1995

An Empirical Analysis of Criteria Utilized to Determine Hospital Revenue Bond Ratings.

Ann L. Watkins

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AN EMPIRICAL ANALYSIS OF CRITERIA UTILIZED TO DETERMINE HOSPITAL REVENUE BOND RATINGS

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in

The Department of Accounting

by

Ann L. Watkins
B.S., McNeese University, 1989
December, 1995
DEDICATION

To four very special men in my life.

To Zack, for the love, patients and understanding through the most difficult of times.

To Ed, my husband, my mentor, for providing an unfailing source of support and guidance in every way.

Most especially, to Anthony and Richard, my sons, for enduring sacrifices that I can never make-up nor repay. Thank you for allowing me this accomplishment.
ACKNOWLEDGMENTS

I owe a debt of gratitude to my Committee Chair, Vincent Brenner. He allowed me great freedom to explore this area and offered me guidance in narrowing my dissertation to a manageable topic. I shall attempt to pass on some of what I gained from Vince.

There are many people who had positive and valuable influences on me during my experience at LSU. They include the following committee members: Bart Hartman, Govind Iyer and Kenneth Zagacki. I appreciate their reviewing this dissertation and providing helpful comments. I would also like to thank Daryl Guffey and Ram Sriram, early committee members, who provided assistance during the early stages of this project. I have never known two more sincere, candid and honest men. Thanks to Dr. Donald Pagach who taught me an immense amount about accounting research, and to Michael Luehlfing for his friendship and encouragement over the past four years and his valuable comments during the early stages of this project.

A fellow student provided stimulating discussions and exchanges of ideas. This whole venture started with the friendship of Steven Filling.

Finally, there were three women who made everything run smoothly on the third floor of CEBA. Thank you Maxine, Rholene and Debbie.
# TABLE OF CONTENTS

**DEDICATION** ........................................ ii

**ACKNOWLEDGMENTS** ................................. iii

**LIST OF TABLES** ..................................... vi

**LIST OF FIGURES** ................................... vii

**ABSTRACT** ........................................ viii

**CHAPTER**  
1 **OVERVIEW OF THE STUDY** ........................ 1  
   Research Question .................................. 2  
   Background ......................................... 3  
      Structural Changes in the Health Care Market 3  
      Disclosure for Tax-Exempt Revenue Bonds .......... 8  
   Research Method .................................... 15  
   Summary ............................................ 17  

2 **LITERATURE REVIEW** .............................. 19  
   Overview of Related Literature ...................... 19  
   Health Care Financial Management Literature ........ 19  
      Initial Research ................................ 19  
      Data Reduction Techniques ......................... 21  
      Predicting Hospital Financial Performance ....... 27  
      Multivariate Ratio Analysis ........................ 29  
   Hospital Bond Rating Studies ....................... 31  
   Accounting Literature ................................ 37  
      Hospital Reporting and Disclosure ................ 37  
   Hospital Bond Rating Studies ....................... 39  
   Summary ............................................ 42  

3 **RESEARCH METHOD** ................................. 44  
   Sample Selection Procedures ....................... 44  
   Dependent Variable ................................ 45  
   Independent Variables .............................. 47  
      Financial Accounting Variables ................. 47  
      Operational Variables ............................ 50  
      Socioeconomic Variables .......................... 54  
   Statistical Analysis ............................... 57  
      Factor Analysis ................................ 57  
      Logistic Regression ............................. 60  
   Summary ............................................ 64  

4 **RESULTS** ........................................ 65  
   Sample Selection Results ............................ 65  
   Hospitals with Credit Enhancements .................. 65  
   Incomplete Financial Information ..................... 65  
   Incomplete Operational Information .................. 66  
   Alcohol and Psychiatric Beds ......................... 66
<table>
<thead>
<tr>
<th></th>
<th>Table Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Bond Rating Categories</td>
<td>46</td>
</tr>
<tr>
<td>4.1</td>
<td>Descriptive Statistics of Independent Variables</td>
<td>82</td>
</tr>
<tr>
<td>4.2</td>
<td>Correlation Matrix for Independent Variables</td>
<td>86</td>
</tr>
<tr>
<td>4.3</td>
<td>Variance Inflation Factors</td>
<td>89</td>
</tr>
<tr>
<td>4.4</td>
<td>Results of Logistic Regression</td>
<td>91</td>
</tr>
<tr>
<td>4.5</td>
<td>Results of Jackknife Procedure</td>
<td>98</td>
</tr>
<tr>
<td>2.1</td>
<td>Definitions of ratios maintained by the CHIPS 23</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Results of Cleverley and Rohleder factor analysis 26</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Independent financial accounting variables and their definition 51</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Operational variables included in this study 55</td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Summary of the independent variables analyzed in this study 56</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Results of sample selection procedures 68</td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Classification of sample hospitals 68</td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>Results of Cattell's Scree test 71</td>
<td></td>
</tr>
<tr>
<td>4.4</td>
<td>Results of maximum likelihood factor analysis 73</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>Percentage variance explained by first fourteen factors 74</td>
<td></td>
</tr>
<tr>
<td>4.6</td>
<td>Definition of factors 79</td>
<td></td>
</tr>
<tr>
<td>4.7</td>
<td>Summary of reduced set of independent variables 80</td>
<td></td>
</tr>
<tr>
<td>4.8</td>
<td>Diagnostics for association of predicted probabilities and observed responses 96</td>
<td></td>
</tr>
</tbody>
</table>
ABSTRACT

The hospital industry has undergone radical changes in the past fifteen years with respect to the production and distribution of health care services. The introduction of Medicare's prospective payment system, the struggle to retain physicians and competitive bidding for managed care contracts have created increasing risks for hospitals. Coupled with the increased amount of debt sold by health care issuers, these changes have made determining the information utilized in predicting hospital revenue bond ratings a topic of significant interest to investors, creditors and regulators.

The primary purpose of this study was to develop an initial model which might be used in predicting hospital bond ratings. In pursuing this goal this study identified a parsimonious set of variables that are significant in predicting hospital bond ratings. These variables might be of interest to those concerned with hospital reporting disclosure and its regulation.

A sample of 127 hospitals was selected from a private data base compiled by Van Kampen Merritt. To be included in the final sample a hospital bond issue must have a Standard and Poor's rating of "B-" or better, must be free of credit enhancements such as insurance and letters of credit, and must have information on all variables tested.
Sixty-four independent variables are initially included in the analysis. Many of these variables share identical values in their numerators or denominators and are, therefore, highly correlated. Factor analysis was applied to the initial group of variables in order to produce a more parsimonious set of independent variables with less correlation. The number of independent variables was reduced from sixty-four to fourteen.

Using the reduced set of independent variables, logistic regression was then employed to construct a hospital bond rating prediction model. Five variables were found to be significant in predicting hospital bond ratings: CMA admissions, net take down, fixed asset financing, total outpatient surgeries and percentage population below poverty.

The classification accuracy of the model was tested using the jackknife technique. The overall classification accuracy of the model is 37.8% which is greater accuracy than that due to chance.
CHAPTER 1

OVERVIEW OF THE STUDY

Determining the information utilized in predicting hospital revenue\(^1\) bond ratings has become a topic of significant interest to investors, creditors, and regulators (Graham 1986; Anderson 1991; Nemes 1992; Pallarito 1993, 1994). Much of this interest perhaps follows from (1) attention to the radical structural changes that have been evolving over the past decade with respect to the production and distribution of health care services (S&P Industry Survey 1994); (2) an initiative on the part of regulators and policy-makers to place hospitals under more rigid operating and reporting requirements (Nemes 1992; Pallarito 1993, 1994; Federal Register 1994); and, (3) a more accounting-specific concern with what type of disclosures ought to be required of hospitals (personal communications with Martha Garner, member of the AICPA Task Force Committee on Health Care).

The primary purpose of this study was to identify a concise set of variables that discriminate between various levels of hospital bond ratings. A premise of this study is that the predictive variables included in the model developed may indicate information necessary in evaluating

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\(^1\)Standard & Poor's Corporation classifies bond issues for health care providers as "revenue bonds". Not-for-profit hospitals qualify for (and generally issue) tax-exempt revenue bonds.
the financial performance of hospitals. These variables might be of interest to those concerned with hospital reporting disclosure and its regulation.

Research Question

Many studies have examined the ability of both accounting and nonaccounting variables to predict hospital bond ratings (Cleverley and Nilsen 1980; La Jolla Management Corporation 1981; Cleverley and Nutt 1984; Sloan et al. 1987; McCue et al. 1990; Carpenter 1991; Craycraft 1994). However, with two exceptions, the data bases used do not extend beyond 1984. Of the two exceptions, one study focused on credit rating downgrades and the other on socioeconomic variables. This casts suspicion over the predictive ability of the models derived from those studies for several reasons. First, the post-1984 set of available variables has expanded substantially. Second, the structure of the health care industry has changed dramatically over the past 15 years (e.g., consider the structural effect of prospective payment systems which only came into existence in 1983). Third, hospital spending and the cost of services have increased by as much as 850% over

2Since many hospitals are not-for-profit there is no consistently available metric (e.g., net income) that can serve as a measure of hospital financial performance. Both for-profit and not-for-profit hospitals are often concerned with multiple goals and therefore quite diverse types of performance. Given the lack of a consistent performance metric, analysts' bond ratings are used to proxy financial performance, a choice common in studies of both hospitals (Cleverley and Nutt 1984; Sloan et al. 1987; McCue et al. 1990; Craycraft 1994) and other institutions (Raman 1982).
the past two decades (U.S. Bureau of the Census 1994).
Combined with certain demographic changes (an aging population, increased urbanization of health care, etc.), these reasons are sufficient to justify a more timely attempt to model the relation between information variables and hospital bond ratings.

This study was somewhat exploratory in nature. Broadly, it seeks to provide some empirical evidence with respect to the association between hospital bond ratings and both financial and nonfinancial variables. More specifically, it represents a step within a possible broad research program concerned with the determination of the information utilized in evaluating the financial performance of hospitals. Therefore, this study raised the following research question:

What information is utilized in determining hospital bond ratings?

Background

Structural Changes in the Health Care Market

Hospital spending has increased 44.4 billion dollars in the first three years of this decade up to 270.8 billion dollars in 1992. The average cost per stay has risen over the past twenty years from $605 in 1972 to $5,794 in 1992 (U.S. Bureau of the Census, 1994). Health care expenditures represented 14% of the U.S. Gross National Product in 1992 (Weissenstein). In response to escalating health care costs, health care reform has generated major
structural changes in the U.S. health care industry (S&P Industry Surveys, 1994).

One unique characteristic of the health care market is that third party payers, not consumers, usually pay for health care services (Phelps 1992). In 1965 amendments to the Social Security Act which created the Medicare and Medicaid programs made the federal government one of the largest third party payers in the health care industry (Preston 1992; S&P Industry Survey 1994). Medicare is a health insurance program operated by the federal government which provides medical coverage primarily for individuals over the age of 65. Medicaid is a health care assistance program operated by state governments within federal guidelines and provides funding of health care for needy individuals (Phelps 1992). During the late 1960's and 1970's hospitals were reimbursed by these programs as well as commercial insurance companies for any "reasonable" costs. Such cost-based revenue functions provided little incentive for hospitals to investigate or curtail their expenses (Morgan & Kappel 1985; Sloan et al. 1988).

In an effort to control public spending, Congress enacted the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) and the Social Security Amendment of 1983. These acts brought about a significant change in Medicare's payment system. Implementation of the prospective payment system began in 1983 and was gradually phased in at a rate
of 25% per year over a four year period which ended in 1986 (Fetter 1991; Chu et al. 1991). That system was converted from a retrospective cost reimbursement system which reimbursed hospitals for any reasonable costs to a prospective payment system (PPS) which determined a "fixed fee" for services prior to their being rendered (Morgan & Kappel 1985; Rosko & Broyles 1984; Sloan et al. 1988).

The new cost containment formula, based on the attending physician’s discharge diagnosis, employs the diagnostic-related group (DRG) system to determine the payment for each Medicare patient’s hospital stay. Medicare payments are made at a predetermined rate for each discharge. All discharges are classified according to a list of approximately 470 DRGs. An average cost is calculated for each DRG3, and the hospital is reimbursed according to this average cost regardless of actual expenses. To some, the use of DRGs as a payment mechanism represents an attempt to move health care costs closer to what might be expected in an open market (Fetter 1991).

Because DRGs are calculated using historical cost, reimbursement rates tend to lag actual costs. Some cost increasing factors like inflation have been factored into

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3The "average cost" for DRGs is a function, in part, of demographic information. The average cost is the basis for revenue, and revenue largely determines "financial performance" which in turn, is the concern of bond raters. This motivates my inclusion of socioeconomic variables as potential predictors of bond ratings.
the formula, but others, like the cost of new technology, have not been adequately approximated (McCarthy 1988).

The older, retrospective, reimbursement system greatly aided hospital survival to the extent that it assured the coverage of hospital expenses. The PPS may have had an adverse affect on hospitals whose costs exceeded the fixed fee reimbursements. The government's shift from a retrospective cost reimbursement system to a prospective fixed fee reimbursement system (PPS hereafter) may have influenced the reimbursement behavior of private insurance companies as well (Chu et al 1991; Dirsmith et al. 1993; Rosko & Broyles 1984; Sloan et al. 1988).

The PPS only regulated medicare reimbursements which represented approximately 40 percent of community hospital patient revenues (S&P Industry Survey 1984). It did not regulate all sources of hospital revenues and, therefore, created an incentive for hospitals to transfer costs to other payers. The increase in revenue from other non-regulated sources could then be used to subsidize losses suffered in providing care to medicare patients. Larger commercial third party payers, however, possessed the contracting power to negotiate large contractual allowances which reduced the actual amounts collected by hospitals for services rendered (Rosko & Broyles 1984; Dirsmith et al. 1993). This currently places approximately 88 percent of hospital revenues under some form of fixed fee or reduced
contractual allowance reimbursement (S&P Industry Surveys 1994).

There are other characteristics of the health care market that contribute to the unique economic environment hospitals face. While consumers in the health care market may exercise some choice when it comes to selecting a physician it is usually the physician who chooses the hospital. In other words, a hospital's clientele to a great extent is controlled by physicians. Hospitals must attract and keep physicians to insure patient utilization (Phelps 1992). This, in turn, perhaps adds costs in order to provide the resources (e.g., technology) necessary to satisfy physicians' preferences. As others have explained, the mid-1980's created conditions such that:

1) Hospitals must compete for physicians, because physicians supply their clientele. When physicians demand new technology, like expensive equipment such as MRIs and CT scanners, hospitals are not in a position to refuse (Interview with Thomas Prince by Johnsson in Hospitals 1992).

2) A cyclical downturn and consolidation in the insurance industry beginning in the mid to late 1980's forced surviving managed care plans and indemnity carriers to adopt tougher contracting terms with hospitals (Interview with Thomas Prince by Johnsson in Hospitals 1992).
Some hospitals were able to readily adjust to these events. Other hospitals also benefitted from government funding being redistributed in their favor. But, in 1992, as many as 500 hospitals were still in the crisis-management mode that they adopted during the late 1980’s (Johnsson 1992). Johnsson cites a 1992 study by Arthur Andersen that predicted that hospital closings would continue at a pace of 60 to 70 closures per year (Johnsson 1992).

The introduction of Medicare’s prospective payment system, the struggle to retain physicians (Phelps 1992), and competitive bidding for managed care contracts have created increasing risks for hospitals. As a result hospital failures and bond defaults have risen considerably since 1983 (Johnsson 1992). Increased competition and cost-consciousness in the health care industry have perhaps made the ability to predict hospital bond ratings increasingly important.

Disclosure for Tax-Exempt Revenue Bonds

Concern over the adequacy of financial disclosure by municipal bond issuers and the debate over disclosure in the secondary market for hospital and other tax-exempt bond

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issuers have escalated over the past two years generating much controversy (Nemes 1992; Pallarito 1993, 1994). Traditionally, the major purchasers of tax-exempt securities were institutional investors, insurance companies, and banks (Carpenter 1991). Individual investors were considered peripheral investors in this market (Van Horne 1984). More recently individual investors have become the principal participants in the tax-exempt bond market (Bland and Yu 1987). Hospitals, along with issuers in other sectors of the municipal market, have been criticized for not providing enough information to these investors (particularly in the secondary market). Investors complain that they cannot make appropriate buy-and-sell decisions in the secondary market without updated information. They claim to lack the information necessary to evaluate credit quality and are, thus, forced to rely heavily on bond ratings (Bland and Yu 1987).

The amount of debt sold by public health-care issuers in the past decade has tripled, rising from $10 billion in 1984 to $31 billion in 1993 (S&P Creditweek 1994). Prior to July 3, 1995, this debt was raised by issuing tax-exempt revenue bonds in a virtually unregulated market with respect to reporting disclosure. This condition, as discussed below, changed July 3, 1995 (Federal Register 1994).
Corporate issuers have been required by Securities and Exchange Commission (SEC) rules to provide updated financial and operational information to investors on a regular basis; but, until the recent ruling by the SEC in the November 17, 1994 Federal Register, municipal bond issuers were under no such obligation (Federal Register 1994). In addition, according to the SEC, health care providers offered substantially less information after the bonds were sold than did municipal issuers who sold bonds more frequently (Pallarito 1994). Without periodic updates, investors who bought health care bonds after the initial offering might not have known if a hospital's financial condition had slipped. Bond ratings provided one of the few sources of indirect updates.

The SEC's new rule makes it illegal for a broker or dealer of municipal securities to underwrite bonds unless the issuer agrees to provide annual financial information and timely notices of "material events," such as delays in making principal and interest payments or ratings changes. Pertinent information on finances and operations will be sent to a nationally recognized municipal securities information repository. However, the proposal provides no other details on how such repositories will be sanctioned, who will run them, how they will be financed or what information hospitals will be required to submit. The absence of specific definition leaves much to the
discretion of health care issuers and their bond counsels (Pallarito 1994).

Anticipating government intervention, organizations within the health care industry began to take action toward self-regulation. The Healthcare Financial Management's (HFMA) Principles and Practices Board drafted a position statement released in 1993 which established guidelines that define the types of financial and operating data that healthcare providers should disclose (Pallarito 1993).

In addition to the SEC's mandate and the efforts of the HFMA, several quasi-governmental groups and trade associations are trying to strengthen voluntary disclosure:

1. Hearings have been held by the House Energy and Commerce finance subcommittee on tightening regulation of the municipal bond market. The subcommittee has regulatory oversight of the securities markets (Pallarito 1993).

2. The National Council of Health Facilities Finance Authorities (NCHFFA), a group that represents tax-exempt bond authorities, would like to see that investors receive more financial information from hospitals. They have been attempting to adopt guidelines for hospitals to follow when dealing with investors who have bought bonds in the secondary market. The national council represents 25 health care financing authorities
that act as conduits to issue tax-exempt debt for not-for-profit hospitals. The NCHFFA has been working on such guidelines since 1990, when a task force was established to make recommendations on a set of guidelines (Nemes 1992).

3. The National Federation of Municipal Analysts (NFMA), a trade association representing municipal analysts and investors, is requesting quarterly reports, including utilization statistics and management reports (Nemes 1992).

4. In April of 1994 New Britain General Hospital promised to provide annual updates of its financial and operating condition. The New Britain deal is one of the first offerings by a tax-exempt healthcare provider to include "secondary disclosure" language in the bond agreement. The Connecticut bond-issuing authority plans to include secondary disclosure language in all future health and education bond agreements (Pallarito 1994).

5. The advisory committee of the National Association of State Auditors, Controllers and Treasurers (NASACT) recently produced draft guidelines on the types of information that tax-exempt health care issuers should annually
disclose to owners of their bonds. They suggested healthcare issuers provide audited financial statements, certain data about operations and a discussion of "material information," including pending litigation (Pallarito 1994).

6. The Government Accounting Standards Board (GASB) is moving toward requiring financial statement disclosure of operational information in the belief that full accountability requires additional information beyond that traditionally supplied in external financial statements (GASB Research Report 1990).

Potential benefits accrue to hospitals for increasing financial and operating data disclosure. Increased disclosure could:

1. Enable the health care industry to reach new investors willing to buy health care bonds (Pallarito 1993);

2. Increase the availability of information which may make investors willing to accept lower interest rates. Thus, lower financing costs may be passed on to patients through lower costs for treatment (Pallarito 1993);

3. Clarify the chief executive officer's responsibility to the public (currently, many
data requests are handled on a case-by-case basis with the advice of an attorney) (Pallarito 1993);

4. Avoid the possibility of insider trading accusations. The SEC requirement helps relieve bond-issuing authorities of the liability of passing along recent financial data to the few institutional investors who ask for it. It is not fair for money managers to unload certain investments based on information they've obtained because "they know who to call and what to ask while individual investors may not." (Pallarito 1994, p. 68).

Some members of the health care community have been less than enthusiastic about increased disclosure. In comments to the HFMA's Principles and Practices Board, many chief executive officers indicated that the information investors need is already available. They pointed out that the new requirements will just create more paperwork and expense in an industry that is already inundated with record-keeping responsibility (Pallarito 1993).

One way to reduce the cost of providing information is to determine a concise set of information that investors need in order to accurately evaluate the financial health of a hospital. For example, studies have demonstrated that though rating analysts indicate that they review an enormous amount of information during the rating process,
the actual rating can be predicted from a more parsimonious set of information (Lev 1974). One of the objectives of this study was to determine a concise set of information that can be used to distinguish various levels of hospital financial performance.

Research Method

As a preliminary step in this analysis, bond rating analysts specializing in the health care sector were contacted at three major bond rating firms -- Moody's, Standard and Poor's (S&P's) and Fitch's. One analyst from each firm participated in a brief interview. Though somewhat reluctant to disclose the exact process by which analysts assign ratings, they made either a hospital information request form available or provided a list of information that they would like to have before conferring a rating. The appendix itemizes the information requested by these forms.

If the growing interest in hospital disclosure issues results in new regulatory requirements, then such requirements ought to be somewhat grounded in empirical evidence of the predictive ability of that information. One way to seek such grounding would be to rely upon variables that have proven significantly predictive in the

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5These forms are questionnaires sent to hospitals by investor services like Moody's, Standard & Poor's or Fitch, to solicit specific information used to determine a rating. Hospitals participating in bond financing are expected to willingly provide such information.
earlier literature. Alternatively, it may be that the aforementioned changes in the health care industry have made these earlier variables less predictive.

Given these possibilities, this study develops a predictive model by analyzing variables suggested by the Center for Healthcare Industry Performance Studies (CHIPS), variables found to be significantly predictive in previous studies, as well as a set of variables formulated from the analysts' lists in the appendix.

The statistical analysis consisted of several steps. First, a factor analysis was performed on the group of variables described above to reduce correlation between variables. A reduced variable set was then constructed by taking the variable which received the highest factor loading in each resulting factor group. In the second part of the analysis a predictive model was constructed using the reduced variable set produced in the first part of the analysis. Since bond ratings represent more than two response categories and are ordinally scaled, cumulative logits were applied to the reduced variable set in constructing the predictive model. This takes advantage of the ordinal nature of the bond rating categories.

The choice between variables found to be predictive in earlier studies and variables included in this study was dependent upon their respective predictive power. The predictive variables included in the model developed in
this study may be seen, at least in a preliminary way, as
variables of potential interest to those concerned with
disclosure and its regulation.

Summary

In summary, the purpose of this study was to develop a
model which predicts hospital revenue bond ratings. In
pursuing this objective this study endeavored to provide a
base model which might be used in future research to refine
the variables used in predicting hospital bond ratings.

This study perhaps improves upon previous studies in
two significant ways. First, Chu et al. (1991) state that
the prospective payment system which began in 1983 may not
have reached its full potential with respect to health care
cost containment by 1987. They suggest that future studies
extend the study period to well beyond 1987. This study
utilized data as recent as 1994.

Second, this study examined a broader range of
nonaccounting criteria than that examined in previous
studies. Information necessary to evaluate a hospital’s
financial performance may not be limited to financial
accounting information. There is evidence that operational
data (which yields some insight into the degree that
hospital facilities are utilized) and socioeconomic data
(regarding the surrounding community) are also relevant in
determining a hospital’s financial health (Craycraft 1994;
La Jolla Management Corp. 1981; Cleverley and Nutt 1984).
The remainder of this study is divided into four chapters. Chapter 2 is a summary and critique of related studies examining the relationship between accounting, non-accounting and socioeconomic information and hospital bond ratings. Chapter 3 details the research method, including sample selection procedures, a discussion of the dependent and independent variables, and the statistical techniques used in this study. Chapter 4 presents the results of the study. The final chapter summarizes the study, identifies limitations, and provides suggestions for future research.
CHAPTER 2

LITERATURE REVIEW

Overview of Related Literature

Hospital bond rating studies first appeared in the healthcare financial management literature in response to attempts to develop financial performance measures for hospitals. These studies use bond ratings as a proxy for various levels of hospital financial performance and attempt to determine whether various information (either financial accounting or operational data) is relevant in determining a hospital's bond rating. These studies, however, do not focus on accounting and disclosure issues. A few accounting studies have attempted to empirically determine the association between accounting and socioeconomic information and hospital revenue bond ratings, but little has been done in the way of examining relevant operational variables. This study endeavored to bridge the two areas of analysis and determine variables, whether financial accounting, operational or socioeconomic, which are significant in discriminating between various categories of hospital revenue bond ratings.

Healthcare Financial Management Literature

Initial Research

Initial research in the health care financial management literature focused on developing measures of financial performance in an attempt to reduce the amount of
information administrators needed to assess when making operational decisions. Glandon et al. (1987) explain that hospital financial statements tend to "contain excessive information and consequently take too long to evaluate" (p.440). A review of the health care literature in this area indicates that initial studies developed out of a need to reduce the volume of information hospital administrators and managers encountered when monitoring the operations, financial strengths, and potential problems of their organizations.

Early work in this area focused exclusively on financial statement data and followed the traditional approach of using financial ratios to describe and evaluate the financial performance of hospitals. Even though the market structure and service delivery system of the hospital industry differed substantially from other industries, the same financial ratios used for retail and manufacturing firms (leverage, liquidity, and profitability or efficiency ratios) were used in early studies to compare performance between various hospitals. Unlike other industries where average ratios were commonly available through investor services like Dun and Bradstreet, early use of ratio analysis was impaired by the lack of comparable financial statement information for the hospital industry (Choate, 1974; 1979).
Choate (1974) developed a preliminary sample of average ratio values for the hospital industry by taking a sample of 25 hospitals and computing averages and ranges for 19 financial ratios. He then proceeded to demonstrate ratio analysis using three hospitals taken from the sample. It is interesting to note Choate's caution that, while industry averages can be obtained for debt and coverage ratios, such averages should not be used as a reference point because many hospitals in the sample did not have debt.

Choate and Tanaka (1979) replicated Choate's 1974 study using 209 hospitals to develop hospital industry averages. Again, analysis of liquidity, leverage, and profitability were performed on three hospitals taken from the sample. The 1979 study produced similar industry averages to the 1974 study even though the sample size varied and there was an interval of five years between the two studies.

Data Reduction Techniques

In the late 1970's the use of ratio analysis among hospital administrators was still novel. Experts in the area offered several reasons why financial ratios were not as widely used in the hospital industry compared to other industries. It is possible that financial pressures in the hospital industry were not as pervasive during the late 1970's as they were in other industries. Also, lack of availability of comparable financial statement information may have slowed the development of meaningful industry ratio
averages. This prompted the development of a national data base with which to develop hospital industry ratio averages. The Financial Analysis Service (FAS)\(^6\) was developed in 1979 by the Healthcare Financial Management Association in cooperation with Ohio State University. A set of 29 key ratios was developed (many were similar to ratios used by other industries, but several reflected the unique characteristics of the hospital industry). Data from participating hospitals was collected and compiled creating a data base on these key ratios. Industry averages were produced and provided to participating hospitals so that they might have benchmarks with which to compare and evaluate their organizations. Figure 2.1 provides definitions for these 29 ratios.

Analyzing a large number of financial ratios can be a source of confusion rather than clarification. Later studies in this area concentrated on reducing the number of significant ratios necessary to evaluate hospital financial performance to a size that was manageable yet maintained adequate representation of a hospital’s financial characteristics.

Concerned with the information overload hospital administrators and managers might be faced with, Cleverley

\(^6\)Currently the Center for Healthcare Industry Performance Studies (CHIPS).
Profitability Measures

1. Deductible Ratio: 
   Allowances for Contractual Adjustments and Uncollectible Accounts 
   Gross Patient Revenue

2. Mark-up: 
   Gross Patient Revenue + Other Operating Revenue 
   Operating Expenses

3. Operating Margin Ratio: 
   Operating Income (Operating Revenue - Operating Expense) 
   Total Operating Revenue

4. Non-operating Revenue Contribution: 
   Nonoperating Revenue 
   Excess of Revenues Over Expenses

5. Reported Income Index: 
   Excess of Revenue Over Expenses 
   Change in Fund Balance

6. Return on Assets: 
   Excess of Revenue Over Expenses 
   Total Assets

7. Return on Equity: 
   Excess of Revenue Over Expenses 
   Fund Balance

Liquidity Measures

8. Current Ratio: 
   Current Assets 
   Current Liabilities

9. Quick Ratio: 
   Cash + Marketable Securities + Accounts Receivable 
   Current Liabilities

10. Acid Test: 
    Cash + Marketable Securities 
    Current Liabilities

11. Average Payment Period: 
    Current Liabilities 
    Operating Expenses - Depreciation 
    365

12. Accounts Receivable Intensiveness: 
    Net Patient Accounts Receivable 
    Patient Revenue

13. Days Cash on Hand: 
    Cash + Marketable Securities 
    Operating Expense - Depreciation 
    365

(figure con'd.)

Figure 2.1--Definitions of ratios maintained by the CHIPS.7

7These ratios represent those maintained by the CHIPS as of 1985.
Capital Structure

14. Equity Financing: \( \frac{\text{Fund Balance}}{\text{Total Assets}} \)

15. Cash Flow to Total Debt: \( \frac{\text{Excess of Revenue over Expenses} + \text{Depreciation}}{\text{Current Liabilities} + \text{Long-term Debt}} \)

16. Long Term Debt to Equity: \( \frac{\text{Long-term Liabilities}}{\text{Fund Balance}} \)

17. Fixed Asset Financing: \( \frac{\text{Long-term Liabilities}}{\text{Net Fixed Assets}} \)

18. Times Interest Earned: \( \frac{\text{Excess of Revenue over Expenses} + \text{Interest Expense}}{\text{Interest Expense}} \)

19. Debt Service Coverage: \( \frac{\text{Revenue}}{\text{Expense} + \text{Depreciation} + \text{Amortization Expense} + \text{Interest Expense}} \)

\quad \text{Current Portion of Long-Term-Debt from Previous Year} + \text{Interest Expense}

Activity Measures

20. Total Asset Turnover: \( \frac{\text{Total Operating Revenue}}{\text{Total Assets}} \)

21. Fixed Asset Turnover: \( \frac{\text{Total Operating Revenue}}{\text{Net Fixed Assets}} \)

22. Current Asset Turnover: \( \frac{\text{Total Operating Revenue}}{\text{Current Assets}} \)

23. Inventory Turnover: \( \frac{\text{Total Operating Revenue}}{\text{Inventory}} \)

Other

24. Average Age of Plant: \( \frac{\text{Accumulated Depreciation}}{\text{Depreciation Expense}} \)

25. Price Level to Historical Depreciation: \( \frac{\text{Price Level Depreciation}}{\text{Depreciation}} \)

26. Operating Margin (Price Level Adjusted (PLA)): \( \frac{\text{Total Operating Revenue} - \text{Operating Expenses} + \text{Depreciation} - \text{Price Level Depreciation}}{\text{Total Operating Revenue}} \)

27. Restricted Equity: \( \frac{\text{Total Restricted Fund Balances}}{\text{Unrestricted Fund Balances}} \)

28. Viability Index: \( \left( 1 - \text{Equity financing Ratio} \right) \times \left( 1 - \text{Operating Margin Ratio} \right)^4 \times (1) \times 4.0 \)

\quad \text{(Current Ratio)}

29. Replacement Viability: \( \frac{\text{Restricted Plant Fund Balance} + \text{Unrestricted Investments}}{\text{Price level adjusted allowance for Depreciation} \times 0.33} \)
and Rohleder (1985) set out to reduce the number of ratios administrators and managers might need to monitor. Recognizing that many financial ratios are highly correlated with others, they utilized factor analysis to reduce the 29 ratios provided by the FAS into 10 prime ratio indicators. Data was analyzed for 1978, 1979, and 1980. The authors state that the results, which are presented in figure 2.2, remained consistent over this three-year period.

The top ten factors explained 90% of the total variation of the entire data set. Factors did not appear to present interpretational difficulties. Operating margin was the highest loading variable on the first factor. Factor 1 appeared to best capture the dimension of profitability in the data. This one factor explained more total variance than any other factor.

Five of the original 29 ratios did not load with other ratios. Inventory turnover was not included in the analysis due to the large variations in value for this ratio introduced through different accounting treatments. Authors justified the exclusion of the viability index on the grounds that it was a combination of three other ratios: total liabilities to total assets, operating expenses divided by operating revenue, and the current ratio.

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With one exception, factor ten. It is not clear why restricted equity loaded with fixed asset turnover.
<table>
<thead>
<tr>
<th>Factor</th>
<th>Dimension</th>
<th>Best Single Ratio Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Profitability</td>
<td>Operating Margin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating Margin (PLA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return on Total Assets</td>
</tr>
<tr>
<td>2</td>
<td>Short-term Cash Position</td>
<td>Days Cash on Hand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acid Test</td>
</tr>
<tr>
<td>3</td>
<td>Capital Structure</td>
<td>Fixed Asset Financing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replacement Viability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equity Financing</td>
</tr>
<tr>
<td>4</td>
<td>Liquidity</td>
<td>Average Payment Period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Current Ratio</td>
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<td></td>
<td></td>
<td>Quick Ratio</td>
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<tr>
<td>5</td>
<td>Age of Plant</td>
<td>Average Age of Plant</td>
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<tr>
<td></td>
<td></td>
<td>Price Level to Historical Depreciation</td>
</tr>
<tr>
<td>6</td>
<td>Debt Coverage</td>
<td>Debt Service Coverage</td>
</tr>
<tr>
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<td></td>
<td>Times Interest Earned</td>
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<td>7</td>
<td>Payment Mix</td>
<td>Deductible Ratio</td>
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<tr>
<td>8</td>
<td>Leverage</td>
<td>Long-term Debt to Equity</td>
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<td></td>
<td></td>
<td>Return on Equity</td>
</tr>
<tr>
<td>9</td>
<td>Current Asset Efficiency</td>
<td>Days in Patient Accounts Receivable</td>
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<td></td>
<td></td>
<td>Current Asset Turnover</td>
</tr>
<tr>
<td>10</td>
<td>Fixed Asset</td>
<td>Fixed Asset Turnover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restricted Equity</td>
</tr>
</tbody>
</table>

**Variables Not Entered**
- Reported Income Index
- Non-Operating Revenue
- Inventory Turnover
- Viability Index

**Variables which did not load at 0.65 or higher**
- Cash Flow to Total Debt

* Total Asset Turnover was not mentioned

Figure 2.2--Results of Cleverley and Rohleder factor analysis.
Reported income index and non-operating revenue did not load onto existing factors, indicating that these ratios may capture unique dimensions of hospital position. Finally, while cash flow to total debt loaded on two factors it did not load at the researchers' cut-off point of 0.65 or better (Though total asset turnover is a ratio monitored by the FAS, it was not mentioned in this study).

**Predicting Hospital Financial Performance**

During the early 1980's, the environment in which hospitals functioned began to take on a more competitive corporate atmosphere. With increased risk of hospital failure, the focus of studies in this area shifted from that of comparing or describing hospital financial performance to predicting hospital financial performance. The initial literature in this area generally focused on hospital failure as the relevant outcome.

In order to partially test the utility of the 29 ratios maintained by the FAS, Cleverley and Nilsen (1980) performed a longitudinal analysis of changes in values in these financial ratios for a sample of 27 New York hospitals which closed between the years 1973 and 1978. They requested uniform financial reports for these hospitals from the New York Department of Health. They received thirty-five reports for twenty-seven of the forty-two original hospitals in the sample. Median values for each of the FAS ratios
were calculated for the hospitals four years before failure and one year before failure.

The results of their analysis provide some empirical evidence on the sharp decline in these ratios prior to hospital failure. Failed hospitals experienced poor liquidity, longer payment cycles, and a deteriorating flow of funds. They also appeared to have little long-term debt four years prior to failure. More than half of the hospitals in the sample were experiencing a situation where liabilities exceeded assets. Activity ratios appeared to be favorable and improving. This may be a result of a reduction, nonreplacement or even liquidation of assets in anticipation of failure. Unusually large deductibles and declining mark-up ratios resulted in negative operating margins. Failed hospitals appeared to have little access to nonoperating sources of funds.

One of the more interesting results was the support the studied provided for the use of the viability index as an indicator of financial difficulty. The norm for this ratio is 1.0 with lower values being indicators of better financial position. The failed hospitals in this study showed a median value of 4.71 four years prior to failure. This increased to a median of 7.07 one year prior to failure. The authors concluded that the FAS ratios provided an early warning signal of impending financial difficulty.
There were numerous limitations to the above study. The sample was small (resulting in as few as one hospital in two of the sample years) and was specific to New York. An unrepresentative percentage of the hospitals were proprietary. Finally, Cleverly and Nilsen's definition of failure was closure, not bankruptcy. It is possible that these hospitals closed for reasons other than financial difficulty.

**Multivariate Ratio Analysis**

The La Jolla Management Corporation (1981) study represents a move away from a univariate ratio comparison toward a multivariate ratio analysis of the relationship between financial accounting information and hospital financial performance. In a study similar to Altman (1968), discriminant analysis was applied to financial data provided by a group of hospitals insured under the Hospital Loan Assistance Program for the Bureau of Health Facilities. This study identified the following eight factors associated with financial failure: quick ratio, days in accounts receivable, permanent financing ratio, debt to asset ratio, deductible ratio, operating margin ratio, viability index and occupancy ratio.

The La Jolla study had several limitations. First, failure was defined as hospitals in default or those regarded as marginal by the Bureau of Health Facilities staff. This ignores the possibility that some hospitals in
excellent financial condition might default because of a temporary cash-flow problem. This problem could be corrected and the hospital could resume making current payments. Second, the credit characteristics of hospitals insured under Federal programs are debatable (Cleverley 1985). There is some evidence that these hospitals are riskier. If this is true, not only were the hospitals in the nonfailed group unrepresentative of hospitals in good financial condition but they were also unrepresentative of hospitals in general.

However, relatively few hospitals actually fail in any given period, and this may explain why alternative methods examining variables to predict hospital bond ratings began to develop. Reduced bond ratings may indicate movement along a continuum of financial performance culminating in failure. Glandon et al. (1987) suggest that predicting a hospital's bond rating may yield a better understanding of hospital financial performance. In addition the hospital industry is dominated by not-for-profit firms with no organized market for the equity of firms. In this respect it has much in common with municipalities. Therefore, bond ratings might provide an alternate metric to evaluate the relevance of accounting information to investors.

Also, the hospital financial management research community began to recognize that resource providers for hospitals included not only investors willing to provide
debt financing but charitable donations, tax support, and third party payers as well. These particular users of financial statements were more likely to need information in addition to financial accounting ratios which would enable assessment of various dimensions of hospital organizational performance (Lawrence and Kurtenbach 1995). The bond rating process incorporates measures of a firm's overall quality, risk, and economic condition; therefore, information which is significantly associated with bond ratings might be expected to be useful in evaluating factors which greatly influence the financial performance of hospitals. Bond ratings could provide a metric which proves more informative to the general body of hospital resource providers.

**Hospital Bond Rating Studies**

Cleverley and Nutt (1984) is of particular relevance here. Their study represents one of the first hospital bond rating studies. It is also one of the first hospital performance studies to incorporate non-accounting criteria. It focused on the hospital bond rating process in an attempt to determine how rating agencies deal with the large amount of information they collect for each bond rating. This study represents a move away from a narrow concentration on financial accounting information used to predict ratings toward the broader task of trying to better understand and determine other factors which influence the financial performance of hospitals.
These researchers performed an analysis to determine the degree of association between bond ratings and the criteria analysts reported using to derive the ratings. Though discriminant analysis had been widely used in the analysis of municipal bonds (Carleton and Lerner 1969; Hempel 1973; Rubinfeld 1973; Morton 1975; Michel 1977; Aronson and Marsden 1980; Stock and Robertson 1981; Raman 1981 1982; Copeland and Ingram 1982; Farnham and Cluff 1982), Cleverley and Nutt decided to use regression analysis. They converted bond rating categories into a scale with values ranging from 1 to 9 and used this scale as the dependent variable. First, decision criteria were derived from a literature review, personal observation, and discussions with bond rating analysts and investment banking firms. Not all criteria could be included in the analysis for two reasons: 1) lack of an adequate number of observations; and, 2) multicollinearity considerations. To deal with problems presented by multicollinearity only the best predictor among correlated criteria that represented a particular issue were included in the analysis.stellar Seventeen criteria survived to be included in the study.

A stepwise regression was used to find the best-fitting linear model. The relevance of a criterion was judged by its level of significance measured by an F-test. Two

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*Cleverley and Nutt do not indicate how the "best predictor" was chosen.*
decision models were developed, one representing the decision process of Moody’s bond rating analysts and the other representing that of Standard and Poor's analysts. Criteria common to both models were peak debt first-year coverage, net take down, bed size and expense per patient-day. Peak debt first-year coverage is a coverage ratio which is prospective in nature. It is defined as the ratio of estimated cash flow before interest expense during the first full year following completion of the construction program to the estimated maximum annual principal and interest on all outstanding bonds and on the bonds to be issued. It indicates the ability of a hospital to cover its maximum debt service on the new issue in its first year of operation after the construction program is complete. Net take down is a profitability measure defined as the present period cash flow plus interest divided by total revenue. Larger values of this ratio imply greater profitability and thus better debt repayment potential.

In addition to the above variables, Moody’s rating model included bed occupancy, cash flow change, and sales to net fixed assets, while debt per bed, percentage of Medicaid revenue and depreciation reserve were included in Standard and Poor’s model.

Present reliance on this study should be made with caution. The data for this study came from the years 1974 to 1977, before the implementation of the Medicare
prospective payment system; therefore, some results may have become obsolete. One good example is that the results of this study indicated that higher expense per patient-day was associated with hospitals receiving higher bond ratings. Since the introduction of a "fixed fee" reimbursement (via PPS) this relationship would be expected to reverse. Also, due to the lack of data, many of the criteria analysts claimed to use could not be examined.

More recently Sloan et al. (1987), observing that hospital systems were growing at a greater rate relative to their independent counterparts, were interested in whether system hospitals reaped advantages over stand-alone hospitals in capital markets. Part of their study focused on the differences in the cost of debt, with particular emphasis on measures associated with the risk-level of the institution. Risk was proxied using bond ratings. They found that, in general, lower bond ratings raised the cost of capital. Results suggest that differences in bond ratings have more to do with other characteristics of the organization than with system status.

Building upon Cleverley and Nutt and Sloan et al., McCue et al. (1990) were interested in identifying important institutional, operational, financial and market area factors associated with hospital tax-exempt bond downgradings. They posited that variables associated with A-rated bonds that were downgraded to a BBB (Type I
downgrade) might be different from factors associated with the downgrading of BBB-rated bonds to a BB-rating or lower. Two separate models were developed, one incorporating A-rated bonds that were downgraded to BBB (Type I downgrade) and one using BBB-rated bonds that were downgraded to BB rating or lower (Type II downgrade).

The first part of the study applied a two-tailed t-test to identify significant differences in hospital performance measures between an experimental group of hospitals whose bonds received a downgrade during the study period and a control group of hospitals whose ratings remained unchanged during the study period. The second stage of the study employed a logit regression model to identify the independent variables significantly associated with a downgrade in rating. Independent variables analyzed in the study were selected based on results of the univariate analysis, the authors' review of prior empirical studies, and the measures used by Standard & Poor's. The dependent variable was binary with "1" equal to a hospital with a bond that received a downgrade and "0" representing a hospital with an unchanged bond rating. Two logit models were developed, one for each type of downgrade.

Multicollinearity precluded the simultaneous inclusion of many of the independent variables in the same model. Multicollinearity was tested by regressing the variable in question against the remaining variables in the model. The
decision to select one variable over another was a function of the degree of importance placed on the variable by Standard & Poor's, the results of previous empirical studies, and the results of the authors' univariate analysis.

Variables found to be significant in both types of downgrades were a hospital's occupancy rate and ratio of cash and cash equivalents to debt service payments. Additional factors contributing to a Type I downgrade were ratio of long-term debt to total capitalization and ratio of net fixed assets per bed. Factors contributing to a Type II downgrade were system affiliation status\textsuperscript{10}, debt service coverage ratio and case-mix adjusted gross revenues per admission.

The common denominator in these health care financial management studies is a focus on generating results which will aid hospital administrators and managers in evaluating their facilities and in decision making. The accounting literature must be used for studies that concentrate on determining relevant accounting information for investors. Even here there have been few studies which focus on hospital financial disclosure.

\textsuperscript{10}The American Hospital Association defines a system hospital as one that is owned, leased, sponsored, or contract-managed by an outside organization (Sloan et al., 1987)
Accounting Literature

Hospital Reporting and Disclosure

Sherman (1986) was one of the first to address disclosure issues pertaining to hospitals. He investigated the types of conclusions about performance that could be gained from comparing the financial statements of not-for-profit hospitals to for-profit hospitals. He concluded that current financial reporting methods do not provide for accurate economic performance comparisons between for-profit and not-for-profit hospital enterprises and that additional data about volume and output mix are necessary to evaluate hospital financial performance.

Chu et al.'s (1991) study was prompted by the American Institute of Certified Public Accountants (AICPA) Task Force on Not-For-Profit Organizations' suggestion that not-for-profit hospitals should be required to present a Statement of Cash Flows in accordance with Statement of Financial Accounting Standard (SFAS) 95. By replicating Gombola and Ketz (1983) (who used factor analysis to classify financial ratios), using data obtained from the audited financial statements of hospitals rather than manufacturing and retailing firms, this study explored several issues related to hospital financial performance.

First, using factor analysis, they sorted 31 ratios taken from the financial statements of 116 Indiana hospitals between the years 1983 and 1987 into independent groups or
factors. Each factor contained a number of financial ratios that had the highest correlations with that factor. They compared the hospital financial ratio groups to industrial firm ratio groups found in previous studies (Pinches et al. 1973; Chen and Shimerda 1981; Gombola and Ketz 1983). One concern was that there might be important differences between hospital ratio groupings and industrial ratio groupings. Of the eight factor groups which emerged, five hospital ratio groups were found to be virtually identical to those established for industrial companies.

In order to compare ratios for the same firm and among firms in the same industry from year to year, ratio groups utilized must demonstrate stability over time. Chu et al.'s second task was to determine whether these ratios remained stable over a five year period. The ratios were observed to be unstable over this length of time. Perhaps this was due to the influence of PPS which was phased in over the period from which their sample was taken.

The main focus of the Chu et al. study, however, was to assess the impact of three asset flow measures (net income plus depreciation, working capital from operations, and cash flow from operations) on ratio groups. Gombola and Ketz (1983) found that the cash flow ratios, as measured by net income plus depreciation and adjusted for all short-term accruals and deferrals, grouped into a separate factor which was different from the findings of earlier studies. In the
Chu et al. study, unlike Gombola and Ketz, cash flow did not emerge consistently as an independent factor. Instead, working capital flow and return on equity emerged as two distinctly separate factors. This suggests that hospital asset flow measures do not conform to the same patterns as do the asset flow measures of industrial firms.

It should be noted that in comparing the 31 ratios in the Chu et al. (1991) study to the 29 ratios collected by the FAS and used in the Cleverly and Rohleder study only seven ratios were common to both studies. The important difference is that the Chu et al. study focused on ratios found to be important in the retail and manufacturing industries while Cleverley and Rohleder concentrated on examining ratios important to the hospital industry. Also, Chu et al. were replicating an earlier study which was interested in determining the effect of different asset flow measures on financial ratio groupings, not in reducing the redundancy of ratios used in performance evaluation.

**Hospital Bond Rating Studies**

Lawrence and Kurtenbach (1995) investigate the relationship between selected operational measures, such as total surgical operations and average length of stay, and market measures of the risk associated with tax-exempt revenue bonds issued by their sample of hospitals. They

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11The following ratios were common to both studies: return on equity, current ratio, acid test, receivable intensiveness, total asset turnover, cash flow from total debt and operating margin.
were interested in determining the extent to which rating agencies, underwriters, and insurers use operational measures. Their data was taken from a national sample of approximately 1600 general surgical hospitals from the years 1987 through 1991.

A correlation analysis was performed between bond ratings and fourteen operational measures. Bond ratings were represented by a numerical index provided by the Merritt System database, which converts bond ratings to a scale from 0 to 100, with higher numbers representing higher ratings. The authors did not indicate whether these ratings represented Standard and Poor’s or Moody’s ratings nor did they indicate whether the sample of hospitals used excluded hospital bonds with credit enhancements such as insurance or letters of credit. When a hospital insures a bond issue against default the insurer guarantees payment if the hospital defaults on the bond. The rating assigned the issue, therefore, reflects the creditworthiness of the insuring organization and not the hospital.

Results of this study indicate a strong correlation between bond ratings and the following variables: full time equivalents (FTEs) per beds in service, number of births, total surgical operations, case mix adjusted equivalent (CMA) admissions, CMA patient days, case mix index, CMA admission per bed, capital cost per bed, noncapital cost per
bed, occupancy rate, and average age of property, plant and equipment.

Craycraft (1994) represents one of the most recent attempts to model the hospital bond rating process. She applied probit analysis to 76 bond ratings issued in 1987. Craycraft was primarily interested in investigating the relationship between hospital bond ratings and socioeconomic variables. Consequently her analysis was limited to 19 variables, ten of which are socioeconomic.

Socioeconomic variables included in this study were based on findings in municipal bond studies. To reduce multicollinearity between variables, financial ratios utilized in this study were obtained from the results of Chu et al.'s (1991) factor analysis. Seven financial variables were chosen by taking the variable that received the highest factor loading from each of seven factor groups (though Chu et al. determined eight ratio factor groups, Craycraft omits a ratio representing cash flow with no explanation). Again, it should be reiterated that Chu et al. utilized ratios indicative of the retail and manufacturing industries, focused on ratios related to cash flows, and used sample data taken from the years 1983 to 1987. Chu et al. advise subsequent researchers that their results were not stable over the five-year sample period and suggested that their analysis be replicated using more recent data.
Probit analysis was applied to the above variables. Coefficients found to be significant included: return on investment, debt structure, return on equity, short-term liquidity, receivable intensiveness, median age, percentage of population over age sixty-five, net change in population, and medicaid percentage. Contrary to previous studies, size (proxied by number of beds) was not a significant variable.

To examine whether socioeconomic data provided incremental information over financial data, a model that contained both socioeconomic data and financial data was compared to a model containing only financial data. Using a likelihood ratio test it was determined that the combined model provided better predictive ability. The reported classification accuracy of this model was sixty-six percent. Results may have been biased upward, however, for it appears Craycraft used the same sample employed to construct the model to test its classification accuracy rather than utilizing a hold-out sample or the Lachenbruch holdout (jackknife) procedure.

Summary

Chapter 2 provided a discussion and critique of the health care financial management literature pertaining to hospital financial performance studies, for it is out of these studies which grew hospital bond rating studies. This chapter also examined accounting studies which have focused
on predicting hospital bond ratings as well as studies concerned with financial disclosure for hospitals.

Studies generated from the health care financial management arena primarily focused on generating results which would aid hospital administrators and managers in evaluating their facilities and in decision making. These studies did not address accounting and disclosure issues. Turning to the accounting literature for studies that focused on determining relevant accounting information for investors provided less than a handful of studies which examined information which might be relevant to hospital financial disclosure.

This study endeavors to bridge the two areas of analysis and provide greater insight into the information needs of providers of hospital resources by determining variables which are significant in predicting hospital bond ratings. Such insight might prove beneficial to those concerned with hospital disclosure and its regulation.
CHAPTER 3
RESEARCH METHOD

As stated, one of the purposes of this study was to develop a model to predict hospital revenue bond ratings. The dependent variable was classified into six bond rating categories. Due to the high correlation and redundancy of the independent variables, a factor analysis was performed to obtain a reduced data set. Logistic regression was used to develop a conditional probability model to predict hospital bond ratings using the reduced data set. Given the logit algorithm, variables included in the final model are significant discriminators across bond rating categories. The jackknife procedure was used to assess the classification accuracy of the model.

Sample Selection Procedures

A sample of hospital bond issues was selected from a private database, the Merritt System, which is compiled by Van Kampen Merritt Management Inc. The hospital sector of this database contains financial accounting, socioeconomic, operational and bond rating information for 2,145 not-for-profit hospitals in the United States. This represents just under half of the 5,700 community hospitals in the United States (GASB Research Report, 1993). The database contains the latest credit ratings by month, operational data on a periodic basis, and financial information on an annual basis.
Bond issues were selected from the years 1990-1994. To enter the initial sample a hospital must have met two criteria. First, the hospital must have issued bonds with a Standard and Poor's rating of "B-" or above. Second, the Merritt System keeps financial records of hospitals only as far back as 1988. Several of the ratios included in this study required three years of financial data. Therefore, to enter the initial sample, hospitals must have had a bond issue dating no earlier than January 1, 1990.

Dependent Variable

The dependent variable, hospital revenue bond ratings, was classified into six Standard and Poor’s bond rating categories. Table 3.1 lists these six bond rating categories and a description of what those categories indicate. The plus and minus signs show the relative standings within the major rating categories.

There were only seven hospitals in the sample with a rating of AA- and above. It was determined that seven hospitals was insufficient to represent a separate category. These seven hospitals were combined with the nineteen hospitals with an A+ rated bond issue. The resulting bond rating category was labeled A+ and above. Similarly, there were only three hospitals with a bond rating of BB+ and below. These three hospitals were placed
Table 3.1--Bond Rating Categories.

<table>
<thead>
<tr>
<th>Indication</th>
<th>Capacity to pay interest and repay principal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A+ and Above</strong></td>
<td>Extremely strong</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>Very strong capacity to pay interest and repay principal and differs from the highest rated issues only in small degree</td>
</tr>
<tr>
<td><strong>A-</strong></td>
<td>Strong capacity to pay interest and repay principal although it is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than debt in higher rated categories</td>
</tr>
<tr>
<td><strong>BBB+</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BBB</strong></td>
<td>Though normally exhibits adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for debt</td>
</tr>
<tr>
<td><strong>BBB- and Below</strong></td>
<td></td>
</tr>
</tbody>
</table>
in the same category as hospitals with a BBB- rating. The resulting category was labeled BBB- and below.\footnote{12}

Independent Variables

Early studies in this area focused on financial accounting and a few operational variables to predict hospital revenue bond ratings. More recent studies incorporate socioeconomic variables with some success. The independent variables in this study are categorized as either financial accounting, operational or socioeconomic variables. The next three sections discuss each independent variable category in more detail.

Financial Accounting Variables

Financial accounting variables included in this category are taken from the list of financial accounting ratios monitored by the CHIPS and financial accounting variables found to be significant predictors in previous hospital bond rating studies. The CHIPS classifies financial variables into five categories: profitability, liquidity, capital structure, activity and other. Figure 3.1 classifies the financial accounting variables examined in this study into these five categories.

Profitability ratios are designed for the evaluation of the firm's operating performance. For hospitals the numerator of these ratios consists of revenue less net...
operating expense.\textsuperscript{13} Revenue less net operating expense
is also referred to as revenue over expenses. The
denominator of these ratios represents the relevant
investment base (fund balance, total assets etc.) (Lev
1974).

The general objective of liquidity ratios is to
indicate the hospital’s ability to meet its short-term
financial obligations. These ratios focus on the size of
the hospital’s reserve of liquid assets relative to its
maturing liabilities.

Capital structure ratios indicate the hospital’s
ability to meet both principal and interest payments on
long-term obligations. These measures depict the long-term
financial and operating structure of the hospital (Lev,
1974). In the past fifteen years the hospital industry has
radically increased its proportion of debt financing
chiefly through tax-exempt revenue bonds. The evaluation
of these ratios may ultimately determine the amount of
financing available to an organization, thus directly
affecting its rate of growth and its ability to deliver
services. The hospitals included in this study are non-
profit; therefore, fund balance (unrestricted unless
otherwise indicated) replaces equity in these ratios.

\textsuperscript{13}The formula for net operating expense is: Operating Expense
- (Depreciation (Amortization) Expense + Interest Expense).
Activity ratios measure the relationship between revenues and assets. The numerator is always revenue and may be thought of as a financial measure of output. The denominator is investment in some category of assets; it may be thought of as a financial measure of input. These ratios are sometimes referred to as efficiency ratios since they measure the relationship between outputs and inputs.

With the exception of fixed asset turnover, activity ratios have not proven to be significant indicators of hospital bond ratings in previous studies. Since fixed assets are the major investment category in most hospitals, this ratio may be of major importance in assessing the relative efficiency of plant investments. Hospital financial management experts are quick to point out that actual measures of utilization, such as occupancy rate, probably provide a better efficiency indicator than activity ratios.

The other category contains financial accounting variables which do not fit well into the other four categories.

In addition to the financial ratios maintained by CHIPS this study will analyze several financial ratios found to be significant in previous hospital bond rating studies. Net take down, cash flow change, debt per bed (Cleverly and Nutt 1984), short-term liquidity, debt structure (Craycraft 1994), working capital, total
operating expense, and unrestricted fund balance (Lawrence and Kurtenbach 1995) were all found to be significantly correlated with hospital bond ratings in previous studies. These additional variables are shown in the appropriate categories in Figure 3.1.

Operational Variables

A hospital's financial performance is greatly influenced by many factors external to the hospital or otherwise beyond its ability to change in the short run. For example, the financial performance of a hospital depends significantly on the number of beds it operates, whether it is a teaching hospital, and its surrounding community (McCue et al., 1990). Financial accounting ratios may adequately reflect these exogenous variables. However, given the extent to which analysts seek out operational and socioeconomic data, it is also possible that financial ratios do not reflect these exogenous variables. One objective of this study was to better understand the relationship of such "external factors" in predicting hospital bond ratings.

All three rating agencies indicated that utilization trends are examined with the same care as financial trends. During the late 1980's many hospitals entered managed care contracts to offset the pressure that technological investments placed on their working capital. Managed care contracts provide incentives to shift care from inpatient
**FINANCIAL VARIABLES**

### Profitability Ratios

Variables followed by the Center for Healthcare Industry Studies (CHIPS)

1. **Operating Margin Ratio:**
   \[
   \text{Operating Income} \div \text{Total Operating Revenue}
   \]

2. **Non-operating Revenue Contribution:**
   \[
   \text{Nonoperating Revenue} \div \text{Excess of Revenues Over Expenses}
   \]

3. **Bad Debt Expense Ratio:**
   \[
   \text{Bad Debt Expense} \div \text{Net Patient Revenue}
   \]

4. **Reported Income Index:**
   \[
   \text{Excess of Revenue Over Expenses} \div \text{Change in Fund Balance}
   \]

5. **Return on Total Assets:**
   \[
   \text{Excess of Revenue Over Expenses} \div \text{Total Assets (Year End)}
   \]

6. **Return on Equity:**
   \[
   \text{Excess of Revenue Over Expenses} \div \text{Fund Balance (Year End)}
   \]

7. **Growth Rate in Equity:**
   \[
   \frac{\text{Change in Fund Balance}}{\text{Fund Balance (Year End)}}
   \]

### Liquidity Measures

8. **Current Ratio:**
   \[
   \frac{\text{Current Assets}}{\text{Current Liabilities}}
   \]

9. **Average Payment Period:**
   \[
   \frac{\text{Current Liabilities}}{\text{Operating Expenses - Depreciation}} \times 365
   \]

10. **Accounts Receivable Intensiveness:**
    \[
    \frac{\text{Net Patient Accounts Receivable}}{\text{Patient Revenue}}
    \]

11. **Days Cash on Hand:**
    \[
    \frac{\text{Cash + Marketable Securities}}{\text{Operating Expense - Depreciation}} \times 365
    \]

### Capital Structure

12. **Equity Financing Ratio:**
    \[
    \frac{\text{Fund Balance}}{\text{Total Assets}}
    \]

13. **Long-Term Debt to Equity:**
    \[
    \frac{\text{Long-Term Liabilities}}{\text{Unrestricted Fund Balance}}
    \]

14. **Fixed Asset Financing Ratio:**
    \[
    \frac{\text{Long-Term Liabilities}}{\text{Net Fixed Assets}}
    \]

15. **Cash Flow to Total Debt:**
    \[
    \frac{\text{Excess of Revenue Over Expenses + Depreciation}}{\text{Current Liabilities + Long-term Debt}}
    \]

(figure con’d.)

Figure 3.1--Independent financial accounting variables and their definitions.
16. Capital Expense Ratio: \[
\frac{\text{Interest} + \text{Depreciation}}{\text{Net Operating Expense}}
\]

17. Times Interest Earned: \[
\frac{\text{Excess of Revenue over Expenses} + \text{Interest Expense}}{\text{Interest Expense}}
\]

18. Debt Service Coverage: \[
\frac{\text{Revenue} - \text{Expense} + \text{Depreciation} + \text{Amortization Expense} + \text{Interest Expense}}{\text{Current Portion of Long-Term-Debt from Previous Year} + \text{Interest Expense}}
\]

19. Restricted Equity: \[
\begin{align*}
\text{Total Restricted Fund Balances} \\
\text{Unrestricted Fund Balances}
\end{align*}
\]

20. Working Capital Absorption: \[
\text{Increase in Net Working Capital Excluding Short-Term Cash} - \text{Revenue over Expenses} + \text{Depreciation}
\]

**Activity Measures**

21. Total Asset Turnover: \[
\frac{\text{Total Operating Revenue}}{\text{Total Assets}}
\]

22. Fixed Asset Turnover: \[
\frac{\text{Total Operating Revenue}}{\text{Net Fixed Assets}}
\]

23. Current Asset Turnover: \[
\frac{\text{Total Operating Revenue}}{\text{Current Assets}}
\]

**Other**

24. Average Age of Plant: \[
\frac{\text{Accumulated Depreciation}}{\text{Depreciation Expense}}
\]

25. Depreciation Rate: \[
\frac{\text{Depreciation Expense}}{\text{Net Fixed Assets} + \text{Accumulated Depreciation}}
\]

**Significant Predictors in Previous Studies**

26. Net Take Down: \[
\frac{\text{Present Period Cash Flow} + \text{Interest Expense}}{\text{Total Revenue}}
\]

27. Cash Flow Change: \[
\frac{\text{Present Year Cash Flow}}{\text{Average Cash Flow in Preceding Two Years}}
\]

**Liquidity Measures**

28. Short-Term Liquidity: \[
\frac{\text{Working Capital}}{\text{Total Assets}}
\]

**Capital Structure**

29. Debt Structure: \[
\frac{\text{Current Liabilities}}{\text{Total Liabilities}}
\]

**Other**

30. Debt Per Bed: \[
\frac{\text{Total Debt}}{\text{Number of Beds in Service}}
\]

31. Total Operating Expense

32. Unrestricted Fund Balance

33. Working Capital
to outpatient settings, as well as to reduce the overall length of stay. The severity of illnesses treated, number of outpatient procedures, number of surgeries, patient days, and other general trends in patient volume, are examined by analysts to accurately assess demand for a provider's services and competitive position (S&P's Municipal Finance Criteria 1994).

Analysts also conveyed that their analyses are taking a much broader view of operational factors indicating institutional characteristics are important considerations in their analysis. For example, major teaching hospitals, regional referral centers, and large medical centers draw patients from broader regional bases, providing some insulation from local economic cycles. A hospital's educational affiliations and/or research facilities may also enhance the hospital's overall reputation and encourage physician affiliation. This supports the inclusion of two dummy variables, one indicating whether or not the hospital is a teaching hospital and the other indicating whether or not it is affiliated with a medical school.

Operational variables examined in previous studies include: occupancy rate, expense per patient day, case mix index (indicates acuity of patients treated), gross patient revenue, and number of beds in service (a proxy for size). Given the increasing importance of operational variables in
the rating process this study analyzed several "new" operational variables. The appendix provides a list of all the variables that three major rating agencies reported requesting. The new variables examined in this study were derived from these lists. Data availability limited the number of variables incorporated from the analysts' lists. Figure 3.2 defines the operational variables analyzed in this study.

**Socioeconomic Variables**

The economy of the hospitals' service area is also an important rating consideration. A hospital in an area facing secular decline may, for example, have that trend reflected in its rating. Population increases are generally deemed favorable unless they reveal demographic shifts to which the hospital cannot adjust. Additionally, the population profile is important in determining the type of services needed. Typically, an older population is likely to require more intense inpatient services than a younger population, which may be more effectively treated on an outpatient basis. Population trends, unemployment rates, and local wealth levels are reflected in the nine socioeconomic variables examined in the study. These variables are included in Figure 3.3 which summarizes all sixty-four independent variables examined in this study.
Variables Analyzed in Previous Studies

Number of Beds in Service: The number of beds which are actually in service or prepared for service during the fiscal year.

Case Mix Index: Measures the intensity of hospital services based on the acuity of patients treated.

Bed Occupancy \( \% \): \[ \frac{\text{Patient Days}}{\text{Beds in Service} \times 365} \]

Expense Per Patient Day: \[ \frac{\text{Operating Expense}}{\text{Patient Days}} \]

System Affiliation: The American Hospital Association defines a system hospital as one that is owned, leased, sponsored, or contract-managed by an outside organization (Sloan et al., 1987)

Variables Initiated In This Study

Patient Days: The number of inpatient days registered during the fiscal year.

Full Time Equivalents (FTEs): The number of full time equivalents employees during the fiscal year.

Average Length of Stay: \[ \frac{\text{Patient Days}}{\text{CMA Admissions}} \]

Staff Efficiency: \[ \frac{\text{Full Time Equivalent Employees}}{\text{Occupied Beds}} \]

Capital Cost Per Bed: \[ \frac{\text{Depreciation/Amortization Expense + Interest}}{\text{Operating Expense}} \]

Case Mix Adjusted (CMA) Admissions: \[ \text{Case Mix Index} \times \text{Admissions} \]

CMA Equivalents Admissions: \[ \text{Case Mix Index} \times \text{Equivalent Admissions}^{1} \]

CMA Patients Days: \[ \text{Case Mix Index} \times \text{Patient Days} \]

CMA Admissions Per Bed: \[ \frac{\text{CMA Admissions}}{\text{Number of Beds in Service}} \]

CMA Admissions Per FTEs: \[ \frac{\text{CMA Equivalent Admissions}}{\text{Number of Beds in Service}} \]

Number of Medical Surgical Beds
Number of Emergency Room Visits
Number of Births
Total Surgical Operations
Total Number of Outpatients Surgeries
Medical School Affiliation\(^1\)
Teaching Hospital

\(^1\)Admissions represent the number of adult inpatients admitted during the fiscal year (excludes newborn admissions).

\(^2\)Admissions adjusted to account for outpatient treatment.

\(^3\)Indicates whether or not the hospital is affiliated with a medical school.

Figure 3.2--Operational variables included in this study.
### FINANCIAL VARIABLES

Variables followed by the Center for Healthcare Industry Studies

1. Operating Margin Ratio
3. Bad Debt Expense Ratio
4. Reported Income Index
5. Return on Total Assets
6. Return on Equity
7. Growth Rate in Equity
8. Current Ratio
9. Days in Patients A/R
10. Average Payment Period
11. Days Cash on Hand
12. Equity Financing Ratio
13. Long Term Debt to Equity
14. Fixed Asset Financing
15. Cash Flow to Total Debt
16. Capital Expense Ratio
17. Times Interest Earned
18. Debt Service Ratio
19. Total Asset Turnover
20. Fixed Asset Turnover
21. Current Asset Turnover
22. Average Age Of Plant
23. Depreciation Rate
24. Working Capital Absorption
25. Restricted Equity Ratio

### OPERATIONAL VARIABLES

34. Bed Occupancy %
35. Expense per Patient Day
36. Case Mix Index
37. Number of Beds in Service
38. Average Length of Stay
39. Staff Efficiency
40. Number of Births
41. Total Surgical Operations
42. Case Mix Adjusted (CMA) Admissions
43. CMA Equivalent Admissions
44. Capital Cost Per Bed
45. Outpatient Visits
46. Emergency Room Visits
47. Outpatient Surgeries
48. Patient Days
49. CMA Patient Days
50. Full Time Equivalents (FTEs)
51. CMA Admissions Per Bed
52. CMA Admissions Per FTE
53. Teaching Hospital
54. Medical School
55. System Affiliation
26. CMA Admissions Per Bed

### SOCIOECONOMIC VARIABLES

Significant Predictors in Previous Studies

26. Net Take Down
27. Cash Flow Change
28. Short-Term Liquidity
29. Debt per Bed
30. Debt Structure
31. Working Capital
32. Total Operating Expense
33. Unrestricted Fund Balance

56. Median Age of Community
57. % Population > 65
58. % Net Change in Population
59. Medicaid %
60. Medicare %
61. Unemployment %
62. Median Income
63. Total Population
64. % Population Below Poverty

---

Figure 3.3--Summary of independent variables analyzed in this study.
Statistical Analysis

Factor Analysis

The statistical analysis of this study was completed in two phases. First, the redundant variables were reduced in the initial variable set. Factor analysis was used to sort the sixty-four predictor variables into independent groups or factors. Factors represent the weighted combination of variables which best explains the variance among the variables. The degree to which a variable is correlated with a particular factor is determined by its "factor loading" or coefficient. The higher the variable "loads" onto a particular factor the more highly correlated the variable is with that particular factor.

It is common for the first factor to contain many variables with high coefficients while the remaining factors contain only one or two variables with high coefficients (Kline 1994). Following Cleverley and Rohleder (1985), the variable which loaded highest on a given factor was chosen to represent that factor in the reduced independent variable set. When two variables had coefficients close in factor loadings, the variable with the highest coefficient was chosen.

In addition to producing a reduced variable set with less correlation between variables, the factor analysis also indicates the degree of correlation between accounting variables and operational variables. If, as many hospital administrators claim, operational information is
sufficiently proxied through accounting numbers, then operational variables should not separate out from accounting variables into different factors. They should group with the accounting variables that proxy them. However, if operational variables load on the same factor as financial variables, but the operational variables load higher, this may indicate that operational variables convey information that better represents the common factor comprised of both financial and operational variables (Kline 1994).

Johnson and Wichern recommend a first pass through the data using principal component factor analysis to determine the number of factors to be retained and rotated. The initial factor analysis produces as many factors as variables. However, since the aim of this procedure is to reduce the variable set, only the most significant factors were retained and rotated. The principal components analysis produces eigenvalues for each factor. Eigenvalues represent the total amount of variance in the correlation matrix explained by each factor. Therefore, the larger the eigenvalue the more variance explained by that factor. According to Kline (1994), factors with eigenvalues equal to or greater than one in the initial principal components analysis should be retained and rotated in a second principal components analysis. The number of factors to retain is supported by Cattell's Scree test, which is produced in the initial principal component analysis (Kline
The Scree test produces a graph of the eigenvalues and the principal components. The cutoff point for factor retention is determined when the line changes slope and becomes flat.

The original factor loadings are usually not readily interpretable and must be rotated to achieve a simpler structure. Ideally the pattern of loadings is such that each variable loads highly on a single factor and has small-to-moderate loadings on the remaining factors. The retained factors are first rotated using principal components analysis and a varimax (orthogonal) rotation. Factors are rotated such that they are always at right angles to each other and are thus uncorrelated with each other.

A maximum likelihood factor analysis was then performed with the number of factors rotated being pre-specified based on results of the initial principal component factor analysis. Again, varimax rotation is utilized. Comparisons are then made between the maximum likelihood factor analysis and the principal component factor analysis to determine if the variables grouped in the same manner.

The order in which factors are extracted is important. The first factor extracted is the most important factor in terms of capturing the variability of the entire set of variables. The first factor contains more information or explains more of the variance for all variables in the
study than any other factor, while the last significant factor (the factor with the smallest eigenvalue that is greater than or equal to one) explains the smallest percentage.

**Logistic Regression**

The second part of the analysis used logistic regression to measure the relationship between the dependent and independent variables. In a logit model one variable is chosen as the dependent variable and the "logit" is simply the log of the odds of being in one versus another category of the dependent variable. Since bond ratings have more than two response levels and are ordinally scaled, an ordinal logistic regression was employed to take advantage of the ordinal nature of the bond rating categories. The advantages of logistic regression over discriminant analysis are threefold: (1) it is a natural extension of logistic regression for a binary response, (2) its results are more interpretable, and (3) there is no requirement that the predictor set have a multivariate normal distribution (Press & Wilson, 1978).

The SAS LOGISTIC procedure was used to fit linear logistic regression models for ordinal response data by the method of maximum likelihood. It fits a parallel lines regression model that is based on the cumulative
distribution probabilities of the response categories and can be defined as:

\[
p_1 = \text{Prob}(Y = 1 \mid X) \\
p_2 = \text{Prob}(Y = 2 \mid X) \\
\vdots \\
p_j = \text{Prob}(Y = j \mid X)
\]

Y is the response variable and X is a continuous predictor variable. SAS's LOGISTIC program fits the model presented in 3.1.

3.1 \ \text{logit} (p_1) = \log \left\{ \frac{P_1}{1 - P_1} \right\} = \alpha_1 + \beta x \\
\text{logit} (p_1 + p_2) = \log \left\{ \frac{P_1 + P_2}{1 - P_1 - P_2} \right\} = \alpha_2 + \beta x \\
\vdots \\
\text{logit} (p_1+p_2+\ldots+p_j)=\log \left\{ \frac{P_1 + P_2 + \ldots + P_j}{1 - P_1 - P_2 - \ldots - P_j} \right\} = \alpha_j + \beta x

LOGISTIC models the cumulative probabilities. This model is known as the proportional-odds model because the ratio of the odds of the event \(Y \leq j\) is independent of the category, \(j\), and assumes a common slope parameter associated with the predictor variable. Therefore, the odds ratio is constant for all categories.

Logit regression provides a global test for the significance of a given predictor controlling for all other predictors in the model, as well as a test for the significance of a set of predictors, controlling for other effects. Wald's chi-square is used to test the
significance of the estimated model parameters (SAS User's Guide 1994, p.33). This statistic is the square of the ratio of the parameter estimate to its standard error. The impact of a given predictor on the dependent variable, adjusted for other effects in the model, is nicely summarized by parameters that translate into odds ratios. The odds ratio indicates the increase in the odds of an event for every unit increase in the value of a particular independent variable.

A correlation matrix is constructed and variance inflation factors are calculated to determine if multicollinearity between the independent variables is a problem.

The -2 Log Likelihood statistic and the Score statistic are used to test the null hypothesis that all regression coefficients are zero. The -2 Likelihood statistic has a chi-square distribution under the null hypothesis that all regression coefficients of the model are zero. The Score statistic has an asymptotic chi-square distribution under the null hypothesis. A significant p-value for either statistic provides evidence that at least one of the regression coefficients for an explanatory variable is nonzero.

Two rank correlation measures are utilized to examine the association of predicted probabilities generated by the model and observed responses: the c-statistic for the receiver operating characteristic (ROC) curve and Gamma.
Since the above statistics test the predictive ability of the model employing data used to construct the model they are usually biased upward due to sampling errors and search bias. Therefore, the classification accuracy of the model is assessed using the jackknife technique (the Lachenbruch technique).

SAS includes a pre-written program which performs the jackknife technique automatically when a logit regression has a binary response variable. The response variable in this study, however, is composed of six levels. Therefore, a unique jackknife program is written using SAS commands.

An algorithm is written which deletes the response variable (bond rating) from one observation. A logit regression model is then constructed using the remaining observations. Finally, the logit regression model is used to generate the missing response. The "predicted" response is then compared to the observed response. This is repeated 127 times, once for each observation.

A six by six classification matrix table is constructed comparing predicted responses to observed responses. The cells along the diagonal of this matrix represent the matches between the predicted bond ratings and the observed bond ratings. Cells one-cell-away from the diagonal represent predicted bond ratings which are one category away from the observed bond ratings. This table is used to calculate the predictive accuracy of the logit model.
Summary

A sample of hospital bond issues is taken from a private database which contains financial accounting, operational, socioeconomic and bond rating information on hospitals whose bond issues are chosen. Sixty-four predictor variables are initially included in the analysis. Factor analysis is applied to the initial group of variables to sort the sixty-four variables into independent groups or factors and, thus, reduce correlation between variables. A reduced data set is constructed by taking the variable which received the highest factor loading in each resulting factor group whose eigenvalue was equal to or greater than one.

A predictive model is then constructed using the reduced data set. Since bond ratings represent more than two response categories and are ordinally scaled, cumulative logits are applied to the reduced data set in constructing a predictive model. Classification accuracy of the resulting model is assessed using the jackknife procedure.
CHAPTER 4
RESULTS

This chapter presents the analysis of the data. The sample selection results are presented first, followed by descriptive statistics of the sample. A factor analysis performed on the sixty-four initial variables produced a more parsimonious set of independent variables. The reduced set of variables was used to construct a predictive model. The classification accuracy of the logit model is then examined. The last section of this chapter offers a summary of the results.

Sample Selection Results

The initial sample meeting the sample selection criteria consisted of 394 hospitals. The final sample consisted of 127 hospitals. The following subsections explain why 267 hospitals were deleted.

Hospitals with Credit Enhancements

When a hospital insures a bond issue against default the insurer guarantees payment if the hospital defaults on the bond. As a result the rating assigned to the issue reflects the creditworthiness of the insuring organization and not the hospital. One hundred and twenty eight hospitals were eliminated due to credit enhancements.

Incomplete Financial Information

One hundred twenty hospitals were deleted due to incomplete financial information for the year of the bond issue and the preceding two years.
Incomplete Operational Information

An additional sixteen hospitals were eliminated due to incomplete operational information during the study's five year window. Eleven hospitals lacked information on births, three did not provide case mix adjusted (CMA) equivalent information, and two did not have information on the number of surgical operations performed.

Operational information was taken from either the year of the bond issue or the closest year prior to the year of the bond issue in which the information was available. Twenty-nine of the hospitals had at least one operational variable taken from at least one year prior to the year of the bond issue. Specific operational information can be particularly difficult to obtain. Therefore, there is reason to believe that in many cases this may be the most recent data that analysts possessed at the time of issuing a bond rating.

Alcohol and Psychiatric Beds

Of the 130 hospitals which met the above criteria, three were eliminated because they contained alcoholic or psychiatric beds. These services are somewhat unique and usually generate considerably more revenue than routine
hospital services. This brought the total for the final sample to 127 hospitals.

The socioeconomic information used in this study reflects 1994 statistics generated by the U.S. Department of Labor and information purchased by Van Kampen Merritt from a private firm. Figure 4.1 summarizes the results of the sample selection procedure.

Sample size appears to be sufficient for the factor analysis performed in this study. Kline suggests two observations for each variable contained in the factor analysis. One hundred and twenty-seven observations is sufficiently close to the 128 that this rule of thumb requires.

Characteristics of Sample Hospitals

The sample of hospital bond issues was divided into the categories indicated in Figure 4.2. Of the 127 sample hospital bond issues, none carried a AAA rating, two were rated AA+, three AA, and two had an AA- rating. When these three rating categories were collapsed the resulting category contained only seven hospitals. Such a sample size was deemed insufficient; and, for this reason, this category was combined with the A+ category which originally contained 19 hospitals. The resulting bond rating category was labeled A+ and above.

Similarly, there was only one hospital bond issue with a BB+ rating in the sample, and two issues with a BB
Procedure

Initial sample of hospitals 394
Less hospitals:
With credit enhancements -128
Without complete financial information -120
Without complete operational information -16
With alcohol and psychiatric beds -3
Final sample 127

Fig. 4.1--Results of sample selection procedure.

<table>
<thead>
<tr>
<th>S&amp;P BOND RATING CATEGORY</th>
<th>Number</th>
<th>Sample %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+ and Above</td>
<td>26</td>
<td>20.5</td>
</tr>
<tr>
<td>A</td>
<td>25</td>
<td>19.7</td>
</tr>
<tr>
<td>A-</td>
<td>26</td>
<td>20.5</td>
</tr>
<tr>
<td>BBB+</td>
<td>19</td>
<td>14.9</td>
</tr>
<tr>
<td>BBB</td>
<td>17</td>
<td>13.4</td>
</tr>
<tr>
<td>BBB- and Below</td>
<td>14</td>
<td>11.0</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Figure 4.2--Classification of sample hospitals.
rating. There were no issues with a BB- rating. As with the AA rated bonds the three BB bond rating categories were collapsed into one category containing three hospitals. Again, such a sample size was deemed insufficient. The BB categories were combined with the BBB- category which originally had 11 hospitals. The result was a category containing BBB- bond ratings and below.

Descriptive Statistics

Descriptive statistics were calculated for the sample of hospitals. The mean, standard deviation, minimum and maximum values for the measures of the independent variable by bond rating category were examined. Outliers were accounted for and obvious recording errors were corrected.

Factor Analysis

Many variables in this analysis share identical values in their numerators or denominators and are thus highly correlated suggesting that redundant information exists among this group of variables. Therefore, factor analysis was performed on the initial sixty-four independent variables to find a more parsimonious set.

Factors were initially extracted using the SAS principal factor analysis program. This procedure produced sixty-four factors, one for each independent variable in the study. Once the factors were determined only those

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14Examination of the correlation matrix of the independent variables supports this statement.
with an eigenvalue equal to or greater than one were retained and rotated. The number of variables to retain and rotate was confirmed by a visual analysis of Cattell's Scree test produced during the principal components analysis. The Scree test is reproduced in Figure 4.3. It is a graph of the eigenvalues plotted on the principal components. The slope of the line drops and permanently flattens after the fourteenth component. The option varimax within a second principal components analysis was invoked to perform an orthogonal factor rotation on the fourteen factors with eigenvalues equal to or greater than one (SAS/STAT User's Guide 1994, pp. 773-821).

Next, a maximum likelihood factor analysis was performed. As mentioned earlier, the principal components analysis indicated that fourteen factors should be retained and rotated. The results of the principal components analysis and the maximum likelihood factor analysis were then compared. The two procedures produced similar factor groupings of variables.

A reduced data set was produced using the results of the maximum likelihood factor analysis. This procedure produced the simplest factor structure with factors containing significant loadings for a few variables ($> 0.65$) and small loadings ($< 0.30$) for the rest of the variables in the analysis.
Figure 4.3--Results of Cattell's Scree test.
Following Cleverley and Nutt (1984), variables were considered to load on a factor if they had positive coefficients equal to or greater than 0.65. The highest loading variable in each factor was chosen to represent the information conveyed in that factor. Figure 4.4 presents the results of the maximum likelihood factor analysis.

Principal components analysis usually produces one general factor upon which many variables load at a high level followed by bipolar factors. Factor 1 represents a general factor with thirteen of the twenty-two operational variables loading at 0.65 or higher. The order of the variables within each factor indicates the magnitude of the factor loading. The factor loading indicates the degree of correlation between the factor and the individual variable. Since CMA admissions has the highest variable loading on factor 1 it is chosen to represent the information that this factor conveys.

As mentioned in Chapter 3 the order in which factors are extracted is also important. Factor 1 is the most important factor in terms of capturing the variability of the entire set of variables and explains more of the total variance among the variables than any other factor. The percentage total variance explained by each factor is calculated by dividing the eigenvalue of each factor by the total number of variables in the study. Figure 4.5
<table>
<thead>
<tr>
<th>Factor 1</th>
<th>Factor 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions</td>
<td>0.98156</td>
</tr>
<tr>
<td>FTEs</td>
<td>0.97468</td>
</tr>
<tr>
<td>Total Op. Expense</td>
<td>0.96656</td>
</tr>
<tr>
<td>Patient Days</td>
<td>0.96436</td>
</tr>
<tr>
<td>Beds in Service</td>
<td>0.96425</td>
</tr>
<tr>
<td>CMA Patient Days</td>
<td>0.96307</td>
</tr>
<tr>
<td>CMA Equivalent Adm.</td>
<td>0.94547</td>
</tr>
<tr>
<td>Unrestr. Fund Bal.</td>
<td>0.82107</td>
</tr>
<tr>
<td>Total Surgeries</td>
<td>0.82036</td>
</tr>
<tr>
<td>Working Capital</td>
<td>0.80307</td>
</tr>
<tr>
<td>Number of Births</td>
<td>0.75621</td>
</tr>
<tr>
<td>E R Visits</td>
<td>0.69995</td>
</tr>
<tr>
<td>Case Mix Index</td>
<td>0.66850</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Factor 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ret. on Equity</td>
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<td>Restr. Equity</td>
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<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>Debt Service</td>
</tr>
<tr>
<td>Tms Int. Earn.</td>
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<thead>
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<td>ALOS</td>
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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Lg-Tm Debt/Eq.</td>
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</table>

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Fix Asst Fin.</td>
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</table>

<table>
<thead>
<tr>
<th>Factor 12</th>
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</thead>
<tbody>
<tr>
<td>Fix Asst Fin.</td>
</tr>
<tr>
<td>CMA FTEs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Adm./Bed</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opsurg</td>
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</tbody>
</table>

Figure 4.4--Results of maximum likelihood factor analysis.
<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage Total Variance Explained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.02</td>
</tr>
<tr>
<td>2</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>06.20</td>
</tr>
<tr>
<td>4</td>
<td>05.80</td>
</tr>
<tr>
<td>5</td>
<td>05.00</td>
</tr>
<tr>
<td>6</td>
<td>04.69</td>
</tr>
<tr>
<td>7</td>
<td>04.12</td>
</tr>
<tr>
<td>8</td>
<td>04.06</td>
</tr>
<tr>
<td>9</td>
<td>03.30</td>
</tr>
<tr>
<td>10</td>
<td>02.97</td>
</tr>
<tr>
<td>11</td>
<td>02.66</td>
</tr>
<tr>
<td>12</td>
<td>02.40</td>
</tr>
<tr>
<td>13</td>
<td>02.14</td>
</tr>
<tr>
<td>14</td>
<td>02.09</td>
</tr>
</tbody>
</table>

Total Variance Explained by First 14 Factors 75.66

Figure 4.5--Percentage total variance explained by first fourteen factors.
presents the percentage total variance explained by each factor. Factor 1 explains 20.2% of the total variation of the data set. The fourteen factors retained and rotated explain 75.66% of the total variance among the variables.

The large number of operational variables loading onto Factor 1 clearly distinguishes it as representing the operational dimension among the other variables. Due to the high degree of variance it explains, it is considered a pervasive influence on other factors or dimensions in the analysis.

Two activity ratios load highly onto Factor 2: fixed asset turnover and total asset turnover. This factor appears to represent fixed asset efficiency. *Fixed asset turnover* loads the highest on this factor and is chosen to represent this financial accounting dimension among the independent variables.

*Current asset turnover* loaded highest onto Factor 3. This factor appears to represent current asset efficiency.

Factor 4 is the only factor onto which socioeconomic variables loaded at the designated level: percentage population below poverty and percentage unemployment. This factor could represent a measure of resources required to treat patients in the surrounding community. Epstein et al. (1990) found that hospitalized patients of lower socioeconomic status have longer stays and probably require more resources.
Average payment period was the only variable to load on Factor 5 at the designated level. It appears to represent liquidity and utilizes both balance sheet and income statement information.

Net take down and return on assets loaded highest on Factor 6. This factor best represents the profitability dimension of the variables. Operating margin, which was so influential in the Cleverley and Rohleder (1985) study, did not load on any factor at the designated level. Net take down seems to be a better representative of this dimension of profitability.

Return on equity loaded highest on Factor 7. Cleverley and Rohleder found that this variable loaded onto the same factor as long-term debt-to-equity. They concluded that the utilization of debt, or financial leverage, had a greater effect on return-on-equity than other profitability ratios such as operating margin. However, it seems more appropriate that this variable would represent a second dimension of profitability.

Two measures of debt repayment ability loaded highly onto Factor 8: debt service coverage and times interest earned. It is interesting that there is a splitting of debt structure ratios with the leverage indicator long-term debt-to-equity loading onto Factor 10. This is consistent with the usual division of debt structure ratios into debt repayment and leverage.
Average length of stay was the highest loading variable on Factor 9. A patient's length of stay can be critical for hospitals with a large percentage of contracted care or medicare patients. These hospitals are reimbursed based on a fixed fee regardless of the length of time a patient is treated. Consistent with what would be expected, percentage population greater than age sixty-five and percentage Medicare patients also loaded on this factor. This supports the premise that age of patients affects the acuity of illness and length of time required to treat an illness. Munoz et al. (1989) found that length of stay generally rose with patient age.

Factor 11 is the third factor to contain a debt structure ratio, fixed asset financing. Like long-term debt-to-equity this ratio relates to the balance sheet only. It indicates what fraction of net fixed assets is financed with long-term debt.

Factors 12, 13, and 14 seem to represent different aspects of hospital productivity and efficiency. CMA admissions per FTEs was the highest loading variable on Factor 12. This factor appears to capture manpower productivity. CMA admissions are a measure of total hospital patient volume (output), taking into account both inpatient turnover, case mix intensity, and outpatient production. FTEs are a good indication of the amount of total hospital labor (input). This ratio is indicative of
the number of CMA admissions serviced by each FTE and represents a combination of total utilization and staffing. It provides a measure of efficiency which is comparable among different hospitals according to FTEs.

Factor 13 is best represented by CMA admissions per beds in service. This ratio is an efficiency measure making inpatient activity produced by each bed comparable with similar productivity across hospitals. The case mix index is used to adjust admissions to generate a comparable level of total inpatient activity; this is divided by beds or capacity to yield a measure of bed turnover.

Number of outpatient surgeries was the highest loading variable on factor 14. Though at a less significant level, total surgical operations and number of births also loaded onto this factor. These variables represent measures of a hospital's service accomplishments.

Descriptions of the dimensions represented by the fourteen significant factors are summarized and presented in Figure 4.6.

Independent Variables Comprising Reduced Data Set

Variables comprising the reduced predictor set are defined in Figure 4.7. It is a premise of this study that this more parsimonious set of independent variables conveys much of the information contained in the initial set of sixty-four variables.
<table>
<thead>
<tr>
<th>Factor</th>
<th>Dimension</th>
<th>Best Single Ratio Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operational</td>
<td>CMA Admissions</td>
</tr>
<tr>
<td>2</td>
<td>Fix Asset Efficiency</td>
<td>Fixed Asset Turnover</td>
</tr>
<tr>
<td>3</td>
<td>Current Asset Eff.</td>
<td>Current Asset Turnover</td>
</tr>
<tr>
<td>4</td>
<td>Socioeconomic</td>
<td>% Population &lt; Poverty</td>
</tr>
<tr>
<td>5</td>
<td>Liquidity</td>
<td>Average Payment Period</td>
</tr>
<tr>
<td>6</td>
<td>Profitability</td>
<td>Net Take Down</td>
</tr>
<tr>
<td>7</td>
<td>Second Prof. Dimension</td>
<td>Return on Equity</td>
</tr>
<tr>
<td>8</td>
<td>Debt Coverage</td>
<td>Debt Service Coverage</td>
</tr>
<tr>
<td>9</td>
<td>Patient Acuity</td>
<td>Average Length of Stay</td>
</tr>
<tr>
<td>10</td>
<td>Leverage</td>
<td>Long-term Debt to Equity</td>
</tr>
<tr>
<td>11</td>
<td>Capital Structure</td>
<td>Fixed Asset Financing</td>
</tr>
<tr>
<td>12</td>
<td>Manpower Productivity</td>
<td>CMA Admissions/Bed</td>
</tr>
<tr>
<td>13</td>
<td>Capacity Productivity</td>
<td>CMA Admissions/FTEs</td>
</tr>
<tr>
<td>14</td>
<td>Service Accomplishments</td>
<td># Outpatient Surgeries</td>
</tr>
</tbody>
</table>

Figure 4.6--Definition of factors.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Sign</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions (CMAADM)</td>
<td>+</td>
<td>Number of CMA Admissions</td>
</tr>
<tr>
<td>Fixed Asset Turnover (FAT)</td>
<td>+</td>
<td>Total Revenue/Net Fixed Assets</td>
</tr>
<tr>
<td>Current Asset Turnover (CAT)</td>
<td>+</td>
<td>Total Revenue/Current Assets</td>
</tr>
<tr>
<td>% Population &lt; Poverty (POPBPOV)</td>
<td>-</td>
<td>% Population in hospital market area with annual income less than $15,000</td>
</tr>
<tr>
<td>Average Payment Period (AVGPP)</td>
<td>-</td>
<td>Current Liabilities x 365/(Operating Exp.-Depreciation (Amrt.) Exp.)</td>
</tr>
<tr>
<td>Net Take Down (NTD)</td>
<td>+</td>
<td>Revenue Over Expenses +Interest Exp./Total Revenue</td>
</tr>
<tr>
<td>Return on Equity (RETEQUIT)</td>
<td>+</td>
<td>Revenue Over Expenses /Unrestricted Fund Balance</td>
</tr>
<tr>
<td>Debt Service Coverage (DSC)</td>
<td>+</td>
<td>(Revenue Over Expenses +Depreciation + Interest Exp.)/(Current Portion Long Term Debt from Previous year + Interest Expense)</td>
</tr>
<tr>
<td>Average Length of Stay (ALOS)</td>
<td>-</td>
<td>Total Patient Days / CMA Admissions</td>
</tr>
<tr>
<td>Long-term Debt to Equity (LTDTEQ)</td>
<td>-</td>
<td>Long-Term Debt / Fund Balance</td>
</tr>
<tr>
<td>Fixed Asset Financing (FIXASSFI)</td>
<td>-</td>
<td>Long-Term Debt / Net Fixed Assets</td>
</tr>
<tr>
<td>CMA Admissions/Bed (CMAABDDBD)</td>
<td>+</td>
<td>CMA Admissions / Number of Beds in Service</td>
</tr>
<tr>
<td>CMA Admissions/FTEs (CMAFTE)</td>
<td>+</td>
<td>CMA Admissions / Full Time Equivalents (FTEs)</td>
</tr>
<tr>
<td>Outpatient Surgeries (OPSURUG)</td>
<td>+</td>
<td>Total Number of Outpatient Surgeries</td>
</tr>
</tbody>
</table>

Figure 4.7--Summary of reduced set of independent variables. Sign indicates the hypothesized sign of the variable's coefficient in the model predicting hospital revenue bond ratings.
The number of observations, mean, standard deviation, and minimum and maximum observation by bond rating category are presented in Table 4.1.

Logistic Regression Model

Logistic regression was used to construct a model to predict hospital bond ratings. The following subsections present the resulting logit model and predictive accuracy testing. They are preceded by an evaluation of multicollinearity among the independent variables comprising the model using two diagnostic techniques.

Evaluation of Multicollinearity

According to Berenson et al. (1983) interpretation of multiple regression analysis is more accurate when the predictor variables comprising the model are uncorrelated. Strong correlation among the independent variables makes it difficult if not impossible to assess the unique effects individual explanatory variables have upon the response variable. The existence of high correlations between the independent variables is referred to as multicollinearity. While factor analysis was employed to produce a set of independent variables with reduced multicollinearity, correlation between independent variables cannot be completely eliminated. To determine if multicollinearity is a problem, a correlation matrix from the set of predictor variables is constructed and variance inflation factors are calculated. Table 4.2 presents the correlation matrix of the independent variables.
Table 4.1--Descriptive statistics of independent variables.

<table>
<thead>
<tr>
<th>A+ and Above Rated Bonds</th>
<th>Statistic</th>
<th>CMA Admissions</th>
<th>Fixed Turnover</th>
<th>Current Turnover</th>
<th>% Pop. Below Poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>31065</td>
<td>1.8494</td>
<td>3.4683</td>
<td>21.8</td>
<td></td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>17430</td>
<td>0.4347</td>
<td>0.6670</td>
<td>05.3</td>
<td></td>
</tr>
<tr>
<td>Min</td>
<td>899</td>
<td>1.0731</td>
<td>2.4837</td>
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</tr>
<tr>
<td>Max</td>
<td>70552</td>
<td>2.9235</td>
<td>4.8897</td>
<td>33.3</td>
<td></td>
</tr>
</tbody>
</table>

| A Rated Bonds            | Statistic | |
|--------------------------|-----------|----------------|----------------|------------------|
| Mean                     | 18099     | 2.2945         | 3.6873         | 19.5             |
| Std. Dev.                | 9344      | 1.1637         | 0.9260         | 05.2             |
| Min                      | 6031      | 1.2426         | 2.2570         | 11.0             |
| Max                      | 43641     | 7.5239         | 6.7477         | 32.2             |

| A- Rated Bonds           | Statistic | |
|--------------------------|-----------|----------------|----------------|------------------|
| Mean                     | 13972     | 2.0476         | 3.5781         | 20.6             |
| Std. Dev.                | 9124      | 0.4760         | 0.9805         | 07.3             |
| Min                      | 5400      | 1.2580         | 1.7459         | 06.9             |
| Max                      | 45322     | 3.0604         | 5.9102         | 37.9             |

| BBB+ Rated Bonds         | Statistic | |
|--------------------------|-----------|----------------|----------------|------------------|
| Mean                     | 11242     | 2.3245         | 3.4854         | 22.5             |
| Std. Dev.                | 6186      | 0.5664         | 0.6558         | 06.5             |
| Min                      | 4196      | 1.5833         | 2.1424         | 13.9             |
| Max                      | 24766     | 4.1513         | 4.4898         | 43.2             |

| BBB Rated Bonds          | Statistic | |
|--------------------------|-----------|----------------|----------------|------------------|
| Mean                     | 10356     | 2.1162         | 3.5086         | 24.3             |
| Std. Dev.                | 5040      | 0.5659         | 0.5773         | 08.0             |
| Min                      | 3861      | 0.7010         | 2.3947         | 06.3             |
| Max                      | 20908     | 3.3597         | 4.6405         | 37.6             |

| BBB- Rated Bonds         | Statistic | |
|--------------------------|-----------|----------------|----------------|------------------|
| Mean                     | 6963      | 2.3141         | 3.3708         | 23.0             |
| Std. Dev.                | 3004      | 0.6847         | 0.7853         | 04.6             |
| Min                      | 2316      | 1.4561         | 1.5041         | 15.0             |
| Max                      | 13077     | 3.8130         | 4.7866         | 29.7             |

(table con'd.)
<table>
<thead>
<tr>
<th>Statistic</th>
<th>A+ and Above Rated Bonds</th>
<th>A Rated Bonds</th>
<th>A- Rated Bonds</th>
<th>BBB+ Rated Bonds</th>
<th>BBB Rated Bonds</th>
<th>BBB- Rated Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Payment Period</td>
<td>Net Take Down</td>
<td>Return on Equity</td>
<td>Debt Service Ratio</td>
<td>Statistic</td>
<td>Statistic</td>
</tr>
<tr>
<td>Mean</td>
<td>58.9</td>
<td>0.1171</td>
<td>0.1056</td>
<td>4.5119</td>
<td>Mean 59.0</td>
<td>0.1230</td>
</tr>
<tr>
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<td>0.0429</td>
<td>0.0500</td>
<td>2.3245</td>
<td>Std. Dev. 19.1</td>
<td>0.0361</td>
</tr>
<tr>
<td>Min</td>
<td>17.8</td>
<td>0.0393</td>
<td>0.0258</td>
<td>1.3600</td>
<td>Min 33.0</td>
<td>0.0590</td>
</tr>
<tr>
<td>Max</td>
<td>119.0</td>
<td>0.1980</td>
<td>0.2817</td>
<td>10.6400</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>Std. Dev. 21.1</td>
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<td></td>
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<td></td>
<td>Mean 53.9</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Min 36.0</td>
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<tr>
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<td></td>
<td>Std. Dev. 19.3</td>
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</tr>
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<td></td>
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<td></td>
<td></td>
<td>Max 90.2</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean 54.5</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Std. Dev. 13.27</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>Min 33.2</td>
<td>0.0448</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Max 90.2</td>
<td>0.1484</td>
</tr>
</tbody>
</table>

(table con'd.)

15This particular hospital had a very low current portion of long-term debt from the previous year and low interest payments compared to its revenue over expenses.
### A+ and Above Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Average Length Of Stay</th>
<th>Long-Term Debt / Equity</th>
<th>Fixed Asset Financing</th>
<th>CMA Admissions/FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.60</td>
<td>0.7906</td>
<td>0.7487</td>
<td>11.96</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>1.02</td>
<td>0.3761</td>
<td>0.2661</td>
<td>2.42</td>
</tr>
<tr>
<td>Min</td>
<td>3.20</td>
<td>0.1050</td>
<td>0.2036</td>
<td>4.58</td>
</tr>
<tr>
<td>Max</td>
<td>7.80</td>
<td>1.5181</td>
<td>1.4251</td>
<td>16.95</td>
</tr>
</tbody>
</table>

### A Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Average Length Of Stay</th>
<th>Long-Term Debt / Equity</th>
<th>Fixed Asset Financing</th>
<th>CMA Admissions/FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.29</td>
<td>0.9779</td>
<td>0.9540</td>
<td>13.25</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.86</td>
<td>0.5877</td>
<td>0.3805</td>
<td>2.97</td>
</tr>
<tr>
<td>Min</td>
<td>2.70</td>
<td>0.0030</td>
<td>0.0058</td>
<td>9.57</td>
</tr>
<tr>
<td>Max</td>
<td>6.30</td>
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<td>1.9047</td>
<td>23.37</td>
</tr>
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</table>

### A- Rated Bonds

<table>
<thead>
<tr>
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<th>Average Length Of Stay</th>
<th>Long-Term Debt / Equity</th>
<th>Fixed Asset Financing</th>
<th>CMA Admissions/FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.76</td>
<td>1.2902</td>
<td>1.0057</td>
<td>11.51</td>
</tr>
<tr>
<td>Std. Dev.</td>
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<td>0.7478</td>
<td>0.4227</td>
<td>3.77</td>
</tr>
<tr>
<td>Min</td>
<td>3.10</td>
<td>0.0626</td>
<td>0.0872</td>
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</tr>
<tr>
<td>Max</td>
<td>8.00</td>
<td>3.0277</td>
<td>1.7283</td>
<td>16.64</td>
</tr>
</tbody>
</table>

### BBB+ Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Average Length Of Stay</th>
<th>Long-Term Debt / Equity</th>
<th>Fixed Asset Financing</th>
<th>CMA Admissions/FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.71</td>
<td>1.0286</td>
<td>0.9923</td>
<td>11.89</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.70</td>
<td>0.7384</td>
<td>0.3994</td>
<td>3.78</td>
</tr>
<tr>
<td>Min</td>
<td>3.70</td>
<td>0.2716</td>
<td>0.3448</td>
<td>0.14</td>
</tr>
<tr>
<td>Max</td>
<td>6.60</td>
<td>3.7311</td>
<td>2.0881</td>
<td>21.05</td>
</tr>
</tbody>
</table>

### BBB Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Average Length Of Stay</th>
<th>Long-Term Debt / Equity</th>
<th>Fixed Asset Financing</th>
<th>CMA Admissions/FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.95</td>
<td>1.4071</td>
<td>0.9549</td>
<td>12.30</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>1.51</td>
<td>1.3955</td>
<td>0.4844</td>
<td>2.97</td>
</tr>
<tr>
<td>Min</td>
<td>3.40</td>
<td>0.0007</td>
<td>0.0019</td>
<td>7.21</td>
</tr>
<tr>
<td>Max</td>
<td>9.80</td>
<td>6.2659</td>
<td>1.8575</td>
<td>17.70</td>
</tr>
</tbody>
</table>

### BBB- Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Average Length Of Stay</th>
<th>Long-Term Debt / Equity</th>
<th>Fixed Asset Financing</th>
<th>CMA Admissions/FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.27</td>
<td>3.3294</td>
<td>1.3002</td>
<td>11.84</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>1.09</td>
<td>6.5945</td>
<td>0.6572</td>
<td>1.59</td>
</tr>
<tr>
<td>Min</td>
<td>3.80</td>
<td>0.4227</td>
<td>0.4699</td>
<td>9.37</td>
</tr>
<tr>
<td>Max</td>
<td>7.30</td>
<td>26.8962</td>
<td>2.9560</td>
<td>14.82</td>
</tr>
</tbody>
</table>

*(table con'd.)*
<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions / Beds in Service</td>
<td>53.95</td>
<td>16.73</td>
<td>1.63</td>
<td>79.13</td>
</tr>
<tr>
<td>Total Outpatient Surgeries</td>
<td>7837</td>
<td>4618</td>
<td>231</td>
<td>16497</td>
</tr>
</tbody>
</table>

### A Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions / Beds in Service</td>
<td>57.91</td>
<td>16.75</td>
<td>13.69</td>
<td>91.74</td>
</tr>
<tr>
<td>Total Outpatient Surgeries</td>
<td>4812</td>
<td>2486</td>
<td>0</td>
<td>10072</td>
</tr>
</tbody>
</table>

### A- Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions / Beds in Service</td>
<td>55.37</td>
<td>15.42</td>
<td>33.78</td>
<td>97.74</td>
</tr>
<tr>
<td>Total Outpatient Surgeries</td>
<td>4352</td>
<td>2970</td>
<td>279</td>
<td>14654</td>
</tr>
</tbody>
</table>

### BBB+ Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions / Beds in Service</td>
<td>49.11</td>
<td>7.39</td>
<td>37.13</td>
<td>59.27</td>
</tr>
<tr>
<td>Total Outpatient Surgeries</td>
<td>3278</td>
<td>1102</td>
<td>2038</td>
<td>6698</td>
</tr>
</tbody>
</table>

### BBB Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions / Beds in Service</td>
<td>48.79</td>
<td>8.79</td>
<td>27.20</td>
<td>63.13</td>
</tr>
<tr>
<td>Total Outpatient Surgeries</td>
<td>3712</td>
<td>1815</td>
<td>1523</td>
<td>7737</td>
</tr>
</tbody>
</table>

### BBB- Rated Bonds

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions / Beds in Service</td>
<td>41.88</td>
<td>5.75</td>
<td>31.34</td>
<td>50.01</td>
</tr>
<tr>
<td>Total Outpatient Surgeries</td>
<td>2651</td>
<td>1566</td>
<td>879</td>
<td>6672</td>
</tr>
<tr>
<td>Variable</td>
<td>CMAADM</td>
<td>FAT</td>
<td>CAT</td>
<td>POPBPOV</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-----</td>
<td>-----</td>
<td>---------</td>
</tr>
<tr>
<td>CMAADM</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAT</td>
<td>-0.0939</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAT</td>
<td>-0.0675</td>
<td>-0.2450</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>POPBPOV</td>
<td>-0.1856</td>
<td>-0.0787</td>
<td>-0.0026</td>
<td>1.0000</td>
</tr>
<tr>
<td>AVGPP</td>
<td>0.1037</td>
<td>0.1715</td>
<td>-0.1898</td>
<td>0.0823</td>
</tr>
<tr>
<td>NTD</td>
<td>-0.0483</td>
<td>-0.1228</td>
<td>-0.0436</td>
<td>0.1867</td>
</tr>
<tr>
<td>RETEQUIT</td>
<td>-0.0560</td>
<td>0.1368</td>
<td>-0.1402</td>
<td>0.0044</td>
</tr>
<tr>
<td>DSR</td>
<td>-0.0810</td>
<td>0.1823</td>
<td>-0.1364</td>
<td>0.0902</td>
</tr>
<tr>
<td>ALOS</td>
<td>-0.1648</td>
<td>-0.1130</td>
<td>0.0740</td>
<td>0.1856</td>
</tr>
<tr>
<td>LTDTEQ</td>
<td>-0.0604</td>
<td>-0.0941</td>
<td>0.0256</td>
<td>0.0246</td>
</tr>
<tr>
<td>FIXASSFI</td>
<td>0.0278</td>
<td>-0.2874</td>
<td>-0.0111</td>
<td>-0.2048</td>
</tr>
<tr>
<td>CMAFTE</td>
<td>0.1349</td>
<td>0.1003</td>
<td>-0.0318</td>
<td>-0.0687</td>
</tr>
<tr>
<td>CMAADBD</td>
<td>-0.0560</td>
<td>0.1045</td>
<td>-0.0125</td>
<td>-0.1922</td>
</tr>
<tr>
<td>OPSURG</td>
<td>0.5514</td>
<td>-0.1987</td>
<td>0.0516</td>
<td>-0.2453</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AVGPP</th>
<th>NTD</th>
<th>RETEQUIT</th>
<th>DSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVGPP</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NTD</td>
<td>0.0823</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>RETEQUIT</td>
<td>0.0224</td>
<td>0.2481</td>
<td>1.0000</td>
</tr>
<tr>
<td>DSR</td>
<td>-0.0514</td>
<td>0.1688</td>
<td>0.0524</td>
</tr>
<tr>
<td>ALOS</td>
<td>-0.0462</td>
<td>-0.1706</td>
<td>0.0448</td>
</tr>
<tr>
<td>LTDTEQ</td>
<td>-0.0381</td>
<td>-0.2151</td>
<td>-0.0152</td>
</tr>
<tr>
<td>FIXASSFI</td>
<td>0.0841</td>
<td>-0.2037</td>
<td>-0.1536</td>
</tr>
<tr>
<td>CMAFTE</td>
<td>-0.0889</td>
<td>-0.0188</td>
<td>0.0223</td>
</tr>
<tr>
<td>CMAADBD</td>
<td>0.2464</td>
<td>0.0033</td>
<td>0.0051</td>
</tr>
<tr>
<td>OPSURG</td>
<td>0.0795</td>
<td>0.0288</td>
<td>-0.0742</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ALOS</th>
<th>LTDTEQ</th>
<th>FIXASSFI</th>
<th>CMAFTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALOS</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTDTEQ</td>
<td>0.0772</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>FIXASSFI</td>
<td>-0.0016</td>
<td>0.3545</td>
<td>1.0000</td>
</tr>
<tr>
<td>CMAFTE</td>
<td>-0.2987</td>
<td>0.0307</td>
<td>0.0563</td>
</tr>
<tr>
<td>CMAADBD</td>
<td>-0.5272</td>
<td>-0.0693</td>
<td>-0.0065</td>
</tr>
<tr>
<td>OPSURG</td>
<td>-0.0188</td>
<td>-0.0833</td>
<td>0.0022</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CMAADBD</th>
<th>OPSURG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMAADBD</td>
<td>1.0000</td>
</tr>
<tr>
<td>OPSURG</td>
<td>-0.0065</td>
</tr>
</tbody>
</table>
The correlation matrix reveals no problem with correlated independent variables. The largest correlation coefficient, 0.5514, is between total outpatient surgeries and CMA admissions and indicates only moderate correlation (Berenson et al. 1983).

According to Freund and Wilson (1993), a useful set of statistics for detecting multicollinearity is the set of variance inflation factors. These factors indicate, for each independent variable, how much larger the variance of the estimated coefficient is than it would be if the variable were uncorrelated with the other independent variables. The variance inflation factor for a given independent variable, $x_j$, is defined in 4.1 as:

$$\frac{1}{1 - R^2_j}$$

Where $R^2_j$ is the coefficient of determination of the regression of the $x_j$ on all other variables. If $R^2_j$ is zero, the variance inflation factor value is one and the variable $x_j$ is not involved in any multicollinearity. Any nonzero value of $R^2_j$ causes the variance inflation factor to exceed one and indicates the existence of some degree of multicollinearity.

There is no universally accepted criterion for establishing the magnitude of a variance inflation factor value necessary to identify serious multicollinearity; but, generally, values exceeding ten are considered to indicate problems with multicollinearity (Freund and Wilson, 1993).
Table 4.3 presents the variance inflation factors calculated for the independent variables. All fourteen variance inflation factors fall well below ten. Values range between 1.1503 and 1.8433 indicating no problem with multicollinearity.

**Results of Logistic Regression Model**

The ordered logit model is simply a set of equations for each cumulative logit. In most cases the predictor variables tend to be invariant to the choice of cut-point category. Provided this situation holds, the logit model can be made much more parsimonious by incorporating the invariance into the logit equation. While each cumulative logit equation will have different coefficients on the intercept, the coefficients on the independent variables are the same.

The p-values for the -2 Log Likelihood statistic and the Score statistic are significant at the 0.001 level. This provides evidence that at least one of the regression coefficients for an explanatory variable is nonzero.

Five of the fourteen independent variables were found to be significant in predicting hospital bond ratings: CMA admissions, net take down, fixed asset financing, percentage population below poverty and total number of outpatient surgeries. These five variables included two financial accounting variables, two operational variables
Table 4.3--Variance Inflation Factors.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Inflation Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA Admissions</td>
<td>1.6002</td>
</tr>
<tr>
<td>Fixed Asset Turnover</td>
<td>1.2868</td>
</tr>
<tr>
<td>Current Asset Turnover</td>
<td>1.1503</td>
</tr>
<tr>
<td>Percentage Population Below Poverty</td>
<td>1.2599</td>
</tr>
<tr>
<td>Average Payment Period</td>
<td>1.2548</td>
</tr>
<tr>
<td>Net Take Down</td>
<td>1.3796</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>1.1761</td>
</tr>
<tr>
<td>Debt Service Coverage</td>
<td>1.2146</td>
</tr>
<tr>
<td>Average Length of Stay</td>
<td>1.6515</td>
</tr>
<tr>
<td>Long-Term Debt to Equity</td>
<td>1.2336</td>
</tr>
<tr>
<td>Fixed Asset Financing</td>
<td>1.3588</td>
</tr>
<tr>
<td>CMA Admission per Bed</td>
<td>1.8433</td>
</tr>
<tr>
<td>Outpatient Surgeries</td>
<td>1.6281</td>
</tr>
<tr>
<td>CMA per FTEs</td>
<td>1.2724</td>
</tr>
</tbody>
</table>
and one socioeconomic variable. Table 4.4 presents the results of the logistic regression.

That CMA admissions is a significant predictor of hospital bond ratings is not surprising given that this variable loaded highest on the first factor extracted in the factor analysis. This also supports Sherman's (1986) conclusion that additional data about patient volume and case mix were necessary to analyze hospital performance. Craycraft (1994) tried to proxy this using four variables: the number of discharges, percentage of revenue received from Medicare, percentage of revenue received from Medicaid, and Diagnosis Related Group (DRG) case-mix. Percentage of revenue received from Medicare was the only significant variable, and it is questionable how well this variable can proxy patient volume.

CMA admissions is a more accurate measure of total hospital inpatient activity than the four separate variables used by Craycraft. It represents total admissions weighted by average intensity of each case as reflected in the case mix index. CMA admissions is significant at the 0.001 level with a p-value of 0.0001 and is positively associated with bond ratings as predicted.

Net take down was also significant at the 0.001 level with a p-value of 0.0001. This profitability measure is defined as the present period cash flow plus interest divided by total revenue. Larger values of this ratio
Table 4.4--Results of Logistic Regression.

Panel A: Analysis of Maximum Likelihood Estimates

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Parameter Estimate</th>
<th>DF</th>
<th>Wald Chi-Square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept1</td>
<td>-5.223900</td>
<td>1</td>
<td>20.8400</td>
<td>0.0001</td>
</tr>
<tr>
<td>Intercept2</td>
<td>-3.480300</td>
<td>1</td>
<td>10.3326</td>
<td>0.0013</td>
</tr>
<tr>
<td>Intercept3</td>
<td>-2.083100</td>
<td>1</td>
<td>3.9127</td>
<td>0.0479</td>
</tr>
<tr>
<td>Intercept4</td>
<td>-1.032000</td>
<td>1</td>
<td>0.9777</td>
<td>0.3228</td>
</tr>
<tr>
<td>Intercept5</td>
<td>0.362100</td>
<td>1</td>
<td>0.1170</td>
<td>0.7323</td>
</tr>
<tr>
<td>CMAADM</td>
<td>0.000138</td>
<td>1</td>
<td>33.2457</td>
<td>0.0001</td>
</tr>
<tr>
<td>NTD</td>
<td>0.228109</td>
<td>1</td>
<td>18.5052</td>
<td>0.0001</td>
</tr>
<tr>
<td>FIXASSFI</td>
<td>-1.684400</td>
<td>1</td>
<td>15.0084</td>
<td>0.0001</td>
</tr>
<tr>
<td>OPSURG</td>
<td>0.000162</td>
<td>1</td>
<td>4.9598</td>
<td>0.0259</td>
</tr>
<tr>
<td>POPBPOV</td>
<td>-0.044300</td>
<td>1</td>
<td>2.7201</td>
<td>0.0991</td>
</tr>
</tbody>
</table>

1 NTD is a fraction which in the study sample ranged from 0.0393 to 0.2188. In order to make it proportional to other parameter estimates it was divided by 100.

Panel B: Criteria for Assessing Model Fit

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Chi-Square for Covariates</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2 LOG Likelihood</td>
<td>105.727 with 5 DF (p=0.0001)</td>
</tr>
<tr>
<td>Score</td>
<td>62.536 with 5 DF (p=0.0001)</td>
</tr>
</tbody>
</table>
imply greater profitability and thus better debt repayment potential. As predicted, this variable is positively associated with bond ratings.

Fixed asset financing measures the proportion of fixed assets that have been financed with debt and is widely used by lenders to evaluate the security of their loans. This ratio is of special importance in the health care industry. Capital costs (depreciation plus interest) have traditionally been reimbursed to hospitals dollar-for-dollar by third party payers. Therefore, the denominator of this ratio, net fixed assets, may represent the major source of future cash flow to an organization. The numerator, long-term debt, represents a future demand for that cash flow. An increasing value for this ratio could indicate that future demand for cash flow is increasing at a rate faster than sources of future cash flow can accommodate. Fixed asset financing was significant at the 0.001 level with a p-value of 0.0001 and, as expected, was negatively associated with bond ratings.

As discussed in Chapter 3 the onset of Medicare's PPS along with managed care contracts has provided incentives for hospitals to shift care to more profitable outpatient settings with outpatient surgeries being among the most profitable outpatient procedures. As predicted, total number of outpatient surgeries is positively associated
with bond ratings. It is significant at the 0.05 level with a p-value of 0.0259.

The only socioeconomic variable in the reduced independent variable set, percentage population below poverty, was significant in predicting bond ratings at the 0.10 level with a p-value of 0.0991. This variable could impact hospitals in three important ways.

First, the socioeconomic status of patients has been shown to influence the amount of resources consumed in their treatment. Epstein et al. (1990) found that patients of a lower socioeconomic status had hospital stays three to thirty percent longer and hospital charges one to eighteen percent higher than those of patients from higher socioeconomic statuses.

Second, the percentage of population below poverty could proxy for percentage of Medicaid patients. Hospitals are reimbursed for treating Medicaid patients at a rate below the standard fee schedules. Craycraft (1994) found percentage of revenues received from Medicaid to be significantly negatively associated with hospital bond ratings.

Finally, patients whose income is less than $15,000 may have either part-time jobs or positions which do not qualify them for full health care insurance benefits. Uninsured patients must "self-pay" any incurred hospital
costs. Hospitals may have more difficulty collecting from such self-paying patients.

**Association of Predicted Probabilities and Observed Responses**

Two measures of association between predicted probabilities and observed responses are used to assess the quality of the logistic model: Gamma and the c-statistic. These indexes of association are based on the percentage of concordant, discordant and tied observations.

The percentage of concordant, discordant and tied observations represents a type of rank correlation index. The foundation of most ordinal measures are pairs of observations. Two variables are considered positively correlated if observations with low values on one variable tend to have low values on the other variables and vice versa.

For all pairs of observations with different values of the response variable, a pair is concordant if one observation is higher (lower) on all measures of the independent variables than the other observation. If for a randomly drawn pair the above relationship does not hold true, then the pair is considered discordant. If a randomly drawn pair has the same values for even one of the independent variables, then the pair is deemed tied.
Gamma is routinely printed by the LOGISTIC procedure in SAS. It is defined as:

\[
\text{Gamma} = \frac{(nc - nd)}{(nc + nd)}
\]

where:

- \(nc\) = number of concordant pairs
- \(nd\) = number of discordant pairs

This statistic has a proportional reduction in error interpretation. The value of gamma for this study's logistic model is 64.6%. This suggests that about 64.6% fewer prediction errors are made in predicting hospital bond ratings when information on the variables included in the model is utilized than when predicting by chance alone.

The receiver operating characteristic curve (ROC) is a graphic display that gives a measure of the predictive accuracy of the logistic regression model. The \(c\)-statistic is a measure of the percentage of area under the ROC curve and ranges from 0 to 1. For a logistic regression model with high predictive accuracy, the ROC curve rises quickly making the area under the curve quite large. Therefore, the higher the percentage for the \(c\)-statistic the higher the predictive accuracy of the model. Figure 4.8 summarizes the results of these two diagnostic test.

**Assessment of Predictive Accuracy**

The indicated predictive ability of the model for the data on which the model is derived is most likely greater than the model's predictive ability for new data. The
Panel A: Percentage concordant, discordant and tied pairs.

Concordant = 81.7%
Discordant = 17.5%
Tied = 00.8%
(6653 pairs)

Panel B: Gamma Statistic

Gamma = 0.646

Panel C: Percentage under the ROC curve

c-statistic = 0.82

Figure 4.8--Diagnostics for association of predicted probabilities and observed responses.
prediction bias arises because the choice of the final model is so uniquely related to the observations at hand. One way to test the predictive accuracy of the model and reduce this bias is to perform a jackknife technique. Each observation was held out in turn and the model was used to predict the response variable for the observation excluded. The results are presented in Table 4.5.

In the absence of any information a naive decision rule would dictate that all bond ratings would be predicted to fall into the category with the highest frequency of observations. Following this naive decision rule, if all bond ratings were predicted to be A- then this prediction would be 20.5% (26/127) accurate. Hair et al. (1987) suggest that the classification accuracy be at least twenty-five percent greater than what would be expected by chance alone. The overall target classification accuracy for this sample then becomes 25.6% (1.25% of the naive accuracy); the observed overall classification accuracy is 37.8%. The model was 79.5% accurate in predicting bond ratings within one category of their observed rating.

It should be noted, however, that the model was markedly better at predicting bond ratings in the A+ and above, A and A- categories (49.4%) than in the BBB+, BBB and BBB- and below categories (20.0%).
### Table 4.5--Results of Jackknife Procedure.

<table>
<thead>
<tr>
<th>OBSERVED RESPONSE</th>
<th>A+</th>
<th>A</th>
<th>A-</th>
<th>BBB+</th>
<th>BBB</th>
<th>BBB-</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>P A+</td>
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<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>R F</td>
<td>(.62)</td>
<td>(.12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I C</td>
<td>6</td>
<td>11</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td>T E</td>
<td>2</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>8</td>
<td>3</td>
<td>43</td>
</tr>
<tr>
<td>D</td>
<td>(.40)</td>
<td>(.42)</td>
<td>(.47)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R E</td>
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<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>S P</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>O N</td>
<td>(.37)</td>
<td>(.18)</td>
<td>(.28)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S E</td>
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<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>25</td>
<td>26</td>
<td>19</td>
<td>17</td>
<td>14</td>
<td>127</td>
</tr>
</tbody>
</table>
Summary

Chapter 4 presented the results of the study. The sampling methodology produced a sample of 127 hospitals. The mean, standard deviation, minimum and maximum for the measures of the independent variable by bond rating category are calculated.

A factor analysis is performed to reduce correlation between variables and produce a reduced data set. Only factors with an eigenvalue of one or greater are retained and rotated. A reduced data set is then constructed by taking the variable which received the highest factor loading in each resulting factor group. The set of independent variables is reduced from sixty-four to fourteen.

A predictive model is constructed using logistic regression and the fourteen variables from the reduced set of independent variables. The following parameter estimates are found to be significant in predicting hospital bond ratings: CMA admissions, net take down, fixed asset financing, total number of outpatient surgeries, and percentage population below poverty. The overall classification accuracy of the model is greater than that due to chance.
CHAPTER 5
SUMMARY AND CONCLUSIONS

Chapter 5 contains a summary of the study and the conclusions reached. It is divided into four sections. First, a brief summary of the study is presented. The next section discusses the limitations of the study. The third section presents conclusions drawn from the study's results, and the last section proposes avenues for future research.

Summary of Study

Motivation

The hospital industry has undergone radical changes in the past fifteen years with respect to the production and the distribution of health care services. The introduction of Medicare's prospective payment system, the struggle to retain physicians, and competitive bidding for managed care contracts have created increasing risks for hospitals. These changes, coupled with the increased amount of debt sold by health care issuers, have made determining the information utilized in predicting hospital revenue bond ratings a topic of significant interest to investors, creditors and regulators.

Concern over the adequacy of financial disclosure in the secondary market for hospital bonds has generated considerable controversy (Nemes 1992; Pallarito 1993, 1994). Hospitals along with issuers in other sectors of
the municipal bond market, have been criticized for not providing enough information to individual investors. A recent ruling by the SEC in November of 1994 made it illegal for a broker or dealer of municipal securities to underwrite bonds unless the issuer agreed to provide annual financial information. The ruling, however, did not provide details on what type of information hospitals will be required to submit.

In addition to the SEC ruling, GASB and several quasi-governmental organizations such as the NCHFFA, the NFMA, and the NASACT have expressed concern that individual investors lack the information necessary to evaluate the credit quality of hospitals. Many hospital administrators, on the other hand, claim that information investors need to make buy-and-sell decisions is already available in financial statements. They are concerned that providing supplementary information to investors will be costly and contribute little additional information.

The primary purpose of this study was to develop an initial model that might be used in predicting hospital bond ratings. This study examined both accounting and nonaccounting variables. It identified a parsimonious set of variables that are significant in predicting hospital bond ratings. These findings might be of interest to the various participants in the hospital revenue bond market. The results of this study may guide investors, creditors,
hospital administrators, and others concerned with hospital reporting disclosure and its regulation as they debate the appropriate information utilized in evaluating the credit quality of hospitals.

Methodology and Results

A sample of 127 hospitals was selected from a private data base compiled by Van Kampen Merritt. To be included in the final sample a hospital bond issue must have a Standard and Poor's rating of B- or better, must be free of credit enhancements such as insurance and letters of credit, and must have information on all variables tested.

Sixty-four independent variables were initially included in the analysis. Many of these variables shared identical or nearly identical values in their numerators or denominators and were, therefore, highly correlated. Factor analysis was applied to the initial group of variables and produced a set of fourteen predictor variables with less correlation.

Using the reduced set of independent variables, logistic regression was then employed to construct a hospital bond rating prediction model. Five of the fourteen predictor variables were found to be significant in predicting hospital revenue bond ratings: CMA admissions, net take down, fixed asset financing, percentage population below poverty, and total number of outpatient surgeries.
The predictive accuracy of the model was tested using the jackknife technique. The target classification accuracy was 25.6%; the observed overall classification accuracy of the model was 37.8%. Thus, the predictive accuracy of the model was greater than chance.

Limitations of This Study

Before discussing the implications of this study, the weaknesses inherent in the dependent variable, omitted variables and the limited generalizability of the results are discussed. The following are limitations of the study.

Inherent Weakness of the Dependent Variable

As has been demonstrated by the Orange County debacle, bond ratings do not always provide an adequate proxy for financial performance. For example, AAA-rated Martha Washington Hospital, Chicago, went into default on September 18, 1990. Nine S&P-rated hospitals have defaulted on bonds between 1989 and 1992. To the extent that hospitals in this study have bond ratings which do not accurately reflect their financial stability, conclusions were impaired.

Omitted Variables

There are many factors which analysts reported using in their ratings process for which no data could be obtained nor could proxies be established. Among the more influential are results of feasibility studies, admission dispersion among the top admitters, the ability to attract
and retain new doctors, recruitment of primary care physicians, medical staff loyalty, and percentage managed care contracts.

The method and extent of data collection is expanding, however. For example, many hospitals are concerned about the factors that affect whether doctors and patients want to use their facility. Several hospitals are standardizing patient questionnaires throughout their facilities in an effort to determine patient satisfaction levels. As new data becomes available, the information used by analysts will change from financial proxies to more direct indicators of the factor of interest (Anderson 1991).

**Limited Generalizability**

Finally, the sample used in this study consisted entirely of not-for-profit hospitals, and bond ratings analyzed were restricted to those issued by S&P. This limits the generalizability of results.

**Implications of the Study**

The results of this study have several implications. First, they may offer some guidance for those concerned with hospital reporting disclosure and its regulation. Second, the results of this study both support and extend previous hospital bond rating research in a way that is discussed below. Finally, in addition to various participants in the hospital bond market, hospital managers
and administrators may find the results of this study of particular interest.

Support for Discloser of Information in Addition to Financial Accounting Numbers

The results of this study support the suggestions of the GASB and several quasi-governmental organizations. These organizations have proposed that full accountability for hospitals requires additional information beyond that traditionally supplied in external financial statements. There has been scant empirical evidence, however, providing support for their assertions. Also, there is a question as to what additional information hospitals should provide to investors.

That three of the five variables found to be significant in predicting hospital bond ratings were not financial accounting variables supports the GASB's belief that information in addition to financial accounting numbers might be useful to various participants in the hospital bond market. More specifically, the results of this study indicate that the number of CMA admissions, the number of outpatient surgeries, and the percentage population below poverty represent nonaccounting information that might prove helpful to investors.

Relevance to Previous Research

Previous research has suggested that information necessary to predict hospital bond ratings may not be limited to financial accounting information. There is some
evidence that operational data (which yields some insight into the degree that hospital facilities are utilized) and socioeconomic data (regarding the surrounding community) are also relevant in determining a hospital's financial risk (Craycraft 1994; La Jolla Management Corp. 1981; Cleverley and Nutt 1984). As Chu et al. (1991) state, "while audited financial statements constitute the major source of information for external parties, they only convey a limited amount of information about the hospitals." (p. 56) That CMA admissions, total number of outpatient surgeries, and percentage population below poverty were found to be significant predictors of hospital bond ratings supports this previous research.

Sherman (1986) concluded that additional data about patient volume and case mix were necessary to analyze a hospital's financial performance. CMA admissions is a variable which conveys this information. It represents a measure of total admissions (volume) weighted by the average intensity of each case as reflected in the case mix index. It is a measure of total hospital inpatient activity.

Finally, Cleverley and Nutt (1984) found percentage Medicaid revenue significant in predicting hospital bond ratings. Sherman (1986) proposed that the percentage of Medicaid patients treated by a hospital might be significant in evaluating hospital financial performance.
Craycraft (1994) found empirical support for this suggestion. The percentage of Medicaid patients treated by a hospital loaded onto the same factor as percentage population below poverty, but at a less significant level. The variable percentage population below poverty was found significant in predicting hospital bond rating and may convey information in addition to the percentage Medicaid patients treated. The results of this study thus lend some indirect support to the findings of previous research.

A Concise Set of Predictor Variables

As the appendix indicates, the quantity of information that analysts request from hospitals is overwhelming. Individual investors might lack the sophistication to navigate through the volumes of information analysts report using. In addition, hospitals may be placed under an unnecessary financial strain if required to produce so much information on an annual basis when a more concise set of information may be adequate in evaluating hospital economic performance. It has been shown that, although rating analysts indicate that they review an enormous amount of information during the rating process, the actual rating can be predicted from a parsimonious set of information variables (Lev 1974). The findings of this study indicate that a more manageable yet adequate set of performance indicators can be used to predict hospital bond ratings.
Suggestions for Future Research

One manifestation of the increased riskiness of the hospital industry's financial environment is the increase in the number of hospital bond rating downgrades. McCue et al. (1990) identified only two variables significantly associated with hospital bond downgrades. Further research could focus on identifying additional variables significantly associated with hospital bond downgrades.

A hospital's financial performance is greatly influenced by many factors external to the hospital or otherwise beyond its ability to change in the short run (McCue et al. 1990). Moreover, bond purchasers are not the only providers of capital for hospitals. Charitable donations, tax support, and third party payers provide resources for hospitals as well. These particular users of financial statements may need information in addition to that necessary to evaluate the default risk or financial performance of hospitals. Future studies could focus on enriching this area of research with more rigorous economic theory.

As previously stated, the sample of hospitals analyzed in this study was comprised entirely of not-for-profit hospitals, therefore, results are not generalizable to their for-profit counterparts. Faced with resource allocation decisions, investors might be equally interested in predicting bond ratings for proprietary hospitals. This
suggests that an appropriate extension of this project would be to test the ability of the model developed in this study to predict for-profit hospital bond ratings.
SELECTED BIBLIOGRAPHY


APPENDIX

LIST OF INFORMATION REQUESTED BY HOSPITAL BOND RATING ANALYST

Standard and Poor's Request List

Number of outpatient procedures
Number of inpatient and outpatient surgeries
Observation days
Trends in outpatient volume
Inpatient volumes
Population trends
Unemployment rates
Local wealth levels
Major employers
Types and level of services offered
Large teaching hospital?
Market Share
Sole community provider?
Size of medical staff
Age of medical staff
Level of board certification
Malpractice insurance
Cash levels
Revenue growth
Payor mix
Profitability by payor
Overall profitability
Financial flexibility (Fixed cost/variable cost or FTE's/adj. occupied bed)
Operating Margins
Excess Margins
Historical pro forma debt service coverage
Historical pro forma debt burden
Leverage
Liquidity
Cash flow
Day’s cash on hand
Cash flow to total debt
Cushion ratio
How well did management budget
Moody's Request List

- Magnitude of debt
- Various debt ratios
- Size of debt load compared to future borrowing needs
- Certificate of need
- Feasibility study
- Intensity of Accounts receivable
- How well has the hospital coped with change to prospective payment system
- Malpractice insurance
- Market share
- Average length of stay
- Economy of hospital service area
- Evaluation of trustees and management team
- Patient mix
- Services provided
- Admissions
- Patient days
- Percent occupancy
- Emergency room visits
- Hospital accreditation status
- Age of admitting doctors
- Rate of staff turnover
- Physician patient ratio
- Percentage of board certified physicians
- Sources and uses of funds
- Number of FTE's
- Medicare case mix index
- % of gross patient revenues
- How well did management budget
- Top 10 admitters

Fitch's Request List

- Payor class mix based on:
  - a. Percentage of revenue
  - b. Percentage of admissions
  - c. Percentage of patient days
  - (Medicare, Medicaid, Blue Cross, HMO/PPO, commercial, self-pay and other -- should total 100%)
- Feasibility study
- Lines of credit
- Certificate of need
- Statement of sources and uses of funds
- Teaching status
- Board of trustees
- Management
- Average age of staff
- Board Certification of staff
- Top 10 admitters
Location of physician offices
Average number of FTE's
General socio-economic data of service area population
trends
major employers
unemployment rates
income levels
Market share data
Accreditation
Insurance policies and coverage limits
Top 10 DRG's
Capabilities of management information systems
Inpatient statistics (medical-surgical, pediatrics,
obstetrics, etc.)
Licensed and available/staffed beds
Admissions
Patient days
Average length of stay
Occupancy rates
Outpatient statistics (ER, clinic, SDS)
Comparison of actual with budget
Medicare and total case mix index
VITA

Ann L. Watkins was born in Welsh, Louisiana September 19, 1961. She graduated from Lacassine High School in 1979. After starting a family, she returned to McNeese State University and received a B.S. in Accounting in 1989. Upon graduation she took a position with MSU as an internal audit assistant. In January of 1991 she took a position with a public accounting firm in Lake Charles, LA.

She began working on her Masters in Accounting at LSU in the Fall of 1991. She entered the Ph.D. Program as a candidate for the Doctor of Philosophy degree in the Department of Accounting at LSU in the Summer of 1992 and was awarded the degree in December of 1995.

She is married to Dr. C. Edward Arrington. She lives with her husband and stepson, Zack, in Glasgow, Scotland where she lectures at the University of Strathclyde.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Ann L. Watkins

Major Field: Accounting

Title of Dissertation: An Empirical Analysis of Criteria Utilized to Determine Hospital Revenue Bond Ratings

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signature]

[Signature]

[Signature]

Date of Examination:

September 20, 1995