ANNOUNCEMENT EFFECTS OF BOND RATING CHANGES
ON COMMON STOCK PRICES

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Denton, Texas
December, 1984
Glascock, John L., Announcement Effects of Bond Rating Changes on Common Stock Prices. Doctor of Philosophy (Finance), December, 1984, 88 pp., 8 tables, 3 illustrations, bibliography, 74 titles.

This dissertation examines the reaction of common stock prices to changes in bond ratings by Moody's Bond Service. The question is whether an announcement of a re-rating by Moody's is new information. There are only two studies of stock price reaction to bond changes and the results are conflicting. Pinches and Singleton (1978) [PS] concluded that any reaction comes well before the re-rating. Griffin and Sanvicente (1982) [GS] found that their portfolio test indicated that rating changes do convey new information. This was particularly true for downgradings. Both studies used monthly data and neither performed a statistical testing of residual reversals. PS provided a graph of the residuals which indicated the presence of a reversal trend. GS provided no information on this topic.

This study, using daily data and the cumulative prediction error technique, finds that bond re-ratings offer new information. The results indicate that the market only partially anticipates the bond change. For the downgrades, the excess return on the announcement day is .6% which is
statistically significant. The residuals reverse after the announcement day, but are not statistically significant. The upgrades do not have a significant reaction on the announcement day, but have a statistically significant negative reaction from day 1 to 10. The cumulative residual for days 1 to 10 is -2.8% with a test statistic of -3.85.

This study finds as PS that there is some anticipation for both upgrades and downgrades. It extends their work by statistically testings the reversals after the announcement date and by testing the announcement day effect. There is significant abnormal return for the downgrades on the announcement day and the upgrades have a significant reversal in their residuals from day 1 to 10. This provides both support and extension of Griffin and Sanvicente's results and suggests that Moody's is offering the market new information.
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CHAPTER I

INTRODUCTION

General Statement of the Problem

Are the re-ratings of securities by agencies such as Moody's and Standard and Poor's an economic event? Do they add information to the market that was not already discounted by investors? The current opinion is markets are efficient and that bond rating changes offer no new information [see Pinches and Singleton (1978), Weinstein (1977) and Wakeman (1983)]. However, the empirical work provides conflicting evidence.

In the area of bond rating prediction, it has been shown that about 70% of the ratings can be predicted [Hawkins et al. (1983)]. Prediction techniques have progressed from regression used by the early researchers [Fisher (1959), Horrigan (1966), Pogue and Soldofsky (1969), and West (1970)] to the use of multiple discriminant analysis [Pinches and Mingo (1973 & 75), Belkaoui (1980), and Perry et al. (1984)].

The research on bond price reactions to re-ratings has been mixed. Katz (1974) and Grier and Katz (1976) find that bond prices react to bond rating changes, while Hettenhouse
and Sartoris (1976) and Weinstein (1977) find no reaction. Wakeman (1983) suggests that, since bond prices adjust prior to the rating change as Weinstein found, the primary use of rating is as a sales device for new issues.

There have been only two studies of stock price reaction and bond rating changes, but the results are conflicting. Pinches and Singleton (1978) find that any reaction comes well before the announcement of a bond rating change. Griffin and Sanvicente (1982) find that the change does convey new information to the market. In particular, downgrading appears to have a significant effect.

The two studies of stock price reaction both used monthly data. A more robust analysis can be performed with daily data [Brown and Warner (1983)] since the event can be better specified. Using daily data to clarify the issue would seem to be justified.

Objectives of the Study

The objective of this study is to determine if stock prices react to bond rating change announcements by Moody's Bond Service. In order to facilitate this research, the study focuses on the following:

1. The reaction of stock prices (in terms of a residual from a single index market model) around the announcement date. This will include a test of the Cumulative Prediction Error from -90 days to the event day and various other intervals
2. The reaction of the Average Residuals for individual companies around the announcement day
3. A 'runs' test of the residual behavior over the interval -90 to 0 and 0 to +90
4. The statistical testing of the raw cumulative prediction errors of (1) and (2)

Scope of the Study

This study uses data from the period January 1, 1977 to December 31, 1981. The data consists of the announcements of bond re-ratings carried in the Moody's Bond Survey and daily stock prices of the affected companies. The stock prices and dividend information is taken from the Chicago Research in Security Prices (CRSP) tapes. Any firm in the study had data available for 290 days before and 90 days after the event. The rating change was the only change that the selected firm experienced for one prior and one year after this re-rating. Firms with multiple changes are not reviewed in this study.

The single index market model is used to predict the expected return. The CRSP market-weighted index is used as the proxy for the market return.

The cumulative prediction error is calculated and a statistical test is performed as described by Dodd and Warner (1983). The proportion test is also used to determine if a significant number of the sample firms experience any effect.
Organizational Plan

Chapter II contains the review of related literature. It is divided into two sections. The first reviews the areas of bond rating prediction, bond rating changes and bond prices, and bond re-ratings and stock price reaction. The second reviews the methodologies used to investigate the link between bond changes and stock price reactions.

Chapter III describes the methodology including a discussion of the sample selection and empirical testing procedures. Chapter IV provides the results and the summary is given in Chapter V.
CHAPTER BIBLIOGRAPHY


CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter reviews the literature relative to bond ratings, rating changes and the methodology commonly used in studying the impact of rating changes on stock market prices. This chapter is divided into two sections. The first reviews the bond rating process, the bond rating prediction models, the potential influence of rating changes on bond prices and the impact of rating changes on stock prices. The second section examines the methodology previously used in studying stock price reactions to rating changes. This includes the works of Fama, Fisher, Jensen and Roll (1969), Pinches and Singleton (1978), Griffin and Sanvicente (1982), and Dodd and Warner (1983).

Introduction to Bond Rating and Prediction Models

The importance of bond ratings has been discussed since 1909 when such ratings were first issued in the United States. Academic research has concentrated on three aspects of this topic. First, what are the factors that influence the rating of a bond? Can the ratings by the various bond rating companies be estimated with success by a statistical
model? Second, do bond ratings affect the prices of bonds or is the association of lower rating and higher yields determined by some underlying economic phenomena? Do lower bond ratings simply reflect what the market already knew when it demanded a higher yield? Third, do bond rating changes affect stock market prices?

Harold (1938) increased interest in bond ratings by showing that the various rating agencies differed substantially in their rating of individual companies. Since Harold's study there have been a number of models developed [Belkaoui (1980), Horrigan (1966), Kaplan and Urdwitz (1979), Perry et al. (1984), Pinches and Mingo (1973 & 75), Pogue and Soldofsky (1979) and West (1970)] for predicting bond ratings. In addition, Ang and Patel (1975) compared the predictive ability of these models with that of the bond rating agencies as to their effectiveness in predicting financial distress.

The early studies used primarily multiple regression. This did not change until Pinches and Mingo (1973) used multiple discriminant analysis. The current view is that a majority of bond ratings (about 70%) can be explained by a few financial factors. The most significant factor is subordination.

The early studies of bond ratings and bond prices [Harold (1938), Katz (1974), and Grier and Katz (1976)]
indicated that bond prices adjust to rating change announcements. A more recent and rigorous analysis by Weinstein (1977) found that any bond price reaction was completed well before the announcement of the bond rating change. The differences between the earlier studies and Weinstein are primarily methodological. Weinstein investigated the effects of rating reclassifications using a more refined risk-adjusted technique and portfolio estimation procedure. Bond prices do not seem to be a function of bond ratings. The same underlying economic forces that cause higher yields and lower bond prices seem to also cause the lower ratings [Weinstein (1977)].

Pinches and Singleton (1978), Carpenter and Chew (1983) and Griffin and Sanvicente (1982) studied the reaction of stock prices and betas to bond rating changes. Their findings generally indicate that any adjustment is made before the bond rating change announcement. Systematic risk, beta, does seem to change around bond announcements.

If the bond ratings do not affect either bond or stock prices, why do the services exist? Wakeman (1983) provides an answer: it is to the bond issuer's advantage to assure potential buyers that the company is safe. There is an agency problem between the company, its owners and its debtholders. If the company expects to sell its bonds to a variety of investors, it needs the rating as confirmation of
its current and potential financial position. Privately placed issues seldom have a rating—a partial validation of such an explanation.

The Bond Rating Process

Standard and Poor's Corporation and Moody's Investor Service, Inc. are the most widely used rating agencies [Phillips and Ritchie (1983)]. John Moody began rating bonds in 1909. By 1976, Moody's Bond Record covered over 19,000 corporate and municipal issues. Today, rating agencies obtain their primary revenue from fees charged issuers (or underwriters). Before 1960, there were no issuer charges and the rating services received their revenue from publication subscribers.

Regulatory authorities began using bond ratings after the numerous business failures of the 1920's. The Comptroller of the Currency first issued regulations requiring the use of bond ratings in 1931. Some of these regulations continue today. Some states regulate trustees and banks through legal lists; these lists delimit the investments of regulated institutions by bond rating quality [Phillips and Ritchie (1983)]. Bond rating changes therefore can require some institutions to sell (downgrades). Bond upgrades can enlarge a bond's market.
Moody's uses a nine class rating system. Table I provides a brief summary. A more detailed description can be found in Sharpe (1978) or Hawkins et al. (1983).

TABLE I
Description of Moody's Bond Ratings

<table>
<thead>
<tr>
<th>RATING</th>
<th>QUALITY</th>
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<tr>
<td>Aaa</td>
<td>Best</td>
</tr>
<tr>
<td>Aa</td>
<td>High</td>
</tr>
<tr>
<td>A</td>
<td>Upper Medium</td>
</tr>
<tr>
<td>Baa</td>
<td>Medium</td>
</tr>
<tr>
<td>Ba</td>
<td>Speculative elements</td>
</tr>
<tr>
<td>B</td>
<td>Very Speculative</td>
</tr>
<tr>
<td>Caa</td>
<td>Default possible</td>
</tr>
<tr>
<td>Ca</td>
<td>Default, only partial recovery expected</td>
</tr>
<tr>
<td>C</td>
<td>Default, little recovery anticipated</td>
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Moody's reviews bond issues for rating or re-rating under three conditions: (1) the issuer or underwriter contacts Moody's to rate a newly issued bond; (2) Moody's reviews a company's bond when something unusual occurs (e.g. a merger, substantial reduction in earnings, etc.); and (3) there is a continual review of selected bonds.

Pinches and Singleton (1978) found that nearly 90% of the bond rating changes in their sample occurred when companies initiated new financing. Thus, not only does a new issue result in a rating, it is likely to result in a
re-rating of the firm's outstanding bonds. Weinstein (1977) also found, as did Pinches and Singleton, that most rating changes occurred with a new issue. This tends to substantiate Wakeman's contention that ratings are used primarily to sell new issues.

In addition to Moody's and Standard and Poor's services, Fitch; Duff and Phelps; McCarthy, Ried, Chrisanti and Maffei; the Bank of New York and the Harris Bank provide rating for selected bond and commercial paper issues. For a discussion of these, see Hawkins et al. (1983:17-36).

**Bond Rating Prediction Models**

Previous research indicates that between 50 and 70 percent of most bond ratings can be explained by a few variables. The key explanatory variables are [Hawkins et al. (1983):7]:

- Subordination
- Size of company
- Degree of financial leverage
- Profitability
- Interest coverage
- Stability of dividends and earnings.

This section will provide a brief review of the primary research on bond rating explanation and prediction.
**Harold, 1938**

Harold's study reviewed a sample of 363 bonds and the rating procedures of Poor, Finch, Moody and Standard. The yields and default risk for each class of bonds were reviewed. Harold concluded that an investor should exercise caution because the agencies differed greatly in their rating of identical bonds.

**Fisher, 1959**

Fisher's objective was to determine what variables, in addition to yield and default which were introduced by Harold, might be useful in predicting bond ratings. He used multiple regression analysis and tested four independent variables: (1) the coefficient of variation of net income, (2) the number of years since the last default, (3) the ratio of market equity to par value of the debt, and (4) the market value of publicly traded bonds. He concluded that these variables were useful in determining the differences in corporate and treasury bonds yields for matched maturities.

**Horrigan, 1966**

Horrigan used a multiple regression procedure to predict the top six bond categories for Moody's and Standard and Poor's. A two stage process was used. First, fifteen
financial ratio variables were tested for 352 manufacturing firms. This resulted in six selected ratios that were used to predict ratings. The six ratios were: (1) subordination, (2) total assets, (3) ratios of working capital over sales, (4) net worth over total debt, (5) sales over net worth, and (6) net profit over sales. The final model predicted 58% of Moody's ratings and 52% of Standard and Poor's ratings. The most important variable was subordination. The study included 200 bonds whose ratings did not change in the 1959-64 time period. He concentrated on accounting data and ratios. A nine point scale was used. Nine was a Aaa, eight was Aa and one was the lowest (C).

West, 1970

West used four of the variables used by Fisher (1959) in a multiple regression model to estimate risk premiums. This was an attempt to use market rather than accounting information. The independent variables were: (1) nine-year earnings variability, (2) period of solvency, (3) debt-equity ratio, and (4) the market value of bonds outstanding. His prediction success rate was 62% of the Moody's ratings. West also criticized Horrigan for using only accounting (non-market) data. However, he used West's nine point scale except his was a logarithmic form. He claimed a higher $R^2$ than Horrigan, but this was incorrect.
since the $R^2$ of the log form cannot directly be compared with the non-log form. When the appropriate adjustment is made, the two studies had similar $R^2$s.

Three key issues arise when reviewing the Horrigan and West studies. First, the studies used a dummy regression test and treated the dependent variable as if it were interval scaled. That is, the difference between a 'Caa' and a 'B' is the same as the difference in an 'Aaa' and 'Aa'. The error term will not likely have normality when dummy ordinal scaled values are used [Kmenta (1971), chapter 11]. Second, Horrigan used accounting data and West used market valued data. How do we choose between these? Third, both of these studies used bonds that were already outstanding. Since even the agencies admit that they may lag the market [Ross (1976)], it would seem that only newly issued bonds would be appropriate for prediction studies.

**Pogue and Soldofsky, 1966**

Pogue and Soldofsky used a series of regression models which use dummy variables. To correct for the problems in the Horrigan and West studies, they used only a 0-1 procedure between only two rating categories at a time. They tested the top four ratings categories. The best results were for the Aaa versus the Baa. The most important variables were: (1) long-term debt to total assets, (2)
coefficient of variation of earnings, and (3) total assets. Profitability was less important and the earnings coverage ratios were insignificant. They predicted 8 of their 10 bonds.

While they improved the methodology from the Horrigan and West studies, they also violated the assumptions of the OLS model. The OLS model has desirable properties asymptotically, but their sample size of 10 cannot qualify. They did not control for industry classification as Horrigan did. They also used outstanding bonds for their study.

**Pinches and Mingo, 1973 & 1975**

Pinches and Mingo provided the first of a series of multiple discriminant analysis (MDA) studies. They used six variables: (1) years of consecutive dividends, (2) issue size, (3) net income plus interest to interest, (4) long-term debt to total assets, (5) net income to total assets, and (6) subordination. Their first study predicted about 65% of Moody's ratings. In their second article, they improved their prediction rate by 5% by using a separate discriminant analysis function for subordinated and non-subordinated bonds and a quadratic, rather than linear, discriminant function.
Ang and Patel, 1975

Ang and Patel attempted to determine whether the statistical models developed by academic researchers or the agencies's ratings are better at predicting financial distress. They reviewed and used as comparison models the work of Horrigan, West, Pogue and Soldofsky [PS] and Pinches and Mingo. They used a total of 424 bonds from the period 1928 to 1939. Financial distress was measured in two ways; (1) default experience and (2) the loss rate (the difference between realized and promised yield).

Their results indicated that the PS model ranked first overall. The Moody's rating came in second. Their conclusions were: (1) that most statistical models, using only published financial data, could do as well as Moody's (which did better than Standard and Poor's), and (2) that there is danger in relying on agency ratings for assessing potential financial distress even for initial offerings.

Belkaoui, 1980

Belkaoui's study gave an economic interpretation for the variables used. However, it turned out that he used variables that a student of the literature would have known. A MDA method was used and the prediction level was about 65%. Belkaoui provides a good summary of previous work.
**Perry, Henderson and Cronan, 1984**

The key issue was whether the use of industry classification would improve prediction ability. It does. They found that the key financial data were (1) liquidity, (2) profitability, (3) size and (4) the long-run averages and variation of these. Statistically, the industry specific models generally produce better results. This seems to support the assertion by the rating agencies that industry variables are important.

**Bond Rating Changes and Bond Prices**

**Katz, 1974**

The issue was whether bond prices react to bond rating changes. Katz used data from electric utility companies for the period 1966 to 1972. The test period was twelve months prior to and five months after a rating change. The study was limited to one industry to provide sample homogeneity. He used a regression process to estimate the expected yield to maturity. This forecast was compared to the actual outcome. The forecast was a function of three variables: (1) time to maturity, (2) total size of issue outstanding, and (3) coupon rate. The conclusion was that there seems to be no anticipation of the rating change and that the full adjustment is not completed until six to ten weeks after the announcement. Katz concludes that this, "... raises
serious questions as to the efficient nature of the bond market.”

**Grier and Katz, 1976**

Grier and Katz's study included both industrial and public utility companies. They tested for a change in bond prices around the rating downgrade announcement (they did not check upgradings). They found that the industrial bond market anticipated a rating being lowered. However, the public utility bond market did not anticipate the downgradings. This implies that markets are segmented.

**Hettenhouse and Sartoris, 1976**

Hettenhouse and Sartoris analyzed the public utilities bond market. Both up and downgradings were examined. Bond rating downgrades were foreseen by the market. It had fully reacted before the announcement. However, bond rating upgrades surprised the market. Adjustments occurred at the announcement date. Unlike the conclusions of Katz (44) and Grier and Katz (34), it appeared that no abnormal profits could be made by a mechanical trading rule. Thus, markets for rating information tend to either anticipate or react immediately.

Their study used a control index to estimate expected return behavior—the index was an average yield on similarly
similarity rated utility bonds. This use of a control index is similar in spirit to Weinstein's work. There was no support for using agency re-ratings as a signal for portfolio rebalancing. Such re-balancing should have already occurred.

**Weinstein, 1977**

Weinstein examined the behavior of bond prices around the announcement of a rating change. The sample consisted of monthly returns on straight debt issues. The data was from July 1962 through July 1974. A risk-adjusted holding period return was used to assess return changes. A portfolio approach was used to estimate predicted returns.

His conclusions were that no significant price reaction occurred around a rating change. There was evidence of a price change in the period -18 to -7 months before, but no evidence was found for the period -6 to 0. This evidence contradicts the work of Katz and Grier and Katz.

Weinstein's work was important in that it attempted to isolate the bond rating change by adjusting for holding period structure and risk differences. His conclusions support the notion of semi-strong form market— the market uses the available information to determine an expectation about the riskiness of bonds (and/or expected return behavior) without Moody's packaging of the information.
Bond Rating Changes, Market Parameters and Stock Prices

The study of bond ratings and stock prices has attempted to answer two questions: (1) do rating changes affect market model parameters for the common stock of affected firms, and (2) do changes affect stock price behavior around the announcement date. This study is primarily concerned with the second question, consequently this section concentrates on the works of Pinches and Singleton (1978) and Griffin and Sanvicente (1982). Other work in this area is reviewed briefly as an introduction.

Melicher and Rush (1974), Schwendiman and Pinches (1975), and Carpenter and Chew (1983) all tested the announcement effect of rating changes on market model parameters of the firm's stock. Melicher and Rush used a 0-1 dummy regression. The 0-1 dummy variable was used to indicate a rating change (1 for change and 0 for no change) and was the independent variable. This was used to explain changes in common stock betas. They found that lower bond ratings were associated with higher common stock betas. Schwendiman and Pinches found similar results.

Carpenter and Chew (1983) in testing "the effects of default risk on the market model" found (1) bond upgradings significantly affected the single index market model (SIMM) estimates, but downgrading did not; (2) the intercept term does not appear to change; (3) beta, the firm's systematic
(3) Beta, the firm's systematic risk, tends to change significantly when bond ratings change. This occurs for both upgradings and downgradings.

(4) Bond upgradings tend to increase a stock's beta and downgradings decrease the stock's beta.

(5) There was no single category of reclassification (A to Aa, etc.) that was more likely to produce changes in the SIMM parameters.

Carpenter and Chew's [CC] fourth finding conflicts with the earlier findings of Schwendiman and Pinches— an inverse relationship between bond rating and firm betas. CC found a positive relationship.

Pinches and Singleton, 1978

Pinches and Singleton [PS] investigated three questions: (1) do bond rating changes possess new information, (2) what is the average rating change lag, and (3) is there a different lag if the rating change is associated with company specific information (rather than no company specific information). Company specific information was defined to be one of four events: the issuance of new debt, the retirement of debt, a merger or a reorganization. Non-company information was the absence of these. PS used the traditional CAR as introduced by FFJR (1969). Their general conclusion is that the market fully anticipates
anticipation occurs well before the re-rating—usually by at least six months.

PS used the market model in log form to estimate expected returns. The log of each company's rate of return is regressed against the log of the return on the market for each period. They use Fisher's link relative (with dividend reinvestment) as the market index. The estimation period is before and after the window—18 months before and 12 months after the event date. The Cumulative Abnormal Residual (CAR) is accumulated over the period -30 to +12 months around the event date. (Note that the initial part of the CAR is over estimation data rather than the forecast period.)

The sample included 207 firms. The sample period was January 1950 to September 1972. The data requirements were: (1) the bond must have been outstanding for at least 18 months before the event, (2) the bond must have remained outstanding at least 12 months after the event, (3) no other change occurred during the period -18 to +12 months around the event, and (4) 79 months of price data were available on the tapes. There were 111 companies with rating upgrades and 96 with rating downgrades. Of the 111 upgrades, 54 had firm specific information associated with these changes, and 57 of the 96 downgrades had such information.
PS's findings indicate that agencies were slower when company specific information was absent. PS suggest that price reactions occurred about two years prior to the rating change when no information was present for rating decreases. However, for the rating downgrades with company specific information, the lag was only about six months. Their conclusion was that the market fully anticipates rating changes. There was, however, a reversal in the CAR after the event date with both types of rating changes.

**Griffin and Sanvicente, 1982**

Griffin and Sanvicente attempted to determine if bond rating changes convey information using three approaches. First, a one factor (market) model was used to estimate the expected returns. Residuals from actual versus predicted returns were used to compute cumulative residuals. Second, a two factor model was constructed which used the Fama-MacBeth least square estimates for the forecast model. The comparison of these estimates with the actual returns provide another method for evaluating potential price effects. The third method estimates the abnormal price adjustment for a given firm in a portfolio as the difference between the actual return and the return on a matched control portfolio. Griffin and Sanvicente generate a cumulative t-test for the portfolio method to test whether
over the interval, -11 to 0, there is significance in the accumulated returns. This cumulative t-test is similar to the Dodd and Warner (1983) method discussed in the methodology section of this paper.

Their test period is the months -11 to 0, where 0 represents the month of the rating change. The estimation period for the single factor model is the months -71 to +12. Average residuals were computed for the period -35 to +12. This estimation period was also used for the two factor model. (Note that the window overlaps the estimation period.) The average residuals for the portfolio tests were constructed from the portfolio differences. Portfolios were tested using linear discriminant analysis to establish similarity of financial profiles before the event.

The results based on the two-factor model and the portfolio return differences indicate that new information is conveyed by bond rating changes. This was particularly true for downgrades. The null was rejected for downgrades for both (1) price adjustments in the month of the announcement, and (2) cumulative price adjustments over the prior eleven months. For bond upgradings, the cumulative test was significant, but the month of the announcement was not. The size of the price adjustment was small. The downgraded firms' rate of return differed from the control sample by only 1.4%. 
The tests with the market model estimates indicate a different story. The test statistics indicate no statistically significant price adjustments. While the mean cumulative residual for downgradings is -.1129 by month zero, the t-statistic is only 1.088. The upgrades had a mean cumulative residual of .0322 by month zero and a t-statistic of .298. Thus the market model tests find no effect around or on the announcement date. Griffin and Sanvicente conclude that, "Future research should be directed to an analysis of daily ... price adjustments."

Summary

The study of bond ratings began as an attempt to ascertain their usefulness when Harold (1938) questioned the varying ratings of the same bonds by the agencies. Studies attempted to determine explanatory variables for the various agency ratings. Later concern was directed to whether bond rating changes affected bond prices. Katz (1974), Grier and Katz (1976), Hettenhouse and Sartoris (1976) and Weinstein all studied bond price reactions. The current conclusion is that the market anticipates the bond rating change and that bond prices do not react around the re-rating.

Pinches and Singleton [PS] (1978) and Griffin and Sanvicente (1982) addressed the linkage of bond changes and stock prices. PS conclude that the market fully anticipates
bond rating changes by the announcement date. However, they did not provide statistical tests of the AR's or of the CAR's. GS found that bond rating changes do provide new information that affects stock prices with two of the approaches used— the two-factor and portfolio tests. However, they find no such effect using market model residuals.

Both of the above studies used monthly data and used a CAR period that partially overlapped the estimation period. Neither study used the forecast error method of estimating the standard error of the forecast for significance. This is the suggested method [Kmenta (1971):240-41 and Dodd and Warner (1983)] when a regression analysis is used. Since there is a conflict in the results of these two studies, a study of this issue with daily data and more rigorous statistical testing could resolve the controversy.

Introductory Review of Empirical Methodology

This section reviews various empirical techniques that have been used to test stock market reaction to bond rating changes. It begins with a review of the original Cumulative Average Residual (CAR) study by Fama, Fisher, Jensen and Roll [FFJR] (1969). They, along with Ball and Brown, introduced residual analysis. The differences in
their approaches is that FFJR accumulate raw average residual for the sample of firms while BB accumulate the residual as a rate of return. The FFJR process assumes that the investors rebalance their portfolio after each period. The BB technique assumes a buy and hold strategy. Both are unbiased estimators of excess returns if the sample is large and randomly selected [Madatesta (1983):160]. Each uses a market model to estimate forecasted returns. Research on stock price reaction to rating changes uses CAR exclusively. Consequently, the discussion will describe only the CAR—excluding BB's Abnormal Performance Index.

After discussing the CAR, and its use by FFJR and PS, the intervention model is reviewed because it attempts to correct some of CAR's deficiencies. The work of Brown and Warner (1980 & 1983) is then considered. Their work suggests that the CAR can be used for event studies of the rating change type. Finally, the work of Griffin and Sanvicente [GS] (1982) and Dodd and Warner [DW] (1983) is reviewed.

GS and DW provide test statistics for the individual excess return of a single day and for cumulative excess returns for various intervals, increasing the precision of information tests. The DW test procedure is used in this study.
The CAR, Fama, Fisher, Jensen, and Roll
and Pinches and Singleton

This section covers the specifics of the FFJR model, its use by Pinches and Singleton, and its potential problems.

Fama, Fisher, Jensen and Roll

FFJR begin by noting two problems in studies of stock splits. First, splits tend to be cyclical—taking place during or shortly after a bull market. Second, one must separate the dividend effect from the split effect.

The study used 940 splits that occurred between January 1927 and December 1959. They used a split sample test. Additionally, they improved event methodology by designing the CAR technique.

FFJR had five main results: (1) Abnormal performance showed as early as 30 months prior to the split. (2) No abnormal performance was found on the split date or following the split. Therefore, by the split date, the market had fully digested the information. (3) Splits tended to follow increased earnings (and increased dividends also followed increased earnings). (4) Those companies with above average dividend increases had positive abnormal returns after the split. (5) Those companies with poor dividends had lower than normal returns and negative abnormal returns after the split. They concluded that markets are efficient.
and suggested that stock splits are used by management as a signaling device.

While FFJR provided information that markets are efficient, their most important contribution was a new method of analyzing excess returns. The CAR has proved to be a durable procedure and is currently still prevalent in the literature. An explanation of the CAR follows.

The Cumulative Average Residual Procedure

The CAR is an arithmetic procedure where the residuals are summed cross-sectionally and then longitudinally. The CAR for period \( t \) is:

\[
\text{CAR}_t = \frac{1}{N} \sum_{i=1}^{N} \sum_{t=1}^{T} e_{it} \tag{3}
\]

where \( e_{it} \) is the excess return for firm \( i \) at time \( t \). \( N \) is the number of firms and \( T \) is the time periods being aggregated. For all companies, the event date is \( t=0 \) even through the calendar time may be different for each company. The CAR can be completed in four steps. First, determine the estimation parameters. This is normally done by using the Ordinary Least Squares (OLS) estimates for the market model. Second, determine the per period excess return estimate. This is the market model residual. Third, sum this estimate of excess return for all companies at event
time \( t \) (i.e., sum all residuals for the 10th day before the event, etc.) This residual sum is commonly called the Average Residual(AR\(_t\)) for time period \( t \). Fourth, sum the AR's across the test period. This is usually done over some number of event days (or weeks etc.) before the event date until some number of days after the event. (However, the test period can have varying test periods as done in Hite and Owers (1983).)

FFJR and PS did not provide statistical tests of either the AR's or the CAR's. Currently it is standard to test the statistical significance of the CAR as well as evaluate the CAR as to excess return earned over the test period [see Griffin and Sanvicente (1982) and Dodd and Warner (1983)].

**Pinches and Singleton, 1978**

PS used essentially the FFJR CAR method. However, they used a log form of the market model running logs of the individual rates of return on logs of the market return. They also provided a Mann-Whitney test of the differences between the AR increases and decreases. There were no statistical tests of the AR's or the CAR's over the entire period or over intervals. This makes it difficult to assess their conclusions which are based on a visual inspection of the CAR. Visual inspection does not give precise information about relative variation. Brown and Warner
(1980:227-231) warn that, "merely looking at a picture of CAR's can easily result in Type I errors."

**Problems with CAR**

A number of potential problems are encountered with the use of the FFJR CAR. Some of these include

1. Model specification
2. Beta instability
3. Serial Correlation of the errors
4. Non-synchronous trading difficulties
5. The need for a statistical test of the AR's
6. The need for a statistical test of the CAR's
7. Non-normality of the data

Each of these problems is addressed below. In general, it appears that the CAR is an efficient and useful test with certain modifications. Griffin and Sanvicente (1982) and Dodd and Warner (1983) provide such extensions. Brown and Warner (1983) provide the answers to the remaining questions.

**The Intervention Model**

The CAR and the API are both subject to OLS assumptions since their residuals are from an OLS equation. Of particular concern is the assumption of non-correlated errors. This can be a significant problem since a t-test
value of 6 can be invalid when autocorrelation is present [Hibbs (1974)]. While this problem could be corrected for within the CAR and API context, there is another. Each of these models assumes that the model parameters remain constant over the estimation and test period. There is evidence [Boness, Chen and Jatusipitak (1974); Sunder (1973); Bar-Yosef and Brown (1977) and Brenner and Smidt (1977)] that betas are not stable. Ignoring beta shifts that might be caused by the event's anticipation or its effect results in potentially serious testing difficulties. Brenner (1977) observed that a change in beta may account for any observed pattern in the residuals around an event date. Thus there would be no evidence of market inefficiency when the beta shift was taken into account.

The Intervention model proposed by Larcker, Gordon, and Pinches (1980) is designed to overcome each of these problems. The general model, based on the work of Box and Tiao (1965 & 1975), is presented in equation (5):

\[ R_t = f(W, \phi) + N_t \]  

(5)

where:  
- \( R_t \) is return on the specific security at time \( t \)  
- \( W \) refers to some set of exogenous variables,  
- \( \phi \) refers to some set of intervention(s), and  
- \( N_t \) refers to the stochastic background noise.
The noise component can be modeled as an autoregressive integrated moving average (ARIMA) process.

The formation of equation (5) allows a number of models to be used to analyze a data series. The approach taken by Larcker, Gordon and Pinches was to construct a dummy variable, regression-testing procedure. Such a procedure allows for the correction of the autocorrelation problem when necessary. The procedure also allows for a shifting beta. The estimation of excess return is done through the use of a dummy variable to ascertain if there is change in the intercept. Their model is as follows.

Consider estimation and testing periods as shown in figure I. The time t-2 to t-1 is the estimation period. This period establishes the comparison intercept for determining excess returns. The testing period has two components: t-1 to t=0 is the pre-announcement of event stage, and t=0 to t+1 is the post-announcement stage. This tests anticipatory and lagging information from the event.

\[ [t-2]------[t-1]------[t=0]------[t+1] \]

Figure 1. Estimation and Testing Period Description
This expanded market model is equation (6).

\[ R_t = a + \beta_1 R_{mt} I[t-2,t-1] + \beta_2 R_{mt} I[t-1,t0] + \beta_3 R_{mt} I[t0,t+1] + \alpha_1 I[t-1,t0] + \alpha_2 I[t0,t+1] + \frac{\theta(B)}{(1-d)^k(b)} e_t. \] (6)

where: \( t-2 \) is the start of the estimation period,
\( \beta_1 \) is the systematic risk in the estimation period; \( \beta_2 \) and \( \beta_3 \) are pre and post-announcement systematic risks,
\( R_{it} \) and \( R_{mt} \) are security and market rates of return in period \( t \),
\( \alpha_1 \) and \( \alpha_2 \) are the changes in the intercept level for the specified periods,
\( I[a,b] \) means that the dummy variable is 1 for the time \( a \) to \( b \), and
\( e_t \) is a random noise component.

The term multiplied times the noise is the autocorrelation adjustment. It is an ARIMA process. If the autocorrelation is of a first order nature, this term can be collapsed into \( 1/(1-k\delta) \) as was done by Larcker, Gordon and Pinches (1980). The last term becomes simply the error \( e_{it} \), if there is no autocorrelation. The Durbin-Watson statistic is commonly used to test for autocorrelation.

The advantage of the intervention model is that it allows for shifts in beta. Thus if the event caused beta to
shift and the return simply adjusted to the new risk level, the intervention model would show no excess return. However under the same circumstances, the CAR and API models would have shown excess returns since they do not correct for changes in beta. Excess return is specified as the change in the intercept in the intervention model. Thus if the intercept changes over the pre-announcement period, \( \alpha_1 \) will be significant. The average level of excess return over the pre-announcement period will be equal to \( \alpha_1 \). The post-announcement period's excess return is measured by \( \alpha_2 \).

While the intervention procedure has the advantage of adjusting for changes in beta, it has two problems. First, the model assumes that beta will change and is so specified. There is no check to determine if such an assumed change is warranted. If such a change is not needed and if there is some variation in the beta value (i.e. beta has a stable mean with some variance), then the intervention model may understate any event effect. The second problem is that intervention presumes that causality goes from beta to return. That is if the rate of return is higher because individuals are buying the stock to take advantage of some good news that will occur, beta will be observed to shift over the test period (perhaps not statistically, but in terms of the intervention model). This shift will result in some of the higher return being explained by the 'shifted'
beta. The model only assumes that beta shifts, it cannot detect whether excess return is causing an apparent beta shift or if the higher beta caused the market to demand higher return.

The above problem with intervention is not the Roll (1977) criticism. Even if there was only one factor and we had an appropriate proxy for the market portfolio, this transitory beta problem could still exist as long as prices are not a deterministic function of the market portfolio. The question is whether there can be transitory non-risk motivated changes in beta. The CAR and the API model serve better if such changes are possible. The CAR and API should be adjusted for autocorrelation before estimating excess returns. Additionally, the researcher should check for beta stability over the estimation, test, and perhaps, post-test periods. This last check for stability can be accomplished while allowing for transitory but statistically insignificant shifts in beta.

The currently preferred methodology is the CAR. Examination of a recent issue of the Journal of Financial Economics (April, 1983) revealed that virtually every article used the CAR. None used intervention analysis. The API is used primarily in accounting research. CAR has the advantage of being statistically testable and can deal with transitory beta changes.
Brown and Warner and Daily Data

Since the estimation of security returns is essential to using event methodology, the goodness of those estimates is critical. Brenner (1979) indicated that different markets models lead to different conclusions. This research was later extended by Brown and Warner (1980) for monthly data. They concluded that the alternative specifications did not greatly affect the conclusions. It also seemed that the simpler models worked as well most of the time. Since much of the current financial research is performed with daily data, Brown and Warner (1983) extended their research. This section concentrates on their conclusions.

Alternative Specifications of excess returns.-- Brown and Warner consider four alternative excess return models. These are listed below:

Raw Returns

\[ A_{it} = R_{it} \]  \hspace{1cm} (7)

Mean Adjusted Returns

\[ A_{it} = R_{it} - k_i \]  \hspace{1cm} (8)

Market Adjusted Returns

\[ A_{it} = R_{it} - R_{mt} \]  \hspace{1cm} (9)

Market Model Residuals

\[ A_{it} = R_{it} - a_i - R_{mt} \]  \hspace{1cm} (10)
where: $A_t^i$ is the excess return, 
$R_{it}$ is the security's actual return for day $t$,  
$k_i$ is the average security return in the sample,  
$R_{mt}$ is the market return,  
is the systematic risk indicator, and  
$a_i$ is the intercept from the market model.

Brown and Warner specifically address two potential difficulties with daily data— non-normality and non-synchronous trading.

Non-normality. -- Evidence generally suggests that the daily return distribution is fat-tailed relative to the normal distribution [Fama (1976)]. However, since daily studies usually concentrate on the cross-sectional means of the sample, the important distribution is that of the means of these samples. The means of such samples can be distributed normally even if the underlying distribution is non-normal. The Central Limit Theorem indicates that if excess returns in the cross section of securities are independently and identically distributed drawings from a distribution with finite variance, the mean excess returns will be distributed normally as the number of securities increases.

Non-synchronous Trading and Systematic Risk Estimation. -- The intercept and slope can be biased and inconsistent when $R_{it}$'s are not measured over the same interval. With daily data there is evidence that this
problem can be severe [Scholes and Williams (1977) and Dimson (1979)]. This problem leads to three concerns. Ruback (1982) has shown that with non-synchronous trading, returns and excess returns can exhibit serial dependence. Second, there can be a cross-sectional dependence in the security-specific excess return measures. (BW also checked to determine if there are any disadvantages to adjustments for this cross-sectional dependence.) Third, there is evidence [Beaver (1968)] that the variance of the stock returns increases for the days immediately around events such as earnings announcements. There is also the potential interaction of all these.

Brown and Warner's Experimental Design.— Abnormal returns were measured with the four models outlined in section IIIA. There were 250 samples of 50 securities constructed. The data was taken from the CRSP tape for July 2, 1962 to December 31, 1979. The test statistic was the ratio of the mean excess return to its estimated standard deviation. BW used real security price data so that their addition of excess return would be to a data series that had the appropriate characteristics. That is the data would have a noise component that is consistent with the noise level encountered in actual financial research. This avoids any problem that simulated data might have.
Results.— In general, there is support for the OLS market model (the market model residual's procedure). Daily data in general results in more powerful tests than do monthly data. BW's specific conclusions are as follows:

1. While there appears to be non-normality in both the daily returns and the daily excess returns, there was evidence that the mean excess return in a cross-section of securities converged to normality as the number of sample securities increased.

2. Standard t-tests for significance of the mean excess return at day 0 were well-specified. The t-tests provided the appropriate probability of Type I error even with only 5 securities and even when the event days were clustered. This conclusion of well-specified applied to a variety of excess return models.

3. The only model that was not well specified in general was the Raw Returns Model. The Raw Returns Model did not have an expected value of approximately zero in the event period. The longer the event period, the more mis-specified the model.

4. Daily data provided tests that had more power than did the monthly data tests. This was particularly true for the Mean Adjusted Returns and the OLS Market Models. The Raw Returns methodology was mis-specified and the Mean Adjusted Returns had low power in event-date clustering cases.

5. The OLS procedure for estimating systematic risk was satisfactory. Procedures other than OLS even in the presence of nonsynchronous trading conveyed no clear cut benefit in detecting abnormal performance. The procedures suggested by Scholes and Williams and of Dimson reduced biases in the OLS estimates of beta, but did not provide better power or specification than did the OLS Market Model. This conclusion also held when the sample securities tended to trade less frequently than average.

6. If the event test involves periods that exceed ten days, it may be important to adjust for autocorrelation. This concern is greatest for securities that trade on the American Stock Exchange.
7. An adjustment for cross-sectional dependence is needed only in special cases. Even then the cost is high. The most common case that needed adjustment was when the test was performed on securities from the same industry. When such adjustments were made, the power was only one-half as good as the non-adjusted case. Additionally, the model's specification was no better than the unadjusted case.

8. Variance increases around the event day have been observed. BW find that under certain circumstances, the hypothesis tests using standard event techniques are mis-specified with such variance increases present. An explanation of this occurrence is that $D_i$, a security's abnormal return conditional on the event is stochastic and that the abnormal return is uncorrelated or positively correlated with $e_{it}$.

The CPE, Griffin and Sanvicente, and Dodd and Warner

Griffin and Sanvicente [GS] (1982) and Dodd and Warner [DW] (1983) used a cumulative t-test in their research. GS used primarily a portfolio approach and cumulative tests conducted on the portfolio return differences. DW used the cumulative t-tests on the cumulative average residuals. Since this is similar to the methodology of this study, their method is explained below. DW applied the technique to mergers (not bond ratings).

The Cumulative Prediction Error procedure [CPE]

The extent of abnormal returns surrounding the event dates is examined. Statistical significance tests are performed both longitudinally and cross-sectionally on both individual company and group data.
Expected returns are estimated with the market model. The event-time methodology used is described in the appendix to Dodd and Warner (1983) and is only briefly described here. For security $j$, the market model is used to calculate the excess return, or prediction error, for event day $t$ as follows:

$$PE_{jt} = R_{jt} - (a_j + \beta_j R_{mt})$$

where $R_{jt}$ is the rate of return on security $j$ for event day $t$, and $R_{mt}$ is the return on the CRSP value-weighted index on event day $t$.

The coefficients $a_j$ and $\beta_j$ are the ordinary least squares estimates of the intercept and slope, respectively, of the market model regression. The parameter estimates are typically from pre-event data and the prediction errors and cumulative prediction errors are for the forecast period only. There is generally no overlap between the event window and the estimation period.

Prediction errors (PE) are calculated over the interval $t = -X$ to $t = +X$ for each firm. $X$ represents the number of periods in the window on each side of the event. The Cumulate Prediction Error (CPE) from event day $T_{1j}$ to event day $T_{2j}$ is defined as

$$CPE_j = \sum_{t=T_{1j}}^{T_{2j}} PE_{jt}.$$

(12)
The accumulation can be over various intervals. Thus $T_{1j}$ and $T_{2j}$ are counters for the desired interval statistics.

For a sample of $N$ securities, the mean cumulative prediction error is defined as

$$\overline{CPE} = \frac{1}{N} \sum_{j=1}^{N} CPE_j . \quad (13)$$

The expected value of the CPE is zero in the absence of abnormal performance. The test statistic described by Dodd-Warner (1983) is the mean standardized cumulative prediction error. To compute this statistic, the $PE_j$ is standardized by its estimated standard deviation $S_j t$.

$$SPE_{jt} = \frac{PE_{jt}}{S_j t} \quad (14)$$

The $S_j t$ is computed as the typical regression forecast error described in econometrics textbooks [e.g. Kmenta (1971):240-241]. This procedure, unlike the standard deviation of the abnormal returns used in some studies [see Davidson (1984) for explanation], explicitly adjusts the standard deviation for the distance away from the mean of the independent variable and is directly associated with the time series standard deviation for each individual firm. Thus the same size prediction error may have different
levels of significance for different firms due to their 'normal' variation. The \( \text{SPE}_{jt} \) is the test statistic for an individual excess return for a specified company.

The standardized cumulative prediction error (\( \text{SCPE}_j \)) over the interval \( t = T_1, \ldots, T_2 \) is

\[
\text{SCPE}_j = \sum_{t=T_1}^{T_2} \text{SPE}_{jt} \div \sqrt{T_2 - T_1 + 1}
\]

The factor \( [T_2 - T_1 + 1] \) is the number of days in the interval tested. The test statistic for a sample of \( N \) securities is

\[
Z = \sum_{j=1}^{N} \text{SCPE}_j \div \sqrt{N}
\]

Each \( \text{SPE}_{jt} \) is assumed to be distributed unit normal in the absence of abnormal performance. Under this assumption, \( Z \) is also unit normal.

A note on terminology and significance testing.— The Cumulative Prediction Error (CPE) that is currently used is the same summation as the CAR or the CER that has been used in the literature. The reason for the distinct terminology is to emphasize that this technique uses the forecast error of the regression to determine the standard error for
study differ from the traditional CAR (sometimes called a CER) methods.

There are at least three methods for estimating the standard error for the t-test: (1) the traditional forecast error from econometrics [Kmenta (1971):240-41. This is the procedure that GS, DW and Malatesta (1983) use.], (2) a time-series estimate of the standard deviation calculated from the AR's in the sample pool [Davidson (1984) provides a detailed explanation of the technique. The disadvantage of this procedure is that the average firm cannot show statistically significant abnormal returns. Thus this would eliminate samples in which the entire population is expected to react to an event.], and (3) there is the procedure developed by Mandelker (1974) and recently used by Asquith (1983). (The procedure is explained in detail by Asquith and will not be explained here; it is similar to Dodd and Warner's except that the estimated standard error is not the regression forecast error.)

Summary

This section reviewed the major empirical techniques used in studying bond rating changes and stock price reactions. Pinches and Singleton (1978) used the FFJR (1969) CAR technique in the first study of such behavior. Brown and Warner (1980 & 1983) answered the relevant
objections to the CAR except for a technique of statistical testing. Griffin and Sanvicente (1982) and Dodd and Warner (1983) provided such a testing procedure. Thus the cumulative residual technique can be used to test for abnormal performance in a market event study with daily data.
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CHAPTER III

METHODOLOGY

Introduction

The research methodology used in this study consists of the following steps:

1. Selecting a sample from all firms that experienced a bond rating change during the period January 1, 1977, to December 31, 1981;

2. Partitioning the sample into bond upgrading and bond downgrading groups for specific hypothesis testing;

3. Using the market model to estimate the return structure of the individual firms;

4. Computing the residuals—substituting market model predicted returns from actual returns;

5. Testing the individual prediction errors for each firm, the average prediction error across firms, and the cumulative prediction errors for all firms during the test period; and

6. Testing differential behavior of the partitioned groups relative to the hypothesis—including the upgrades versus the downgrades and various interval tests within each group.
Hypothesis

The expectation is that markets are efficient and that bond rating changes are at most a confirmation of recent poor or good performance. It is expected that most of any reaction to such performance information will have occurred before the announcement of a rating change. There may be a confirmation effect at or around the announcement date. Formally the null hypothesis is that the conditional and unconditional means of the expected prediction errors ($e_{it}$) are zero regardless of the information.

$$H_0: E(e_{it} | \Psi_{it}) - E(e_{it}) = 0 \text{ for all } \Psi_{it}$$

$$H_1: E(e_{it} | \Psi_{it}) - E(e_{it}) > 0 \text{ for } \Psi_1^{it} \text{ and }$$

$$E(e_{it} | \Psi_{it}) - E(e_{it}) < 0 \text{ for } \Psi_2^{it} .$$

The information is represented by $\Psi$, where $\Psi^1$ is a bond upgrading and $\Psi^2$ is a downgrading. Expected return is from the market model.

Sample Selection

The sample was selected according to the following criteria: (1) the rating change must have been listed in Moody's Bond Survey, and (2) there must have been 381 days of price data on the Chicago Research in Security Prices (CRSP) tapes, specifically 90 days on each side of the announcement and 200 days of estimation data prior to the
test period. (3) There must be no other rating change one year prior or one year after this change. Multiple bond re-ratings are not analyzed in this study.

There are 77 companies that meet these restrictions. There were 46 downgradings and 31 upgradings. These companies are listed in sample listing section.

Empirical Testing

This study uses the ordinary least squares procedure to estimate the single index market model for the companies in the sample. Equation (17) illustrates the model.

\[ R_{it} = \alpha_i + \beta_i (R_{mt}) + \varepsilon_{it} \]  

where:  
- \( R_{it} \) = the return on security \( i \) at time \( t \),  
- \( \alpha_i \) = the constant term for security \( i \)'s equation,  
- \( \beta_i \) = the covariance of the market return with security \( i \)'s return,  
- \( R_{mt} \) = the return of the market at time \( t \), and  
- \( \varepsilon_{it} \) = the error term for company \( i \) at time \( t \).

This model is used to forecast the expected returns during the test period (i.e., the event window). The test period is 90 days on each side of the announcement.

Prediction error is the difference between forecasted and actual rate of return. The t-test is used to determine if the prediction error is statistically significant. The null hypothesis is a prediction error of zero. This test statistic is called the standardized prediction error (SPE).
Equation (18) provides the formula.

\[ \text{SPE} = \frac{\text{PE}}{s} \]  

(18)

where the standard deviation ,s, is the forecast error as shown in equation (19).

\[ s = \left[ 1 + \frac{1}{n} + \frac{(\bar{R}_{mt}^* - R_m)^2}{\sum (\bar{R}_{mt} - \bar{R}_m)^2} \right]^{1/2} \]  

(19)

where: \( R_{mt} \) = the return on the market on day \( t \) 
\( * \) is the event day return) 
\( \bar{R}_m \) = the mean market return for the estimation period.

The standardized mean cumulative prediction error (SCPE) is given in equation (20). It provides the basis for a test of the cumulative residuals.

\[ \overline{\text{SCPE}} = \sum_{t=1}^{T} \frac{\text{SPE}_t}{\sqrt{t}} \]  

(20)

where: \( \overline{\text{SCPE}} \) = the mean sum of the cumulative prediction error, 
\( \text{SPE} \) = standardized prediction error, and 
\( T \) = the number of days in the cumulation.

The test statistic for a sample of \( N \) securities is:

\[ Z = \sum_{j=1}^{N} \frac{\overline{\text{SCPE}_j}}{\sqrt{N}} \]  

(21)

To illustrate the process, consider the information in Table II. The test of the interval -90 to 0 requires 4
steps:

(1) Calculate the SPE (given in Table II for convenience).

\[ \text{SPE} = -543.99 \]

(2) Compute the mean \( \overline{\text{SCPE}} \).

\[
\overline{\text{SCPE}} = \frac{\text{SPE}}{\# \text{ days}}
\]
\[ = \frac{-543.99}{91} = -57.03 \]

(3) Standardize for the number of companies to provide a z statistic.

\[ z = \frac{57}{23} = 11.89 \]

(4) Compare the z statistic with the table value to determine the significance level. The z-value for the intervals -35 to -34 and -10 to 0 are -14.79 and -13.24. The significance of these statistics are found in Kmenta (1971) and are .001 in both cases.

**TABLE II**

CPE Raw Statistical Data

<table>
<thead>
<tr>
<th>DAY</th>
<th>PE</th>
<th>SPE</th>
<th>CPE</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>-90</td>
<td>-0.00081</td>
<td>-0.00081</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>-35</td>
<td>-0.0160</td>
<td>-231.62</td>
<td>-0.138</td>
<td>23</td>
</tr>
<tr>
<td>-34</td>
<td>-0.0424</td>
<td>-302.57</td>
<td>-0.181</td>
<td>23</td>
</tr>
<tr>
<td>-10</td>
<td>+0.0013</td>
<td>-343.25</td>
<td>-0.193</td>
<td>23</td>
</tr>
<tr>
<td>0</td>
<td>-0.0171</td>
<td>-601.96</td>
<td>-0.323</td>
<td>23</td>
</tr>
</tbody>
</table>

The cumulative prediction error technique illustrates the test procedure for this study. It was most recently used by Dodd and Warner (1983) and Hite and Owers (1983). This procedure has the advantage that a cumulative cross-sectional and cumulative longitudinal prediction error can be tested. Thus this procedure provides a more precise examination of the data than previous research. This is important in that it allows the testing of individual company daily excess residuals and groups of excess residuals for various sample sub-groups.

The proportion test will also be used to determine if the number of sample firms that are positive (or negative) is significantly different from 50%. This is the standard binomial test where the expected mean is 50% and the actual proportion is subtracted from the expected. This is standardized by dividing by the standard deviation (the square root of npq where n is the number of trials, p the proportion expected, and the q the proportion not expected). For large samples, the test statistic is distributed normally. This is important in that it allow us to determine if any reaction is a general occurrence or one caused by a small subset of the general sample. Thus if both the CPE test and the proportion tests are significant, more confidence is achieved that new information is present.
SAMPLE LISTING

The companies that are included in this study are listed in this section. The total sample size is 77. Those companies with insufficient data listed on the CRSP tapes and those with multiple changes in the estimation and test periods are not used in this study.

The 31 upgrade companies are

Alaska Airlines Inc.
Ampex Corp.
Arizona Public Service
Atlantic Richfield Co.
Baker International
Bristol-Myers
Consolidated Edison Co. of N.Y.
Consolidated Freightways Inc.
Continental Telecom. Corp.
Data Products Corp.
Dresser Inds Inc.
E-Systems Inc.
Fairchild Industries
Grace (W.R.) & Co.
Iowa Beef Processors Inc.
Iowa Electric Light & Power
Lifemark Corp.
Litton Industries Inc.
Matsushita Electric Industries
Mohawk Data Sciences Corp.
Orange & Rockland Utilities, Inc.
Parker-Hannifin Corp.
Ralston Purina Company
Raytheon Company
Revlon Incorporated
Savannah Electric & Power
Sierra Pacific Power Co.
Soo Line Railroad Company
Texas Eastern Transmission Corp.
Wometco Enterprises, Inc.
The 46 downgrade companies are listed below:

Allied Products Corp.
Allis Chalmers
Arlin Realty & Development Corp.
Armstrong Rubber
Avery Int'l Corp.
Bankers Trust NY
Beneficial Corp.
Bethlehem Steel
Champion Spark Plug
Continental Airlines
Diamond Int'l Corp.
Duquesne Light Company
Fibreboard Corp.
Fisher Foods Inc.
General Motors Corp.
Genesco Inc.
Georgia Pacific Corp.
Gulf States Utilities
Hershey Foods
Idaho Power Company
Inco Ltd.
Inland Steel Company
International Harvester Corp.
Ipco Corporation
Kane Miller Corp.
Keystone Consolidated Industries
Long Island Light
Louisville Gas & Electric Co.
Lowenstein (M.) Corp.
McGraw Edison Company
Murphy (G.C.) & Company
National Homes
New York Electric & Gas
Outboard Marine
Quacker State Oil
Reichhold Chemicals
Sears Roebuck & Company
Sybron Corp.
Texfi Inds Inc.
UNC Resources Inc.
Union Corp.
Union Electric Company
Vendo Company
Western Airlines
Woolworth (F.W.) Company
CHAPTER BIBLIOGRAPHY


CHAPTER IV

TEST RESULTS

Introduction

This chapter presents the results of the investigation of stock price reaction to bond rating changes. The results indicate that stock prices generally react around bond rating change announcements. This reaction was found to be statistically significant for both upgrades and downgrades. Both the CPE interval tests and the proportion tests indicate that new information is present. This is a stronger finding than that of Griffin and Sanvicente (1982) [GS] and contradicts the findings of Pinches and Singleton (1978) [PS]. The stronger outcomes appear to result from the increased power due to the use of daily data and the improved precision of the forecast error procedure—PS and GS used monthly data and did not use the forecast error as an estimate of the standard deviation.

PS found that the market fully anticipated bond rating changes. However, they indicated that there were reversals in the direction of the CAR's after announcements. They did not perform a statistical test of the reversals or of the cumulative residuals. GS found that rating changes provide information. For upgrades, the cumulative test by month 0
was significant, but the announcement month itself was not. The CAR, in the GS study, for the upgrades was .0322 (with a t of .298). For downgrades, the CAR was -.1129 (with a t of 1.088) by the month of the announcement. While GS's market model residual results do not support the contention that new information is present, their matched portfolio tests do—especially for downgrades.

The results of this study provide stronger evidence that new information is conveyed to the market. The CPE by announcement day is 0.036 for the upgrades (with a t of 1.056). Similarly to GS, the cumulative residuals of the upgrades are not statistically significant at normal research thresholds. However, the CPEs did reverse around the announcement day as PS observed. (GS provided no information on this in their study.) Further, the reversal was statistically significant for the upgrades. From day 1 to day 10, the CPE is -.028 (with a test statistic of -3.85). There appears to be a negative reaction to the announcement. The size of the negative reaction does not fully offset the previous cumulative gain. Additionally, the negative reaction is partially offset by the residuals from day 11 to day 90. The CPE for the period 1 to 90 is only -.009 and its test statistic is only -.676.

The downgrade results provide statistically significant support for inferring that bond rating changes convey new
information. The cumulative residuals from day -90 to day 0 are statistically significant as is the individual residual for t=0. The CPE by announcement day is -.1196 (with a test statistic of -4.335). The announcement day CPE is -.006 (with a test statistic of -2.310). The intervals -90, -60 and -30 to 0 were all found to be statistically significant at the 5% level for both parametric and non-parametric tests. The PE for the interval -1 to 0 and the PE for t=0 were both statistically significant with parametric tests. There is a reversal in the residual pattern after the announcement, but it is not statistically significant. From day 1 to 90, the CPE is .022 (with a test statistic of 0.603). All other intervals (that were checked) in the post-announcement period also had non-significant CPEs (at the 5% level). These results indicate that bond rating changes have a significant impact of stock prices around the announcement date. This is contrary to PS's conclusions (but not necessarily with their results) and offers stronger evidence of an informational effect than was reported by GS.

A question remains as to why upgrades would have a statistically significant negative impact immediately after announcement. While statistically significant, this reversal is not economically significant, i.e., it would not support a trading strategy that would overcome minimal transactions costs.
Review of the CPE Picture

As Brown and Warner (1980) warned, it can be misleading to base decisions on a visual display alone. However, the graphs of the CPE (Figures 2 and 3) offer a context for discussing the various interval statistics. Figure 2 provides the graph of the upgrades and Figure 3 is for the downgrades.

Upgrade Results

As shown in Figure 2, the upgrades appear to exhibit more volatility than the downgrades. The upward drift seems to begin its climb at about day -48. The last ten days before the announcement seem to have a strong positive drift. There is a strong reversal in the CPE from day 0 to day +11. However, most of this reversal movement is recouped by day +90.

Table III provides interval statistics for the upgrades. This allows more precise evaluation of the residual movements. There are four important intervals—the -48 to -38 period, the -38 to 0, the day 0 period, and the day 1 to day 10 period. The main positive drift occurs in the -48 to -38 period and is statistically significant. However, the periods immediately prior to the announcement are not significant. The period day 1 to day 10 has a
Figure 2. Cumulative Prediction Errors around Bond Upgrades
Figure 3. Cumulative Prediction Errors around Bond Downgrades
-2.8% return and a test statistic of -3.85. Thus the primary reaction around a bond upgrading is the significant reversal in excess return immediately after the announcement. If someone bought companies based on the bond upgrading and held the company for 90 days, the results would be disappointing. The 90 day excess return is -.009.

The ZP in Table III is the proportion test of whether the number of positives is different from 50%. The proportion statistic supports the inference that there is information in the period 1 to 10 of the test period.

**TABLE III**

CPE Upgrade Intervals

<table>
<thead>
<tr>
<th>Day(s)</th>
<th>CPE</th>
<th>Test Stat</th>
<th>N</th>
<th>Pos</th>
<th>Neg</th>
<th>ZP</th>
</tr>
</thead>
<tbody>
<tr>
<td>-90,0</td>
<td>0.036</td>
<td>1.056</td>
<td>31</td>
<td>17</td>
<td>14</td>
<td>0.539</td>
</tr>
<tr>
<td>-48,-38</td>
<td>0.037</td>
<td>3.800</td>
<td>31</td>
<td>26</td>
<td>5</td>
<td>3.772</td>
</tr>
<tr>
<td>-30,0</td>
<td>0.005</td>
<td>0.494</td>
<td>31</td>
<td>16</td>
<td>15</td>
<td>0.180</td>
</tr>
<tr>
<td>-10,0</td>
<td>0.002</td>
<td>0.537</td>
<td>31</td>
<td>19</td>
<td>12</td>
<td>1.257</td>
</tr>
<tr>
<td>-1,0</td>
<td>-0.001</td>
<td>-0.436</td>
<td>31</td>
<td>13</td>
<td>18</td>
<td>-0.898</td>
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<td>0,0</td>
<td>-0.002</td>
<td>-0.010</td>
<td>31</td>
<td>12</td>
<td>19</td>
<td>-1.257</td>
</tr>
<tr>
<td>1,10</td>
<td>-0.028</td>
<td>-3.846</td>
<td>31</td>
<td>6</td>
<td>25</td>
<td>-3.413</td>
</tr>
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<td>1,90</td>
<td>-0.009</td>
<td>-0.676</td>
<td>31</td>
<td>13</td>
<td>18</td>
<td>-0.898</td>
</tr>
</tbody>
</table>

**Downgrade Results**

Figure 3 shows that the downward drift in prediction errors begins early in the accumulation period. By day -61, the CPE is -.0435. There is a marked drop from day -20 to
zero. The CPE from zero until +90 exhibits an upward but statistically insignificant drift. Day 0 itself appears to have a sharp downward movement.

Table IV shows the interval test information for bond downgrades. Three outcomes are important. First, all of the intervals before the announcement that are presented are statistically significant (at the 5% level or better). Second, the announcement day return is significant. Third, there are no intervals that statistically have excess return after the announcement even though there is a reversal in the CPE.

**TABLE IV**

**CPE Downgrade Intervals**

<table>
<thead>
<tr>
<th>Day(s)</th>
<th>CPE</th>
<th>Test Stat</th>
<th>N</th>
<th>Pos</th>
<th>Neg</th>
<th>ZP</th>
</tr>
</thead>
<tbody>
<tr>
<td>-90,0</td>
<td>-0.120</td>
<td>-4.313</td>
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<td>11</td>
<td>35</td>
<td>-3.539</td>
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<td>-30,0</td>
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<td>-2.843</td>
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<td>16</td>
<td>30</td>
<td>-2.064</td>
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<td>-10,0</td>
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<td>46</td>
<td>20</td>
<td>26</td>
<td>-0.885</td>
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<td>-1.180</td>
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<td>-2.310</td>
<td>46</td>
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<td>0.994</td>
<td>46</td>
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<td>0.603</td>
<td>46</td>
<td>26</td>
<td>20</td>
<td>0.885</td>
</tr>
</tbody>
</table>

**Individual Company Information**

**Upgrades**

Table V provides CPE data on individual upgrade companies for various intervals. This information indicates
that the reversals after the announcement date is a general occurrence. Twenty-five of the thirty-one companies have negative CPE's for the interval day 1 to 10. The number of individual companies with positive CPE's for the interval -90 to 0 is not decisive. It appears that the overall positive CPE for the interval from day -90 to 0 is greatly influenced by a few companies with large CPE's. The only interval around day 0 that has a proportion test that is significant is the period day 1 to 10.

**Downgrades**

Table VI provides individual company information on the downgrades. There is a wide variation of both positive and negative CPE's. No individual firms seems to have a pronounced effect on the overall CPE for any interval. The announcement date PE's indicate that information is probably provided by the bond downgrading. The proportion test (Table IV) also indicates that the periods prior to the event seem to be statistically negative. However, the day 0 proportion test is not significant even through the CPE is statistically significant. Table VI shows that the companies with negative PEs have a larger average magnitude than the positive PE companies.
<table>
<thead>
<tr>
<th>Company</th>
<th>Intervals</th>
</tr>
</thead>
<tbody>
<tr>
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<td>-30,0</td>
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<tr>
<td>Alaska Airlines</td>
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<td>Apex Corp</td>
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<td>Arizona Pub Svc Co</td>
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</tr>
<tr>
<td>Atlantic Richfield</td>
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</tr>
<tr>
<td>Baker Intl Corp</td>
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</tr>
<tr>
<td>Bristol Myers Co</td>
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</tr>
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<td>Consolidated Ed</td>
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<td>Continental Tele</td>
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<td>Dataproducts Corp</td>
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</tr>
<tr>
<td>Dresser Industries</td>
<td>0.011</td>
</tr>
<tr>
<td>E Systems Inc</td>
<td>0.233</td>
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<td>Fairchild Inds</td>
<td>-0.006</td>
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</tr>
<tr>
<td>Iowa Beef Processors</td>
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<tr>
<td>Iowa Elec Lt &amp; Pwr</td>
<td>-0.044</td>
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<tr>
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<td>0.067</td>
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<tr>
<td>Litton Inds Inc</td>
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<tr>
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</tr>
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<td>Savannah Ele &amp; Pwr</td>
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<td>Sierra Pac Pwr</td>
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</tr>
<tr>
<td>Soo Line Railroad</td>
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<tr>
<td>Texas Eastn Corp</td>
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<td>0.001</td>
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TABLE VI
Individual Company Downgrade Interval Data

<table>
<thead>
<tr>
<th>Company</th>
<th>-90.0</th>
<th>-30.0</th>
<th>-10.0</th>
<th>-1.0</th>
<th>0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allied Prods Corp</td>
<td>-0.186</td>
<td>-0.156</td>
<td>-0.070</td>
<td>-0.031</td>
<td>-0.007</td>
</tr>
<tr>
<td>Allis Chalmers</td>
<td>-0.252</td>
<td>-0.090</td>
<td>-0.122</td>
<td>-0.067</td>
<td>-0.025</td>
</tr>
<tr>
<td>Arlin Rty &amp; Dev</td>
<td>0.343</td>
<td>-0.108</td>
<td>0.150</td>
<td>-0.039</td>
<td>0.002</td>
</tr>
<tr>
<td>Armstrong Rubber</td>
<td>-0.026</td>
<td>0.045</td>
<td>-0.017</td>
<td>-0.024</td>
<td>-0.001</td>
</tr>
<tr>
<td>Avery Intl Corp</td>
<td>0.046</td>
<td>-0.045</td>
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<td>0.035</td>
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<td>-0.025</td>
<td>-0.011</td>
<td>-0.012</td>
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</tr>
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<td>-0.010</td>
<td>-0.083</td>
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<td>Bethlehem Steel</td>
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</tr>
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<td>-0.041</td>
<td>-0.022</td>
</tr>
<tr>
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<td>-0.022</td>
<td>0.104</td>
<td>0.016</td>
<td>-0.009</td>
<td>-0.008</td>
</tr>
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<td>0.012</td>
</tr>
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<td>Fisher Foods Inc</td>
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<td>-0.063</td>
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<td>General Motors</td>
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<td>Genesco Inc</td>
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<td>-0.033</td>
<td>0.192</td>
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<td>Georgia Pac Corp</td>
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<td>Gulf Sts Utils</td>
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<td>0.009</td>
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<td>-0.023</td>
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<tr>
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<td>-0.016</td>
<td>-0.032</td>
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<tr>
<td>Inco Ltd</td>
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<td>0.014</td>
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<td>International Harv</td>
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<td>0.006</td>
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<td>Louisville Gas &amp; El</td>
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<td>-0.043</td>
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<td>Murphy G C &amp; Co</td>
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<td>National Homes</td>
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<td>0.027</td>
<td>-0.036</td>
<td>-0.091</td>
<td>-0.047</td>
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<tr>
<td>New York El &amp; Gas</td>
<td>-0.238</td>
<td>-0.104</td>
<td>-0.066</td>
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<td>Outboard Marine</td>
<td>-0.109</td>
<td>0.264</td>
<td>0.001</td>
<td>-0.048</td>
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<td>Quaker State Oil</td>
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<td>Reichhold Chems</td>
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<td>-0.023</td>
<td>-0.053</td>
<td>-0.001</td>
<td>0.005</td>
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<tr>
<td>Sears Roebuck &amp; Co</td>
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<td>-0.070</td>
<td>0.016</td>
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<td>-0.009</td>
</tr>
<tr>
<td>Sun Chemical Co</td>
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<td>0.046</td>
<td>0.050</td>
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<td>0.011</td>
</tr>
<tr>
<td>Sybron Corp</td>
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<td>0.041</td>
<td>0.039</td>
<td>-0.000</td>
<td>0.004</td>
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<tr>
<td>Texfi Inds Inc</td>
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<td>-0.074</td>
<td>0.056</td>
<td>0.053</td>
<td>0.052</td>
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<tr>
<td>UNC Res Inc</td>
<td>-0.109</td>
<td>0.024</td>
<td>-0.105</td>
<td>-0.017</td>
<td>-0.056</td>
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<tr>
<td>Union Corp</td>
<td>0.234</td>
<td>0.091</td>
<td>0.086</td>
<td>0.042</td>
<td>0.070</td>
</tr>
<tr>
<td>Union Elect Co</td>
<td>-0.039</td>
<td>0.052</td>
<td>0.001</td>
<td>0.018</td>
<td>0.005</td>
</tr>
<tr>
<td>Vendo Company</td>
<td>0.014</td>
<td>0.006</td>
<td>0.002</td>
<td>0.026</td>
<td>0.002</td>
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<td>Western Airlines</td>
<td>-0.575</td>
<td>-0.242</td>
<td>-0.163</td>
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<td>0.002</td>
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<td>Woolworth F W Co</td>
<td>-0.331</td>
<td>-0.130</td>
<td>-0.089</td>
<td>-0.004</td>
<td>-0.029</td>
</tr>
</tbody>
</table>
Autocorrelation and Runs Tests

For the entire sample, only two companies have a Durbin-Watson [DW] test that indicates the presence of autocorrelation at the 1% level. Allis Chalmers's data indicates a positive autocorrelation and National Homes's data indicates the presence of negative autocorrelation. Both of these firms were in the downgrade sample. Three other companies had a DW statistic in the questionable zone. A correction for autocorrelation is not needed. Thus confidence in the reported test statistics is high.

The companies that had significant runs test statistics are given in Tables VII and VIII. An interesting outcome is that all the significant t-tests for the downgrades had a positive sign.

TABLE VII
Upgrade Companies With Significant Runs Tests

<table>
<thead>
<tr>
<th>Company</th>
<th>Runs Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continental Tele Comm</td>
<td>3.20</td>
</tr>
<tr>
<td>Dresser Inds Inc</td>
<td>-2.43</td>
</tr>
<tr>
<td>Fairchild Inds Inc</td>
<td>-2.25</td>
</tr>
<tr>
<td>Iowa Beef Processors</td>
<td>2.87</td>
</tr>
<tr>
<td>Litton Industries</td>
<td>-2.51</td>
</tr>
<tr>
<td>Orange &amp; Rockland</td>
<td>2.21</td>
</tr>
<tr>
<td>Savannah Elec &amp; Pwr Co</td>
<td>2.07</td>
</tr>
<tr>
<td>Sierra Pacific Pwr Co</td>
<td>2.75</td>
</tr>
</tbody>
</table>
TABLE VIII

Downgrade Companies with Significant Runs Test

<table>
<thead>
<tr>
<th>Company</th>
<th>Runs Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulf States Utilities</td>
<td>2.61</td>
</tr>
<tr>
<td>IPCO Corporation</td>
<td>2.21</td>
</tr>
<tr>
<td>Murphy (G.C.) &amp; Company</td>
<td>2.62</td>
</tr>
<tr>
<td>National Homes Corp</td>
<td>3.36</td>
</tr>
<tr>
<td>N.Y. State Elec &amp; Gas</td>
<td>1.97</td>
</tr>
<tr>
<td>Sybron Corporation</td>
<td>2.33</td>
</tr>
<tr>
<td>Union Corporation</td>
<td>2.62</td>
</tr>
<tr>
<td>Vendo Company</td>
<td>2.01</td>
</tr>
</tbody>
</table>

Summary

The results indicate that the announcement by Moody's of a bond rating change has informational content. The market was found to react statistically on the day of the announcement for downgrades and during the first week to ten days following the upgrade announcement. This supports the results of Griffin and Sanvicente (1982) and contradicts the conclusions of Pinches and Singleton (1978). While, the differences in outcomes could be due to a different test period and a different methodology, both this study and the PS study found drifting before the event and strong reversals in the cumulative residuals after the announcement. The positive significance tests may be due to more precise measurement of the event using daily data.
CHAPTER BIBLIOGRAPHY


CHAPTER V

SUMMARY

The topic of bond rating prediction has been extensively studied. Chapter II provides a review of the major studies. The general conclusion is that a majority of the ratings can be predicted by academic models [Hawkins et al. (1983)]. In particular, Ang and Patel concluded that Pogue and Soldofsky's model outperformed the agencies' models in predicting financial distress. This questions the usefulness of agency ratings.

The impact of bond rating changes on stock prices has been less studied. There are only two studies—Pinches and Singleton [PS] (1978) and Griffin and Sanvicente [GS] (1982); their conclusions differ. PS conclude that the market fully anticipated any bond rating change. GS conclude that the re-rating is new information and affects stock prices—particularly for bond downgradings.

Each of these studies uses monthly data. Brown and Warner (1980 & 83) indicate that, in general, more powerful event studies can be attained with daily data. GS conclude that, "Future research should be directed to an analysis of daily ... price adjustments."
This study, using daily data and the cumulative prediction error technique, finds that bond re-rating offer new information. The cumulative prediction errors for the downgrades are statistically significant for the intervals day -90, -60, -30, and -10 to day 0. The announcement day itself also is statistically significant. This indicates that the market uses Moody's rating information. The upgrades show a statistically significant increase in their CPE in the period day -48 to -38. There are no other significant intervals prior to the announcement day. However, the upgrades reverse their cumulative residuals from day 1 to 10 in a statistically significant manner.

Although the announcement day CPE is statistically significant for the downgrades, it is not economically significant. The CPE reversals for the upgrades will not support minimal transaction costs and disappear over the interval day 12 to 90. This study concludes that there is information in rating changes, but it does not support a trading strategy that would allow excess returns. The conclusion is that Moody's provides a useful service and that the market is efficient.

Limitations

This study is limited by the inherent nature of social science research. It is not possible to perform a study in which all variables except bond rating changes are constant.
Additionally, the results may be time period specific. The study, however, does provide evidence that some of the studied behavior is general in nature (at least for the time periods studied). First, this study finds reversals in the cumulative residuals after re-rating announcements as did PS. Second, the drift and general pattern of the cumulative residuals are similar to those of PS. Third, the reported results are similar to those of GS except that they are statistically stronger. This was expected in that daily data provides more precise information.

**Implications for Future Research**

Even with this encouragement, caution must be exercised given the imprecision of current statistical tools. Numerous questions remain unanswered. First, why do the residuals reverse after the re-rating? Second, is there a different reaction to the announcement of the re-rating in Moody's Bond Survey than that of Moody's announcement to the media. The effective date (announcement to media) is usually about three days before the Survey publication. This study used the Survey publication date. The efficient market hypothesis would suggest that most reaction should be on the media announcement date. Third, is Moody's or Standard and Poor's more efficient in bond re-rating— which does the market value more? Fourth, is there a change in the volume of activity around re-ratings? Fifth, does the
market react differently when a company has experienced multiple re-ratings in a short time period?

Conclusions

The general conclusion of this research is that Moody's offers a useful service since the market has a statistically significant reaction around re-rating announcements. Further, the results support market efficiency in the semi-strong form since an economic profit could not be made on the announcements even with minimal transaction costs. The traditional caveats are in order with regards to interpretation of statistical studies of economic phenomenon.
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Unpublished Materials

