicate that the models developed could assist policymakers in choosing hospitals that should have their exemptions re-evaluated.

3. Contributions.

This study contributes to our knowledge of the comparative performance of nonprofit tax-exempt and investor-owned taxable hospitals by using a different statistical technique than has been used in previous studies. Past researchers used ordinary least squares (OLS) regression to test whether tax-exempt hospitals provide more uncompensated care and are more profitable than taxable hospitals. These researchers modeled uncompensated care or profitability as the dependent variable and captured the effect of tax-exempt status by using independent dummy variables. OLS regression assumes normality of the error terms, which may not be a valid assumption for analyses of hospital financial data. This study uses logistic regression to compare tax-exempt hospitals and investor-owned taxable hospitals. The logistic function does not assume normality of the error terms.

This study also demonstrates the use of logistic regression diagnostics to examine the effects of influential observations. Version 6 is the first SAS package to produce influence statistics for logistic regression. As in ordinary least squares regression, a single influential observation can sometimes determine the significance and/or direction of a parameter estimate. Regression diagnostics such as DFBETAs identify which individual observations most influence parameter estimates. Analyses performed after removing these observations can indicate when statistical results are driven by a few influential observations.

In the past, state and local governments have challenged the tax-exempt status of specific nonprofit hospitals rather than attempting to revoke all hospital tax exemptions. Because models developed in this study exhibit significant classification ability, these models could assist policymakers in re-evaluating nonprofit hospitals' tax exemptions. Also, logistic models can be used to calculate the conditional probability of an observation coming from a particular group. This conditional probability provides an interpretable measure to help evaluate individual hospital behavior. Conditional probabilities produced by logistic regression models could help identify which tax-exempt hospitals should have their exemptions re-evaluated.

Regulators could simply examine tax-exempt hospitals misclassified as investor-owned taxable hospitals by the models. Hospital regulators, however, may not be concerned when a tax-exempt hospital exhibits a probability slightly above .5 of coming from the investor-owned taxable group. Rather, regulators could concentrate their attention on tax-exempt hospitals exhibiting high conditional probabilities of being an investor-owned taxable hospital.

Statistical packages can produce a confidence interval for the conditional probability of observations coming from a particular group. Confidence intervals provide a statistical technique to assist regulators in determining which misclassified hospitals warrant a tax-exemption re-evaluation. With tax-exempt hospitals as the reference group, a confidence interval of probabilities of each hospital being tax-exempt is produced. In SAS, the default in the LOGISTIC procedure is for a 95% confidence interval. Any tax-exempt hospital exhibiting a confidence level upper limit below .5 demonstrates significant investor-owned taxable hospital behavior. Any investor-owned taxable hospital exhibiting a confidence level lower limit above .5 demonstrates significant tax-exempt hospital behavior.

At the 95% confidence interval, the 1989 Tennessee logistic regression model including STBEDS and UNCOMP identifies four tax-exempt Tennessee hospitals behaving as investor-owned taxable hospitals. At this confidence level, the model identifies 12 Tennessee investor-owned taxable hospitals operating like tax-exempt hospitals. The 1989 Florida logistic regression model including STBEDS and UNCOMP identifies 20 tax-exempt Florida hospitals behaving as investor-owned taxable hospitals at a 95% confidence level. The model also identifies 14 Florida investor-owned taxable hospitals operating like tax-exempt hospitals.

Using a statistical tool such as the confidence interval of conditional probability would add objectivity to regulators' decisions to re-evaluate nonprofit hospitals' tax exemptions. However, governments may consider not examining a hospital that is not earning its exemptions to be a greater error than examining a hospital that is earning its exemptions. The default in the LOGISTIC procedure can be changed to provide other confidence intervals, such as 90%. A lower percentage confidence interval produces a smaller range of probabilities, thereby identifying more hospitals behaving unlike their respective group than a 95% confidence interval. Thus, the number of tax-exempt hospitals selected for tax-exemption re-evaluation increases as the confidence level is reduced.

Logistic regression conditional probability estimates should not be the only criteria used to determine whether a nonprofit hospital deserves tax exemptions. Rather, the statistical method developed in this study can provide a starting point to identify hospitals that should have their exempt status re-evaluated. Hospital administrators' knowledge that such a technique is in use may encourage them to provide additional charity and indigent care.

4. Limitations.

The sample used in this study presents a limitation. Hospitals from the states included in the study are not a representative sample of all U.S. hospitals. However, the included hospitals represent a stratified sample of U.S. hospitals. Tennessee and Florida have a higher percentage of investor-owned taxable hospitals than the national average, but West Virginia and Arizona have proportions of taxable community hospitals near the national average. The results suggest that the models developed may be more applicable to states with a large number of hospitals and a relatively high percentage of investor-owned taxable hospitals. Consequently, the techniques developed in this study may not help address the policy question of whether or not nonprofit hospitals earn their exemptions in states where few or no investor-owned taxable hospitals operate.

This study's finding on profitability of hospital groups may have limited impact on the theoretical debate concerning which hospital type needs a higher return on equity (ROE). Pauly [1986], theorized that in most economic markets, taxable hospitals require a higher ROE than tax-exempt hospitals. Pauly's analysis may not necessarily apply to the hospital markets in the states and time period included in this study. Macroeconomic conditions in the short time period examined in this study affect profitability of both tax-exempt and taxable hospitals. Also, the time period included in this study may not be long enough to capture investor and donor expectations and adequately test Pauly's assertions. Investors in taxable hospitals and contributors to tax-exempt hospitals may measure their ROE over several years.

Another limitation is that equity measures at the individual hospital level can not be obtained because many hospitals belong to multi-hospital systems. Various profit measures expressed as a percentage of net patient revenue or total net revenue for each individual hospital serve as proxies for return on equity in this study.

Profitability variables may not be good proxies for the theoretical construct of return on equity.

The profitability variables used in this study may likewise be poor measures of hospitals' economic income. Because the data used in this study is taken from unaudited reports hospitals submit to the states, the data may lack reliability. More fundamental problems may be present in the measures. Some accountants argue that accounting net income measures are poor proxies for earnings of traditional profit seeking entities. Hospital accounting practices (illustrated in Figure 1) and the mixture of nonprofit and investor-owned entities in the hospital industry creates additional variation in net surplus or <loss> calculations.

The ownership structures of some hospitals may lead to purposefully reducing hospitals' reported surpluses. Some taxable hospitals are owned by a few individuals. Consequently, the owners may try to extract economic income produced by the entity as expenses such as high salaries or other deductible payments to the owners. Also, as Bittker and Rhadert [1976] contend, defining the profits of nonprofit entities such as tax-exempt hospitals may be impossible.

Even though prior research is not conclusive concerning whether tax-exempt or investor-owned hospitals have lower costs, relatively lower costs for tax-exempt hospitals could drive this study's profitability results. For example, tax-exempt hospitals generally can, and do, issue tax-exempt bonds that normally pay lower interest rates than taxable bonds. Reduced interest costs could improve tax-exempt hospitals' net surplus or <loss> relative to that of investor-owned hospitals unable to issue tax-exempt bonds. However, interest costs are not included in operating expenses and thus should not affect operating incomes. In this study, tax-exempt hospitals' operating incomes are not significantly lower than taxable hospitals' operating incomes.

Tax-exempt hospitals may also benefit from volunteer workers who can reduce operating costs. Catholic-owned hospitals in particular may receive substantial voluntary services. However, only five Catholic-owned hospitals operate in Tennessee. The amount of volunteer services hospitals receive is not available from data sources used in this study. With other data sources, future research could investigate the effect of volunteer services on the profits of tax-exempt hospitals.

Previous researchers pointed out that some tax-exempt hospitals do not perform much differently than their taxable counterparts. Therefore, some outliers are expected in the data analyzed for this study. The logistic models fitted to the data may be contaminated somewhat by these observations. However, use of influence diagnostics and the large number of observations included in the analyses reduce the risk of contamination. Nevertheless, future researchers might improve the quality of models developed by using statistical techniques less sensitive to influential observations.

5. Conclusions and Implications.

Currently, the IRS criteria for nonprofit hospitals' tax exemptions is that the hospital provide a benefit to the community. If nonprofit hospitals do not actively demonstrate the benefits they provide to their communities, all hospitals may lose their exemptions. This study indicates that tax-exempt hospitals provide more charity and indigent care than taxable hospitals. Consequently, if medical care is a service subject to market failure criteria, a theoretical basis exists for subsidizing, through tax exemptions, nonprofit hospitals that provide substantial charity and indigent medical care. Revoking tax exemptions from all nonprofit hospitals is not apparently warranted at this time. However, the analyses also indicate that not all tax-exempt hospitals provide more charity and indigent care than taxable hospitals.

Therefore, empirical evidence supports the current process of challenging the exemptions of specific nonprofit hospitals. The statistical techniques developed in this dissertation can provide a starting point for governments by identifying nonprofit hospitals that should have their exemptions re-examined. Tax-exempt hospitals are more profitable and provide more uncompensated care than taxable hospitals. This result can be interpreted as evidence to support legislation requiring all tax-exempt hospitals to provide a certain amount of charity care in exchange for their exemptions.

Future research could improve our understanding of the comparative performance of tax-exempt and taxable hospitals by using a more refined measure of return on equity or profitability. Applying this study's research techniques to data from additional states would also contribute to our knowledge. Data used in this study was obtained from different government agencies in the four states included. Many other states contacted either did not collect hospital information in enough detail for the analyses or would not release their hospital information. In the future, states should adopt uniform hospital reporting requirements, maintain data bases on hospitals in their state, and make this information available to researchers.

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APPENDICES

APPENDIX A

LIST OF HOSPITALS INCLUDED IN 1989 TENNESSEE ANALYSES BY OWNERSHIP, WITH ASSOCIATED INFLUENCE DIAGNOSTICS

NAME	COUNTY	DFBETAs UNCOMP	PROF
Government-owned Tax-exempt			
(all individually owned by separate entities)			
Bedford County General Hospital	Bedford	0.0549	0.0186
Blount Memorial Hospital	Blount	0.0292	0.0194
Bradley Memorial Hospital	Bradley	-0.0150	0.0070
City of Milan Hospital	Gibson	-0.0209	0.0576
Claiborne County Hospital	Claiborne	0.0574	0.0131
Clarksville Memorial Hospital	Montgomery	0.0185	0.0038
Coffee Medical Center	Coffee	0.0462	0.0624
Cookeville General Hospital	Putnam	0.0246	0.0144
Decatur County General Hospital	Decatur	0.0587	0.0216
Erlanger Medical Center	Hamilton	0.0081	-0.0008
Hancock County Hospital	Hancock	-0.0097	0.0314
Hardin County General Hospital	Hardin	0.0488	0.0279
Harriman City Hospital	Roane	0.0500	0.0326
Hawkins County Memorial	Hawkins	0.0548	0.0251
Henry County Medical Center	Henry	-0.0688	-0.0228
Jackson/Madison County General Hospital	Madison	-0.0028	-0.0109
Jefferson Memorial Hospital	Jefferson	-0.4026	0.0263
Jesse Holman Jones Hospital	Robertson	0.0463	0.0205
Lafollette Community Hospital	Campbell	0.0549	0.0213
Lincoln Regional Hospital	Lincoln	0.0528	0.0118
McNairy County General Hospital	McNairy	-0.0402	0.0275
Maury Regional Hospital	Maury	0.0256	0.0161
Metro Nashville General Hospital	Davidson	0.0001	0.0001
Rhea County Medical Center	Rhea	0.0256	-0.0085
Sumner Memorial Hospital	Sumner	-0.0861	0.0466
University of Tennessee Medical Center	Knox	0.0104	-0.0005
University of Tennessee Medical Center	Shelby	-0.1082	0.0359
Woods Memorial Hospital	McMinn	0.0435	0.0573

NAME	COUNTY	DFBETAs UNCOMP	PROF
Privately-owned Tax-exempt			
Adventist Health System			
Highland Hospital	Sumner	0.0383	0.0079
Jellico Community Hospital	Campbell	-0.0963	0.0716
Takoma Adventist Hospital	Greene	0.0336	0.0038
Tennessee Christian Medical Center	Davidson	-0.0253	-0.0293
Baptist Health System of East Tn.			
Baptist Hospital	Roane	-0.0551	-0.0419
Cocke County Baptist Hospital	Cocke	0.0488	0.0204
East Tennessee Baptist Hospital	Knox	0.0279	-0.0135
Baptist Mem. Healthcare Development Corp.			
Baptist Memorial Hospital-Germantown	Shelby	-0.0029	-0.4719
Baptist Memorial Hospital-Huntingdon	Carroll	-0.0282	0.1147
Baptist Memorial Hospital-Lauderdale	Lauderdale	0.0490	-0.0947
Baptist Memorial Hospital-Tipton	Tipton	0.0391	0.0380
Baptist Memorial Hospital-Union City	Obion	0.0110	0.0696
Daughters of Charity Natl. Health System			
St. Thomas Hospital	Davidson	-0.0108	-0.0142
Fort Sanders Health Systems			
Fort Sanders Loudon Medical Center	Loudon	0.0320	0.0108
Fort Sanders Regional Medical Center	Knox	0.0212	0.0048
Fort Sanders Sevier Medical Center	Sevier	0.0514	0.0269
Mercy Health System			
St. Mary's Medical Center	Knox	0.0130	-0.0062
Methodist Health System			
Haywood Park General Hospital	Haywood	-0.0005	0.0134
Methodist Hospital of Dyersburg	Dyer	0.0173	0.0377
Methodist Hospital of Lexington	Henderson	-0.0395	0.0981
Methodist Hospital of McKenzie	Carroll	0.0583	0.0194
Methodist Hospital of Middle Tn.	Franklin	0.0425	0.0244
Methodist Hospital of Memphis	Shelby	0.0031	-0.0030
Methodist Hospital of Somerville	Fayette	0.0307	0.0028

NAME	COUNTY	DFBETAs UNCOMP	PROF
Privately-owned Tax-exempt (continued)			
Sisters of Charity of Nazareth Memorial Hospital	Hamilton	-0.1420	-0.0137
Sisters of St. Francis Health Services St. Joseph's Hospital	Shelby	0.0230	-0.0067
(individually owned by separate entities)			
Baptist Hospital	Davidson	0.0076	-0.0067
Baptist Memorial Hospital	Shelby	0.0010	-0.0016
Bristol Memorial Hospital	Sullivan	0.0223	0.0130
Cheatham Medical Center	Cheatham	0.0545	0.0400
Community Hospital of Bolivar	Hardeman	0.0722	-0.0327
Copper Basin Medical Center	Polk	0.0516	0.0525
Cumberland Medical Center	Cumberland	0.0380	0.0147
Downtown General Hospital	Hamilton	-0.1243	-0.0857
Forum Trenton Hospital	Gibson	-0.1835	-0.0936
Goodlark Medical Center	Dickson	0.0405	0.0339
Hickman County Health Services Hospital	Hickman	0.0589	-0.2413
Holston Valley Hospital	Sullivan	0.0112	-0.0098
Johnson City Medical Center	Washington	0.0157	0.0090
Laughlin Memorial Hospital	Greene	0.0151	0.0781
Lewis County Hospital	Lewis	-0.0332	-0.2413
Macon County General Hospital	Macon	0.0110	0.0353
Meharry Medical College-Hubbard Hospital	Davidson	0.0551	-0.0908
Methodist Medical Center-Oak Ridge	Anderson	0.0226	0.0265
Middle Tennessee Medical Center	Rutherford	0.0322	0.0296
Morristown/Hamblen Hospital	Hamblen	0.0395	0.0125
Nashville Memorial Hospital	Davidson	0.0088	0.0247
Perry Memorial Hospital	Perry	-0.0574	-0.2757
Regional Medical Center at Memphis	Shelby	0.0001	0.0001
St. Francis' Hospital	Shelby	0.0105	-0.0054
Sequatchie General Hospital	Sequatchie	-0.3718	-0.0738
Sweetwater Association Hospital	Monroe	0.0522	0.0283
Unicoi County Memorial Hospital	Unicoi	-0.0094	0.1374
Vanderbilt University Hospital	Davidson	0.0086	-0.0013
Williamson County Hospital	Williamson	0.0412	0.0169
Whitwell Medical Center	Marion	0.0645	-0.0055

NAME	COUNTY	DFBETAs UNCOMP	PROF
<u>Investor-owned Taxable</u>			
American Healthcare Management			
Gibson General Hospital	Gibson	0.0414	0.0321
Three Rivers Community Hospital	Humphreys	0.0492	0.1069
Community Health Systems			
Hillside Hospital	Giles	0.0393	0.0009
Cumberland Health Systems			
Lewisburg Community Hospital	Marshall	0.0495	0.0972
Oakwood Medical Center	Knox	-0.1603	0.6731
Forum Health Investors			
Metropolitan Hospital	Hamilton	-0.0024	0.1795
Healthcare International			
Eastwood Hospital	Shelby	0.0468	-0.0162
Healthtrust - the Hospital Company			
Benton Community Hospital	Benton	0.0862	-0.0201
Crockett Hospital	Lawrence	0.0389	-0.0907
Delkalb General Hospital	Delkalb	0.0760	0.0107
Edgefield Hospital	Davidson	0.0638	0.0325
Hendersonville Community Hospital	Sumner	0.0682	0.0332
Livingston Regional Hospital	Overton	-0.0479	-0.0475
Northside Hospital	Washington	0.0868	0.0034
River Park Hospital	Warren	0.0343	-0.0076
South Pittsburg Municipal Hospital	Marion	0.0492	0.0751
Stones River Hospital	Cannon	0.0475	0.0952
Sycamore Shoals Hospital	Carter	0.0429	-0.0682
Trinity Hospital	Houston	0.0677	0.0073
Humana			
Humana East Ridge Hospital	Hamilton	0.0826	-0.1061
Humana Hospital-McFarland	Wilson	-0.0293	-0.0726
Humana Hospital-Morristown	Hamblen	0.0983	-0.0278

NAME	COUNTY	DFBETAs UNCOMP	PROF
Investor-owned Taxable (continued)			
Hospital Corporation of America			
HCA Athens Community Hospital	McMinn	0.0611	-0.0046
HCA Donelson Hospital	Davidson	0.0799	0.0327
HCA Indian Path Medical Center	Sullivan	0.1100	0.0139
HCA Parkridge Medical Center	Hamilton	0.1149	0.0329
HCA Regional Hospital of Jackson	Madison	0.0252	0.0240
HCA Southern Hills Medical Center	Davidson	0.0683	0.0102
HCA Volunteer General Hospital	Weakley	0.0741	0.0342
HCA Park View Medical Center	Davidson	0.1128	0.2127
HCA Park West Medical Center	Knox	0.0573	-0.0177
National Healthcare			
Cleveland Community Hospital	Bradley	0.0709	-0.0097
Warren County General Hospital	Warren	-0.0612	0.1222
White County Community Hospital	White	0.0250	-0.2103
National Medical Enterprises			
J.W. Harton Regional Medical Center	Coffee	-0.0470	-0.2214
University Medical Center	Wilson	-0.1347	-0.1599
Paracelsus Healthcare			
Bledsoe County General Hospital	Bledsoe	-0.3486	0.0506
Clay County Hospital	Clay	-0.1199	0.0875
Fentress County General Hospital	Fentress	-0.3029	-0.0323
(individually owned by separate entities)			
Carthage General Hospital	Smith	-0.5921	-0.2153
Germantown Community Hospital	Shelby	0.0909	0.0033
Hartsville General Hospital	Trousdale	0.0302	0.0373
Jackson County Hospital	Jackson	0.0422	0.0125
Medical Center-Manchester	Coffee	0.0488	-0.0714
North Park Hospital	Hamilton	0.0787	-0.1446
Scott County Hospital	Scott	-0.1799	-0.0215
Smith County Memorial Hospital	Smith	0.0771	0.0088
Wayne County General Hospital	Wayne	-0.1413	-0.1162

APPENDIX B

LIST OF FLORIDA, WEST VIRGINIA, AND ARIZONA HOSPITALS INCLUDED IN ANALYSES

Government-owned Tax-exempt

Bay Medical Center
Calhoun General Hospital
Clay Memorial Hospital
Ed Fraser Memorial Hospital
Florida Keys Memorial Hospital
Halifax Medical Center
Hardee Memorial Hospital
Imperial Point Medical Center
Jackson Memorial Hospital
Lawnwood Regional Medical Center
Memorial Hospital - Broward County
North Broward Medical Center
Parrish Medical Center
Sarasota Memorial Hospital
South Lake Memorial Hospital
University Hospital - Escambia County
West Volusia Memorial Hospital
Broward General Medical Center
Citrus Memorial Hospital
Coral Springs Medical Center
Fish Memorial Hospital
Glades General Hospital
Hamilton County Memorial Hospital
Hendry General Hospital
Jackson Hospital
James Archer Smith Hospital
Lee Memorial Hospital
Nassau General Hospital
Northwest Florida Community Hospital
Polk General Hospital
Southeast Volusia Hospital
Tampa General Hospital
West Orange Memorial Hospital

Privately-owned Tax-exempt

Alachua General Hospital
Baptist Hospital of Miami
Bartow Memorial Hospital
Bethesda Memorial Hospital
Bradford Hospital
Cape Coral Hospital
Desoto Memorial Hospital
Doctors Memorial Hospital
Flagler Hospital
Gadsen Memorial Hospital
Gulf Breeze Hospital
Helen Ellis Memorial Hospital
Holms Regional Medical Center
Indian River Memorial Hospital
JFK Medical Center
Lakeland Regional Medical Center
Lake Wales Hospital
Lykes Memorial Hospital
Baptist Hospital - Escambia
Baptist Medical Center
Bayfront Medical Center
Boca Raton Community Hospital
Cape Canaveral Hospital
Cedars Medical Center
Doctor's Hospital
East Paco Medical Center
Florida Hospital
Good Samaritan Hospital
Heart of Florida Hospital
Hialeah Hospital
Holy Cross Hospital
Jay Hospital
Jupiter Hospital
Lake Shore Hospital
Leesburg Regional Medical Center
Madison County Memorial Hospital

Privately-owned Tax-exempt
(continued)

Manatee Memorial Hospital
Martin Memorial Hospital
Medical Center Hospital
Memorial Hospital Flagler
Mercy Hospital
Miami Heart Institute
Morton F. Plant Hospital
Munroe Regional Medical Center
North Shore Medical Center
Orlando Regional Medical Center
Pan American Hospital
Sacred Heart Hospital of Pensacola
St. Cloud Hospital
St. Joseph's Hospital - Charlotte
St. Luke's Hospital
St. Vincent's Medical Center
South Florida Baptist Hospital
Sun Coast Hospital
Tallahassee Memorial Reg Med Ctr
University Hospital of Jacksonville
Walker Memorial Hospital
Waterman Medical Center
Winter Haven Hospital
Wuesthoff Memorial Hospital

Mariners Hospital
Mease Hospital and Clinic
Meese Hospital Countryside
Mem Med Ctr of Jacksonville
Methodist Medical Center
Morrow Memorial Hospital
Mount Siani Medical Center
Naples Community Hospital
Orlando General Hospital
Ormond Beach Mem. Hospital
Riverside Hospital
St. Antony's Hospital
St. Francis Hospital - Dade
St. Joseph's Hosp - Hillsborough
St. Mary's Hospital
Shands Teaching Hospital
South Miami Hospital
Suwanee Hospital
University Community Hospital
University of Miami Hospital
Walton Regional Hospital
Williston Memorial Hospital
Winter Park Memorial Hospital
Venice Hospital

Investor-owned Taxable

AMI Clearwater Community Hosp.
AMI Medical Center - Orange
AMI Northridge Medical Center
AMI Palmetto General Hospital
AMI Southeastern Medical Center
Bayonet Pt./Hudson Reg. Med. Ctr.
Centro Asturiano Hospital
Comm. Hosp. of New Port Richey
Coral Reef Hospital
Depoo Hospital

AMI Kendall Reg. Med. Ctr.
AMI Memorial Hospital of Tampa
AMI Palm Beach Gardens
AMI Parkway Regional Med. Ctr.
AMI Town & Country Med. Ctr.
Central Florida Reg. Med. Ctr.
Centurian of Carrollwood
Coral Gables Hospital
Delray Community Hospital
Doctor's Hospital of Hollywood

Investor-owned Taxable
(continued)

Doctors Hospital of Lake Worth
Doctor's Hospital of Sarasota
East Pointe Hospital
Englewood Community Hospital
Fisherman's Hospital
Gulf Coast Hospital
HCA Northwest Regional Hospital
HCA Raulerson Hospital
Highlands Regional Med. Ctr.
Humana Hospital - Bennett
Humana Hospital - Brandon
Humana Hospital - Daytona
Humana Hospital - Ft. Walton
Humana Hospital - Lucerne
Humana Hospital - Orange Park
Humana Hospital - Pasco
Humana Hospital - Sebastian
Humana Hospital - Sun Bay
Lake City Medical Center
Larkin General Hospital
Marion Community Hospital
North Beach Community Hospital
North Gables
North Okaloosa Medical Center
Palm Springs Hospital
Palms West Hospital
Peninsula Medical Center
Ramadan/Lake Butler Hospital
St. Augustine General Hospital
Seven Rivers Community Hospital
Southwest Florida Reg. Med. Ctr.
Tallahassee Community Hospital
Universal Medical Center
Vencor Hospital - Ft. Lauderdale
Wellington Regional Medical Ctr.
Westchester General Hospital
West Shore Hospital

Doctor's Hospital of Tampa
Doctors Memorial Hospital
E.H. White Memorial Hospital
Fawcett Memorial Hospital
Florida Medical Center - Broward
Harborside Hospital
HCA Putnam Community Hospital
HCA University Community Hospital
Hollywood Medical Center
Humana Hospital - Biscayne
Humana Hospital - Cypress
Humana Hospital - Destin
Humana Hospital - Kissimmee
Humana Hospital - Northside
Humana Hospital - Palm Beach
Humana Hospital - St. Petersburg
Humana Hospital - South Broward
Kissimmee Memorial Hospital
Largo Medical Center Hospital
L.W. Blake Memorial Hospital
Med. Ctr. of Port St. Lucie
North Florida Regional Med. Ctr.
North Miami Medical Center
Oak Hill Community Hospital
Palms of Pasadena Hospital
Pembroke Pines General Hospital
Plantation General Hospital
Riverside Hospital
Santa Rosa Medical Center
South Seminole Medical Center
Sun City Hospital
Twin Cities Hospital
University General Hospital
Victoria Hospital
West Boca Medical Center
West Florida Reg. Med. Ctr.
Women's Medical Center

WEST VIRGINIA HOSPITALS

Government-owned Tax-exempt

Boone Memorial Hospital
Grant Memorial Hospital
Pocahontas Memorial Hospital
Sisterville General Hospital
Summersville Memorial Hospital
Welch Emergency Hospital
Camden Clark Memorial Hospital
Morgan County War Memorial
Princeton Community Hospital
Summers County Hospital
Webster County Memorial Hospital
Wetzel County Hospital

Privately-owned Tax-exempt

Beckley Appalachian Regional
Braxton County Memorial Hospital
Cabell-Huntington Hospital
Charleston Area Medical Center
Davis Memorial Hospital
Grafton City Hospital
Jackson General Hospital
Logan General Hospital
Monongalia General Hospital
Ohio Valley Medical Center
Preston Memorial Hospital
Roane General Hospital
St. Francis Hospital
St. Joseph's Hospital - Parkersburg
Thomas Memorial Hospital
Weirton Medical Center
W.V.U. Hospital
Bluefield Regional Medical Center
Broaddus Hospital
Calhoun General Hospital
City Hospital
Fairmont General Hospital
Guyan Valley Hospital
Jefferson Memorial Hospital
Man Appalachian Regional Hospital
Montgomery General Hospital
Pleasant Valley Hospital
Reynolds Memorial Hospital
Stonewall Jackson Mem. Hospital
St. Joseph's Hospital - Buckhannon
St. Mary's Hospital
United Hospital Center
Wheeling Hospital

Investor-owned Taxable

Beckley Hospital, Inc.
Hampshire Valley Hospital
Potomac Valley Hospital
Raleigh General Hospital
South Charleston Community Hospital
Greenbrier Valley Hospital
Plateau Medical Center
Putnam General Hospital
St. Luke's Hospital
Williamson Memorial Hospital

ARIZONA HOSPITALS

Government-owned Tax-exempt

Benson Hospital
Kino Community Hospital
Maricopa Medical Center
Pinal General Hospital
Gila County General Hospital
Kingman Regional Hospital
North Cochise Community Hospital

Privately-owned Tax-exempt

Arrowhead Community Hospital
Casa Grande Regional Medical Center
Copper Queen Hospital
D.E. Webb Memorial Hospital
Good Samaritan Reg. Med. Ctr.
Holy Cross Hospital
L.R. Pyle Memorial Hospital
Mesa Lutheran Hospital
Mt. Graham Hospital
Page Hospital
Phoenix Baptist Hospital
Phoenix General Hospital
Sage Memorial Hospital
St. Joseph's Hospital - Tucson
St. Mary's Hospital
Scottsdale Mem. Hosp. - North
Southeast Arizona Medical Center
Thunderbird Samaritan Hospital
University Medical Center
Valley View Hospital
Wickenburg Community Hosp. Assn.
W.O. Boswell Memorial Hospital
Yuma Regional Medical Center
Bullhead Community Hospital
Chandler Regional Hospital
Desert Samaritan Medical Center
Flagstaff Medical Center
Havasu Samaritan Hospital
J.C. Lincoln Hospital
Maryvale Samaritan Hospital
Miami Inspirational Hospital
Navapache Hospital
Parker Community Hospital
Phoenix Children's Hospital
Pheonix Memorial Hospital
St. Joseph's Hospital
St. Luke's Medical Center
Scottsdale Memorial Hospital
Sierra Vista Community Hospital
Tempe St. Luke's Hospital
Tucson Medical Center
Valley Lutheran Hospital
White Mountain Com. Hospital
Winslow Memorial Hospital
Yavapai Regional Medical Ctr.

Investor-owned Taxable

Aspen Hill Hospital
Community Hospital Medical Center
Humana Hospital - Desert Valley
Mesa General Hospital
Tucson General Hospital
Community General Hospital
El Dorado Hospital
Humana Hospital - Phoenix
Northwest Hospital

VITA

Benjamin P. Foster was born in Owensboro, Kentucky on January 5, 1959. He was graduated from Daviess County High School of Owensboro in June 1977. In August 1977 he enrolled at Kentucky Wesleyan College where he majored in business administration with a concentration in accounting. In May 1980, Ben was graduated from Kentucky Wesleyan College summa cum laude. From July 1980 to June 1982 Ben worked as a staff accountant for Donald H. Love, CPA, and Welenken, Himmelfarb, & Company, CPAs. From June 1982 to July 1983 Ben attended Murray State University where he obtained a Master's of Business Administration degree.

Ben was employed as an accounting instructor at Kentucky Wesleyan College from August 1983 to May 1985 and at Marshall University during the Spring of 1988. Between the two teaching positions, Ben worked as vice-president and treasurer of a construction and mine supply company, R.P. Foster, Incorporated.

In July 1988, Ben entered the Graduate School at the University of Tennessee, Knoxville. He obtained the Doctor of Philosophy degree in business administration with a concentration in accounting in August 1991.

Ben became a Certified Public Accountant in 1983 and a Certified Management Accountant in 1988. He is a member of the AICPA, the Kentucky Society of CPAs, the National Association of Accountants, the American Accounting Association, and the American Taxation Association. Mr. Foster is currently employed as an Assistant Professor at Eastern Kentucky University.