Replicating Electric Utility Short-term Credit Ratings

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REPLICATING ELECTRIC UTILITY
SHORT-TERM CREDIT RATINGS

Working Paper 82-901*

by

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*This paper represents a draft of work in progress by the authors and is being sent to you for information and review. Responsibility for the contents rests solely with the authors. This working paper may not be reproduced or distributed without the written consent of the authors. Please address all correspondence to John W. Peavy, III.
The market has devised a more detailed public utility commercial paper rating scheme than presently exists at the major rating bureaus. This study identifies the key financial variables that contribute to market rating differences. A multiple discriminant model is developed that employs these variables to replicate not only agency ratings, but also the more precise market ratings. The empirical results verify the contention that public utility paper issuers can be effectively classified into more distinct quality categories than are currently provided by the agency raters.
Introduction

The increased difficulty in selling traditional long-term debt and equity securities has caused many public utility companies to rely on the issuance of commercial paper to supplement their financing needs. Commercial paper is an unsecured promissory note that usually carries an original maturity of 60 days or less.\(^1\) Since commercial paper is unsecured and matures rapidly, the prospective purchaser must carefully evaluate the issuer's ability to come up with cash in a very short period of time. Thus, paper buyers would seem to be more concerned with the issuer's liquidity status than would bond buyers who generally are more conscious of the long-term financial viability of the debtor.

The predominant buyers of commercial paper are large financial institutions which use these obligations as a relatively low-risk outlet for short-term funds. In recent years the institutional buying of paper has expanded dramatically (outstanding paper surged from only $9.0 billion outstanding at year-end 1965 to $164.0 billion at year-end 1981). The combined effect of the increased institutional appetite for commercial paper and the risk-averse profile of most paper buyers led to the outcry for a responsive risk-measurement scheme. Although the major rating agencies (primarily Moody's and Standard & Poor's) have published bond quality ratings for many years, they have traditionally avoided the rating of very short-term debt issues.\(^2\) Both agencies, however, readily admit that bond ratings are not reliable surrogates for the default risk probability of very short-term debt issues [1].
The agencies devised commercial paper ratings as a result of the market's demand for short-term credit indicators. Both major agencies developed three-tier rating continuums to distinguish the commercial paper risk classes -- Moody's ranks paper from P-1 (highest quality) to P-3 (lowest quality); S & P uses a comparable A-1 to A-3 rating scale [22, 28]. The creation of a new set of ratings to assess the short-term quality of an issuer confirms that the raters believe that bond ratings are not appropriate risk measures for commercial paper.

Emergence of a Market Rating Scheme

Most commercial paper is purchased as a low-risk, temporary investment and, as a result, unrated or lower-rated paper cannot be sold easily in today's market [13]. Only paper with the two highest agency ratings is readily accepted -- low-grade P-3 or A-3 issues, for example, comprise less than one percent of outstanding paper [1]. But most major investors do not believe that the resulting division of over 99 percent of paper issues into only two agency rating categories provides enough quality separation. The market substantiates this belief by attributing different yields (risk premiums) to separate issuers possessing identical paper ratings [16]. To accommodate this demand for additional quality distinction, some market participants have developed their own, more detailed rating categories.

Goldman, Sachs & Co., the largest commercial paper dealer, uses a more detailed ranking system that combines an issuer's paper rating with its bond rating, thus deriving five classes. S & P has also recognized that commercial paper buyers need more precise credit quality indications, particularly among A-1 rated issuers, and has recently begun to assign "plus sign" designations to A-1 paper of certain issuers [16]. Thus, the new S & P rating scale
more closely conforms to some of the existing market rating schemes. For ex-
ample, the five rating groups of Goldman, Sachs & Co. and the new four class
rating scale of S & P are very similar (Exhibit 1).

Purpose of This Study

The bond raters assert that statistical models using financial data cannot be used to replicate their bond ratings [5, 12]. Nevertheless, a number of studies have been successful in employing pertinent financial statistics to classify industrial [14, 25, 27, 30] and public utility [6, 26] bonds into their proper agency rating groups. Other studies have effectively used financial ratios to predict industrial [15, 24] and public utility [4, 19] bond rating changes. However, no such study could be found that replicates commercial paper ratings. Since the raters clearly state that they place emphasis on different financial considerations when assessing the riskiness of commercial paper as opposed to bonds, it would seem that the classification formulae for paper ratings would differ from those for bond ratings.

The purpose of this study is to determine if some combination of financial variables can be used successfully to explain S & P's ratings on electric utility commercial paper. In addition, an effort is made to explain the more detailed market rating groups used by Goldman, Sachs & Co. Multiple discriminant analysis (MDA) is used to "predict" both the S & P rating and the market rating attributed to the commercial paper issuer. The results of this study should be particularly interesting due to the relative newness of paper ratings and the corresponding unfamiliarity associated with the process for rating these obligations.
Sample and Variable Selection

All 42 electric utilities that were assigned both a S & P commercial paper and bond rating as of year-end 1980 are considered. The existence of a bond rating, when accompanying the paper rating, makes it possible to create the market quality group for the issuer.

An original set of 37 diverse financial, operating, and qualitative variables is originally observed (Appendix A). The selection of these variables is based upon those considered in the previous research designed to predict ratings and rating changes for electric utility bonds, as well as those that S&P regards as important.

A forward stepwise procedure is used to reduce the original variable set to a much smaller set of meaningful explanatory variables. The main advantage of the stepwise method is that it eliminates variables which explain similar amounts of data variability, thus reducing the multicollinearity problems that could otherwise impede the statistical power of the discriminant functions. By sequentially selecting the variable with the highest F-value, the resulting Wilks' Lambda is minimized, thereby maximizing discrimination among rating groups.

The four final variables that are selected via this stepwise procedure for inclusion in the MDA classification model are as follow (Exhibit 2):

\[ X_{19} = \text{Fixed charge coverage}, \]
\[ X_{6} = \text{Sales/working capital}, \]
\[ X_{33} = \text{Value Line safety rating [29]}, \] and
\[ X_{12} = \text{Return on equity}. \]

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Enter Exhibit 2 Here
---
These explanatory variables are compared to those employed in three major electric utility bond rating studies (Exhibit 3). All three bond rating efforts found the fixed charge coverage to be the most crucial predictive variable. Also, several non-rating studies have asserted the overwhelming importance of fixed charge coverage in gauging the quality of utility debt [9, 18, 20, 21]. This study confirms those findings by selecting this coverage ratio as its initial, and thus most important, predictive variable. In addition, this study includes variables measuring profitability (return on equity) and earnings stability (Value Line's safety index) as important variables. Both the Bhandari et al. and Pinches et al. bond rating studies considered these factors to be important and correspondingly used a representative variable from each of these dimensions in their final classification models. Interestingly, Edelman did not select a variable from either of these broad factors for inclusion with his final model.

The main variable discrepancy between the bond and commercial paper rating studies occurs in the liquidity area. None of the bond rating studies found a liquidity ratio to be helpful in classifying a bond into its proper rating group; however, the stepwise selection procedure singled out sales/working capital, a measure of corporate liquidity, as the second most important explanatory variable for rating commercial paper. The early entry of this liquidity ratio coincides with the notion that commercial paper investors are more concerned than are bond buyers with an issuer's liquidity status. The apparent importance of this liquidity variable, in effect, reinforces the raters' contention that commercial paper is a substantially different instrument than a bond is and accordingly should be rated based upon a different formula.
Multiple discriminant analysis is used to classify each of the 42 commercial paper issuers into the S & P rating group in which it has the highest probability of belonging (see [11] for a complete description of MDA). A centroid (mean) is calculated, based upon the four selected variables, for each of the three a priori rating groups. Each electric utility is assigned a group membership based on the closeness of the company's observation values to the respective group's centroids.

Since three rating groups exist, a maximum of two discriminant functions result. However, the possibility exists that one of these functions may not significantly contribute to the ability to separate the groups. The ability of each derived function to discriminate among groups is shown by its Eigenvalue and the associated percentage of variance explained by the function (Exhibit 4).

The first discriminant function, which captures 89.5 percent of total data dispersion, is the more important for differentiating among the three commercial paper rating groups. The second function, however, still accounts for an important 10.5 percent of data variability. As a result, both discriminant functions are employed for classification purposes in order to explain the maximum amount of variability in the data set (see [10] for a discussion of the problems created by discarding a potentially meaningful amount of discriminating information).

The classification matrix shows that 83.3 percent (35/42) of the electric utilities are correctly classified according to their S & P rating; none of
the issuers is misclassified by more than one group (Exhibit 5). Also, the model's predictive ability is very consistent across all rating categories. Classification accuracy ranges from a low of 75.0 percent (P-3) to a high of 85.2 percent (P-1). Apparently these four financial variables are quite effective in explaining S & P's commercial paper rating scheme.

These predictive results, however, may be biased upward because the same observations being classified are used to generate the model. To verify the model, the Lachenbruch jackknife procedure [17] is employed. This technique holds out one observation at a time, computes the discriminant functions based on the remaining observations, and then classifies the held-out observation. This process is repeated until all observations are reclassified. This jackknife technique is especially valuable when the sample size is too small to justify a separate hold-out sample. The results using this validation procedure indicate that 83.3 percent of the issuers are correctly classified (Exhibit 6) -- identical to the results obtained with the original discriminant model. Thus, these results confirm that reported financial data can be effectively employed to explain S & P's assigned commercial paper ratings.

Examining Market Rating Groups

The high classification accuracy of the MDA model suggests that the top three S & P paper rating grades are clearly separate and distinct. In fact, many market participants believe that these rating groups are too broad, not providing enough quality separation among issuers. To determine if financial
statistics can provide more quality distinction among issuers, an effort is made to replicate the more detailed market rating groups used by Goldman, Sachs & Co. This market classification scheme divides each of S & P's top two ratings into two subgroups, thus expanding S & P's three scale rating continuum to five market groups. Of the 42 electric utility commercial paper issuers, 1 belongs to market Group A, 25 to Group B, 6 to Group C, 5 to Group D, and 5 to Group E. However, due to an inadequate sample size, Group A is deleted from further consideration, leaving a final sample of 41 firms.

The same four explanatory variables used to create the agency rating model are employed to develop a market classification model. Since four market groups exist (B through E), a maximum of three discriminant functions result. However, one or more of these functions may not significantly contribute to the ability to distinguish among groups. Thus, the Eigenvalue and corresponding percentage of explained variability for each discriminant function is calculated to determine the importance of each function (Exhibit 7).

Enter Exhibit 7 Here

The first function accounts for a very large portion (94.6 percent) of explained data variability. The seemingly insignificant 5.4 percent of variability that remains, however, could still contribute to the overall ability to discriminate among the market rating groups. Thus, all three discriminant functions are used for classification purposes in order to capture the maximum amount of total data dispersion.

The resultant model correctly classifies 80.5 percent (33/41) of the paper issuers into their market rating group; only two issuers are misclassified by more than one group. These results approximate those obtained by the S & P
paper rating classification model -- thus suggesting that financial variables can be used to expand the existing S & P rating scale.

The Lachenbruch jackknife procedure is used to verify the above four-group model. Total classification accuracy declines to 75.6 percent (31/41) -- approximately five percentage points lower than the original MDA results (Exhibit 9). Nevertheless, the validation model still performs at a high level of predictive accuracy, reinforcing the contention that pertinent financial variables can be used to replicate the market rating scheme.

Conclusions

In this study a large set of diverse financial variables is examined to determine if some combination of these variables can be used to replicate public utility commercial paper ratings. A derived discriminant model reveals that a condensed set of these variables is able to correctly classify 83.3 percent of their correct S&P commercial paper rating categories. These classification results surpass those obtained in the bond rating studies.

The fact that the rating agencies provide only three paper rating categories has caused many investors to charge that the raters do not provide enough quality separation among issuers. As a result, more detailed market rating schemes have emerged. This study demonstrates that the same explanatory variables employed in the S&P rating model can be effectively used to replicate the more refined five-tier market rating scheme devised by Goldman, Sachs, & Co. The resulting MDA model performs at approximately an eighty
percent predictive ability -- similar to the results for the agency rating classification model. Thus, this multivariate market model effectively expands the existing agency rating scale.

The final predictive models employ only four explanatory variables, three of which correspond closely to those used in public utility bond rating studies. The other variable (sales/working capital) is clearly a measure of a firm's short-term liquidity status -- a dimension that was not found to be very important in explaining bond ratings.

Commercial paper is obviously different from bonds as an investment security, and the important explanatory variables selected for inclusion in the commercial paper discriminant rating models confirm this difference. Previous public utility bond rating efforts have concentrated on the long-term viability of the issuer. This commercial paper rating study reveals that a short-term liquidity ratio contributes a substantial amount of discriminating ability for purposes of classifying paper issuers. Thus, this study infers that the rating agencies do, in fact, observe different parameters in assessing the quality of short-term commercial paper as compared to that for long-term bonds.
Exhibit 1

Comparative Commercial Paper Rating Scales

<table>
<thead>
<tr>
<th>Goldman, Sachs &amp; Co.</th>
<th>S &amp; P Ratings</th>
<th>Standard &amp; Poor's Commercial Paper Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Group</td>
<td>Paper</td>
<td>Bond</td>
</tr>
<tr>
<td>A</td>
<td>A-1</td>
<td>AAA</td>
</tr>
<tr>
<td>B</td>
<td>A-1</td>
<td>AA or A</td>
</tr>
<tr>
<td>C</td>
<td>A-2</td>
<td>A</td>
</tr>
<tr>
<td>D</td>
<td>A-2</td>
<td>BBB or N/R</td>
</tr>
<tr>
<td>E</td>
<td>A-3</td>
<td>--</td>
</tr>
</tbody>
</table>
### Exhibit 2

**Stepwise Variable Selection**

**Moody's Rating Model**

<table>
<thead>
<tr>
<th>Step Number</th>
<th>Variable Entered</th>
<th>F-Value to Enter&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Wilks' Lambda</th>
<th>Number of Variables Entered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X19</td>
<td>10.554</td>
<td>0.649</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>X6</td>
<td>7.989</td>
<td>0.496</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>X33</td>
<td>8.332</td>
<td>0.356</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>X12</td>
<td>8.856</td>
<td>0.254</td>
<td>4</td>
</tr>
</tbody>
</table>

<sup>a</sup>A minimum F-value, corresponding to the .05 significance level, was chosen as the stepwise variable cut-off.
### Exhibit 3

**Ratios Used in Rating Classification Studies**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Ratio</th>
<th>Bond Rating Studies</th>
<th>Commercial Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bhandari, Soldofsky, and Boe</td>
<td>Pinches Singleton, &amp; Edelman</td>
</tr>
<tr>
<td>Coverage</td>
<td>Fixed charge coverage</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Leverage</td>
<td>Long-term debt/capital</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Profitability</td>
<td>Return on total assets</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Return on equity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Total assets</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Earnings/Cash Flow</td>
<td>Std. error of ROA</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Stability</td>
<td>Std. dev. of Cash Flow</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td>Regulatory climate&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Capital Expenditures</td>
<td>Construction expenditures/ total assets</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Liquidity</td>
<td>Sales/working capital</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>As determined by Value Line.

<sup>b</sup>As determined by White, Weld & Company.
## Exhibit 4

### Discriminant Function Results

**Moody's Rating Model**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Function 1</th>
<th>Function 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>X19</td>
<td>2.683</td>
<td>-0.785</td>
</tr>
<tr>
<td>X6</td>
<td>0.015</td>
<td>0.018</td>
</tr>
<tr>
<td>X33</td>
<td>-0.158</td>
<td>0.024</td>
</tr>
<tr>
<td>X12</td>
<td>-0.433</td>
<td>-0.201</td>
</tr>
<tr>
<td>Eigenvalue</td>
<td>2.146</td>
<td>0.251</td>
</tr>
<tr>
<td>Percentage of Explained Variance</td>
<td>89.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Cumulative Percentage</td>
<td>89.5%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Exhibit 5

Classification Results Using Moody's Ratings

<table>
<thead>
<tr>
<th>Actual Moody's Rating</th>
<th>Predicted Rating</th>
<th>Percentage Correctly Classified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P-1</td>
<td>P-2</td>
</tr>
<tr>
<td>P-1</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>P-2</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>P-3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>14</td>
</tr>
</tbody>
</table>
Exhibit 6

Classification Results Using Moody's Ratings

Lachenbruch Jackknife Procedure

<table>
<thead>
<tr>
<th>Actual Moody's Rating</th>
<th>Predicted Rating</th>
<th>Percentage Correctly Classified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P-1 P-2 P-3</td>
<td>Total</td>
</tr>
<tr>
<td>P-1</td>
<td>23 4 0</td>
<td>27 85.2</td>
</tr>
<tr>
<td>P-2</td>
<td>2 9 0</td>
<td>11 81.8</td>
</tr>
<tr>
<td>P-3</td>
<td>0 1 3</td>
<td>4 75.0</td>
</tr>
<tr>
<td>Total</td>
<td>25 14 3</td>
<td>42 83.3</td>
</tr>
</tbody>
</table>
### Exhibit 7

**Discriminant Function Results**

**Market Rating Model**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Function 1</th>
<th>Function 2</th>
<th>Function 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>X19</td>
<td>3.025</td>
<td>0.966</td>
<td>-1.636</td>
</tr>
<tr>
<td>X6</td>
<td>-0.168</td>
<td>0.025</td>
<td>-0.133</td>
</tr>
<tr>
<td>X12</td>
<td>-0.404</td>
<td>-0.539</td>
<td>0.006</td>
</tr>
<tr>
<td>X33</td>
<td>0.008</td>
<td>0.010</td>
<td>-0.013</td>
</tr>
</tbody>
</table>

**Eigenvalue**

<table>
<thead>
<tr>
<th></th>
<th>Function 1</th>
<th>Function 2</th>
<th>Function 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.126</td>
<td>0.117</td>
<td>0.004</td>
</tr>
</tbody>
</table>

**Percentage of Explained Variance**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>94.6%</td>
<td>5.2%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

**Cumulative Percentage**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>94.6%</td>
<td>99.8%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Exhibit 8

Classification Results Using Market Groups

<table>
<thead>
<tr>
<th>Actual Market Group</th>
<th>Predicted Group</th>
<th>Percentage Correctly Classified</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>21 3 0 1 25</td>
<td>84.0</td>
</tr>
<tr>
<td>C</td>
<td>1 4 0 1 6</td>
<td>66.7</td>
</tr>
<tr>
<td>D</td>
<td>0 0 4 1 5</td>
<td>80.0</td>
</tr>
<tr>
<td>E</td>
<td>0 1 0 4 5</td>
<td>80.0</td>
</tr>
<tr>
<td>Total</td>
<td>22 8 4 7 41</td>
<td>80.5</td>
</tr>
</tbody>
</table>
Exhibit 9

Classification Results Using Market Groups

Lachenbruch Jackknife Procedure

<table>
<thead>
<tr>
<th>Actual Market Group</th>
<th>Predicted Group</th>
<th>Percentage Correctly Classified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>8</td>
</tr>
</tbody>
</table>
Footnotes

1 Commercial paper carries a 270-day maximum maturity reflecting the fact that the Securities and Exchange Commission exempts it from registration provided that the original maturity does not exceed this limit (Securities Act of 1933). However, it is very unusual to issue commercial paper with a maturity greater than 60 days.


3 An F-test based upon Wilks' Lambda was used to test the null hypothesis that there is no difference in the group centroids for the three paper rating categories. The null hypothesis was rejected at the .001 significance level.

4 The number of commercial paper issuers correctly classified is determined by summing the values along the main upper left-lower right diagonal of the classification matrix.
References


Appendix A

Variables List

\[ X_1 = \text{Current Ratio} \ (\text{Current Assets/Current Liabilities}) \]
\[ X_2 = \text{Acid Test Ratio} \ (\text{Current Assets - Inventory/Current Liabilities}) \]
\[ X_3 = \text{Cash Turnover} \ (\text{Sales/Cash}) \]
\[ X_4 = \text{Receivables Turnover} \ (\text{Sales/Accounts Receivables}) \]
\[ X_5 = \text{Inventory Turnover} \ (\text{Sales/Inventory}) \]
\[ X_6 = \text{Sales/Working Capital} \]
\[ X_7 = \text{Cash/Total Assets} \]
\[ X_8 = \text{Receivables/Total Assets} \]
\[ X_9 = \text{Inventory/Total Assets} \]
\[ X_{10} = \text{Earning Power} \ (\text{Net Plant & Equipment + Current Assets + Current Liabilities/Operating Income Before Depreciation & Taxes}) \]
\[ X_{11} = \text{Profit Margin} \ (\text{Operating Income Before Depreciation & Taxes/Sales}) \]
\[ X_{12} = \text{Return on Equity} \ (\text{Net Income Available to Common/Common Equity}) \]
\[ X_{13} = \text{Earnings Before Interest and Taxes/Total Assets} \]
\[ X_{14} = \text{Earnings Before Interest and Taxes/Sales} \]
\[ X_{15} = \text{Net Income/Total Assets} \]
\[ X_{16} = \text{Return on Capital} \ (\text{Net Income/Long-term Invested Capital}) \]
\[ X_{17} = \text{Long-Term Debt Total Assets} \]
\[ X_{18} = \text{Long-Term Debt Total Invested Capital} \]
\[ X_{19} = \text{Fixed Charge Coverage (pre-tax)} \]
\[ X_{20} = \text{Cash Flow/Total Debt} \]
\[ X_{21} = \text{Market Value of Equity/Total Debt} \]
\[ X_{22} = \text{Common Stock Price/Cash Flow per Share} \]
\[ X_{23} = \text{Sales/Net Worth} \]
\[ X_{24} = \text{Sales/Total Assets} \]


References


### Variables Used in Classification Models

<table>
<thead>
<tr>
<th>Dimension and Variable</th>
<th>Market Group and Mean Value</th>
<th>Univariate F-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed charge coverage</td>
<td>2.84</td>
<td>2.35</td>
</tr>
<tr>
<td><strong>Earnings Stability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value Line safety</td>
<td>1.54</td>
<td>2.02</td>
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<tr>
<td><strong>Return</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return on equity</td>
<td>11.42</td>
<td>10.72</td>
</tr>
<tr>
<td><strong>Liquidity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales/working capital</td>
<td>14.72</td>
<td>12.45</td>
</tr>
</tbody>
</table>

*Significant at .001 level.
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