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INDUSTRY-SPECIFIC CHARACTERISTICS
OF CYCLICAL VARIATIONS IN THE YIELD STRUCTURE
OF CORPORATE BONDS

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ABSTRACT

INDUSTRY-SPECIFIC CHARACTERISTICS
OF CYCLICAL VARIATIONS IN THE YIELD STRUCTURE
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By
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This research examines the relationship between changes in corporate bond risk premiums and changes in macroeconomic factors representing expected default and call risk in the aggregate. The analysis focuses on three primary hypotheses: (i) that changes in corporate bond risk premiums are related to changes in the selected economic variables, (ii) that the strength of the observed relationships increases as the rated quality of the bond portfolios decreases, and (iii) that characteristics of the relationship between changes in the yield spreads and changes in the selected economic factors are not homogeneous with respect to the industry classification of the issuer. The study is composed of two major divisions. Both employ OLS regression methodology and covariance analysis are employed with all variables defined in terms of a percentage change between two consecutive time points to control for serial correlation.

The first division employs a traditional data set using popular yield indexes as proxies for corporate and

government bond yields. Industry-rating groups are defined in broad terms by Moody's four categories of yield series (Industrial, Average Corporate, Utilities, and Rails; Aaa to Baa ratings). Technical problems inherent in the use of these series are discussed. The results are consistent with the above hypotheses.

The second division employs original portfolio risk premium series constructed for ten narrowly-defined industry groups using individual bond data to reduce the technical problems inherent in broad-based yield series. The data sample contains quarterly observations from 1974 to 1986. Portfolio risk premiums are defined as the difference between the average yield of a corporate bond portfolio and the yield on a U.S. Treasury bond of equal duration. Risk premium series are compiled through a procedure which minimizes technical inconsistencies across portfolios.

The major conclusions are (1) that significant portions of the variability of risk premiums can be explained by movements in simple macroeconomic variables, particularly the Index of Leading Indicators and the Consumer Price Index, and (2) the behavior of bond risk premiums with respect to these factors is not homogeneous across industry-rating groups.

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1. INTRODUCTION

1.1 Overview

This research centers on an examination of the relationship between changes in the risk premiums of corporate bonds and changes in specific economic variables representing expected default risk and expected call risk.

The analysis focuses on the acquisition and interpretation of empirical evidence with respect to three hypotheses, stated as follows:

- Ia) Changes in Corporate-Government bond yield spreads are related to changes in the selected economic variables.
- Ib) The strength of the observed relationships increases as the rated quality of the dependent variable bond index decreases.
- Ic) Characteristics of the relationship between changes in the yield spreads and changes in the selected economic factors are not homogeneous with respect to the business classification of the issuer.

The study is divided into two major stages. Stage I uses a traditional approach with methodology that is similar to previous studies in the general subject area. For this stage of the analysis, corporate bond yields are proxied by Moody's Corporate Bond Yield Series. Issuer categories are defined in a broad sense by Moody's four categories of yield series; Industrial, Average Corporate, Utilities, and Rails. Industry/rating groups are defined in terms of these four issuer categories and Moody's Aaa to Baa rating classifications. The yield on government bonds is proxied by Standard and Poor's Long-Maturity Government Bond Index. For Stage I analysis, the yield spread is defined as the difference between the nominal yield quoted for Moody's yield series for a given rating and issuer category and the nominal yield quoted for the S&P Government Index at the same point in time. The nature of the relationship between changes in the corporate-government yield spreads and changes in selected economic factors is explored through a number of test procedures which will be described in later sections.

Stage II analysis takes a more refined approach in order to correct for technical problems that are inherent in the yield indexes used in Stage I analysis. Risk premium series are constructed for portfolios of bonds of narrowly-defined industry/rating classes using price/yield data for individual bonds. The risk premium for each bond

is defined as the difference between the average yield of the corporate portfolio and the yield on a U.S. Treasury bond of equal duration. Risk premium series for each issuer/rating group are compiled using a procedure which minimizes technical and structural differences between the groups. Stage I analysis procedures are repeated using the more precise Stage II data, and the results are compared.

The Stage I data sample is composed of quarterly observations spanning the period 1969.Q1 to 1984.Q4 . The Stage II data sample is composed of quarterly observations spanning the period 1973.Q4 to 1986.Q1 .

1.2 Theoretical Background

This study is primarily concerned with cyclical variations in the yield spreads of corporate bonds. The occurrence and behavior of such cyclical variations would be expected to be associated with two primary types of influences: (1) cyclical variations in investors' perceptions of the default risk of issuers, and (2) cyclical variations in investors' expectations regarding the risk of call.

Economic fluctuations would be expected to influence the default risk of issuers by affecting the level and volatility of corporate cash flows, demand for output, the marginal cost of capital, and many other elements of the business environment. Therefore, the actual level of default risk associated with a particular firm would be expected to vary over the business cycle.¹

However, all types of issuers would not be expected to exhibit identical responses to changes in economic conditions. Cyclical changes in default risk would be expected to have industry-specific components since the timing and degree of adjustment in firm-specific factors in response to economic changes need not be identical across issuer categories.

The actual default risk of a given issuer would be expected to change over the business cycle for a number of

reasons. During an economic contraction, cash flows would have a tendency to deteriorate or at least become more uncertain, thus increasing the uncertainty associated with the firm's ability to service its debt obligations. The severity of this cash flow deterioration would not be expected to be constant across issuer categories since the factors that influence the level and volatility of cash flows are not necessarily homogeneous across industries. Many differences exist in price and cost structures among different industries. The income-elasticity of demand for the firm's products would not be expected to be constant across industries, thus contributing to differential cash flow behavior with respect to economic fluctuations. Differences in the timing of peaks and troughs in the cash flow cycle could also produce industry-specific characteristics in the cyclical behavior of yield spreads.

For example, airlines are typically characterized by high levels of operating and financial leverage along with (recently) high output price volatility and a highly elastic demand function (with respect to both output price and income). Consequently, small changes in revenues are associated with large changes in operating cash flows. Therefore, the default risk of airlines would be expected to increase rapidly during a contractionary phase as the volatility of sales and cash flows increases.

Public utilities are also characterized by high operating leverage, but the input and output price structure of utilities is generally more stable than that of the airlines. In addition, the demand function for utilities should be less elastic with respect to income and price. Consequently, cash flow deterioration for utilities would be expected to be less severe (and much more predictable) during economic contractions than for airlines. Therefore, the default risk of the average utility would be expected to increase at a much slower rate than that of the average airline during a contractionary phase.

It is important to note that, for the purposes of this study, it is not important whether the actual default risk of a given issuer or issuer category varies over the business cycle. Rather, it is only necessary that investors' perception of expected default risk varies with respect to a given issuer/rating category, since it is investors' perceptions and expectations that directly determine bond yields and, hence, yield spreads.

Cyclical variations in expected risk of call could also produce cyclical movement in the risk premium. Since lower (higher) interest rates imply a higher (lower) value for the early call of bond issue, call-risk premiums are expected to vary inversely with expected interest rates. While interest rate cycles and business cycles are not necessarily concurrent, there has been a high level of

correspondence between the two cycles in recent times.² Since the value associated with a bond call is not dependent on the industry of the issuer, there is no reason to expect any industry-specific characteristics in the behavior of the call-risk premium over the business or interest rate cycle.

Even so, it is important to include a consideration of call-risk factors in the present study since such factors constitute a potential source of noise in the data which could obscure important movements in the yield spread series related to cyclical variations in expected default risk. The consideration of expected call risk is accomplished through the inclusion of independent variables representing interest rate expectations. These variables will be discussed in the following section.

The cyclical variation in yield spreads may be influenced by other factors, although such factors and their influences are beyond the scope of the current study. For example, it has been suggested that investors' risk/return utility functions may exhibit cyclical variation. It would be reasonable to assume that investors' risk/return preferences may vary over the business cycle due to variation in the level of uncertainty associated with expectations regarding such things as personal income and reinvestment rates. The risk/return preference function of the average investor would therefore be expected to reflect a higher

degree of risk aversion during contractionary phases of the business cycle and a lower degree of risk aversion during expansionary phases. Given an efficient frontier that is stable across the economic cycle, an increase in risk aversion implies an adjustment in the optimal portfolio toward lower portfolio risk. Thus, during a contractionary phase the demand for low-risk (high-risk) bonds would be expected to increase (decrease) relative to the demand for equivalent bonds during an expansionary phase. Assuming a stable supply of bonds of the various risk levels, this cyclical adjustment in demand would be expected to produce a pattern of cyclical variation in the price spread between high and low risk bonds and thus a contracyclical variation in yield spreads.³

Liquidity factors could also contribute to the contracyclical variation in yield spreads.⁴ If the average investor assigns a higher utility to liquidity during contractionary phases relative to stable or expansionary phases, then the demand for low-risk and Treasury bonds would be expected to increase relative to less liquid investments, thus amplifying the demand adjustment discussed in the preceding paragraph.

Cyclical variations in the utility functions and liquidity preferences of investors would be expected to contribute to wider yield spreads during contractions and narrower yield spreads during expansions.

However, cyclical variations in investors' utility functions, considered in isolation, would be expected to produce homogeneous yield-spread adjustments across issuer categories (i.e. industrial classifications). That is, assuming constant relative default risk for like-rated bonds (regardless of industry) over the business cycle, there is no reason to expect that these yield spread adjustments would exhibit any industry-specific characteristics.

On the other hand, if the default risk of like-rated bonds varies over the business cycle, and if the timing and/or degree of the variation is not homogeneous across industries, then the cyclical utility and liquidity-preference function adjustments could tend to amplify the yield spread adjustments produced by variations in expected default.

If the degree of response to a change in cyclical factors is not homogeneous for all bonds of similar risk, but instead varies with the industry of the issuer, then it is possible that the bond investor could develop sophisticated trading strategies to take advantage of temporary pricing discrepancies and expected yield adjustments. More complete information concerning the relationship between short-term price volatility and economic variations would enhance the investor's decision environment and contribute to better decisions concerning the timing of buy/sell

decisions in order to achieve the desired level of price volatility. This information would also be of value in the development of corporate strategies concerned with the timing of new bond issues in order to take advantage of yield fluctuations resulting from current or expected economic conditions. The information would also contribute to better pricing strategies (and therefore reduced underwriting risk) for investment bankers due to more complete knowledge of the responsiveness of a particular industry's yield structure to economic changes. Institutional lenders would value more complete industry-specific information with respect to yield-spread volatility for its contribution to better hedging strategies.

Researchers should find the information to be useful in efforts to develop a comprehensive model of bond yields, as well as in the development of arbitrage and hedging strategies with industry-specific components. Also, the introduction of more appropriate yield series and risk premium measures will contribute to more reliable empirical results in related research endeavors.

1.3 Empirical Background

A detailed review of the methodology and findings of the previous studies that are most closely related to this subject area is provided in Appendix D. The following paragraphs will provide a more limited summary.

Previous research has produced evidence that, in general, tends to support the three hypotheses stated above. However, the methodology of most previous studies has involved input data for the dependent variables that is based on broadly-defined yield indexes (such as Moody's Industrial, Average Corporate, and Utility Bond Indexes) rather than actual portfolios of individual bond issues. The use of such broad-based indexes can involve significant empirical problems, as will be discussed later in this introduction and throughout the paper. Included among these problems is the inability to compare observed relationships across specific issuer categories to test for industry-specific characteristics in the relationships.

Since industry-specific bond data has not been readily available in the past, research concerning the determinants of bond risk premiums has produced relatively little information regarding the impact of the industry classification of the bond issuer on the relationship between bond risk premiums and various determinant factors.

However, information regarding industry-specific characteristics in the behavior of risk premiums is potentially of great value to portfolio managers, corporate issuers, and investment bankers for the reasons cited above.

Silvers (1973) studied the cyclical behavior of investors' assessments of expected default risk and reported a strong cyclical component in expected default risk.⁵

Cook and Hendershott (1978), Kidwell and Koch (1982), and Kidwell and Trzcinka (1979) also report evidence that yield spreads vary contracyclically.⁶ Jaffee (1975) studied cyclical variations in yield spreads using Moody's yield series (Average Corporate, Industrials, Utilities, Rails; Aaa to Baa). His results showed the strength of the relationship between the level of the selected cyclical variables and the concurrent magnitude of the yield spreads to be greater for the utility series than the industrial series, and weakest for rails.⁷ Ferri (1978) studied cyclical variations in yield spreads using Moody's A-rated seasoned yield series for Industrials and Utilities. He found the behavior of the utility-government and the industrial-government yield spreads to differ over the business cycle, but concluded that this difference was due to differences in call risk rather than differences in expected default risk.⁸

With the exception of Silvers (1973), these studies employed bond indexes or averages in the computation of the yield or yield-spread series to be used as the dependent variable. The empirical usefulness of such indexes is questionable unless the composition of the indexes does not vary significantly over economic cycles. Compositional stability insures that a change in the observed value of the dependent variable reflects an actual change in the yield spreads of the bonds represented by the index rather than reflecting a change in the composition of the index resulting from the addition and/or deletion of bonds from the index roster. The indexes used to produce the yield series should also be free of technical or computational dissimilarities which can result in random or spurious movement in the dependent variable.⁹

Moody's Corporate Bond Indexes (segregated by rating) are frequently chosen for such studies because it is generally acknowledged that their computational and compositional characteristics are more stable over time than other prepared indexes of this type. Cohan (1973) presented evidence that Moody's rating is not adjusted for short-run economic variations.¹⁰ This implies that the roster of bonds included in the yield series of a bond of a particular rating is quite consistent over time, since the rating of the individual bonds included in the index is relatively stable. Thus, changes in the level of the

indexes should be attributable to changes in the average yield of a relatively stable group of bonds over time. This reasoning is adopted for the current analysis as justification for the use of Moody's Indexes, although it is recognized that the indexes are not perfect measures. The assumption here is simply that they are the best alternative among the readily available measures.¹¹

Studies which involve a comparison of estimated relationships across risk classes often choose Moody's yield series as the basis for the dependent variable under the assumption that the rating system is able to separate bonds into groups of different relative default risk with a reasonable degree of accuracy and consistency over time. In other words, the rating is not assumed to provide an absolute measure of default risk, but rather a relative measure of risk viewed with respect to other risky bonds. This assumption was stated concisely by Jaffee (1975):

We assume that Moody's classifications are accurate in the sense that at any moment in time they accurately separate bonds into differential risk categories. We do not assume, however, that the risk associated with any given category remains constant over the business cycle.¹²

Studies concerned with the determination of factors which influence Moody's ratings have generally lent credibility to this assumption.

As in the Jaffee study, the empirical analysis performed in this section focuses on the possibility that the risk of the bonds in a particular rating category may exhibit cyclical variation, and that the characteristics of this variation may be significantly different from bonds of other rating classifications. It would be expected that a bond of relatively high risk would exhibit a greater change in the risk premium in response to changes in economic expectations than a bond of lower risk. That is, the expected default risk of a low-risk bond may be virtually unaffected by changes in economic conditions while the expected default risk for a high-risk bond should be quite sensitive to economic changes since such changes would be expected to have a greater impact on the high-risk issuer as compared to low-risk issuers.

The relevant question, then, is how risky must the bonds be before their perceived default risk is affected by variations in economic conditions? An examination of this question is difficult when a traditional definition of the dependent variable is employed¹³ since the magnitude of the corporate-government yield spread decreases as the focus of attention moves from lower to higher rating categories, thus reducing the absolute magnitude of the variation in

the dependent variable. Such limited volatility in the dependent variable hinders the ability of the regression model to associate variation in the dependent variable with variation in the independent variables.

This problem should be less troublesome in the current study since the dependent variable is defined as the percentage change in the corporate-government yield spread (in Stage I analysis) or the percentage change in the corporate risk premium (in Stage II analysis) between two consecutive time points. Thus, small absolute changes in yield spreads of low risk bonds would result in relatively large percentage changes.

1.4 Overview of Data Sources

1.4.1 Stage I Dependent Variables:

The yields of corporate bonds of different industry-rating groups are represented by Moody's Corporate Bond Yield Indexes, as reported in Moody's Bond Survey. These yield series are based on bonds of four broad issuer categories (Industrials, Average Corporate, Utilities, and Rails) with each category divided into four rating classifications (Aaa - Baa).¹⁴

The yields of Treasury bonds are represented by the quoted yields for Standard and Poor's Long-Maturity Government Bond index. This index was chosen as the proxy for the risk-free rate in the traditional analysis because the average maturity of the member bonds (usually between 12 and 14 years) most closely matches the average maturity of the corporate bonds included in Moody's corporate bond yield series.

Reported quotes for all series are monthly averages of the yields of member bonds. This study uses quarterly observations (represented as the quoted monthly averages for March, June, September, and December) spanning the period 1969.Q1 to 1984.Q4.

1.4.2 Stage II Dependent Variables:

Stage II analysis is based on specially compiled original risk premium series which are representative of specific industry/rating classes of issuers. These series are computed from quarterly price data for individual bonds spanning the period 1973.Q4 to 1986.Q2.¹⁵

The input database includes corporate straight-debenture bonds outstanding at some time during the period between 9-30-73 and 3-31-86. All bonds are issued by domestic or Canadian companies and are denominated in U.S. dollars. Issuers must be listed in the Value-Line Investment Survey, and must be categorized by Value-Line as belonging to one of the following primary business activity (i.e. industry) classifications:

- | | |
|-----------------------------|---------------------------|
| 1. Aerospace | 6. Petroleum Producing |
| 2. Auto/Truck Manufacturers | 7. Air Transportation |
| 3. Computers/Electronics | 8. Retail Stores |
| 4. Forest Products | 9. Agricultural Equipment |
| 5. Metals/Mining | 10. Electric Utilities |

These industry classifications were chosen so as to represent both new and mature industries with high and low growth characteristics and a wide variety of risk levels.

Previous studies concerning the cyclical variation of risk premiums have not focused on risk premiums of specific industry groups, but rather have dealt with broadly defined issuer classes as represented by the popular yield indexes. By focusing attention on specific industry classes, this study seeks to determine whether the relationship between the selected economic variables and bond risk premiums differs with respect to the industrial classification of the issuer.

In addition to the general selection criteria discussed above, the homogeneity of the bond sample is further prescribed by the following set of requirements:

- a) The bond must be listed in Moody's Bond Survey and Moody's Bond Record. These references are the common source of much information pertaining to each bond.
- b) The bond must be callable.
- c) The bond must be subject to a sinking fund requirement.
- d) The bond must have been originally sold at approximately par value (i.e. original deep-discount bonds are excluded).
- e) The bond must be fully taxable.
- f) The bond must have been issued at least one year prior to the date of inclusion in the sample to eliminate any "seasoning" effect.

- h) The bond must not be convertible. Convertible bonds on which the convertability provision has expired are acceptable.

The bonds of each of the ten industry classifications (listed above) are subdivided into the following three risk categories based on Moody's quality rating:

Rate Group 1: High Grade (Aaa - Aa)

Rate Group 2: Medium Grade (A - Baa)

Rate Group 3: Low Grade (Below Baa)

Thus, each sample group contains bonds that are mutually similar with respect to the principle business activity of the issuer and the risk of the issue. In large part, the bonds within a given portfolio differ only in terms of bond-specific and firm-specific characteristics such as debt ratio, firm size, coupon rate, size of issue, etc.

The exclusion of original deep-discount bonds from the sample avoids many tax-related complications without producing a serious constraint on sample size. Specifically, deep-discount bonds have a built-in tax advantage from the preferential tax-treatment of capital gains as the discount is amortized over the life of the bond. In addition, such bonds possess built-in call protection (relative to other

bonds) since the low coupon rate requires the market (refunding) rate to drop to a very low level before refunding is economically justified. The exclusion of such bonds from the sample is necessary in order to preserve the homogeneity of the bonds within each industry/rating group.

Intra-group homogeneity is further controlled by the requirements that all bonds are callable and subject to a sinking fund provision. These requirements are not overly restrictive with respect to the sample size since corporate debentures without call or sinking fund provisions are rare.

Individual bonds were deleted from the sample one year prior to maturity to reduce the effects of price fluctuations attributable to short maturity and related factors.

Bonds that are in default and trading flat are also excluded from the sample since the quoted price is generally the result of dealers' subjective assessments of value rather than a market-determined value based on current transactions. Consequently, these bonds will generally show no change in price over long periods of time.

The actual selection and screening process for the individual bonds proceeded as follows. First, the Value-Line II database was screened for all companies that were listed within each of the ten selected classifications. These companies were checked for debenture issues that were outstanding during the 1973-1986 period and conformed to

the selection criteria listed above. CUSIP numbers were obtained for as many of the qualified bonds as possible.¹⁶ Using these CUSIP numbers, price quotes were obtained for each bond from Data Resources, Inc., Chicago. Bonds which did not exist in the DRI database were excluded from the sample. Price quotes are the ask price for the last trading day of each calendar quarter. The resulting data set was checked against Moody's Bond Record for accuracy and completeness. If errors or inconsistencies were observed in the price data for any bond, it was deleted from the database.

For each bond remaining in the sample after prices were obtained and checked, ratings were obtained for each quarterly time point using Moody's Bond Record as the source. This information was used to compose portfolios for each industry/rating group at each time point. Specifically, each individual portfolio (ijt) is composed of all bonds in the sample at time (t) with industry classification (i) and rate group classification (j). Thus, the composition of the portfolio for industry/rating group (ij) varies slightly over time as individual bonds enter and leave the sample due to issues, expirations, and rating changes.

The quarterly risk-premium series are computed using these portfolios as inputs. The specific computational procedure is described in detail in the next section. The

individual bonds included in the final database are listed and described in Appendix B.

1.4.3 Independent Variables:

All independent variables will be discussed specifically in later sections of this paper. Economic Data is obtained from series published in the Business Conditions Digest in either monthly or quarterly form. If published in monthly form, quarterly observations are represented as the monthly figures for March, June, September, and December. Observations span the sample period 1969.Q1 to 1986.Q2 .

1.5 Major Contributions

Previous research concerning factors which influence bond yields and yield spreads has been primarily concentrated in two broad areas: (1) exploration of the effects of bond-specific and firm-specific factors on corporate bond yields and yield spreads using bond portfolios or indexes of broadly-defined business activity classifications (i.e. industrial, utility, or government), and (2) exploration of the effects of general economic factors and bond-specific factors (such as term to maturity, coupon rate, and duration) on the yields of risk-free Treasury bonds.

The current study differs from previous research in the following important ways:

- 1) Narrowly-defined issuer categories.

Since changes in economic conditions would not be expected to exert identical influences on the yields of bonds of different industry categories, as discussed in the previous section, it is quite possible that important differences exist in the sensitivity of the risk premiums of bonds of dissimilar industries to changes in certain economic factors. Most studies that have compared the

behavior of bond yields or yield spreads across industries have done so using only broadly-defined bond indexes such as Moody's popular bond yield series. Such studies have provided evidence that is consistent with the hypothesis that the characteristics of the relationship between bond yields or yield spreads and cyclical economic factors are not completely homogeneous across industries.¹⁷

However, very little specific evidence has been presented concerning how the sensitivity of bond risk premiums to economic factors compares across issuer categories.

In response to this gap in information, the current study examines the behavior of corporate bond risk premiums within narrowly-defined industry classifications. The objective is to determine how the nature of the issuer's primary business activity affects the sensitivity of the risk premium to changes in certain general economic factors.

- 2) An examination of the effects of selected economic factors on the risk premiums of bonds of dissimilar industries and rating categories.

Investors' expectations regarding future economic conditions may affect their assessment of expected default risk or expected call risk. If the average investor has optimistic expectations concerning general economic

conditions in the near future, then that investor's expectations concerning the default risk of the average corporate bond should reflect a declining probability of default since an improvement in general economic conditions would be expected to be reflected in improved corporate performance, thus improving the corporation's cash flows and ability to cover debt obligations as they come due. On the other hand, if a recession is expected then the average corporation would be expected to have an increasing probability of default as sales recede and cash flows diminish in relation to fixed debt obligations.

Various studies have found evidence that would tend to support such a hypothesis.¹⁸ Therefore, the economic factors that should be most closely related to default risk are those that are indicative of the economic cycle.

Although changes in investor expectations concerning future economic conditions and interest rates would be expected to be reflected primarily in the risk-free portion of the bond yield, (and consequently their effects would be filtered out in the calculation of the risk premium), it is possible that a residual effect exists which influences the risk premium, also.

This study seeks evidence that is consistent with the existence of such a residual effect, and tests for the consistency of the effect across industry/rating classifications. This question is addressed specifically through a

comparison of the estimated regression coefficients (of selected cyclical variables) across narrowly-defined issuer categories to determine whether significant response differences exist, and if so, to rank the industries with respect to the strength of the response. The consistency of the ranking over time is also examined by dividing the data sample into two time subsamples representing the first and second halves of the full sample time period.

- 3) The origination of new yield-spread series for narrowly defined issuer classifications which are technically and structurally standardized and are based on a matching of risky and riskless bonds by duration instead of term to maturity.

The yield series are composed of quarterly observations spanning the period 1973.Q4 to 1986.Q1. This time period includes major swings in the inflation rate, general interest rates, common stock indexes, the price of gold and oil, the relative strength of the U.S. dollar and other currencies, and economic activity in general. The sample period encompasses many economic shocks that could have affected investors' risk preferences and assessments. Examples of such shocks include the Arab oil embargo in 1974, the resignation of President Nixon in 1974, the end of the

Vietnam War, the switch in Federal Reserve policy in 1979, and the advent of Reaganomics in 1981. This level of economic volatility provides an environment that is highly conducive to an exploration of the cyclical behavior of yield spreads.

Traditional studies of risk premiums or yield spreads most frequently define the dependent variable as the difference between the yield on the risky bond and the yield on a riskless (Treasury) bond of identical maturity. This definition ignores differences in the "matched" bonds which can have a major impact on their relative yields. Such differences can include the coupon rate and the duration of the bonds, among other things. These differences, if not recognized, constitute a potential source of noise and spurious movement in the yield spread series which can seriously hinder the dependable interpretation of empirical results.

In the second stage of the current study, original yield-spread series are calculated using a procedure which produces risk premiums by matching the corporate and Treasury bonds by duration. Matching on the basis of duration effectively incorporates all three of the major issue characteristics which affect yields; i.e. coupon rate, term to maturity, and duration. This procedure results in a set of risk premium series which are standardized with respect to

technical and structural composition. This procedure is discussed in detail in a later section of this paper.

ENDNOTES

1. Thomas R. Atkinson. Trends in Corporate Bond Quality (New York: National Bureau of Economic Research, 1967). Studied actual default rates through 1965 and found a high correlation between actual default experience and the economic cycle.

James C. Van Horn. Financial Market Rates and Flows, 2nd ed. (New Jersey: Prentice-Hall, Inc. 1984), 182. Emphasizes the relationship between default risk and the economic cycle: "If Atkinson were extended into the 1970's and 1980's, I am sure that the incidence of corporate bankruptcies would have increased... Moreover, the number of bankruptcies increased during the three recessions -- 1970, 1974-75, and 1981-82. Particularly, in the last recession, the combination of hard economic times and high interest rates caused many a company to succumb. The bankruptcy courts sagged under an unprecedented case load."

2. Evidence to this effect was presented by Philip Cagan, "The Influence of Interest Rates on the Duration of Business Cycles," included in Gutenberg and Cagan, eds. Essays on Interest Rates, Vol. 1. (New York: National Bureau of Economic Research, Columbia University Press, 1969). Cagan found six business cycles for which there were no significant interest rate cycles in the first half of the present century. In more recent years, however, the association has been much more dependable. Cagan suggests that the improved correspondence may be attributable to more reliable economic data in more recent periods.
3. The cyclical utility function argument was presented in James C. Van Horn. Financial Market Rates and Flows, 2nd ed. (New Jersey: Prentice-Hall, Inc. 1984) p. 182.
4. J.R. Hicks. Value and Capital, 2nd ed. (London: Oxford University Press, 1946). Argued that forward rates are biased estimators of future rates due to the presence of a liquidity premium in forward rates. The liquidity premium would be expected to increase with the term of the bond for two reasons: (1) The interest-rate elasticity of a bond's price increases with the term of the bond. Under the assumption that the average investor prefers to lend short rather than long due to the lower

price volatility of short maturity bonds, the demand function for bonds should be biased toward short maturities. Thus, long-maturity bonds would require an extra yield incentive to compensate investors for the liquidity foregone. (2) The maturity preference of the average borrower would be expected to tend toward long maturity bonds in order to smooth out cash flow requirements over time and to reduce the risk associated with principle repayments and rollover interest rates. Such a borrower preference would tend to bias the supply function toward long-maturity bonds. Hicks suggested that there is a "constitutional weakness" at the longer maturities (high supply relative to low demand) and that investors must therefore demand (and borrowers must pay) an extra yield premium to compensate the investor for the greater price volatility and lower liquidity.

5. J.B. Silvers. "An Alternative to the Yield Spread as a Measure of Risk," Journal of Finance 28(Sep 1973), 933-955.

6. Timothy Q. Cook and Patrick H. Hendershott. "The Impact of Taxes, Risk, and Relative Security Supplies on Interest Rate Differentials", Journal of Finance 33(Sept 1978), 1173-1186.

D. S. Kidwell and T. W. Koch. "The Behavior of the Interest Rate Differential Between Tax-Exempt Revenue and General Obligation Bonds", Journal of Finance 37(Mar 1982), 73-85.

David S. Kidwell and Charles S. Tzcinka. "The Risk Structure of Interest Rates and the Penn Central Crisis", Journal of Finance 34(June 1979), 751-760.

7. Dwight M. Jaffee. "Cyclical Variations in the Risk Structure of Interest Rates," Journal of Monetary Economics 1(1975), 309-325.
8. Michael G. Ferri. "An Empirical Examination of the Determinants of Bond Yield Spreads," Financial Management 7(Aut 78), 40-46.

9. Such technical problems are discussed in detail in a later section of this paper. Technical influences are particularly troublesome in many of the popular indexes of government bond yields.
10. Avery B. Cohan. The Risk Structure of Interest Rates. (General Learning Press, 1973).
11. Stage II of this study is based on yield series that are computed in such a way as to minimize the effects of technical factors, and thus represent a significant improvement over the previously available yield series for studies of this type.
12. Op. cit., page 310. Also, Hickman (1958), Pogue and Soldofsky (1969), and Pinches and Mingo (1973) have reported evidence that Moody's ratings exhibit a strong relationship with firm-specific factors generally associated with creditworthiness and financial health.
13. Meaning that the dependent variables are based on the simple quoted levels of popular yield indexes.

14. The Aaa Rail index was suspended early in the sample period. Consequently, there are 15 industry/rating groups represented by the yield series rather than 16 groups.
15. Prices for individual bonds were obtained from Data Resources, Inc., Chicago. The DRI database was the most complete that the author could locate. The earliest data in the database is 4th quarter, 1973.
16. CUSIP numbers for bonds which have not yet matured were obtained from the MICROQUOTE database on Compuserve Information Service, Inc. Accurate CUSIPS for bonds that have matured are extremely difficult to obtain. Consequently, the final sample of bonds is heavily weighted toward bond issues that had not yet matured as of January, 1986.
17. In these studies, "industry" has most often been defined in terms of a broadly-defined yield series, such as Moody's series for Average Corporate, Industrials, Utilities, and Rails (ratings Aaa to Baa). Thus, evidence concerning the cyclical variation in bond yields for more narrowly defined issuer classifications has heretofore been unavailable.

For example, see:

Dwight M. Jaffee. "Cyclical Variations in the Risk Structure of Interest Rates," Journal of Monetary Economics 1(1975), 309-325. Jaffee studied cyclical variations in yield spreads using Moody's yield series (Average Corporate, Industrials, Utilities, Rails; Aaa to Baa). His results showed the strength of the relationship between cyclical variables and yield spreads to be greater for the utility series than the industrial series, and weakest for rails.

Michael G. Ferri. "An Empirical Examination of the Determinants of Bond Yield Spreads," Financial Management 7(Aut 78), 40-46. Studied cyclical variations in yield spreads using Moody's A-rated seasoned yield series for Industrials and Utilities. He found the behavior of the utility-government spread to have a stronger relationship to cyclical factors than the industrial-government yield spread.

18. Actually, the related studies can be divided into two groups: those that study actual default experience and those that study the behavior of yield spreads (which reflect the risk perceptions of the average investor).

Thomas R. Atkinson. Trends in Corporate Bond Quality (New York: National Bureau of Economic Research, 1967). Concluded that actual default experience was highly correlated with the economic cycle. This was a refined extension of previous studies by Hickman (1958) and Fraine and Mills (1961), both of which reported similar results.

J.B. Silvers. "An Alternative to the Yield Spread as a Measure of Risk," *Journal of Finance* 28(Sep 1973), 933-955. Used certainty equivalent factors to study the cyclical behavior of investors' default risk assessments. Found a strong cyclical relationship.

Cook and Hendershott (1978), Kidwell and Koch (1982), Kidwell and Trzcinka (1979), Jaffee (1975), and Ferri (1978) also report evidence that yield spreads vary contracyclically.

2. EMPIRICAL TESTING

2.1 Summary of Hypotheses and Expected Results

The current research centers on an examination of the relationship between changes in the risk premiums of corporate bonds and changes in specific economic variables representing expected default risk and expected call risk.

The analysis focuses on the acquisition and interpretation of empirical evidence with respect to three hypotheses, stated as follows:

- Ia) Changes in Corporate-Government bond yield spreads are related to changes in the selected economic variables.
- Ib) The strength of the observed relationships increases as the rated quality of the dependent variable bond index decreases.
- Ic) Characteristics of the relationship between changes in the yield spreads and changes in the selected economic factors are not homogeneous with respect to the business classification of the issuer.

This study is primarily concerned with cyclical variations in the yield spreads of corporate bonds. The theoretical and empirical motivation for these hypotheses was discussed in some detail in the previous section.¹ For the convenience of the reader, a brief summary of that discussion will be provided here.

Cyclical variations in bond risk premiums would be expected to be associated with two primary types of influences: (1) cyclical variations in investors' perceptions of the default risk of issuers, and (2) cyclical variations in investors' expectations regarding the risk of call.

Cyclical economic fluctuations would be expected to influence both the actual and expected default risk of issuers by affecting the level and volatility of corporate cash flows, demand for output, the marginal cost of capital, and many other elements of the business environment. Since all types of issuers would not be expected to be equally and simultaneously affected by changes in economic conditions, changes in default risk resulting from changes in economic conditions would be expected to have industry-specific components.

Cyclical variations in the actual and/or expected risk of call would also be expected to produce cyclical variations in bond risk premiums. Since lower (higher) interest rates imply a higher (lower) value for the early call of bond issue, call-risk premiums are expected to vary

inversely with expected interest rates. Since the value associated with a bond call is not dependent on the industry of the issuer, there is no reason to expect any industry-specific characteristics in the behavior of the call-risk premium over the business or interest rate cycle. Call risk factors are included in the study as a control for the effects of variations in the risk premium that are attributable to variations in call risk. The consideration of expected call risk is accomplished through the inclusion of independent variables representing interest rate expectations. These independent variables will be described in Section 2.2.2.

A detailed review of the methodology and findings of the previous studies that are most closely related to this subject area is provided in Appendix D. The following paragraphs will provide a more limited summary.

Previous research has produced evidence that, in general, tends to support the three hypotheses stated above.

Silvers (1973) studied the cyclical behavior of investors' assessments of expected default risk and reported a strong cyclical component in expected default risk.² Cook and Hendershott (1978), Kidwell and Koch (1982), and Kidwell and Trzcinka (1979) also report evidence that yield spreads vary contracyclically.³ Jaffee (1975) studied cyclical variations in yield spreads using Moody's yield

series (Average Corporate, Industrials, Utilities, Rails; Aaa to Baa). His results showed the strength of the relationship between the level of the selected cyclical variables and the concurrent magnitude of the yield spreads to be greater for the utility series than the industrial series, and weakest for rails.⁴ Ferri (1978) studied cyclical variations in yield spreads using Moody's A-rated seasoned yield series for Industrials and Utilities. He found the behavior of the utility-government and the industrial-government yield spreads to differ over the business cycle, but concluded that this difference was due to differences in call risk rather than differences in expected default risk.⁵

Considering the results of previous research and the theoretical considerations discussed previously, it is expected that the analysis carried out in this dissertation will produce evidence in support of the hypotheses stated above.

ENDNOTES

1. See Section 1; pages 1 - 16.
 2. J.B. Silvers. "An Alternative to the Yield Spread as a Measure of Risk," Journal of Finance 28(Sep 1973), 933-955.
 3. Timothy Q. Cook and Patrick H. Hendershott. "The Impact of Taxes, Risk, and Relative Security Supplies on Interest Rate Differentials", Journal of Finance 33(Sept 1978), 1173-1186.
- D. S. Kidwell and T. W. Koch. "The Behavior of the Interest Rate Differential Between Tax-Exempt Revenue and General Obligation Bonds", Journal of Finance 37(Mar 1982), 73-85.
- David S. Kidwell and Charles S. Tzcinka. "The Risk Structure of Interest Rates and the Penn Central Crisis", Journal of Finance 34(June 1979), 751-760.

4. Dwight M. Jaffee. "Cyclical Variations in the Risk Structure of Interest Rates," Journal of Monetary Economics 1(1975), 309-325.
5. Michael G. Ferri. "An Empirical Examination of the Determinants of Bond Yield Spreads," Financial Management 7(Aut 78), 40-46.

2.2 Data Description and Variable Definitions

2.2.1 Dependent Variables

The term "bond risk premium" does not have a standard or generally accepted technical definition in the related literature, although a theoretical definition is less elusive. The theoretical bond risk premium is generally defined as the difference between the nominal yields to maturity of a risky and riskless bond that are identical in all aspects other than risk (i.e. identical maturity date, coupon rate, taxability, and callability). Unfortunately, it is extremely difficult to translate the theoretical definition into a useful or empirically feasible technical definition for research purposes.

In studies involving an examination of the determinants of individual bond risk premiums, the dependent variable has frequently been defined as the difference between the yield to maturity of a risky bond and the yield to maturity of a riskless (Treasury) bond of equal maturity, ignoring other distinguishing aspects of the two bonds.¹ Although this definition is convenient in terms of data availability and computational complexity, it poses serious problems concerning the reliable interpretation of empirical results. For example, this definition allows the "matched"

bonds in the risky/riskless pair to have different coupon rates and durations at the same point in time. The magnitudes of these differences can vary considerably over time. Such temporal inconsistency produces fluctuations in the dependent variable that do not reflect actual changes in the risk premium, but are merely technical noise. This noise, if not filtered from the data, reduces the efficiency of the estimated regression coefficients and may produce bias in the estimated parameters. In addition, the traditional definition makes it impossible to accurately assess the sensitivity of risk premiums to differences in coupon rates and duration since the integrity of these two dimensions has not been controlled in the dependent variable.

The most useful definition of "risk premium" for the purposes of this or similar studies would involve matching the risky and riskless bonds on as many dimensions as possible. Three dimensions are of principle importance in the context of such studies: duration, coupon rate, and term to maturity. Obviously, a pair of risky and riskless bonds cannot be matched on all three dimensions, since matching any two dimensions precludes a match in the third. Consequently, it is necessary to select the most appropriate dimension(s) for the match.

Buse² showed that the expected yield to maturity of a riskless bond, calculated in a manner that reflects expected one-period forward rates, depends not only on the shape of the yield curve and the implied forward rates, but also on the size of the coupon payments. This "coupon effect" is positive (larger coupon is associated with higher yield) if the yield curve is downward sloping and negative if the yield curve is upward sloping. The rate of change in the yield should decrease as the size of the coupon increases. These arguments are based entirely on the mathematics of the yield calculations. Robichek and Niebuhr³ showed that even if the yield curve is flat, bonds of equal risk and maturity but different coupon rates can have different yields due to the differential taxation of coupon and terminal payments. Issues of differential taxation are also addressed in Cook and Hendershott⁴ and Caks⁵.

Term to maturity has a clear positive relationship to the volatility of bond prices with respect to changes in market yields. This is a mathematical artifact of the discounted cash flow computation as it applies to bond yields. In addition, term to maturity has been shown to be positively associated with the systematic risk of bonds.⁶

Numerous studies have presented evidence that duration is closely related to both the price volatility and systematic risk of bonds.

For example, Hopewell and Kaufman⁷ showed that the price volatility of a bond is a linear function of its duration and changes in the yield structure:

$$\delta P/P = -D \delta r$$

where: P = Market Price
 D = Duration
 r = Market Rate

Livingston⁸ related the Duration of a particular bond to systematic risk through the use of the market average duration:

$$\beta_{it} = \left[\frac{D_{it}}{D_{mt}} \right] \left[\frac{\text{Cov}(dr_{it}, dr_{mt})}{\text{Var}(dr_{mt})} \right]$$

where: D_{it} = duration of bond (i) at time (t).
 D_{mt} = market average duration at time (t).
 r_{it} = market yield on bond (i) at time (t).
 r_{mt} = market average yield at time (t).

Boquist, Racette, and Schlarbaum⁹ extended this model to show that the systematic risk of a bond is critically dependent on the bond's duration:

$$\beta_{it} = -D \cdot \left[\frac{\text{Cov}(dr_{mt}, R_{mt})}{\text{Var}(R_{mt})} \right]$$

where: $R_{mt} = \frac{dv_m}{v_m}$ at time (t).

v_m = Value of the market portfolio at time (t).

McEnally and Ferri¹⁰ tested the relationship between the bond Beta and a number of bond specific factors including duration, coupon, and term to maturity. They concluded that coupon rate and term to maturity together account for much of the variability in the bond Beta, but that duration was a superior predictor variable.

As stated previously, while all three dimensions (coupon rate, term to maturity, and duration) have important influences on bond yields, is not possible to match the risky/riskless bond pairs in all three. Even an attempt to match the pairs on any two dimensions would be a task of

monumental proportions, and would undoubtedly result in a seriously limited sample size.

In time series studies concerned with the volatility of risk premiums with respect to selected factors, the dimension of principle importance is duration since the price volatility of a bond is a linear function of its duration and changes in the yield structure, as described above.¹¹ Therefore, if a risky bond of a given duration is paired with a riskless bond of a longer duration, the volatility of the risk premium (if defined in the traditional sense) will tend to be overstated and the ability to draw meaningful conclusions with respect to its sensitivity to any independent factors will be jeopardized.

Problems concerning dependent variable definition also exist for studies that use bond yield averages rather than individual bond yields. Such studies generally define the dependent variable as the spread between the yield of the risky bond index or average and the yield of an index composed of riskless (Treasury) bonds. The behavior of this yield spread is then examined in relation to changes in selected independent factors which are most often of a macroeconomic nature. This formulation of the dependent variable results in firm-specific and bond-specific factors being averaged to some extent, with portfolio parameters taking their place.

Yield spreads are a convenient formulation for the dependent variable for studies involving time-series analysis of the risk structure of bond yields. Such studies are generally concerned with the nature of the relationship between certain macroeconomic factors and the behavior of the risk structure over long time periods. However, technical anomalies in the popular yield indexes used as the basis for the spreads can result in misleading empirical results due to the fact that the behavior of virtually all of the popular indexes is influenced to some extent by technical factors that are not common among all indexes. Each index has inherent structural or compositional aspects which can influence the movement of the index relative to others such that observed changes in any yield spread over time are only partially the result of fundamental changes in the risk structure, being also partially the result of purely technical aberrations. In order to draw meaningful conclusions regarding the relationship between the dependent and independent variables, it is necessary to control or eliminate the effects of these technical dissimilarities so as to isolate the relevant fundamental yield structure adjustments from the irrelevant (within the scope of this study) technical movements.

One such technical problem involves changes in the structural characteristics of the index relative to others over time. For example, the average maturity, coupon, and

duration of the portfolio underlying most yield indexes varies over time. In addition, the list of bonds included in the portfolio changes over time. Since these structural changes are generally not distributed smoothly over time, relatively large changes in the structural characteristics of the index can occur over short time intervals. Consequently, the spread between two yield series can exhibit an increasing or decreasing long-term trend if the roster of bonds included in the index portfolios remains constant while the average maturity and duration of the portfolios changes gradually over time.

The yield spread can also exhibit short-term movements of significant magnitude as the roster of bonds included in either portfolio changes suddenly, resulting in sudden changes in the average duration, coupon rate and maturity of the portfolio. Such movements in the yield spread would be entirely the result of technical factors without any relation to actual changes in the underlying risk structure or independent variables.

U.S. Government bond yield series involve additional technical problems due to (1) the existence of long time gaps in the origination of U.S. Treasury bonds and (2) special tax advantages conferred on certain so-called "flower" bonds.

During the period from May 1963 to January 1973, no new Treasury Bonds were issued with a maturity of 20 years or

more. The general level of interest rates was rising during the same period, and consequently all outstanding long maturity U.S. bonds became discount bonds. Other things equal, this situation would have contributed to downward pressure on observed before-tax yields for long-maturity government bonds due to the important tax advantages associated with discount bonds.¹²

In addition, certain low-coupon Treasury bonds issued prior to 1971 are granted special tax privileges for estate planning purposes. This special tax status serves to increase the relative demand for these bonds, thus exerting upward pressure on their market price and reducing their required yields relative to other riskless bonds lacking "flower bond" status.

Because of the existence of these two special tax situations for some government bonds, defining the corporate-government yield spread in terms of a U.S. bond yield series that is based on the market yields of individual bonds without compensation for differential tax treatment would result in a yield spread series that tends to be wider than it would be if the bonds in the risky and riskless portfolios were of subject to the identical tax treatment.¹³

In addition to the technical problems discussed above, any study involving yield spreads is complicated by the existence of isolated random shocks to the general risk

structure which are not related to the selected independent variables in any systematic manner. Random shocks induce noise in the dependent series which reduces the efficiency of regression coefficients.

One source of such shocks is the occasional default of a large bond issue. While a default is a relatively rare occurrence, it is an event with a potentially large impact on the risk structure of yields. Other sudden (unexpected) catastrophic or momentous events can also constitute a significant shock to the yield structure. Within the sample time period of this study, examples of such potential shocks include the Arab oil embargo, the Iranian revolution, the resignation of President Nixon, and the Three Mile Island nuclear power plant accident. Although an exploration of the effects of such shocks on the risk structure of bonds would be interesting and useful, it is beyond the scope of the present study. Since there is no feasible methodology by which to filter the effects of this type of random shock from the data, they represent a potential source of noise in this study.

The reader will recall that this study is composed of two major divisions. Stage I analysis follows a more traditional approach, basing the definition of the independent variables (corporate-government yield spreads) on popular yield indexes. The Stage I industry/rating categories are defined in terms of Moody's corporate bond yield series

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(broadly classified as Industrial, Average Corporate, Utilities, and Rails; Aaa - Baa ratings). Risk-free government bond yields are represented by Standard and Poor's Long-Maturity Government Bond Index. The independent variables for Stage I analysis are based on corporate-government yield spreads defined as follows:

The yield spread for industry category (i) of rating (k) at time (t) is the difference between the reported yield for Moody's bond index for industry (i) and rating (k) at time (t) and the reported yield for the S&P Long-Maturity Government Bond Index at time (t).

As discussed above, the use of yield indexes such as these involves potential problems concerning the reliability of empirical results. Consequently, Stage I analysis is a "rough cut" examination of the data which is similar in methodology to previous studies. Stage II analysis takes a more refined approach by correcting for many of the technical problems associated with the popular yield series employed in Stage I analysis.

In order to improve the efficiency of the estimated coefficients, it is necessary to control for variability in the dependent series associated with the technical factors discussed above. Other researchers have employed various adjustment procedures in an effort to remove technical

effects from the popular yield series.¹⁴ However, these procedures are of questionable validity and limited usefulness in the context of the current study. Consequently, the second stage of this study relies on original risk premium series which are constructed by way of a computational methodology which reduces technical inconsistency among the series by standardizing all risk premiums with respect to the duration of the underlying securities.¹⁵

The riskless rate proxy for the risk premium series used in the second phase of the study is the duration-based yield curve for U.S. Treasury bonds. This yield curve is conceptually identical to the traditional maturity-based yield curve in that it relates the market yield of the riskless security to a time dimension which represents the relative maturity of the underlying securities. However, instead of using term-to-maturity as the measure of relative maturity, duration is used instead. This redefinition of the riskless rate proxy helps to reduce the presence of technical inconsistencies in the riskless rate proxy and consequently in the risk premium series which are based on this riskless proxy.

A duration-based yield curve was derived for each quarterly time point in the Stage II sample period (1973.Q4 - 1986.Q1). Data points for each quarterly yield curve included all outstanding U.S. Treasury notes and bonds exclusive of "flower" bonds¹⁶ and callable bonds with less

than 10 years of call protection.¹⁷ Closing price quotes were obtained for each Treasury security as of the last business day of each calendar quarter. Market yields were derived based on the ask price plus accrued interest. The duration-based yield curve for a given quarter was constructed by plotting yield-to-maturity against duration for each Treasury issue in the sample at the given time point.

The use of these duration-based yield curves as the riskless rate proxy in the calculation of portfolio risk premiums involves important advantages over alternative methodologies involving traditional riskless rate proxies. First, technical inconsistencies due to differential tax characteristics are reduced by eliminating "flower" bonds and bonds with very low coupon rates from the sample. All bonds, both risky and riskless, that are included in the sample are subject to identical tax treatment. Second, technical noise in the risk premium series caused by sudden or gradual changes in the average coupon rate and/or average maturity of the industry/ rating group portfolios is reduced by taking both parameters into consideration, via the duration measure, in the risk premium calculation.

2.2.1a Calculation of the Portfolio Risk Premium

Risk premium series for each of the 29 portfolios representing specific industry/rating groups¹⁸ were computed as follows:

- 1) For each risky bond [i] in portfolio [p] at sample time point [q], the yield to maturity (YLD[iq]), duration (D[iq]), and single cashflow equivalent (CFE[iq]) are computed:

- 1a) (YLD[iq]) is derived through an iterative process using the following algorithm:

$$PRICE_{iq} = \sum_t \frac{CPN_t}{2} (1+YLD_{iq})^{-t} + 100(1+YLD_{iq})^{-T}$$

where: t = Future time point (in years) when coupon payments are to be paid.

T = term to maturity in years.

CPN_t = semiannual coupon payment at time (t).

$PRICE_{iq}$ = quoted ask price plus accrued interest for bond (i) at time (t).

$$1b) \quad D_{iq} = \frac{\sum_t \frac{(CPN_t / 2) \cdot t}{(1+YLD_{iq})^t} + \frac{100 \cdot T}{(1+YLD_{iq})^T}}{PRICE_{iq}}$$

$$1c) \quad CFE_i = \sum_t \left[CPN_t (1+YLD_{iq})^{D_{iq}-t} \right] + 100 (1+YLD_{iq})^{D_{iq}-T}$$

The single cashflow equivalent, $CFE[iq]$, represents the value of a lump-sum cash flow to be received at $t = D[iq]$ that would give the same yield to maturity as the actual coupon and terminal payment stream, based on the actual price ($PRICE[iq]$) for bond $[i]$ at time $[q]$. That is, the measure restates the cashflows of each bond as only two cash flows, the current purchase price and a single future payment at time $t = D[iq]$, while preserving the actual yield to maturity and duration of the bond.

The average yield and duration of each portfolio $[p]$ at each time point $[q]$ is computed using the using the single cashflow equivalents of the member bonds as the portfolio cash flows rather than using the actual cashflows of the member bonds. This improves the speed and

efficiency of the portfolio yield and duration calculations.

- 2) For each portfolio [p] at time point [q], the portfolio yield (YLD[pq]) is computed using an iterative process based on the following algorithm:

$$V_{pq} = \sum_q CFE_{iq} \cdot (1+YLD_{pq})^{-D_{iq}}$$

where:
$$V_{pq} = \sum_{i=1}^N PRICE_{iq}$$

and: (i) represents each bond included in portfolio (p).

(N) represents the total number of bonds included in portfolio (p) at time (q).

- 3) The duration for portfolio (p) at time (q) is computed as follows:

$$D_{pq} = \left[\sum_q \frac{CFE_{iq} \cdot D_{iq}}{(1+YLD_{pq})^{D_{iq}}} \right] \cdot \frac{1}{V_{pq}}$$

- 4) The Risk Premium for Portfolio (i) at time (q)
is defined as:

$$RP_{pq} = YLD_{pq} - Rf_q$$

where:

$Rf[q]$ represents the yield to maturity of a Treasury issue with duration $D[pq]$ as given by the duration-based yield curve for quarter (q).

These computations produce a set of quarterly time series composed of risk premiums for each portfolio [p] over the time period 1973.Q4 to 1986.Q1 . These risk premium series have important research advantages over series based on the popular yield indexes. These advantages include:

- 1) Structural standardization:

All series are compiled using identical calculations and are subject to identical assumptions.

2) Reduction of technical noise:

Problems associated with changes in the average portfolio coupon rate and term to maturity over time are reduced since all yield spreads are standardized by duration. Thus, the construction of the yield series does not ignore the impact of coupon rate and term to maturity on price volatility with respect to changes in the general level of interest rates. Therefore, yield series should be directly comparable across industry and rating classifications.

3) Narrowly-defined issuer classifications:

The composition of the underlying portfolios is more industry-specific than in any of the popular yield series. This allows a more detailed comparison of the behavior of the yield series across industrial classifications than was previously possible.

2.2.2 Independent Variables

The major portion of the association between cyclical economic factors and corporate bond yields would be expected to result from shifts in the risk-free yield curve as nominal interest rates adjust in response to changes in expectations regarding inflation, forward interest rates, and economic conditions in general. Since this study focuses on risk premiums and corporate-government yield spreads, the variability in bond yields produced by variations in the risk-free yield structure is removed from the data in the calculation in the dependent variable series.

According to the Fisher Hypothesis of nominal interest rates¹⁹, the nominal rate of interest on a riskless security is composed of two elements: the real interest rate and an inflation premium. The real interest rate represents the average investor's required compensation for the deferral of consumption over the period an investment in an inflationless and riskless environment. The level of the real rate is primarily a function of the expected rate of return on real assets, which is in turn a function of the supply and demand for loanable funds. Technically, the equilibrium real rate of interest equates ex ante saving and investment.²⁰ The inflation premium represents the average investor's required compensation for expected

deterioration in the purchasing power of future cash inflows due to inflation over the life of the asset. Thus, the nominal rate of interest on a Treasury bond (according to Fisher) is the sum of the real rate and the inflation premium.²¹

It follows that economic factors which influence investors' expectations concerning the general level of interest rates, inflation, and the business cycle would be expected to exert a major impact on the nominal risk-free rate. However, there is no reason to expect the impact of such factors to be confined exclusively to the risk-free portion of the yields of risky bonds. It is quite possible that factors which influence expectations concerning economic conditions and interest rates also have a "residual" impact on risk premiums by influencing investors' assessments of default risk and call risk. There are reasons to suspect that this residual effect could exhibit industry-specific characteristics since it is unlikely that the sensitivity of different types of issuing firms to changes in economic conditions is completely homogeneous with respect to the timing and/or magnitude of the effect.

Consider the default-risk premium. If the average investor expects that the economy is moving toward a phase characterized by strong growth, then the average corporation would be expected to have a declining probability of default since business conditions would be expected to

improve, thus improving cash flows and the ability to cover debt obligations as they come due. On the other hand, if the average investor expects a weakening or recessionary phase, then the average corporation would be expected to have an increasing probability of default due to weakening sales and deteriorating cash flows in relation to fixed debt obligations. Since these events would not be expected to affect all corporations in the same manner and degree at the same time, there could be significant differences across industry/rating categories in the sensitivity of default risk premiums to changes in certain macroeconomic factors.

The existence of an association between default risk premiums and cyclical economic factors is supported by a considerable body of research. Atkinson (1967) studied actual default experience and found that the timing and degree of default are closely related to swings in the business cycle.²² Silvers (1973) found that the market's default risk assessments become more pessimistic as a recession approaches. His regression results showed "a definite movement of the corporate risk structure with the business cycle".²³ Kidwell and Koch (1982), in a study that was confined in scope to municipal bonds, found that the business cycle may contribute to changes in default risk.²⁴ Jaffee (1985) used a measure of consumer's

subjective opinions regarding future movements in the business cycle (gathered in a survey) and found it to be the most significant variable in his yield spread regressions.²⁵ Ferri (1978) used three economic indicators to represent expectations regarding future business conditions and the prospect of default by corporate borrowers in the aggregate. These were the only default risk proxies in his yield spread models.²⁶ The measures were:

- 1) New orders for durable goods (market value)
- 2) Dividend yield on the S&P 500 Stock Index
- 3) Composite Index of Leading Economic Indicators

Ferri found the estimated coefficients for all three variables to be significantly different from zero and of the expected sign for the Industrial-Government yield spread. However, no significant association was detected between the three independent variables and the Utility-Government yield spread.²⁷

Based on these results, it would be expected that the economic factors most closely related to expected default risk are those which are associated with the expectations concerning the general behavior of the business cycle.

Macroeconomic factors would also be expected to influence the behavior of risk premiums by affecting investors' expectations regarding future nominal interest rates

and, therefore, the risk of call. Other things equal, the risk of call decreases as interest rates increase because refunding is economically justifiable only if the coupon rate of the existing debt is substantially greater than the rate that would be demanded by investors if the issue were refunded.²⁸

Therefore, factors that affect investors' expectations regarding future movements of interest rates would be expected to influence the call-risk portion of the bond risk premium. However, the relationship between changes in expected call risk and changes in economic factors representing expected interest rates would not be expected to exhibit great variation across industry/rating categories since the attractiveness of refunding is a function of factors that are not primarily industry-specific in nature.²⁹

It is beyond the scope of this study to seek to determine the "best" set of macroeconomic factors to represent investors' expectations of future economic conditions. That is, the intention here is not to determine how investors form their expectations. Indeed, such a determination is unnecessary within the context of this study. Instead, the objective of this study is to determine whether risk premiums exhibit a significant sensitivity to general economic fluctuations, and if so, whether that sensitivity exhibits industry-specific characteristics.

In keeping with this objective, economic factors selected for inclusion in this study were chosen on the basis of their ability to represent, in an efficient manner, the major sources of potential concern for bond investors with respect to economic conditions.

Investors assess the value of securities based on subjective estimates of the probability of future events and conditions. Individual investors, presented with identical ex ante information, may form drastically different valuation estimates based on that information. The capital markets serve to smooth the differences in individual opinions as investors bid to buy and sell securities until equilibrium is achieved. The equilibrium price represents the consensus of investors' opinions as to the true value of a security given the current set of ex ante information concerning the security and expected economic conditions.

This study is not concerned with the question of whether the market consensus is an efficient estimator of future economic conditions (i.e. whether it impounds all currently available relevant information), or whether it is an accurate estimator (i.e. whether a hypothesis of rational expectations holds). Even so, given the size of the bond market, it would seem likely that the consensus estimate of future economic conditions, as reflected in the market price of bonds, would be efficient with respect to available economic information.³⁰ Even if the bond market

is not completely efficient with respect to economic information, there would be no reason to expect a particular industry/rating group to be more efficient than any other since identical information is available to all investors and there are no investment barriers that would be likely to produce significant segmentation in the bond market with respect to issuer categories.

On the other hand, the accuracy of the consensus estimate of expected economic conditions is debatable, especially with respect to long-term projections. The economic system is tremendously complex. Unanticipated random shocks can, and do, occur. However, inaccuracy in the consensus estimate is more likely to result from poor ex ante information and the tremendously complex, and hence unpredictable, nature of the economic system than it is to result from irrational expectations on the part of investors. Furthermore, if the consensus opinion is inaccurate, there is no reason to expect systematic differences in accuracy between industry/rating categories. That is, there is no reason for the consensus opinion of Industry A investors to differ systematically from the consensus opinion of Industry B investors since the same information set is available to all investors at the same point in time and investors are free to invest in the securities of any issuer category they may choose.

On the basis of this reasoning, the following assumption is made for the purposes of this study:

On average, investors' expectations concerning future economic events and conditions are homogeneous across industry/rating categories.

As stated previously, the scope of this study does not require the inclusion of all possible macroeconomic factors which influence risk premiums. Rather, the objective is to test for the existence of differential effects concerning a few major factors. The use of too many economic variables would introduce serious multicollinearity among independent variables which would drastically hinder the reliable interpretation of regression results. Since the objective of this study is to determine whether economic factors exert a significant and/or differential influence across industry-rating groups, the reliability of individual regression coefficients is extremely important. Consequently, the pool of independent variables selected for this study was kept small, with low multicollinearity among the selected variables being an important selection criterion.

Selection of the independent variables was also based on the results of previous related research. Series that were found to be useful in similar studies were given strong consideration.

Since the risk premium is composed of a default risk component and a call risk component, independent variables were grouped into two categories: (1) those selected to represent current and expected economic conditions in general (as a proxy for expected default risk) and (2) those selected to represent current and expected interest rates (as a proxy for expected call risk). In conjunction with the criteria and requirements discussed above, the economic series listed on the following pages were selected as independent variables for this study. (Note: Business Conditions Digest is abbreviated as BCD in the variable descriptions.)

Series Representing Current and Expected
Economic Conditions

=====

MOOD: Index of Consumer Sentiment
BCD #58: Reported Quarterly.
Not seasonally adjusted.

Represents consumer attitudes and expectations with respect to future economic conditions based on a monthly survey of 700 households conducted by the University of Michigan Survey Research Center.³¹

Expected sign: Negative. A positive change in MOOD implies consumer expectations of better economic conditions in the future (5 year horizon) which should reduce default expectations, thus reducing the risk premium.

CF: Net Corporate Cash Flow in 1972 dollars
BCD #35: Annual rate; reported quarterly
Seasonally adjusted.

Represents the aggregate cash flow for domestic corporations. Computed as the sum of undistributed corporate profits and corporate consumption allowances. Assumed to be a leading indicator of economic trends since the cash flows of some firms will begin to deteriorate (improve) in advance of an economic downturn (upturn).

Expected sign: Negative. Positive change in CF implies improving economic conditions which would be expected to reduce default expectations, thus reducing the risk premium.

EMP: Unemployment Rate
BCD #43: Monthly figures for Mar, Jun, Sept, Dec.
Seasonally adjusted.

Computed as the ratio of the number of persons unemployed expressed as a percentage of the civilian labor force based on data collected in monthly surveys. The

series tends to vary inversely with broad movements in economic activity.

Expected sign: Positive. A decrease (increase in EMP is generally associated with an expanding (contracting) economy, although it also may be associated with rising (falling) interest rates and inflation. Dominant effect should be a decrease (increase) in expected default risk and therefore a decrease (increase) in the risk premium.

STK: S&P 500 Stock Index

BCD #19: Monthly averages (Mar,Jun,Sep,Dec).

Not seasonally adjusted.

Represents the average price of 500 NYSE and OTC stocks of broad issuer basis. Figures used are monthly averages of daily closing prices (value weighted and adjusted for unusual price changes such as dividends, splits, mergers, etc.) A component of the Index of Leading Indicators.

Expected sign: Negative. Changes in the stock index should be positively related to investors' expectations with respect to future economic events and conditions

as they affect publicly held corporations. Therefore, a positive (negative) change in STK would be expected to be associated with a decrease (increase) in expected default risk, and thus a decrease (increase) in the risk premium.

ILI: Composite Index of 12 Leading Indicators
BCD #910: Monthly figures (Mar,Jun,Sep,Dec).
Seasonally adjusted.

Composite of 12 economic series that show similar timing at business cycle turns but represent widely different activities and sectors of the economy. It is acknowledged that other independent variables defined for this study are components of ILI. Those components are examined individually in the course of the study, as well as collectively in the form of ILI.

Expected sign: Negative. A positive (negative) change in ILI is expected to reflect an improvement (deterioration) in economic conditions and thus a decrease (increase) in expected default risk.

GNP: Gross National Product in 1972 dollars:
BCD #50: Annual Rate; Reported Quarterly
Seasonally adjusted

The most widely used measure of domestic productivity.
GNP represents the market value of final sales of goods
and services plus inventory change.

Expected sign: Negative. A positive (negative) change
in GNP indicates in improvement (deterioration) in
current economic conditions, which would be expected to
be associated with a decrease (increase) in expected
default risk and thus a decrease (increase) in the risk
premium.

NOTE: In the discussion of selected independent variables
on the preceding and following pages, much of the descrip-
tive information concerning the economic series was taken
from Business Conditions Digest Handbook of Cyclical In-
dicators; 1984.

Series Representing Current and Expected
Interest Rates and Inflation

=====

CPI: Consumer Price Index for All Urban Consumers
BCD #320: Monthly averages (Mar,Jun,Sep,Dec).
Not seasonally adjusted.

CPI measures changes in the cost of selected goods and services that are considered to be representative of the consumption patterns of domestic consumers.

Expected sign: Negative. A large positive (negative) change in the CPI would be expected to be associated with an increase (decrease) in expected inflation which would have a negative (positive) impact on individual firms and the economy in general, causing an increase (decrease) in expected default risk and thus an increase (decrease) in the risk premium.

BILL: Current Yield on New 91-Day Treasury Bills
Computed from BCD #114: Discount rate on new
91-day Treasury Bills (Monthly averages for
March, June, September, and December).
Not seasonally adjusted.

BILL was included under the assumption that a rise
(fall) in short-term rates generates an expectation
that future long-term rates will also rise (fall).

Expected sign: ? An increase (decrease) in expected
interest rate implies a decrease (increase) in expected
call risk, but may imply an increase (decrease) in
expected default risk.

MS2: Money Supply (M2) in 1972 Dollars
BCD #106: Monthly averages (Mar,Jun,Sep,Dec).
Seasonally adjusted.

MS2 represents real money balances in the hands of the
public.

Expected sign: ? Increases in the money supply reduce
pressures on interest rates during expansions, but may

have inflationary implications. Thus, possible opposing effects make preliminary predictions impossible.

GDP: Total Government Debt as a percentage of GNP
Computed from Total Government Debt Outstanding
(Source: Standard & Poor's Statistics) at the ends
of months March, June, September, and December.

GDP was included in order to determine whether changes in the level of the national debt influence bond risk premiums.

Expected Sign: ? Possible opposing effects and the lack of previous research make preliminary assumptions impossible.

Such opposing effects could include:

- + Large increases in the national debt may contribute to higher interest rates and economic instability, thus increasing expected default risk and risk premiums.
- Large increases in the national debt may imply higher interest rates, thus reducing expected call risk and risk premiums.

- 0 Any effects may be confined to the real rate, and thus would be reflected in all nominal rates equally and simultaneously.

BILL, MS2, and CPI were selected to represent expectations with respect to inflation and the general level of interest rates, and thus changes in expected call risk. A consideration of inflationary expectations is important for at least two reasons.

First, inflation has an impact on risk of call. Risk of call increases as market interest rates decrease, other things equal. Therefore, an increase in expected inflation should imply a decrease in expected call risk as market rates rise and, consequently, a decrease in the call risk premium. Under these conditions, there is no apparent reason to expect any differential response in risk premiums across industry/rating categories since it is unlikely that the bonds of any category would be more likely to be called than those of any other category. Consequently, changes in expected inflation would be expected to exert a significant influence on call risk premiums, but would not be expected to produce significantly different changes in risk premiums across industry/rating categories.

Second, changes in expected inflation would be expected to influence expectations concerning default risk. A high rate of inflation implies that interest and principle

payments will be made in dollars of lower value than was originally expected when the debt was issued, thus making future cash flow obligations (especially the terminal payment) less of a burden to the firm and reducing the risk of default. On the other hand, certain industries have considerable difficulty in adjusting the price structure of their output during periods of high inflation (notably utilities) even though their cost structure may be increasing at a rapid rate, thus increasing the likelihood of default. Although the former impact of inflation (a decreasing real debt burden in high inflation periods) would not be expected to produce industry-specific effects, the latter impact (inability to conform an inflexible price structure with an increasing cost structure) would be expected to have industry-specific effects for some industry/rating categories.

Since the potential relationship between changes in these factors and changes in risk premiums are in conflict with both positive and negative expected signs, preliminary hypotheses with respect to the actual sign of these variables are not possible.

In the selection of the independent variables, the intention was to use objective data that is not influenced by subjective or personal factors. The intention was not to select the "best" possible set of economic indicators, but only to select a set that would conform to the criteria

specified and represent likely inputs in the formation of investor expectations. Most of the economic series that were selected are among the most widely used cyclical indicators for forecasting future economic conditions. Many of the series have been popular as independent variables in previous studies of bond yields and yield spreads. Consequently, it is likely that these economic indicators would be included as fundamental inputs to the process by which investors form expectations with respect to general economic conditions and interest rates.

ENDNOTES

1. For example, see Lawrence Fisher, "Determinants of Risk Premiums of Corporate Bonds," Journal of Political Economy 67(June 59), 217-237.
2. A. Buse, "Expectations, Prices, Coupons, and Yields," Journal of Finance 32(Mar 1977), 103-115.
3. A. Robichek and W.D. Niebuhr, "Tax-Induced Bias in Reported Treasury Yields", Journal of Finance 25(Dec 1970), 1081-1090.
4. Cook and Hendershott, "The Impact of Taxes, Risk and Relative Security Supplies on Interest Rate Differentials," Journal of Finance 33(Spring 1978), 1173-1186.
5. John Caks, "The Coupon Effect on Yield to Maturity", Journal of Finance 32(Mar 1977), 103-115.
6. For example, see Percival(1974), McEnally and Ferri(1982), and Wienstien(1983).

7. Hopewell and Kaufman, "Bond Price Volatility and Term to Maturity: A Generalized Respecification," American Economic Review 62(Sept 73), 749-753.
8. M. Livingston, "Duration and Risk Assessment for Bonds and Common Stocks," Journal of Finance (Mar 78), 293-295.
9. Boquist, Racette, and Schlarbaum, "Duration and Risk Assessment for Bonds and Common Stocks," Journal of Finance 30(Dec 75), 1360.
10. McEnally and Ferri, "Determinants of Systematic Volatility of Corporate Bonds," Journal of Economics and Banking 3(1982), 215-229.
11. Hopewell and Kaufman (1983) op. cit.
12. Tax advantages for discount bonds include capital gains treatment on the portion of the total return represented by the excess of terminal payment over purchase price and deferred tax liability on a portion of the total realizable return in a given period.

13. The technical problems inherent in U.S. Bond Yield series were discussed in Cook and Hendershott, "The Impact of Taxes and Relative Security Supplies on Interest Rate Differentials," Journal of Finance 33(Sep 78), 1173-1186.
14. For example, see Cook and Hendershott (1978). Op. cit.
15. The procedure described here concerning the construction of the duration-based yield curve and risk premiums was originally developed by Larry J. Johnson, University of Tulsa. It is used here with his kind permission. I am deeply indebted to him for supplying me with this important and useful tool.
16. These issues are acceptable at par as payment for federal estate taxes when they are part of the decedents estate at death. The bonds normally are priced at a large discount from par due to their low coupon rates. Prior to 1977, any capital gain realized on the bonds at the owners death was not taxed. Beginning in 1977, the capital gain became taxable. While this reduced the advantage of these bonds somewhat, they still involve significant advantages over other fixed-income investments for estate planning purposes. Due to desirability of these issues for estate planning, they

typically sell at a higher price (and therefore a lower yield than similar issues without the special tax status.

The specific issues that are accorded special tax status are:

3.25% Due Jan 15, 1978-83	4.25% Due May 15, 1975-85
3.25% Due May 15, 1985	3.50% Due Feb 15, 1990
4.25% Due Aug 15, 1987-92	4.00% Due Feb 15, 1988-93
4.125% Due May 15, 1989-94	3.00% Due Feb 15, 1995
3.50% DUE Nov 15, 1998	

In addition to the exclusion of the above bonds from the sample, the following issues were also excluded:

3.50% Due Nov 15, 1980	4.00% Due Feb 15, 1980
------------------------	------------------------

While these issues are not given any special tax status, they are generally priced at a severe discount and thus have a built-in tax advantage due to the lower tax on capital gains which would accrue as the bonds approach maturity.

17. The call risk associated with the corporate bonds in the industry/rating portfolios is likely to be a major contributory factor to the total risk premium of the portfolios, and thus is of interest in this study. Consequently, the exclusion of callable bonds from the sample of riskless bonds is necessary in order to be able to observe the effects of call risk in the corporate sample. Callable Treasury issues with at least 10 years of call protection were retained in the sample for two reasons: (1) the effect of the call provision is likely to be negligible when callability is postponed for such a long period and (2) there was a shortage of longer maturities in the sample in many time periods, thus leaving large gaps in the yield curves at the long end if the callable issues were excluded. When callable issues were included, yield-to-call was used instead of yield-to-maturity in the derivation of the duration for the issue.
18. See pages 16-22 for a detailed description of these portfolios.
19. Irving Fisher, "Appreciation and Interest," Publications of the American Economic Association 11(Aug 1896), 1-100.

20. J. Van Horne, Financial Market Rates and Flows, 2nd ed. (Englewood Cliffs, N.J.: Prentice Hall, 1984).

21. The Fisher Hypothesis implies a one-to-one relationship between changes in expected inflation and changes in the nominal risk-free rate. This implication has not been without criticism. Arguments have been proposed for the relationship being less than one-to-one (Mundell and Tobin, among others) and greater than one-to-one (Darby and Feldstien, among others).

Robert Mundell, "Inflation and Real Interest," Journal of Political Economy 71(June 1963), 280-283.

James Tobin, "Money and Economic Growth," Econometrica 33(Oct 1965), 671-684.

Both offer reasoning to support an argument that an increase in inflation will produce a decrease in the real rate of interest.

Michael R. Darby, "The Financial and Tax Effects of Monetary Policy on Interest Rates," Economic Inquiry 13(June 1975), 266-276.

Martin Feldstein, "Inflation, Income Taxes, and the

Rate of Inflation: A Theoretical Analysis," American Economic Review 66(Dec 1976), 809-820.

Their argument is based on the contention that investors require compensation for the expected increase in their tax burden resulting from inflation. That is, in order for the after-tax real return to remain unchanged in the presence of inflation and taxes, the nominal return would have to increase by more than the increase in inflation since taxes are computed using the nominal rate of return.

22. T.R. Atkinson, "Trends in Corporate Bond Quality," National Bureau of Economic Research (1967).
23. J.B. Silvers, "An Alternative to the Yield Spread as a Measure of Risk," Journal of Finance 28(Spring 1973), 933-955.
24. D.S. Kidwell and T.W. Koch, "The Behavior of the Interest Rate Differential Between Tax-Exempt Revenue and General Obligation Bonds," Journal of Finance 37(Mar 1982), 73-85.

25. D.W. Jaffee, "Cyclical Variations in the Risk Structure," Journal of Monetary Economics 01(July 1985), 309-325.
26. The dependent variable in these models was based on Moody's bond indexes for Industrials, Utilities, and Government bonds.
27. M.G. Ferri, "An Empirical Examination of the Determinants of Bond Yield Spreads," Financial Management 7(Fall 1978), 40-46.
28. J.B. Silvers, "An Alternative to the Yield Spread as a Measure of Risk", Journal of Finance 28(Sept 1973), 933-955. Defined the value of a bond call to the firm using net present value concepts. Silvers' call value (V) is defined as:

$$V = \sum_t (C-Y)(1+r_t)^{-t} - CP$$

where: C = the coupon payment required at time (t).
 Y = the coupon rate obtainable in refinancing.
 r_t = the risk-free rate expected at time (t).
 CP = the contractual call premium.
 t = the time (in years) when each remaining coupon payment is required.

T = the term-to-maturity (in years) for the existing bond issue.

Thus, the value of the call (and therefore call risk) increases as the refunding rate (Y) and the expected level future interest rates ($r[t]$) decrease. The threshold for the call is when the present value of the coupon savings exceeds the call premium.

29. The refunding rate for a bond could have industry-specific components since it is simply the market yield that would be required on a new issue (priced at par) with the same default risk as the existing issue. The level of the market yield at a point in time may be influenced by the industry category of the issuer, as discussed throughout this paper.
30. However, the efficiency of the bond market within small time intervals may be arguable given the infrequency of trading associated with many corporate bonds.

31. The index is based on the responses to five questions:

1. We are interested in how people are getting along financially these days. Would you say that you and your family are better off or worse off financially than you were a year ago?
2. Now looking ahead, do you think that a year from now you people will be financially better off or worse off or just about the same as now?
3. Now turning to business conditions in the country as a whole, do you think that during the next 12 months we'll have good times financially or bad times or what?
4. Looking ahead, which would you say is more likely -- that in the country as a whole, we'll have continuous good times during the next five years or so, or that we will have periods of widespread unemployment or depression, or what?
5. About the big things people buy for their homes -- such as furniture, house furnishings, refrigerator, stove, television, and things like that -- for people in general, do you think now is a good or a bad time to buy major household items?

Source: Fabbozzi and Greenfield, Handbook of Economic and Financial Measures (Homewood, Ill.: Dow Jones-Irwin, 1984).

2.3 Summary of Methodology and Model Specification

2.3.1 Stage I Aggregate Analysis; Summary of Methodology

Stage I Aggregate Analysis is concerned with an examination of the relationship between changes in corporate-government bond yield spreads and changes in each of the selected economic variables previously discussed.

In keeping with previous studies concerning the cyclical behavior of bond yields,¹ Stage I analysis examines yield spreads between Moody's Corporate Bond Yield Indexes (Average Corporate, Industrials, Utilities, and Rails; Aaa to Baa ratings; quarterly observations) and the Standard and Poors Long-Maturity Government Bond Index.² The S&P Long-Maturity Government Bond Index was chosen to represent the risk-free rate because the average maturity of this index (usually about 13 years) most closely matches the average maturity of the corporate bond indexes.³

The corporate-government bond yield spread series used in Stage I analysis are defined as the difference between the yield on Moody's Corporate Bond Indexes⁴ and the yield on the Standard and Poors Long-Maturity Government Bond Index at the concurrent point in time. The dependent variable for the regression models is defined as the percentage

change in the yield spread between two consecutive (quarterly) time points.

The decision to define the regression variables in terms of percentage changes in the underlying measures rather than in terms of their absolute levels was predicated on several important considerations. First, preliminary analysis showed that all of the yield spread series contained a strong serial correlation component. Obviously, the raw independent variables also have high serial correlation. By defining the regression variables in terms of percentage changes, the serial correlation in the dependent and independent variables was largely eliminated, thus preserving the efficiency of the estimated coefficients. Second, the independent variables that would be included in the multi-factor regression models tend to exhibit a high degree of multicollinearity when they are defined in terms of their absolute levels. This multicollinearity can also be virtually eliminated when the variables are defined in terms of their relative changes.

Stage I Aggregate Analysis focuses on three hypotheses, stated as follows:

- Ia) Changes in the corporate-government yield spread are related to changes in the selected economic indicators.
- Ib) The strength of the observed relationships increases as the rated quality of the dependent variable bond index decreases.
- Ic) Characteristics of the relationship (strength of the relationship and magnitude of the slope coefficients) are not homogeneous with respect to the business classification of the issuer.

Stage I analysis consists of three primary segments. Stage Ia analysis involves single-factor regressions of the 10 selected independent variables on the 15 yield-spread series used as the dependent variables. These regressions provide information on the nature of the relationship between changes in the yield spreads and changes in the individual economic and call risk factors, and on the degree of homogeneity of the observed relationships across broadly defined industry/rating groups.

The general specification of the single-factor regression models used in Stage I analysis is as follows:

$$\text{Model [1]} \quad \Delta YS_{kt} = a_{jkt} + b_{jk}(\Delta X_{jt}) + e_{jkt}$$

where:

ΔYS_{kt} represents the percentage change between (t-1) and (t) in the yield spread between the Average Corporate Index of rating (k) and the yield of the government bond index.

ΔX_{jt} is the percentage change in one of the ten selected economic factors. (See pages 71-80 for descriptions of the independent variables.)

k represents ratings classes Aaa to Baa

j represents independent variables 1 to 10

t represents the quarterly time points from 1969.Q1 to 1984.Q4

The specification of this model will be discussed in greater detail in Section 2.3.3.

Stage Ib analysis involves multi-factor regressions which include independent variables representing expected default risk (proxied by macroeconomic factors representing current and expected economic conditions) and expected call risk (proxied by factors representing current and expected

interest rates).⁵ These regressions provide information on the nature of the relationship between changes in the yield spreads and changes in expected default risk and call risk considered together. In addition, the observed relationships are compared across industry/rating groups for evidence of heterogeneous response characteristics.

The general specification of the Stage I multi-factor regression models is:

$$\text{Model [2]} \quad \Delta YS_{ikt} = b_0 + b_1(\Delta X_{dt}) + b_2(\Delta X_{ct}) + e_t$$

where:

- ▲ YS_{ikt} represents the percentage change from time (t-1) to (t) in the spread between the reported yield on the S&P Long Maturity Government Bond Index and the reported yield on Moody's Corporate Bond Index of business class (i) and rating class (k).
- ▲ X_{dt} is the percentage change in an independent variable selected to represent current and expected economic conditions as proxy for expected default risk. (See pages 62 to 81 for descriptions of the independent variables.)
- ▲ X_{ct} is the percentage change in an independent variable selected to represent expected interest rates as proxy for expected call risk.

The specification of this model will be discussed in greater detail in Section 2.3.4.

Stage Ic analysis examines the extent to which the relationships observed in Stages Ia and Ib are consistent across two consecutive subsamples of the full sample time period.⁶ This comparison across subperiods is based on the application of covariance analysis techniques to the subperiod data. This procedure will be discussed in detail in Section 2.4.3 of this paper.

2.3.2 Stage II Cross-Industry Analysis; Summary of Methodology

Stage II analysis involves an examination of the relationship between changes in the bond risk premiums of narrowly-defined industry groups and changes in the selected economic variables previously defined.⁷

Throughout this stage of the analysis, the risk premium is defined as the difference between the average yield of a portfolio of risky bonds and the yield of a U.S. Treasury bond with duration equal to that of the risky bond portfolio.⁸

Given the problems inherent in popular bond yield series,⁹ and given the intent to test for homogeneity in the hypothesized relationships across industry/rating groups, it was necessary to create original yield series for use in this study. Twenty-nine yield series were created from quarterly price data for 296 individual bonds representing ten industry classifications and three rating categories.¹⁰ These yield series formed the basis of twenty-nine corresponding risk premium series spanning the time period 1973.Q4 to 1986.Q1.¹¹

For the purposes of this and similar studies, these original risk premium series represent a significant improvement over the popular yield series used in previous

research and in the preceding section of this paper. These advantages include:

1) Structural standardization:

All series are compiled using identical calculations and are subject to identical assumptions.

2) Reduction of technical noise:

Problems associated with changes in the average portfolio coupon rate and term to maturity over time are reduced since all yield spreads are standardized by duration. Thus, the construction of the yield series does not ignore the impact of coupon rate and term to maturity on price volatility with respect to changes in the general level of interest rates. Therefore, yield series are directly comparable across industry and rating classifications.

3) Narrowly-defined issuer classifications:

The composition of the underlying portfolios is more industry-specific than in any of the popular yield series. This allows a more detailed comparison of the behavior of the yield series across industrial classifications than was previously possible.

The primary purposes of this stage of the analysis are (1) to compare the results obtained with the original industry-specific yield series with the results obtained with the unrefined series used in Stage I analysis, and (2) to test for differences in the observed relationships across industry classifications.

Stage II analysis focuses on the three hypotheses previously defined in conjunction with Stage I analysis, restated here:

- IIa) Changes in corporate bond risk premiums are related to changes in the selected economic indicators.
- IIb) The strength of the observed relationships increases as the rated quality of the bonds decreases.
- IIc) Characteristics of the observed relationships, (strength of the relationship and magnitude of the estimated coefficients), are not necessarily homogeneous with respect to the industry classification of the issuer.

The aggregate analysis of Stage I, using a single government bond yield index and corporate bond yield series that are classified by industry only in a very broad sense, is similar in methodology to previous studies in this area. However, the use of such broad-based yield indexes to define the independent variable series would be expected to produce yield spread series that contain significant levels of noise due to technical and structural factors inherent in the underlying series.¹² The existence of this noise would make accurate interpretation of results difficult, and could hinder the detection of significant relationships.

Furthermore, due to the structural characteristics of the Stage I series and the broad scope of the industry classifications for these series, a comparison of observed relationships across industrial classifications would be confined to only the most general levels of issuer categories. The "Industrials" index included bonds from many different types of industries, and the same can be said of the other indexes used in Stage I analysis and the traditional studies. In addition, the roster of bonds included in the index portfolio varies greatly over relatively short time periods. Thus, the specific industry composition of the portfolio underlying the index can change substantially from period to period. The combination of bonds of many different industries into one portfolio would be expected

to produce a yield series that is smoothed with respect to industry-specific variations, if such variations do exist. Movements in the portfolio yield series would reflect only the concerted movements of the underlying securities, while movements of more narrowly defined industry groups would tend to be masked. Consequently, the industry-specific risk premium series used in Stage II analysis should allow a more reliable investigation of industry-specific influences.

The procedural format of the analysis in this section is similar to that of Stage I analysis, being composed of two major divisions. The first involves single-factor regressions of the twenty-nine risk premium series on the ten selected economic variables. These regressions provide information on the nature of the relationship between changes in the risk premiums and changes in the individual factors representing default and call risk, and allow a comparison of the estimated relationships across industry groups.

The single-factor regression analysis conducted in this section is based on the following general model:

$$\text{Model [3]} \quad \Delta RP_{ikt} = a_{ikt} + b_{ik}(\Delta X_{jt}) + e_{ikt}$$

where:

ΔRP_{ikt} represents the percentage change in the portfolio risk premium for industry (i) of rating group (k) between time (t-1) and (t).

i represents the ten narrowly-defined industry groups.

k represents the three rating groups:

High Quality: Aaa and Aa

Medium Quality: A and Baa

Low Quality: Below Baa

t represents quarterly time points from 1973.Q4 to 1986.Q1

ΔX_{jt} represents the percentage change in independent variable (j) between (t-1) and (t).

The specification of this model will be discussed in greater detail in section 2.3.3.

The second part of the analysis involves the multi-factor regressions used in the analysis of Stage I, which include independent variables representing changes in expected default risk and call risk in the aggregate.

As defined in conjunction with Stage I analysis, the multi-factor regression models used in this section are of the following general form:

$$\text{Model [4]} \quad \Delta RP_{ikt} = b_0 + b_1(\Delta X_{dt}) + b_2(\Delta X_{ct}) + e_t$$

where:

- ΔRP_{ikt} represents the percentage change from time (t-1) to (t) in the risk premium for the portfolio representing Industry (i) of Rating Group (k).
- ΔX_{dt} represents the change in expected aggregate default risk associated with changes in current and expected economic conditions. (See pages 71 to 75 for descriptions of these independent variables.)
- ΔX_{ct} represents the change in expected call risk associated with a change in expected interest rates and expected inflation. (See pages 76 to 81 for descriptions of these independent variables.)

The results of the single-factor and multi-factor regression analysis are compared across the Stage II industry groups using covariance analysis. This procedure is discussed in detail in the section of this paper where Stage II results are presented.

2.3.3 Specification of Single-Factor Regression Models

To facilitate the discussion of the single-factor regression methodology, the following notation is defined:

- ▲ YS_{ikt} = the percentage change from time (t-1) to (t) in the spread between the reported yield on the S&P Long Maturity Government Bond Index and the reported yield on Moody's Corporate Bond Index of business class (i) and rating class (k).
- ▲ X_{jt} = the percentage change from time (t-1) to (t) in the magnitude of independent variable (j). Note that some independent variables are defined as lagged values.
- b_{jik} = the estimated regression coefficient for independent variable (j) given the dependent variable series is of business class (i) and rating class(k).
- e_{jikt} = the residual error at time (t) given $X(jt)$ and $YS(ikt)$.

In order to select an appropriate specification for each independent variable to be used in subsequent single-factor regression procedures, the following selection process was performed.

First, each of the selected macro-economic series¹³ was regressed individually on the Baa Corporate yield series using the following model:

$$\text{Model [i]} \quad \Delta YS_t = a_{jt} + b_j (\Delta X_{jt}) + e_{jt}$$

where YS_t is the yield spread between Moody's Average Corporate Bond Index of Baa rating and the government bond index.¹⁴

Various specifications of each independent variable were examined in conjunction with Model [i] to determine which specification produced the most well-behaved residuals and the strongest relationship for each independent variable. The analysis included an tests for heteroscedasticity and autocorrelation of residuals. Lagged values of each independent variable were also tested and compared to contemporary values for evidence of superior explanatory power. Regression residuals were examined for evidence of log or exponential components, although no such components were actually observed.

From the set of independent variable specifications producing well-behaved residuals, the specification resulting in the highest R^2 (i.e. the Coefficient of Determination, adjusted for degrees of freedom) was chosen as the representative independent variable specification for all subsequent regression analysis.

The independent variable specifications produced by this procedure are listed on the following page. These independent variable specifications are used in all subsequent single-factor regression analysis of the 15 Stage I yield-spread series and the 29 Stage II risk premium series.

Independent Variables Representing
Current or Expected Economic Conditions

Change in Consumer Sentiment (MOOD):

$$\text{MOODCHG}(t) = [\text{MOOD}(t) / \text{MOOD}(t-1)] - 1$$

Change in Aggregate Corporate Cash Flow (CF):

$$\text{CFCHG}(t) = [\text{CF}(t) / \text{CF}(t-1)] - 1$$

Change in Unemployment Rate (EMP):

$$\text{EMPCHG}(t) = [\text{EMP}(t) / \text{EMP}(t-1)] - 1$$

Change in the S&P 500 Stock Index (STK):

$$\text{STKCHG}(t) = [\text{STK}(t-1) / \text{STK}(t-2)] - 1 \text{ (Lag 1)}$$

Change in the Index of Leading Economic Indicators (ILI):

$$\text{ILICHG}(t) = [\text{ILI}(t) / \text{ILI}(t-1)] - 1$$

Change in Gross National Product (GNP):

$$\text{GNPCHG}(t) = [\text{GNP}(t-1) / \text{GNP}(t-2)] - 1 \text{ (Lag 1)}$$

Independent Variables Representing
Current or Expected Interest Rates

Change in the Consumer Price Index (CPI):

$$\text{CPICHG}(t) = [\text{CPI}(t-1) / \text{CPI}(t-2)] - 1 \text{ (Lag 1)}$$

Change in the rate on 90-day Treasury Bills (BILL):

$$\text{BILLCH}(t) = [\text{BILL}(t) / \text{BILL}(t-1)] - 1$$

Change in Government Debt as a percentage of GNP (GDP):

$$\text{GDPCHG}(t) = [\text{GDP}(t-1) / \text{GDP}(t-2)] - 1 \text{ (Lag 1)}$$

Change in M-2 Money Supply (MS2):

$$\text{MS2CHG}(t) = [\text{MS2}(t) / \text{MS2}(t-1)] - 1$$

2.3.4 Specification of Multi-Factor Regression Models

To facilitate a discussion of the multi-factor regression procedures, the following general regression model is defined:

$$\text{Model [iii]} \quad \Delta YS_{ikt} = b_0 + b_1(\Delta X_{dt}) + b_2(\Delta X_{ct}) + e_t$$

where:

ΔYS_{ikt} represents the percentage change from time (t-1) to (t) in the spread between the reported yield on the S&P Long Maturity Government Bond Index and the reported yield on Moody's Corporate Bond Index of business class (i) and rating class (k).

ΔX_{dt} represents the change in expected default risk associated with changes in current and expected economic conditions. (See pages 71 to 79 for descriptions of the independent variables.) Multiple ΔX_{dt} terms may be present in the model.

ΔX_{Ct} represents the change in expected call risk associated with a change in expected interest rates. This term is included as a control factor for yield spread fluctuations that are not associated with default risk expectations. Multiple ΔX_{Ct} terms may be present in the model.

The specifications of individual independent variables, discussed in section 2.3.3, are retained here. Four representative specifications of the general Model [ii] were selected as the basis for further analysis.

The selection process involved the estimation of many trial models composed of various combinations of the two primary classes of independent variables using the Baa Average Corporate Yield Spread series as the dependent variable.¹⁵

Preliminary formulation of the trial models was based on the results of the single-factor regression analysis of the previous section, using those factors that were shown to have the strongest association with the dependent variables in that context.

The formulation of the trial models was revised through an iterative process of model estimation and examination of residuals. The residuals produced by each trial model were tested for significant autocorrelation at any lag and the models were appended with autoregressive terms when necessary.

The estimated regression equations produced from the trial models were compared with respect to explanatory power and compliance with the OLS assumptions of independent identically distributed residuals.

From the set of trial models, four were selected as the most appropriate representations of the general Model [ii] based on the following criteria:

- a) No apparent heteroscedasticity in the error vector.
- b) The error vector produced by the trial model was free of significant autocorrelation at any lag.
- c) All estimated coefficients in the trial model were significantly different from zero at the 10 percent level of significance.
- d) R^2 (Coefficient of Determination, adjusted for degrees of freedom) was among the four highest of those models which satisfied criteria (a) through (c).

This procedure resulted in the selection of the four models listed in Table 1 on the following page.

TABLE 1

Selected Specifications of the General Multi-Factor Model

Model [5]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + e_t$$

$$b(0) = -.036$$

$$b(1) = -1.68 \quad (2.75)$$

$$b(2) = 4.51 \quad (2.23)$$

$$b(3) = -.99 \quad (4.70)$$

$$R^2 = .414$$

$$D.W. = 2.23$$

$$F = 15.83$$

Model [6]:

$$\Delta Y_{ikt} = b_0 + b_1(CFCHG_t) + b_2(MS2CHG_t) + b_3(LNGCHG_t) + e_t$$

$$b(0) = -.073$$

$$b(1) = -0.71 \quad (1.97)$$

$$b(2) = 1.11 \quad (4.95)$$

$$b(3) = -1.28 \quad (6.23)$$

$$R^2 = .508$$

$$D.W. = 2.31$$

$$F = 22.68$$

Model [7]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + AR(4) + e_t$$

$$b(0) = -.078$$

$$b(1) = -1.14 \quad (2.46)$$

$$b(2) = 6.62 \quad (3.21)$$

$$b(3) = -0.94 \quad (5.15)$$

$$b(4) = .468 \quad (4.11)$$

$$R^2 = .528$$

$$D.W. = 2.35$$

$$F = 18.65$$

Model [8]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(LNGCHG_t) + b_3(LNGCHG_{t-1}) + AR(4) + e_t$$

$$b(0) = .032$$

$$b(1) = -1.69 \quad (3.63)$$

$$b(2) = -0.93 \quad (4.73)$$

$$b(3) = 0.49 \quad (2.29)$$

$$b(4) = .304 \quad (2.42)$$

$$R^2 = .492$$

$$D.W. = 2.09$$

$$F = 16.30$$

ILICHG(t) = Percentage change in Index of Leading Indicators
 CFCHG(t) = Percentage change in Corporate Cash Flow
 CPICHG(t-1) = Percentage change in Consumer Price Index (Lag 1)
 MS2CHG(t) = Percentage change in M2 Money Supply
 LNGCHG(t) = Percentage change in the S&P Long Maturity
 Government Bond Index between (t-1) and (t).
 LNGCHG(t-1) = Percentage change in the S&P Long Maturity
 Government Bond Index between (t-2) and (t-1).
 AR(4) = Autoregressive Lag 4 adjustment.

Figures shown for coefficients and summary statistics are the results of the trial regression on the Baa Corporate Index. t-statistics are reported in parentheses.

Several previous studies that included the Index of Consumer Sentiment (MOOD) as an independent variable reported that the measure exhibited a strong association with the level of bond yields and yield spreads observed over various time periods, and contributed significantly to the overall explanatory power of those authors' models.¹⁶

This finding was not duplicated here, as MOODCH was not included in any of the representative models shown above. The estimated coefficient for MOODCH was not significantly different from zero in any model in which it was included.

The insignificance of this coefficient is not the result of multicollinearity with other independent variables, since only variables with low correlation were included in the same model.

A likely explanation for the seemingly conflicting results between this and previous studies stems from differences in the definition of the dependent variable in the regression models where MOOD was employed as a dependent variable. Studies which found MOOD to be an important explanatory variable defined the dependent variable as the absolute magnitude of the yield or yield spread series at a point in time.

The current study defines the dependent variable as the percentage change in the yield spread between two points in time. The Consumer Sentiment Index is not particularly volatile over short (quarterly) time periods. (The mean

quarterly change is .6 percent with a standard deviation of 11 percent.) However, the dependent variable series used in this study are highly volatile over short time periods. Thus, it is likely that there is not enough variation in the MOODCH series to produce a significant association with the highly volatile dependent variables.

On the other hand, the simple yield or yield spread series used in the other studies cited are much less volatile and therefore the lower volatility of the MOOD series is not a serious problem. Similar logic can be applied with respect to the low explanatory power of GNPCHG, the independent series representing the percentage change in GNP.

The variable representing the percentage change in the rate on 90-day Treasury Bills (BILLCH) was found to be a very poor explanatory variable in the current context. This factor has been used in several studies previously cited in relation to the MOOD variable and had been reported to be a useful proxy for expected interest rates.

This conclusion was not supported in the current analysis. However, an interesting related result of the model selection process is the presence of the variable LNGCHG(t) in all four of the selected models. This variable represents the percentage change in the S&P Long Maturity Government Bond Index between time ($t-1$) and (t). The series was included in the set of independent variables

representing current or expected interest rates under the assumption that a change in long-term interest rates reflects a change in expected long-term rates and therefore also reflects a change in expected call risk. If this assumption is valid, then a negative sign would be expected for this variable's estimated coefficient. The analysis that follows confirms that the direction of the relationship is negative. Furthermore, this factor is found to be a very important explanatory variable in all four representative models.

The four representative models listed in Table 1 are used in all subsequent multi-factor regressions. The specific applications of these models and the results obtained are discussed in detail in later sections of this paper.

ENDNOTES

1. Such studies include:

D.W. Jaffee (1975) op. cit.

M.G. Ferri (1978) op. cit.

Cook and Hendershott (1978) op. cit.

2. See pages 44-55 for a discussion of the technical problems associated with the use of these series.

3. The many problems associated with the use of such an index as a surrogate for the risk-free rate are discussed in detail on pages 44-55. Its use here follows the traditional approach exemplified by the previously cited studies.

Stage II analysis eliminates many of these problems by replacing the popular yield indexes with specially computed yield series formulated in such a way as to minimize the technical and structural anomalies which are present in the popular yield series. See pages 57-60 for an explanation of the computations involved in the compilation of the Stage II yield series.

4. Average Corporate, Utilities, Industrials, and Rails; Aaa-Baa Rating; 1969.Q1 to 1984.Q4. Each quarterly observation is the monthly average for March, June, September, or December as listed in Business Conditions Digest.
5. See section 1.2, pages 4-10, for a discussion of the theoretical basis of this hypothesized relationship.
6. The two subsamples are 1969.Q1 to 1976.Q4 and 1977.Q1 to 1984.Q4.
7. See pages 62-80 for detailed definitions of the independent variables.
8. See pages 55-61 for a description of the dependent variables used in Stage II analysis.

9. See pages 44-56 for a discussion of the technical problems inherent in the popular yield series.
10. See pages 18-23 for a description of the data underlying these series, and pages 57-61 for a description of the computations involved in the actual compilation of the series.
11. Not all series span the entire time period due to a shortage of debentures that conform to the requirements specified on pages 18-22.
12. See pages 44-55.
13. See pages 71-79 for a list of the selected independent variables.

14. This yield-spread series was chosen as the representative series for this procedure for the following reasons:

The Baa rating should ensure that a yield spread exists and is of sufficient magnitude to facilitate its observation.

Preliminary analysis indicated that Moody's Industrial Bond yield series displays more volatility over time than the other three series, and that the relationship of the yield spread to cyclical factors is strongest in this yield series.

Stage II analysis examines the cyclical characteristics of the yield spreads of narrowly-defined industry groups. Of the four Moody's yield series categories, the Industrial series should best represent the general behavior of these more specific yield series.

15. This series was chosen for use in the selection procedure because it is purported to represent the average corporate bond of Baa rating. The low rating should assure the existence of an observable risk premium.

16. For example, see:

Timothy Cook and Patrick Hendershott, "The Impact of Taxes, Risk, and Relative Security Supplies on Interest Rate Differentials," Journal of Finance 33(Sept 1978), 1173-1186.

Dwight Jaffee, "Cyclical Variations in the Risk Structure of Interest Rates," Journal of Monetary Economics 1(1975), 309-325.

2.4 Stage I; Aggregate Analysis

Stage I analysis consists of three primary segments. Stage Ia analysis involves single-factor regressions of the 10 selected independent variables on the 15 yield-spread series used as the dependent variables.¹ These regressions provide information on the nature of the relationship between changes in the yield spreads and changes in the individual economic and call risk factors, and on the degree of homogeneity of the observed relationships across broadly defined industry/rating groups.

Stage Ib analysis involves multi-factor regressions which include independent variables representing expected default risk (proxied by macroeconomic factors representing current and expected economic conditions) and expected call risk (proxied by factors representing current and expected interest rates).² These regressions provide information on the nature of the relationship between changes in the yield spreads and changes in expected default risk and call risk considered together.

Stage Ic analysis examines the extent to which the relationships observed in Stages Ia and Ib are consistent across two consecutive subsamples of the full sample time period.³ This comparison across subperiods is based on the application of covariance analysis techniques to the data.

2.4.1 Stage IA; Single Factor Regression Analysis

2.4.1a Results with Respect to Hypotheses Ia and Ib

For the convenience of the reader, Hypotheses Ia and Ib are restated here:

Ia) Changes in the Corporate-Government yield spread are related to changes in the selected economic variables.

Ib) The strength of the observed relationships increases as the rated quality of the dependent variable bond index decreases.

Evidence to support both hypotheses was obtained using the following single-factor regression model in conjunction with the 15 yield-spread series:

$$\text{Model [1]} \quad \Delta YS_{kt} = a_{jkt} + b_{jk}(\Delta X_{jt}) + e_{jkt}$$

where:

ΔYS_{kt} represents the percentage change between (t-1) and (t) in the yield spread between the Average Corporate Index of rating (k) at time (t) and the yield of the government bond index.

ΔX_{jt} is the percentage change in one of the selected independent variables. (See page 71-79 for descriptions of the independent variables.)

- k represents ratings classes Aaa to Baa
- j represents independent variables 1 to 10
- t represents the quarterly time points from 1969.Q1 to 1984.Q4

Table 2 summarizes the results of the 40 regression models implied by Model [1]. As expected, significant associations occur more frequently in the lower rating categories. Also, the strength of the relationships, as indicated by the t-statistic and adjusted R^2 , consistently increases as the rated quality of the yield index decreases. The strongest relationships are found in models using Corporate Cash Flow (CFCHG), the Index of Leading Indicators (ILICHG), the Unemployment Rate (EMPCHG), the Consumer Price Index (CPICHG), and the Money Supply M-2 (MS2CHG), where significant coefficients are found in the Aa and A rating categories as well as in the Baa category.

The lack of a clear association with the other economic and interest rate variables is not surprising. Ex-post movements in GNP and the S&P 500 would not be expected to provide the most appropriate representation of expected future economic conditions. Likewise, ex-post changes in the T-Bill rate would not be expected to be the best indicator of future levels of interest rates. These series were included as indicators of the current state of the economy rather than as indicators of future expectations under the assumption that the impact on expectations

TABLE 2

Single-Factor Regression Results
Model 1: Average Corporate Indexes

$$\text{Model [1]: } \Delta YS_{kt} = a_{jkt} + b_{jk} (\Delta X_{jt}) + e_{jkt}$$

where: ΔYS_{kt} represents the percentage change between (t-1) and (t) in the yield spread between the Average Corporate Index of rating (k) at time (t) and the yield of the government bond index.

ΔX_{jt} is the percentage change in one of the selected independent variables.

k represents ratings classes Aaa to Baa
j represents independent variables 1 to 10
t represents the quarterly time points from 1969.Q1 to 1984.Q4

Aaa			Aa			A			Baa		
X(j)	t	R ²	t	R ²	t	R ²	t	R ²			
CF	1.54	.02	2.28 [5]	.06	2.33 [5]	.07	3.38 [1]	.14			
MOOD	.02	.02	.04	.04	.22	.00	1.31	.01			
STK	.21	.00	.57	.00	1.51	.02	2.60 [5]	.09			
GNP	.12	.00	.13	.00	.44	.00	.74	.00			
ILI	1.16	.02	2.51 [5]	.08	2.75 [1]	.09	3.84 [1]	.19			
EMP	.72	.00	1.43	.02	1.91 [10]	.04	2.98 [1]	.11			
CPI	.30	.00	2.39 [5]	.07	3.08 [1]	.12	3.40 [1]	.14			
GD	.10	.00	1.10	.00	1.23	.01	.84 [10]	.04			
MS2	1.01	.00	2.50 [5]	.08	2.67 [5]	.09	3.35 [1]	.14			
BILL	.02	.00	.77	.00	1.11	.00	1.23	.01			

CF = Corporate Cash Flow
MOOD = Index of Consumer Sentiment
STK = S&P 500 Stock Index (Lag 1)
GNP = Gross National Product (Lag 1)
ILI = Index of Leading Indicators
EMP = Unemployment Rate
CPI = Consumer Price Index (Lag 1)
GD = Government Debt as percentage of GNP (Lag 1)
MS2 = M-2 Money Supply
BILL = Rate on 90-day Treasury Bills

[1],[5],[10] represent significant t-statistics at 1%, 5%, and 10% levels respectively.

resulting from a change in a forward-oriented economic measure may depend in part on the current state of the economy as represented by the more present-oriented economic measures.

This possibility is considered in the multi-factor regression analysis conducted in stage Ib. Aside from this, the risk premium would not be expected to be greatly affected by current or recent conditions, except in the unlikely event that current or recent conditions are perceived by the average investor as being a useful in the prediction of future conditions.

On the other hand, it would be expected that the risk premium would be sensitive to changes in expectations regarding future economic trends and conditions. The independent variables that show significant associations with changes in the yield spreads (see Table 2) are characteristically future-oriented with respect to the economic cycle and the general level of interest rates.

It should be noted that previous studies concerning bond yields or yield spreads which employed the Consumer Sentiment Index (MOOD) as an independent variable in multi-factor regression models reported that the measure provided a valuable contribution to the explanatory power of their models.⁴ In contrast, this factor is of little apparent consequence in the current application. The lack of association between this variable and changes in bond

yield spreads will be more fully examined in the following sections.

The results of this procedure, as summarized in Table 2, tend to support the hypotheses that changes in the yield spreads of corporate bonds are associated with changes in expectations of future economic conditions, and that the strength of the association increases as the rated quality declines.

As an additional test of Hypothesis Ia, the actual signs of the estimated coefficients were compared with their expected signs.⁵ This comparison is based on 15 estimated coefficients for each independent variable, determined in conjunction with Model [1] but including all four business classifications. Only the signs of coefficients that were significantly different from zero (at a significance level of 10percent) are compared.

The results of this comparison are reported in Table 3. In order for a sign to be reported as positive or negative for a particular independent variable in Table 3, the estimated sign must have been completely consistent among all of the significant coefficients for that variable. It should also be noted that when this test was repeated using subsets of the time series representing the first and second halves of the full time series, the reported signs were completely consistent for all significant coefficients in those regressions as well.

TABLE 3

Comparison of Actual vs. Expected Signs
for Independent Variable Coefficients

Independent Variable	Expected Sign	Actual Sign	Number of Significant Coefficients
Cash Flow	-	-	9/15
Consumer Sentiment	-	-	1/15
S&P 500 Stocks	-	-	3/15
Gross National Product*	-	-	0/15
Leading Indicators	-	-	12/15
Unemployment Rate	+	+	6/15
Consumer Price Index	+	+	10/15
Government Debt/GNP	?	-	4/15
Money Supply	?	-	11/15
Treasury Bill Rate	?	-	3/15

*Reported sign is based on estimated coefficients in the two time subsamples. No significant coefficients were obtained in the full time sample regressions.

The fact that these signs are completely consistent across all industry/rating groups supports the conclusion that the observed relationships discussed previously are not the result of spurious correlation or random factors.

The reader will recall that the expected sign of the call risk factors was indeterminant due to the possible dual nature of their influence. For example, large positive changes in the money supply may imply higher expected inflation or the possibility of a tighter monetary policy and higher interest rates in the future. These outcomes would be expected to have a negative effect on the economy and business conditions in general and therefore should contribute to higher expected default risk and larger yield spreads. Under these assumptions the expected sign of the Money Supply coefficient would be positive. On the other hand, higher inflation rates and higher interest rates imply a reduced risk of call, thus implying an expected negative sign on the coefficient. Therefore, depending on which of these possible associations is dominant in the actual relationship, the sign of the estimated coefficient could be positive, negative, or indeterminant (i.e. inconsistent across industry/rating groups).

If the variable is to be useful as a proxy for expected risk of call in later multi-factor regression models, then the dominant association should be with expected interest rates rather than with expected economic conditions.

Consequently, the most desirable sign for purposes of this study would be negative.

Similar reasoning would apply with respect to the variables representing the change in the rate on T-Bills and the change in the level of Government Debt relative to GNP. As shown in Table 3, these three variables had an observed sign that was consistently negative for all significant coefficients. This implies that the association of the explanatory variable with expected call risk dominates its association with expected economic conditions in general.

In summary, the evidence presented above supports the hypotheses that changes in factors representing expected economic conditions and expected interest rates are associated with changes in the corporate-government bond yield spread, and that the strength of the association increases as the rated quality of the bonds declines.

2.4.1b Results with Respect to Hypothesis Ic

For the convenience of the reader, Hypothesis Ic is restated here:

Ic) Characteristics of the relationship between the yield spread and the selected economic indicators are not homogeneous with respect to the business classification of the issuer.

This hypothesis is examined by comparing two primary characteristics of the estimated relationships; (1) the magnitude of the slope coefficients and (2) the strength of the observed association. The comparisons are based on the results of the 10 independent variables on each of the 15 industry/rating groups in conjunction with the following model:

$$\text{Model [1a]: } \Delta YS_{ikt} = a_{jikt} + b_{jik} (\Delta X_{jt}) + e_{jikt}$$

where:

ΔYS_{ikt} = the percentage change from time (t-1) to (t) in the spread between the reported yield on the S&P Long Maturity Government Bond Index and the reported yield on Moody's Corporate

Bond Index of business class (i) and rating class (k).

ΔX_{jt} = the percentage change from time (t-1) to (t) in the magnitude of independent variable (j).
Note that some independent variables are defined as lagged values.

b_{jik} = the estimated regression coefficient for independent variable (j) given the dependent variable series is of business class (i) and rating class(k).

e_{jikt} = the residual error at time (t) given $X(jt)$ and $YS(ikt)$.

i = Moody's Index business classifications: Average Corporate, Industrials, Utilities, Rails.

k = Moody's ratings categories Aaa to Baa

j = the 10 independent variable series.

t = represents the quarterly time points from 1969.Q1 to 1984.Q4

This specification implies 15 single-variable regressions for each of the 10 independent variables. The results of these regressions are presented in detail in Appendix A.

Comparison of Estimated Slope Coefficients:

The relative magnitudes of the estimated slope coefficients were compared using the following procedure:

- 1) For each independent variable $X(j)$, 15 regression coefficients $b(jik)$ are estimated in conjunction with Model [1a].
- 2) Within one rating class (k), the t -statistic of the estimated coefficients for the average corporate, industrial, and utility series are tested against the null hypothesis that the true value of the coefficients is zero, using a 10 percent level of significance.
- 3) If all three estimated slope coefficients (for the three models based on the Industrial, Average Corporate, and Utility Indexes of the same rating class) are found to be significantly different from zero, then

they are ranked by absolute magnitude of the estimated slope coefficients.

- 4) These three steps are repeated for all rating groups (k) and all independent variables (j).

This procedure isolated one ranking that was clearly dominant over all others. The magnitude of the estimated coefficient tends to be largest when the dependent variable is based on the Industrial indexes and smallest when based on the Utility indexes. These results are summarized in Table 4.

For the six independent variables representing current or expected economic conditions, there were 7 cases (out of 24 possible) where the estimated coefficients for a particular independent variable were significantly different from zero for all three business classifications within the same rating category. In all 7 cases, the magnitudes of the coefficients ranked (largest to smallest) as Industrial - Average Corporate - Utilities. There were three instances where the estimated coefficient for the Average Corporate yield-spread series was not significantly different from zero, but the coefficients for the Industrial and Utility series were significant. In all three of these cases, the magnitudes of the coefficients ranked as Industrial - Utilities.

Table 4

Comparison of Coefficient Magnitudes
Across Issuer Classifications

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Independent Variables Representing Current or Expected
Economic Conditions:

Number of occurrences where all three coefficients are significant within a particular rating category (out of 24 possible):	7
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Number of occurrences where the magnitudes of the coefficients rank as Industrials - Avg. Corp. - Utilities:	7
--	---

Number of occurrences where slope coefficients are significant only for the Industrial and Utility business classifications:	3
--	---

Number of occurrences where the magnitudes of the coefficients rank as Industrials - Utilities:	3
---	---

Independent Variables Representing Current or Expected
Interest Rates:

Number of occurrences where all three coefficients are significant within a particular rating category (out of 16 possible):	5
---	---

Number of occurrences where the magnitudes of the coefficients rank as Industrials - Avg. Corp. - Utilities:	3
--	---

Number of occurrences where slope coefficients are significant only for the Industrial and Utility business classifications:	2
--	---

Number of occurrences where the magnitudes of the coefficients rank as Industrials - Utilities:	2
---	---

=====

For the four independent variables representing current or expected interest rates, there were five cases (out of 16 possible) where all three estimated coefficients were significantly different from zero within the same rating category. In three of these cases, the magnitudes of the coefficients ranked as Industrial - Average Corporate - Utilities. There were two cases where only the estimated coefficients for the Industrial and Utility series were significant, and in both of these cases the magnitudes of the coefficients ranked as Industrials - Utilities.

The evidence summarized in Table 4 supports the hypothesis that the nature of the association between changes in the yield spread and changes in the selected economic variables is not homogeneous across these broadly defined business classifications. Changes in the independent variables representing expected economic conditions and expected interest rates are associated with larger changes in the yield spreads of industrial bonds than utility bonds, while no significant association exists with the yield spreads of railroad bonds.⁶

Comparison of the Strength of the Estimated Relationships

A similar procedure was employed to compare the relative strengths of the estimated relationships, as represented by the Coefficients of Determination for each regression, adjusted for degrees of freedom (hereafter denoted as R^2). The procedure is summarized as follows:

- 1) For each independent variable $X(j)$, 15 regression coefficients $b(jik)$ are estimated in conjunction with Model [1a].
- 2) Within one rating class (k), the t -statistic of the estimated coefficients for the Average Corporate, Industrial, and Utility series are tested for statistical difference from zero at the 10 percent level of significance.
- 3) If all three estimated coefficients are found to be significantly different from zero (at a 10 percent level of significance), then the adjusted R^2 's associated with those regressions are ranked by absolute magnitude.

- 4) These three steps are repeated for all rating groups (k) and all independent variables (j).

Table 5 summarizes these results. As shown, there were 7 cases (out of 24 possible) where the estimated coefficients for a particular independent variable were significantly different from zero for all three business classifications within the same rating category. In 3 of those cases, the magnitudes of the adjusted R^2 's ranked (largest to smallest) as Industrials - Average Corporate - Utilities.

Of the three cases where only the estimated coefficients for the Industrial and Utility series were significant, the magnitudes of the R^2 's ranked as Industrial - Utilities in all three cases.

Of the five cases where the estimated coefficients for the four independent variables representing current or expected interest rates were significant within the same rating category for all three business classifications, the magnitude of the R^2 's ranked as Industrial- Average Corporate - Utilities in two of those cases. Of the two cases where only the estimated coefficients for the Industrial and Utility series were significant, the magnitudes of the adjusted R^2 's ranked as Industrials - Utilities in both cases.

Table 5

Comparison of R^2 Magnitudes
Across Issuer Classifications

=====

Independent Variables Representing Current or Expected
Economic Conditions:

Number of occurrences where all three coefficients are significant within a particular rating category (out of 24 possible):	7
Number of occurrences where the magnitudes of the adjusted R^2 's ranked as Industrials - Avg. Corp. - Utilities:	3
Number of occurrences where slope coefficients are significant only for the Industrial and Utility business classifications:	3
Number of occurrences where the magnitudes of the adjusted R^2 's ranked as Industrials - Utilities:	3

Independent Variables Representing Current or Expected
Interest Rates:

Number of occurrences where all three coefficients are significant within a particular rating category (out of 16 possible):	5
Number of occurrences where the magnitudes of the adjusted R^2 's ranked as Industrials - Avg. Corp. - Utilities:	2
Number of occurrences where slope coefficients are significant only for the Industrial and Utility business classifications:	2
Number of occurrences where the magnitudes of the adjusted R^2 's ranked as Industrials - Utilities:	2

=====

The evidence presented in Table 5 supports the hypothesis that the strength of the association between changes in the yield spread and changes in the selected economic variables is not homogeneous across these broadly defined business classifications. Changes in the independent variables representing expected economic conditions and expected interest rates were observed to have a stronger relationship with changes in the yield spreads of industrial bonds than utility bonds.

It should be noted that the ranking of the magnitudes of the slope coefficients and adjusted R^2 's described above was highly consistent with rankings produced when identical procedures were applied to subsets of the data sample representing the first and second halves of the sample period. However, the strength of the observed relationships was consistently greater in the second half of the time sample than in the first half. These results are presented in detail in Appendix A.

2.4.1c Stage 1A Summary

The conclusions that can be drawn on the basis of the tests described are as follows:

- 1) Evidence supports Hypothesis Ia. That is, changes in corporate-government yield spreads are associated with changes in factors representing expectations of future economic conditions and interest rates.
- 2) Evidence supports Hypothesis Ib. That is, the strength of the association increases as the rated quality of the bond index decreases.
- 3) There is conflicting evidence regarding Hypothesis Ic. That is, the nature of the association between the yield spreads and the economic variables may differ with the business classification of the issuer. However, the evidence concerning this hypothesis was generally weak and not altogether consistent.

Stage II analysis examines these hypotheses in greater detail using yield-spread series which are relatively free of the technical and structural problems inherent in the popular indexes employed in this section.

2.4.2 Stage IB; Multi-Factor Regression Analysis

The objective of this section is to produce additional evidence concerning the hypotheses defined in the previous section through the use of multiple regression models. These models include terms representing changes in expected economic conditions (as a proxy for changes in expected default risk) and changes in expected interest rates (as a proxy for changes in expected call risk).

For the convenience of the reader, the three hypotheses are restated here:

- Ia) Changes in the corporate-government yield spread are related to changes in the selected economic indicators representing current and expected economic conditions and current and expected interest rates.
- Ib) Characteristics of the relationship are not homogeneous with respect to the risk class (Moody's rating) of the issuer.
- Ic) Characteristics of the relationship (strength of the relationship and magnitude of the slope coefficients) are not homogeneous with respect to the business classification of the issuer (broadly defined by Moody's

three primary issuer classifications: Industrials, Utilities, and Average Corporate).

For the multi-factor analysis of this section, the following general regression model is defined:

$$\text{Model [2]} \quad \Delta YS_{ikt} = b_0 + b_1(\Delta X_{dt}) + b_2(\Delta X_{ct}) + e_t$$

where:

- ΔYS_{ikt} represents the percentage change from time (t-1) to (t) in the spread between the reported yield on the S&P Long Maturity Government Bond Index and the reported yield on Moody's Corporate Bond Index of business class (i) and rating class (k).
- ΔX_{dt} is the percentage change in an independent variable selected to represent current and expected economic conditions. (See pages 71 to 79 for descriptions of the independent variables.)
- ΔX_{ct} is the percentage change in an independent variable selected to represent expected interest rates. This term is included as a control factor for yield spread fluctuations that are not associated with default risk expectations.

The independent variable specifications chosen in conjunction with Stage Ia analysis are retained here. The general model may contain multiple X_{dt} or X_{ct} terms.

As discussed in Section 2.3.4, four representative specifications of the general Model [2] were selected as the basis for further analysis.⁷

2.4.2a Results with Respect to Hypotheses Ia and Ib

Following the selection of the four representative models, each model was used in turn to estimate regression equations for each of the 12 Stage I yield series (Average Corporate, Industrials, and Utilities; Aaa to Baa ratings).⁸ The results are presented in Tables 6 - 9 on the following four pages.

These results are largely consistent with the findings reported in conjunction with the Stage Ia single-variable regression analysis. As expected, significant coefficients occur more frequently in the lower rating categories. Also, the explanatory power of the estimated relationships, as indicated by the adjusted R^2 and F-statistic, consistently increases as the rated quality of the bond index decreases. These simple models can explain up to 60 percent of the variation in the Baa-rated yield series but

TABLE 6

Results of the Regression of Model [5] on 12 Industry/Rating Groups

Full Time Period: 1969.Q1 to 1984.Q4

$$\text{Model [5]: } \Delta Y_{ikt} = b_0 + b_1(\text{ILICHG}_t) + b_2(\text{CPICHG}_{t-1}) + b_3(\text{LNGCHG}_t) + e_t$$

	Constant			ILICHG(t)			CPICHG(t-1)			LNGCHG(t)			R ²	DW	F
	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat			
Aaa Corp	.189	.136	1.39	-3.58	2.05	1.74	-3.89	6.81	0.57	-1.93	0.71	2.71	.188	1.79	3.53
Utl	.044	.064	0.70	-1.56	0.97	1.62	-0.02	3.19	0.00	-0.41	0.33	1.24	.031	2.29	1.69
Ind	-.024	.319	0.07	-4.70	4.83	0.97	14.37	15.96	0.97	-1.15	1.67	0.69	.016	2.53	1.34
Aa Corp	-.029	.061	0.48	-1.45	0.93	1.56	4.79	3.06	1.56	-1.16	0.32	3.61	.241	2.37	7.66
Utl	-.009	.060	0.16	-1.13	0.91	1.25	2.68	3.00	0.89	-0.37	0.31	1.18	.046	2.23	2.03
Ind	-.043	.118	0.39	-2.01	1.66	1.21	9.67	5.49	1.76	-2.65	0.57	4.60	.382	2.71	10.08
A Corp	-.057	.052	1.08	-1.21	0.79	1.52	6.15	2.63	2.34	-1.15	0.27	4.19	.322	2.22	10.98
Utl	-.048	.054	0.87	-0.99	0.82	1.21	4.94	2.72	4.01	-0.53	0.28	1.87	.136	2.22	4.29
Ind	-.074	.072	1.04	-1.69	1.08	1.56	9.18	3.57	2.54	-2.03	0.37	5.43	.411	2.40	15.64
Baa Corp	-.036	.040	0.88	-1.68	0.61	2.75	4.51	2.82	2.23	-0.99	0.21	4.70	.414	2.23	15.83
Utl	-.027	.045	0.61	-1.44	0.68	2.10	3.42	2.26	1.51	-0.37	0.24	1.57	.188	2.22	5.27
Ind	-.072	.057	1.23	-1.97	0.87	2.25	8.27	2.89	2.85	-1.99	0.30	6.57	.514	2.25	23.27

ΔY_{ikt} = Percentage change in the yield spread between Moody's yield series for issuer class (i) of rating (k) and the S&P Long-Maturity Government Bond Index over the period (t-1) to (t). (i = Industrials (Ind), Average Corporate (Corp), and Utilities (Utl)). (t = 1...64 representing quarterly time points from 1969.Q1 to 1984.Q4)

ILICHG(t) = Percentage change in the Index of Leading Indicators

CPICHG(t-1) = Percentage change in Consumer Price Index (Lag 1)

LNGCHG(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

Coef, SE, and t-stat are the estimated regression coefficient, its standard error, and its t-statistic respectively. R² is the Coefficient of Determination for the estimated regression equation, adjusted for degrees of freedom. DW is the Durbin-Watson statistic. F is the regression F-statistic.

Table 7

Results of the Regression of Model [6] on 12 Industry/Rating Groups

Full Time Period: 1969.Q1 to 1984.Q4

$$\text{Model [6]} \quad \Delta Y_{ikt} = b_0 + b_1(\text{CFCNG}_t) + b_2(\text{MS2CHG}_t) + b_3(\text{LNBCHG}_t) + e_t$$

	Constant			CFCNG(t)			MS2CHG(t)			LNBCHG(t)			R ²	DW	F
	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat			
Aaa Corp	.148	.058	2.52	-1.02	1.31	0.78	-6.14	4.03	1.52	-2.25	0.75	3.01	.125	1.72	4.00
Utl	.066	.026	2.48	-0.32	0.59	0.53	-4.62	1.03	2.51	-0.67	0.34	1.96	.106	2.42	3.51
Ind	.033	.136	2.39	-2.09	3.04	0.95	-16.45	9.37	1.75	-1.98	1.74	1.14	.053	2.44	2.19
Aa Corp	.087	.025	3.47	-0.52	0.56	0.93	-6.07	1.73	3.50	-1.48	0.32	4.61	.320	2.47	10.89
Utl	.063	.025	2.54	0.02	0.55	0.04	-5.45	1.71	3.19	-0.68	0.32	2.17	.141	2.43	4.44
Ind	.101	.045	3.95	-1.64	1.02	1.60	-0.53	3.15	2.71	-3.07	0.58	5.25	.360	2.57	12.81
A Corp	.084	.021	3.83	-0.43	0.48	0.88	-6.00	1.50	3.99	-1.48	0.27	5.31	.382	2.39	13.96
Utl	.067	.022	2.98	-0.10	0.50	0.19	-5.62	1.55	3.61	-0.05	0.28	2.93	.208	2.44	6.54
Ind	.127	.030	4.18	-1.07	0.67	1.58	-7.08	2.09	3.37	-2.39	0.38	6.15	.435	2.42	17.21
Baa Corp	.073	.016	4.54	-0.71	0.35	1.97	-5.58	1.11	4.95	-1.28	0.21	6.23	.508	2.31	22.68
Utl	.060	.018	3.33	-0.38	0.40	0.75	-5.61	1.24	4.51	-0.68	0.23	2.96	.301	2.33	10.07
Ind	.112	.024	4.58	-1.48	0.54	2.72	-6.07	1.67	3.61	-2.28	0.31	7.32	.545	2.19	26.18

- $\Delta Y(ikt)$ = Percentage change in the yield spread between Moody's yield series for issuer class (i) of rating (k) and the S&P Long-Maturity Government Bond Index over the period (t-1) to (t). (i = Industrials (Ind), Average Corporate (Corp), and Utilities (Utl)). (t = 1...64 representing quarterly time points from 1969.Q1 to 1984.Q4)
- CFCNG(t) = Percentage change in Corporate Cash Flow
- MS2CHG(t) = Percentage change in M2 Money Supply
- LNBCHG(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

Coef, SE, and t-stat are the estimated regression coefficient, its standard error, and its t-statistic respectively. R² is the Coefficient of Determination for the estimated regression equation, adjusted for degrees of freedom. DW is the Durbin-Watson statistic. F is the regression F-statistic.

TABLE 8

Results of the Regression of Model [7] on 12 Industry/Rating Groups

Full Time Period: 1980.Q1 to 1984.Q4

$$\text{Model [7]} \Delta Y_{ikt} = b_0 + b_1(\text{ILICHN}_t) + b_2(\text{CPICHN}_{t-1}) + b_3(\text{LNBCHN}_t) + \text{AR}(4) + e_t$$

	Constant			ILICHN(t)			CPICHN(t-1)			LNBCHN(t)			AR(4)			R ²	DW	F
	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t			
Avg Corp	.225	.152	1.48	-8.29	1.93	1.71	5.42	7.98	0.73	-2.82	0.72	2.82	.226	.211	1.07	.107	1.77	2.98
Ut1	.045	.066	0.67	-1.49	0.96	1.56	-0.73	3.31	0.82	-0.41	0.34	1.19	.068	.129	0.52	.820	2.29	1.32
Ind	-.049	.248	0.14	-4.13	4.68	0.88	15.84	16.88	0.94	-1.16	1.88	0.67	.122	.137	0.88	.013	2.49	1.28
Avg Corp	-.049	.066	0.73	-1.88	0.87	1.23	5.71	3.27	1.75	-1.12	0.32	3.48	.107	.129	1.51	.255	2.41	6.39
Ut1	-.034	.066	0.52	-0.71	0.83	0.85	3.86	3.21	1.20	-0.35	0.31	1.14	.251	.129	2.83	.072	2.34	2.88
Ind	-.052	.118	0.44	-1.88	1.58	1.86	18.16	5.84	1.74	-2.64	0.58	4.53	.158	.148	1.88	.382	2.89	7.81
Avg Corp	-.088	.068	1.48	-0.88	0.72	1.11	7.77	2.85	2.72	-1.16	0.27	4.31	.257	.125	2.85	.383	2.34	9.62
Ut1	-.075	.068	1.24	-0.88	0.74	0.82	6.35	2.81	2.18	-0.55	0.27	1.97	.287	.119	2.23	.186	2.18	4.61
Ind	-.101	.079	1.27	-1.38	1.04	1.32	18.52	3.83	2.67	-2.83	0.37	5.35	.149	.138	1.88	.411	2.97	12.83
Avg Corp	-.078	.046	1.68	-1.14	0.46	2.46	5.62	2.88	3.21	-0.84	0.18	5.15	.068	.114	4.11	.528	2.35	18.85
Ut1	-.075	.051	1.45	-0.81	0.57	1.42	5.74	2.48	2.38	-0.41	0.22	1.87	.383	.115	3.38	.275	2.31	6.97
Ind	-.083	.064	1.44	-1.88	0.78	2.15	9.33	3.12	2.88	-1.81	0.38	5.34	.272	.133	2.84	.538	2.11	19.39

$\Delta Y(ikt)$ = Percentage change in the yield spread between Moody's yield series for issuer class (i) of rating (k) and the S&P Long-Maturity Government Bond Index over the period (t-1) to (t). (i = Industrials (Ind), Average Corporate (Corp), and Utilities (Ut1)). (t = 1...64 representing quarterly time points from 1980.Q1 to 1984.Q4)

ILICHN(t) = Percentage change in the Index of Leading Indicators

CPICHN(t-1) = Percentage change in Consumer Price Index (Lag 1)

LNBCHN(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

AR(4) = Autoregressive Lag 4 adjustment.

Coef, SE, and t-stat are the estimated regression coefficient, its standard error, and its t-statistic respectively. R² is the Coefficient of Determination for the estimated regression equation, adjusted for degrees of freedom. DW is the Durbin-Watson statistic. F is the regression F-statistic.

have virtually no explanatory power when applied to the Aaa yield series.

Regression equations estimated with Model [8] produce a surprising result with respect to the LNGCHG series lagged one period. This variable was included in the trial models to capture any lagged effects of a change in the general level of long-term rates. Under the assumption stated with respect to the unlagged series, a negative sign was expected for the coefficient of the lagged series. The 12 regression equations estimated for Model [8] produced 7 significant coefficients for the lagged LNGCHG series, and all 7 had positive signs. The reason for this contradictory behavior is not immediately evident. However, the same result was observed in all the trial models which contained the lagged LNGCHG variable. This contradictory outcome will be examined in more detail in the second phase of the study.

The reported results offer general support for Hypothesis Ia. That is, that changes in the yield spreads are associated with changes in expectations regarding economic conditions and interest rates. However, the major contribution to the explanatory power of the models appears to come from the independent variables representing expected call risk. The estimated coefficients for the variables representing changes in expected interest rates tend to attain statistical difference from zero in a higher rating

have virtually no explanatory power when applied to the Aaa yield series.

Regression equations estimated with Model [8] produce a surprising result with respect to the LNGCHG series lagged one period. This variable was included in the trial models to capture any lagged effects of a change in the general level of long-term rates. Under the assumption stated with respect to the unlagged series, a negative sign was expected for the coefficient of the lagged series. The 12 regression equations estimated for Model [8] produced 7 significant coefficients for the lagged LNGCHG series, and all 7 had positive signs. The reason for this contradictory behavior is not immediately evident. However, the same result was observed in all the trial models which contained the lagged LNGCHG variable. This contradictory outcome will be examined in more detail in the second phase of the study.

The reported results offer general support for Hypothesis Ia. That is, that changes in the yield spreads are associated with changes in expectations regarding economic conditions and interest rates. However, the major contribution to the explanatory power of the models appears to come from the independent variables representing expected call risk. The estimated coefficients for the variables representing changes in expected interest rates tend to attain statistical difference from zero in a higher rating

category than the variables representing changes in expected economic conditions. This tendency is evident in the reported results for all four models.

The observed signs on the significant coefficients are consistent with their expected values,⁹ and with the signs reported in conjunction with the single-variable regressions of the previous section.¹⁰ This lends additional support to the conclusions stated in the preceding paragraph.

In summary, the evidence presented here tends to support Hypotheses Ia and Ib. That is, that changes in factors representing expected economic conditions and expected interest rates are associated with changes in the corporate-government bond yield spread, and that the strength of the association increases as the rated quality of the bond index decreases.

2.4.2b Results With Respect to Hypothesis Ic

Hypothesis Ic states that the characteristics of the relationship between changes in yield spreads and changes in the two classes of independent variables are not homogeneous with respect to the business classification of the issuer. This hypothesis is examined here in light of the results reported in Tables 6 - 9 by comparing the magnitudes of the estimated coefficients and regression R^2 's across the three broad business classifications. The procedure follows closely with that described previously in conjunction with Stage Ia analysis.

Comparison of the Magnitudes of the Estimated Coefficients

The reader will recall that Stage Ia analysis determined that the dominant pattern in the ranking of the magnitudes (from largest to smallest) of the estimated coefficients was Industrials - Average Corporate - Utilities. Evidence was offered in support of the conclusion that the yield spread of the average bond represented by the Industrial Index is more sensitive to changes in some of the selected variables than the yield spreads of the bonds represented by the Corporate Index, and both are more

sensitive to such changes than the average bond represented by the Utility Index.

The application of the four multi-factor models to the yield spread series of the 12 Industry/Rating groups produced evidence that was consistent with the earlier conclusions.

Table 10 presents a comparison of the magnitudes of estimated coefficients across the three business classifications. For the independent variables representing expected economic conditions (ILICHG and CFCHG), the magnitudes of the three estimated coefficients within a given rating class ranked as Industrial - Average Corporate - Utility in all cases (16 out of a possible 16). There were three cases where all three coefficients within a given rating class were significant at the 10 percent level. In all three cases, the magnitudes of the coefficients ranked as Industrials - Average Corporate - Utilities.

For independent variables representing expected interest rates, the magnitudes of the coefficients had the same ranking in 26 cases out of 32 possible. There were 15 cases where all three coefficients were significant within a given rating category. Of those 15 cases, coefficient magnitudes ranked as Industrial - Corporate - Utility in 14 cases.

TABLE 10

Comparison of Coefficient Magnitudes
across Issuer Classifications
for Multi-Factor Regression Models

=====

Independent Variables Representing Current or
Expected Economic Conditions:

Number of possible occurrences:	16
Number of cases where the magnitudes of the estimated coefficients ranked Industrials - Avg. Corp. - Utilities:	16
Number of occurrences where all three coefficients are significant within a particular rating category (out of 16 possible):	3
Of those 3 cases:	
Number of occurrences where the magnitudes of the coefficients ranked as Industrials - Avg. Corp. - Utilities:	3

Independent Variables Representing Current or
Expected Interest Rates:

Number of possible occurrences:	32
Number of cases where the magnitudes of the estimated coefficients ranked Industrials - Avg. Corp. - Utilities:	26
Number of occurrences where all three coefficients are significant within a particular rating category (out of 16 possible):	15
Of those 15 cases:	
Number of occurrences where the magnitudes of the coefficients ranked as Industrials - Avg. Corp. - Utilities:	14

=====

The degree of disparity between some of the estimated coefficients across business classifications is quite sizable in the lower rating categories. For example, the application of Model [5] to the three Baa indexes produced the following coefficients:

TABLE 11

Model [5] Estimated Coefficients for Baa Indexes

Dependent Variable Business Class	ILICHG	CPICHG	LNGCHG
Industrials	-1.97 (0.87)	8.27 (2.89)	-1.99 (0.30)
Avg. Corporate	-1.68 (0.61)	4.51 (2.02)	- .99 (0.21)
Utilities	-1.49 (0.68)	3.42 (2.26)	- .37 (0.24)

Standard Error of the coefficient is shown in parentheses.

ILICHG = percentage change in Index of Leading Indicators
 CPICHG = percentage change in Consumer Price Index (Lag 1)
 LNGCHG = percentage change in S&P Long-Maturity Govt. Bond Index

The difference in the magnitudes of the ILICHG coefficients is small relative to the other two variables. This suggests that while changes in the yield spreads of all three business classes are significantly related to changes in expected economic conditions, the degree of sensitivity does not differ appreciably across business classifications.

However, there does appear to be a wide disparity in the sensitivity of the yield spreads of the three issuer classifications to changes in expected interest rates. In the example case shown above, a 1 percent change in the CPI is associated with an 8 percent change in the Baa Industrial yield spread but only a 3 percent change in the Baa Utility yield spread. A similar level of disparity is evident in the estimated coefficients for the change in the Long- Maturity Government Bond Index.

This suggests that the call risk premium of the average bond in the Industrials Index is more sensitive to changes in expected interest rates than the average bond in the Corporate or Utilities Index.

The difference in the sensitivity of the yield spreads to changes in expected interest rates can be at least partially attributed to the fact that the quoted yield for the Utilities Index is invariably higher than that of the Corporate Index, which is higher than that of the Industrials Index. This relationship between the magnitudes of the index yields exists in all four rating categories at all points in time. This fact would support an argument that the average bond represented by the Utilities Index should have less call risk at a given point in time than the average bond represented by either the Corporate or the Industrial indexes since the market yield approximates the refunding rate for called bonds. Thus, other things equal,

a lower market yield implies a higher risk of call. Therefore, since the average Industrial bond has a lower yield than the average Utility bond at any point in time, it should have a greater risk of call and a greater sensitivity to changes in expected interest rates. Similar logic applies to the differential call-risk sensitivity observed between the Utility and Corporate indexes and the Corporate and Industrial indexes.

This evidence is consistent with previous studies, which generally agree that industrial bonds have more call risk than utilities.¹¹

In summary, the evidence presented here supports the hypothesis that the nature of the association between changes in the yield spread and changes in the selected economic variables is not homogeneous across the three broadly defined business classifications used here. Changes in the independent variables representing expected economic conditions and expected interest rates are associated with larger changes in the yields spreads of industrial bonds than utility bonds. These results are fully consistent with the results reported in the previous section.

Comparison of the Strength of the Estimated Relationships

The explanatory power of the estimated relationships is compared across the three broadly defined business classifications by ranking the magnitudes of the adjusted R^2 's produced by the regressions of Models [5] through [8] on the 12 industry/rating groups. The results of this comparison are summarized in Table 12.

Of the 16 groups of three regression equations, (each group is composed of the estimated equations produced by the application of a given model to the Utility, Corporate, and Industrial indexes of a given rating), the magnitudes of the adjusted R^2 's ranked as Industrials - Average Corporate - Utilities in 12 cases. Of the 16 groups, there were 9 cases where all three estimated equations within the group had F-statistics greater than the critical value at a 5 percent level of significance. The magnitudes of the R^2 's ranked as Industrials - Corporate - Utilities in 7 of those cases.

Table 12

Comparison of R^2 Magnitudes Across Issuer Categories
for Multi-Factor Regression Models

=====	
Number of possible occurrences:	16
Number of cases where the magnitudes of the adjusted R^2 's ranked as Industrials - Avg. Corp. - Utilities:	12
Number of occurrences where all three estimated equations are significant within a particular rating category (out of 16 possible):	9
Of those 9 cases:	
Number of occurrences where the magnitudes of the adjusted R^2 's ranked as Industrials - Avg. Corp. - Utilities:	7
=====	

In general, there is relatively little difference in the explanatory power of the models with respect to the Industrial and Corporate Indexes, although the R^2 's for regressions based on the Industrial Index are consistently larger than the R^2 's for regressions based on the Corporate Index. However, the strength of the estimated relationships based on the Utilities index is consistently much weaker. This is illustrated in Table 13, which lists the R^2 and F-statistic for each of the four representative models as applied to the 12 industry/rating groups.

TABLE 13

Comparison of Estimated R² and F-statistic
across Issuer Classifications

Model:	[5]		[6]		[7]		[8]	
	R ²	F	R ²	F	R ²	F	R ²	F
Aaa Ind	.016	1.34	.053	2.19	.013	1.20	.004	1.07
Corp	.108	3.53	.125	4.00	.107	2.90	.100	2.75
Utl	.031	1.69	.106	3.51	.020	1.32	.026	1.43
Aa Ind	.302	10.08	.360	12.81	.302	7.81	.388	10.98
Corp	.241	7.66	.320	10.89	.255	6.39	.265	6.70
Utl	.046	2.03	.141	4.44	.072	2.59	.069	2.18
A Ind	.411	15.64	.435	17.21	.411	12.03	.458	14.34
Corp	.322	10.98	.382	13.96	.353	9.62	.353	9.69
Utl	.136	4.29	.208	6.54	.186	4.61	.155	3.90
Baa Ind	.514	23.27	.545	26.18	.538	19.39	.611	25.81
Corp	.414	15.83	.508	22.68	.528	18.65	.492	16.30
Utl	.168	5.27	.301	10.07	.275	6.97	.207	5.12

Ind = Dependent Variable based on the Industrials Index

Corp = Dependent Variable based on the Corporate Index

Utl = Dependent Variable based on the Utilities Index

Model [5]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + e_t$$

Model [6]:

$$\Delta Y_{ikt} = b_0 + b_1(CFCHG_t) + b_2(MS2CHG_t) + b_3(LNGCHG_t) + e_t$$

Model [7]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + AR(4) + e_t$$

Model [8]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(LNGCHG_t) + b_3(LNGCHG_{t-1}) + AR(4) + e_t$$

ILICHG(t) = Percentage change in Index of Leading Indicators

CFCHG(t) = Percentage change in Corporate Cash Flow

CPICHG(t-1) = Percentage change in Consumer Price Index (Lag 1)

MS2CHG(t) = Percentage change in M2 Money Supply

LNGCHG(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

LNGCHG(t-1) = Percentage change in the S&P Long Maturity Government Bond Index between (t-2) and (t-1).

AR(4) = Autoregressive Lag 4 adjustment.

The relative weakness of the Utilities relationships may be due in part to the fact that the Utility-based dependent variable series are much less volatile than the dependent variable series derived from the Industrial bond indexes. Lower volatility in the dependent variable implies greater difficulty for the regression model to detect significant relationships with the independent variables. However, the dependent variable series based on the Average Corporate yield series are also much less volatile than the Industrial series, yet the strength of the Corporate relationships is much greater than that of the Utility relationships.

For example, the following information pertains to the three issuer classes in the Baa rating category:

TABLE 14

Observed R^2 's for the Four Models in the Baa Rating Category

Dependent Variable	Mean	S.D.	[5]	[6]	[7]	[8]
% Change in Baa Industrial Yield Spread	.032	.255	.514	.545	.538	.611
% Change in Baa Corporate Yield Spread	.017	.164	.414	.508	.528	.492
% Change in Baa Utility Yield Spread	.017	.158	.168	.301	.275	.207

As shown above, the explanatory power of the four models, applied to Baa Industrial yield-spread series far exceeds their explanatory power with respect to the Utility series. A similar pattern is evident in the other rating categories as well. It would seem to be quite unlikely that the observed differences in the explanatory power of the regressions could be attributed solely to the differences in the volatilities of the dependent variable series.

This evidence tends to support Hypothesis Ic. That is, the strength of the relationship between changes in the selected independent variables and changes in the yield spreads is not necessarily homogeneous with respect to business classification of the issuer. Changes in the independent variables representing expected economic conditions and expected interest rates are observed to have a stronger relationship with changes in the yield spreads of bonds represented by the Industrial and Average Corporate indexes than with bonds represented by the Utilities indexes.

2.4.2c Stage IB Summary

The conclusions that can be drawn on the basis of Stage Ib analysis are as follows:

- 1) Evidence supports Hypothesis Ia. That is, changes in corporate-government yield spreads are associated with changes in expectations regarding future economic conditions (representing expected default risk) and future interest rates (representing expected call risk).
- 2) Evidence supports Hypothesis Ib. That is, the strength of the observed association increases as the rated quality of the bond index decreases.
- 3) Evidence supports the hypothesis that the nature of the association between the changes in spreads and changes in economic variables is not necessarily homogeneous with respect to the business classification of the issuer.

2.4.3 Stage IC: Comparison of Observed Relationships Between Two Time Subsamples

2.4.3a Background

The objective of this section is to determine whether the conclusions of Stage Ia and Ib are generally applicable in two subperiods of the full sample time period, or whether some characteristics of the observed relationships are period-dependent. Stage Ic analysis involves the repetition of Stage Ia and Ib procedures using two data subsets representing the first and second halves of the full sample time period, containing observations for 1969.Q1 to 1976.Q4 (hereafter called Period 1) and 1977.Q1 to 1984.Q4 (hereafter called Period 2), respectively.

Prior to a discussion of the results of this analysis, it is advantageous to briefly review and compare the general economic conditions that prevailed in the two subperiods. The discussion here will focus primarily on the behavior of interest rates and yield spreads.

Figure 1 shows the nominal yields for Moody's Aaa and Baa Average Corporate bond indexes and for the S&P Long-Maturity Government Bond Index over the full sample time period (1969.Q1 to 1984.Q4). It is immediately evident that the general level of long-term rates was much higher

in the Period 2. In addition, second period rates exhibited increased volatility relative to first period rates, particularly in the 1979 - 1984 period.

The increase in the level and volatility of interest rates during this period is traditionally attributed to two primary factors: (1) the October, 1979 Federal Reserve Board revision of monetary policy objectives which changed the primary objective of the FRB's Open-Market Committee operations from the maintenance of a stable interest rate structure to the control of money supply growth in an attempt to reduce inflationary pressures, and (2) the advent of the Reagan administration in January 1981 with concurrent monumental changes in domestic economic policy. It is reasonable to assume that these events mark the beginning of a period characterized by increased uncertainty with respect to expected economic conditions. The increased uncertainty in the investment environment would be expected to contribute to higher risk premiums and greater volatility of interest rates throughout this period. Of course, the dramatic increase in volatility of interest rates was also a direct result of the redirection of Federal Reserve Board policy which (1) allowed such volatility to occur and (2) contributed to the volatility through restrictive monetary policy.

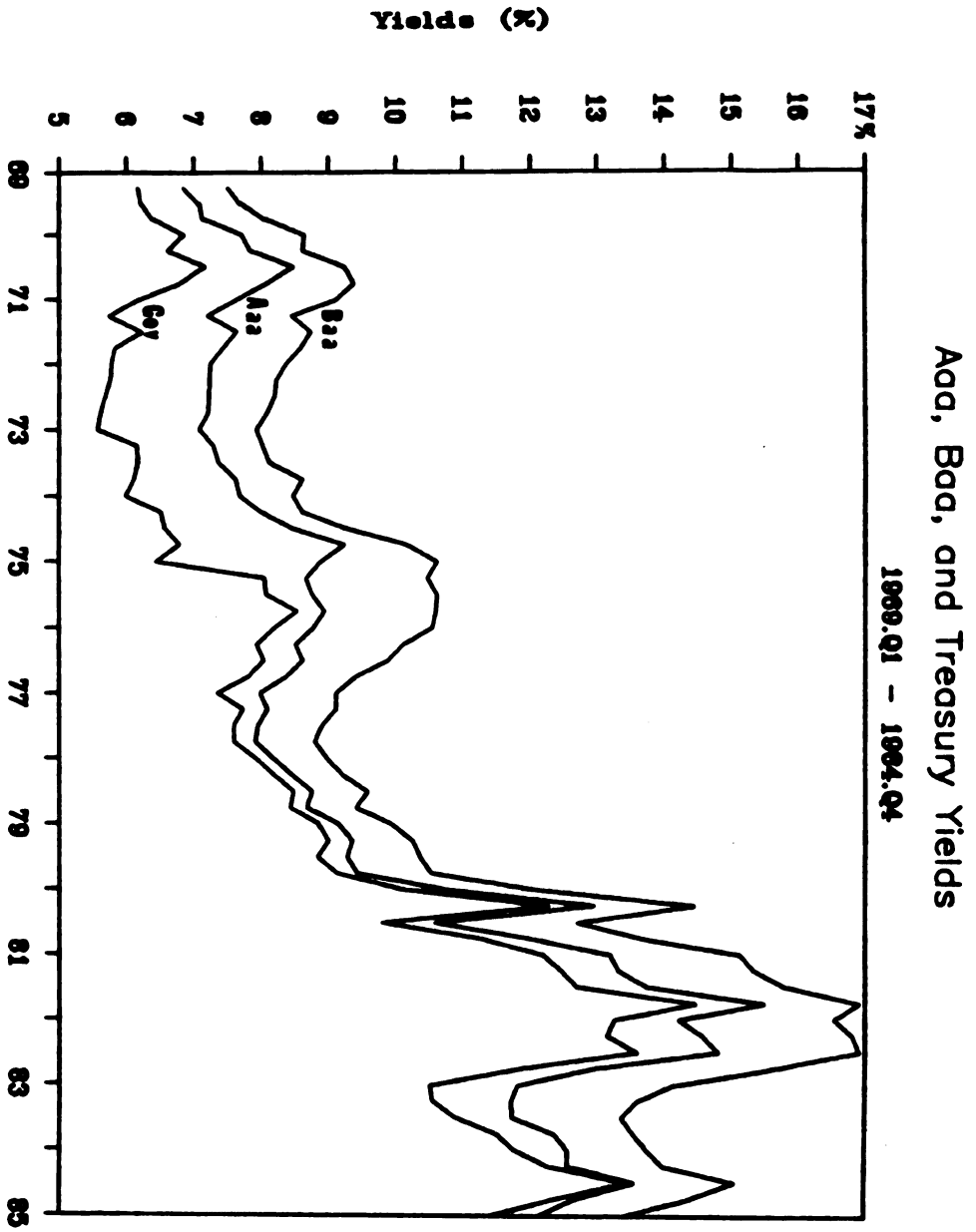


Figure 1

The higher level and volatility of second period rates is also evident in the information presented in Table 15, which compares the mean yield and relative volatility of the 12 yield series (Average Corporate, Industrials, and Utilities; Aaa - Baa ratings) across the two subperiods.

In all cases, the mean yield and the relative volatility of each yield series were much higher in the second period. In fact, relative volatility in the second period was approximately twice that of the first period in all 12 industry/rating groups.

Although apparent differences in the level and volatility of bond yields exist between the two subperiods, differences in the behavior of risk premiums between the two subperiods are less distinct. However, some general comments are appropriate.

Table 16 shows the mean and relative volatility of yield spreads for the 12 industry/rating groups in both subperiods. As shown, the mean yield spread on high-grade (Aaa and Aa ratings) bond indexes was larger in Period 1 than in Period 2 while the mean yield spread of the investment-grade (A and Baa ratings) showed little difference between the two periods. However, the relative volatility of yield spreads was greater in Period 2 for all but the Aaa-rated indexes where the results were mixed.

TABLE 15

Comparison of the Bond Yield Level and Volatility
Between the First and Second Subperiods

Yield Index	Period	Mean Yield	SD	COV	Max	Min
=====						
Aaa Industrials	1	7.971	0.694	.087	9.12	6.73
	2	10.784	2.270	.211	14.92	7.76
Aaa Corporate	1	7.888	0.679	.086	9.24	6.85
	2	11.073	2.358	.213	15.49	7.92
Aaa Utilities	1	8.095	0.680	.084	9.36	6.97
	2	11.419	2.507	.219	16.06	8.07
Aa Industrials	1	7.875	0.765	.097	9.26	6.85
	2	11.162	2.388	.214	15.32	7.97
Aa Corporate	1	8.145	0.696	.085	9.35	9.96
	2	11.498	2.508	.218	15.95	8.15
Aa Utilities	1	8.351	0.778	.093	10.05	7.08
	2	11.830	2.632	.222	16.58	8.32
A Industrials	1	8.153	0.781	.096	9.62	7.04
	2	11.598	2.537	.219	15.73	8.27
A Corporate	1	8.441	0.827	.098	10.04	7.13
	2	11.962	2.694	.225	16.36	8.37
A Utilities	1	8.617	0.956	.111	10.45	7.27
	2	12.321	2.857	.232	17.16	8.46
Baa Industrials	1	8.802	0.876	.099	10.39	7.44
	2	12.219	2.627	.215	16.63	8.74
Baa Corporate	1	8.991	0.947	.105	10.63	7.51
	2	12.527	2.767	.221	16.92	8.80
Baa Utilities	1	9.109	1.081	.119	11.40	7.61
	2	12.829	2.921	.227	17.76	8.85
=====						

SD = Standard Deviation of the Yield
COV = Coefficient of Variation of the Yield
Period 1 = 1969.Q1 to 1976.Q4
Period 2 = 1977.Q1 to 1984.Q4

TABLE 16

Comparison of Yield Spread Level and Volatility
Between the First and Second Subperiods

Index	Period	Mean Yield Spread	SD	COV	Max	Min
=====						
Aaa Industrials	1	0.937	0.496	1.89	2.33	0.15
	2	0.365	0.243	1.50	0.93	0.05
Aaa Corporate	1	1.117	0.519	0.46	2.45	0.42
	2	0.665	0.370	0.56	1.42	0.09
Aaa Utilities	1	1.298	0.553	0.43	2.58	0.63
	2	1.029	0.434	0.42	1.89	0.37

Aa Industrials	1	1.121	0.486	0.43	2.59	0.53
	2	0.749	0.452	0.60	1.69	0.22
Aa Corporate	1	1.362	0.520	0.38	2.59	0.71
	2	1.106	0.508	0.46	2.05	0.46
Aa Utilities	1	1.527	0.607	0.40	3.26	0.70
	2	1.459	0.606	0.41	2.41	0.59

A Industrials	1	1.373	0.522	0.38	2.87	0.69
	2	1.202	0.646	0.54	2.87	0.47
A Corporate	1	1.635	0.589	0.36	3.36	0.85
	2	1.587	0.775	0.49	3.21	0.63
A Utilities	1	1.775	0.654	0.37	3.83	0.92
	2	1.968	0.941	0.48	3.91	0.71

Baa Industrials	1	1.995	0.504	0.25	3.41	1.14
	2	1.808	0.828	0.46	3.71	0.87
Baa Corporate	1	2.151	0.619	0.29	4.19	1.23
	2	2.143	0.878	0.41	3.77	0.98
Baa Utilities	1	2.232	0.739	0.33	4.96	1.19
	2	2.473	0.992	0.40	4.19	1.03
=====						

Yield Spread = the yield on the risky bond index less the yield on the S&P Long-Maturity Government Bond Index.

SD = Standard Deviation of the Yield Spread

COV = Coefficient of Variation of the Yield Spread

Period 1 = 1969.Q1 to 1976.Q4 Period 2 = 1977.Q1 to 1984.Q4

Even though Period 2 was portrayed previously as having a great deal of volatility in economic conditions and interest rates, lower average yield spreads in the second period can be rationalized in at least two ways.

Quickly rising interest rates would tend to reduce expected call risk, thus reducing the call-risk portion of bond risk premiums. However, it is important to note that the yield series employed here may possess structural biases with respect to their method of construction which would contribute to a technical magnification of the actual effect of reduced call risk on yield spreads. For example, the roster of bonds included in Moody's indexes tends to remain unchanged over long periods of time. Consequently, bonds included in the indexes tend to be seasoned issues.

In the second period, this resulted in the computation of the index yields being based on bonds with relatively low coupon rates as compared to the historically high market yields that prevailed during much of the second period. In an environment characterized by historically high and rapidly rising interest rates, low-coupon bonds should experience a greater reduction in expected call risk than more recent issues with greater call protection (due to a longer deferment period) and higher coupon rates. Thus the observed difference in yield spreads across the two time periods may be partially attributable to technical bias in the corporate yield series.¹²

Lower average yield spreads on high-grade bonds in the second period could also be the result of a "flight to quality" on the part of investors. Under the "flight to quality hypothesis, demand for low-risk investments should tend to increase relative to the demand for high risk investments as economic uncertainty increases. Given the more volatile and uncertain economic environment of the second period, this would imply that investors would be willing to pay an extra premium for the safety of highgrade bonds, resulting in a corresponding reduction in their yield spreads.¹³

The information presented in Table 16 is brought into sharper focus through a graphical representation of the behavior of yield spreads in the two subperiods. Figure 2 shows the yield spread for the Aaa Industrial and Aaa Utility indexes in the first and second periods. Figures 3 - 5 show the same information for the Aa - Baa rating categories. Table 16 reported much higher maximum values for the Aaa yield spreads in Period 1 than in Period 2. However, Figure 2 makes it apparent that the Aaa yield spreads exhibited a drastic though short-lived spike in the third and fourth quarter of 1974.¹⁴ Previous to this spike, the Aaa yield spreads were well below the maximum and quite stable, ranging for the most part between 100 and 200 basis points. Immediately following the spike, Aaa yield spreads dropped to their lowest levels for the entire sample

period, with all series exhibiting yield spreads below 100 basis points.

It is also interesting to note that the gap between the three Aaa yield spread series remained relatively constant in the first period over long periods of time. Figure 6, which depicts the difference (gap) between the Industrial and Utility yield spread series (Aaa and Baa rating categories) over time, shows that the yield spreads tended to move approximately in unison throughout the first period.

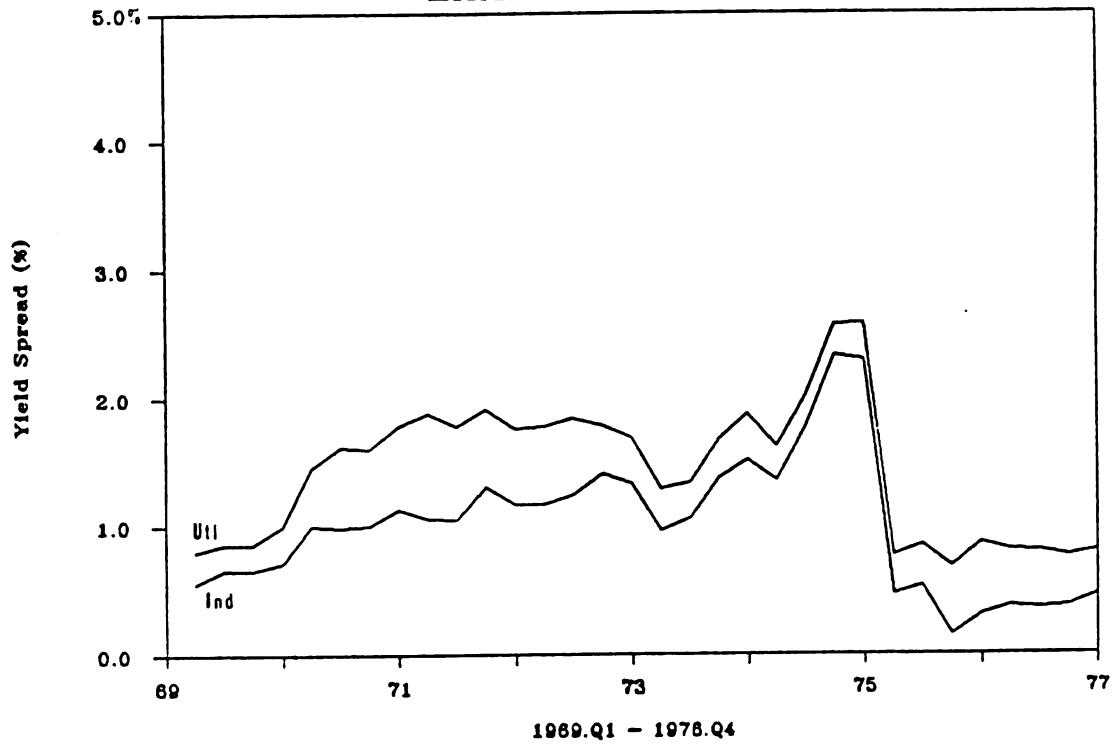
In the second period, however, gap between the yield spread series of the two issuer classes widened considerably beginning in 1980, and the uniformity of movement over time was much less in evidence. Similar behavior of the yield spreads can be observed in Figures 3 and 4 for the remaining rating categories.

Figure 2

Figure 2

Aaa Yield Spreads

Industrials and Utilities; 1st Period



Industrials and Utilities; 2nd Period

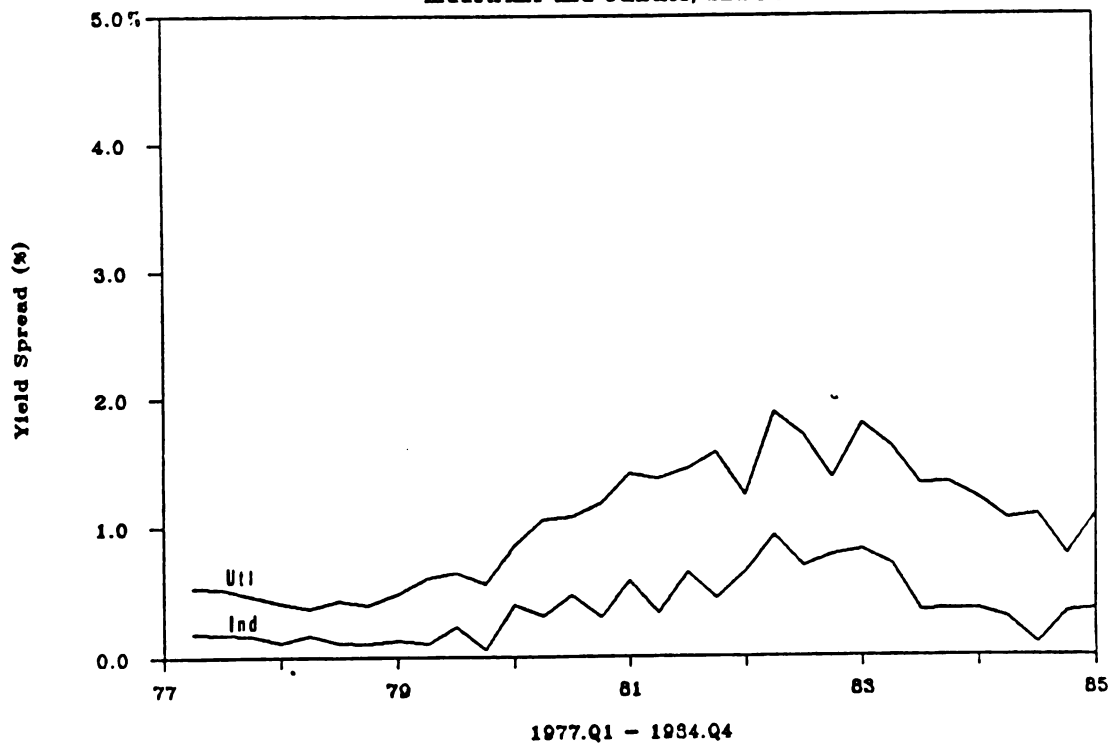


Figure 5

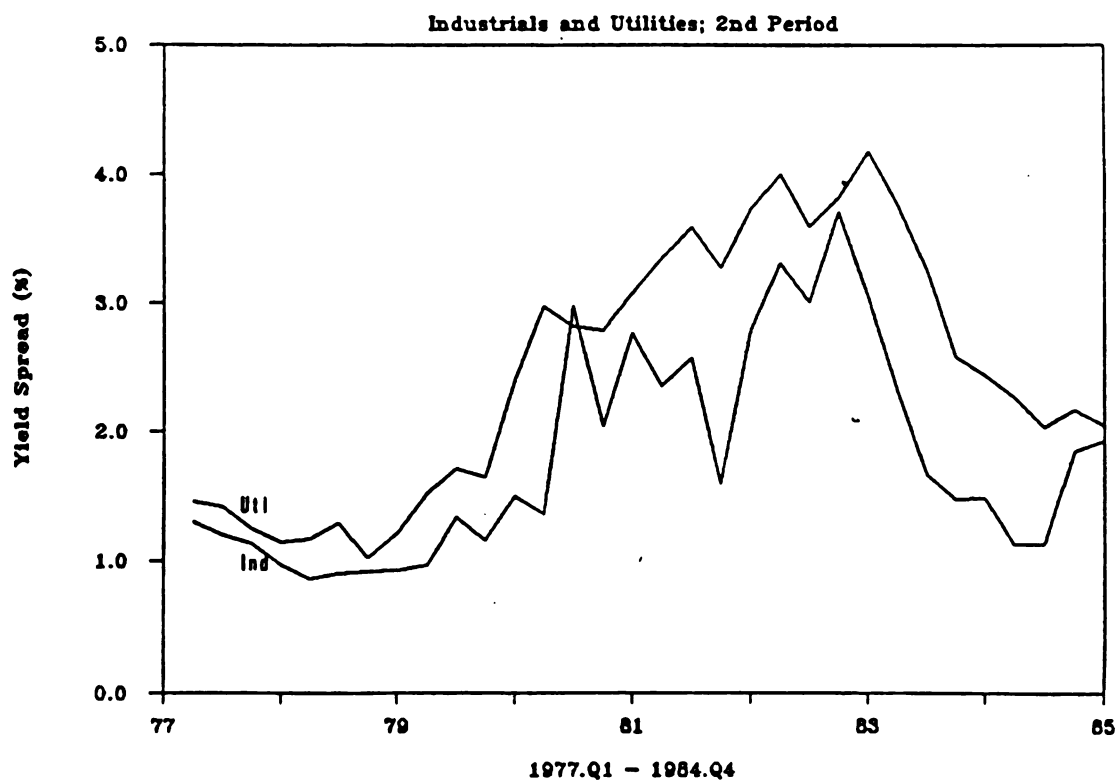
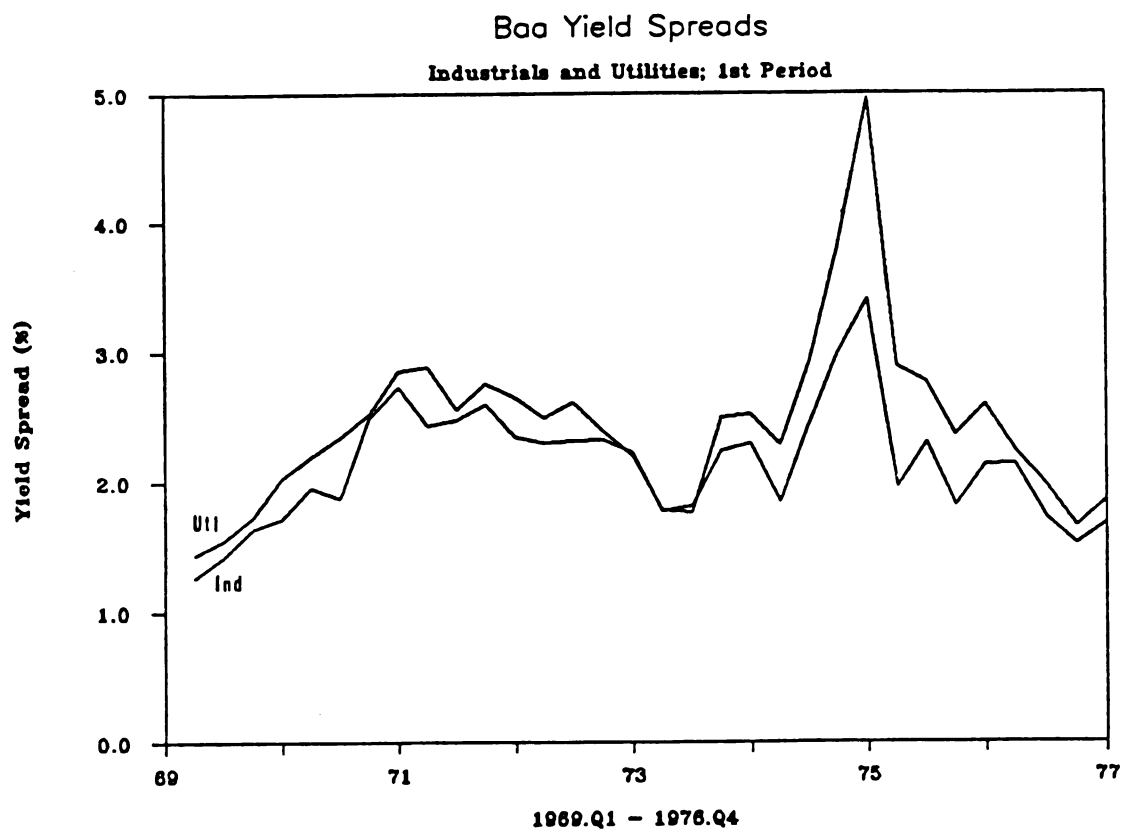
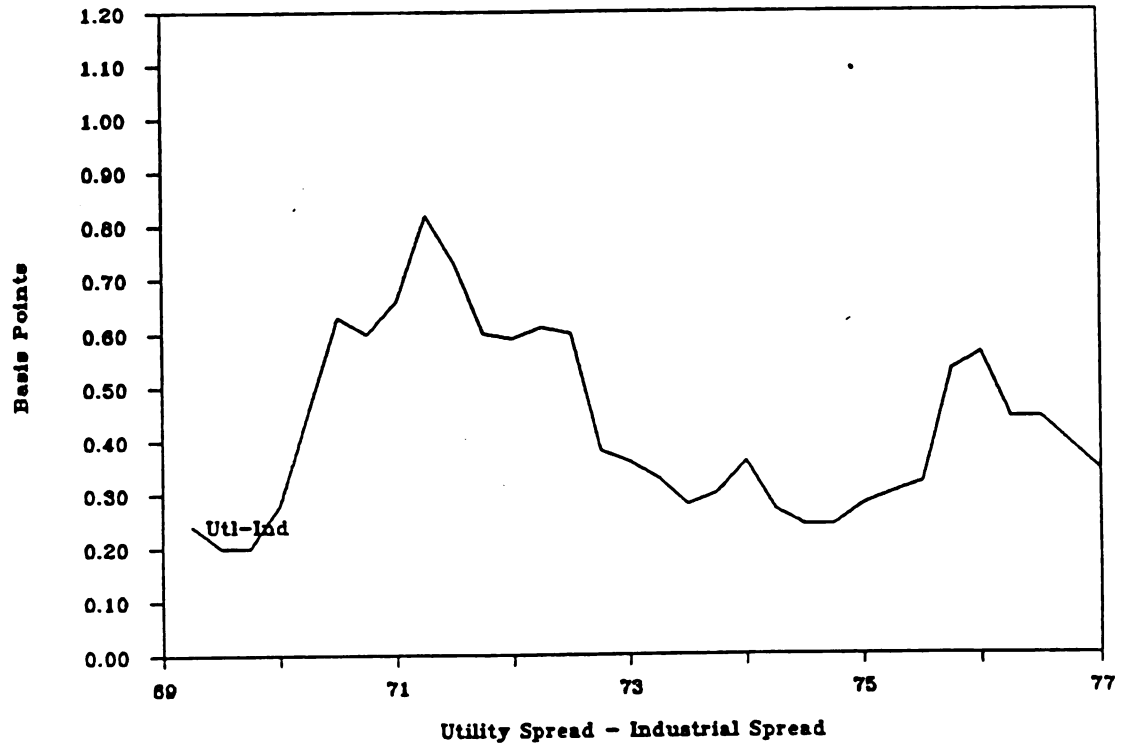


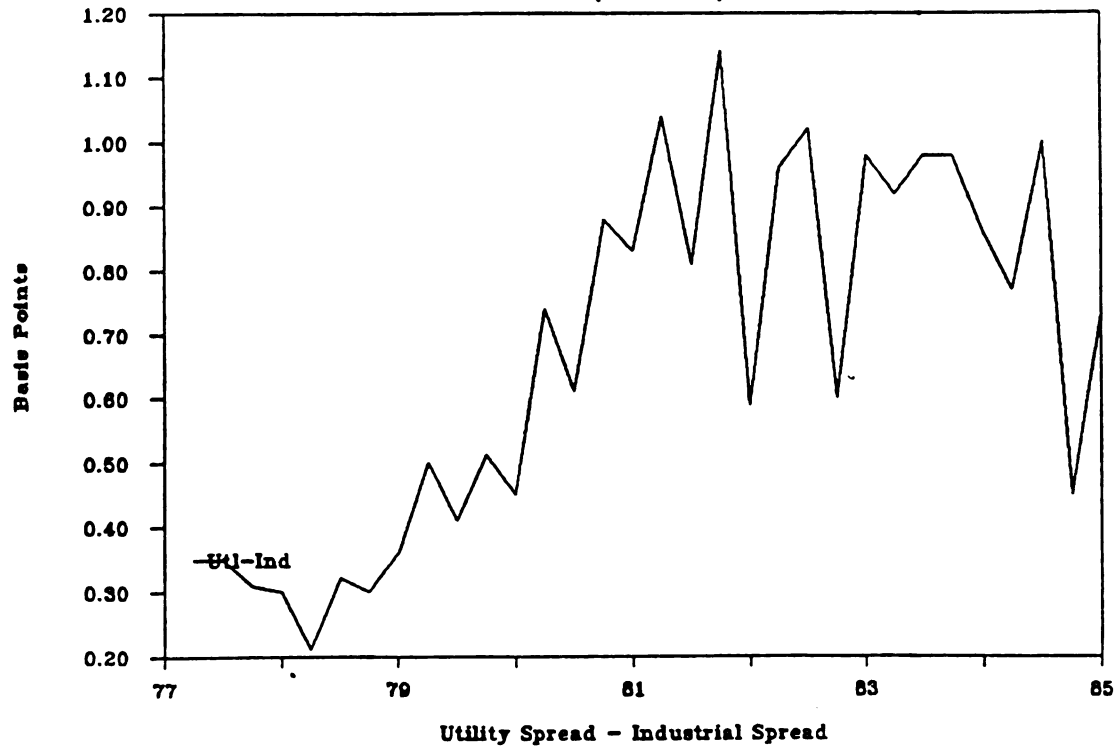
Figure 6

Gap Between Aaa Yield Spreads

1969.Q1 - 1976.Q4



1977.Q1 - 1984.Q4



In summary, the behavior of interest rates and yield spreads exhibited many dissimilarities between the two subperiods chosen for this analysis. The overview presented above will serve to aid the discussion that follows.

2.4.3b Comparison of Single-Factor Regression Results Across Two Subperiods

The procedures employed in this section follow closely with those described in conjunction with Stage Ia analysis. Consequently, the procedural descriptions here will be brief and the reader will be referred to more detailed explanations in preceding sections.

The analysis performed in Stage Ia¹⁵ supported the conclusions that (1) a significant association exists between changes in corporate-government yield spreads and changes in certain economic variables representing expected economic conditions¹⁶ and expected interest rates¹⁷ when observed over the period 1969.Q1 to 1984.Q4, (2) that the strength of the relationships improves as the rated quality of the bond index declines, and (3) that the characteristics of the observed relationships are not necessarily homogeneous with respect to the broadly defined business classification of the issuer.¹⁸

The single-factor regression models described in Stage Ia¹⁹ were used to estimate regression equations for each of the two subperiods, producing 120 estimated equations for Period 1 and Period 2.²⁰ Estimated parameters and statistics for the full set of regression equations are presented

in Appendix A along with the results for the full time period.

Results with Respect to Hypotheses Ia and Ib:

The first part of Stage Ia analysis focused on full-period tests of Hypotheses Ia and Ib, which are restated below:

Ia) Changes in the Corporate-Government yield spreads are related to changes in the selected economic variables.

Ib) The strength of the observed relationships increases as the rated quality of the dependent variable bond index decreases.

The procedures used in Stage Ia to test these hypotheses are essentially repeated in the two subperiods in order to determine whether the Stage Ia conclusions with respect to these hypotheses can be generalized to the two subperiods.²¹

Table 17 focuses on a subset of the results produced by the single-factor regressions described above. The independent variables included in Table 17 are those five that were observed to have the strongest relationships with

TABLE 17

Results of Single-Factor Regression Models in the Two Subperiods

$$\text{Model: } \Delta Y_{k,t} = b_0 + b_1 (\Delta X_{j,t}) + e_t$$

where: $\Delta Y_{k,t}$ = the percentage change in the yield spread between the Average Corporate Bond Index of rating (k) at time (t).

$\Delta X_{j,t}$ = the observed value of independent variable (j) at time (t).

Period 1 represents (t = 1...32) for quarterly time points 1969.Q1 to 1976.Q4

Period 2 represents (t = 33...64) for quarterly time points 1977.Q1 to 1984.Q4

Rating Group:			Aaa				Aa				A				Baa			
X(J)	Prd	Coef	t	R²	Coef	t	R²	Coef	t	R²	Coef	t	R²					
CFCHG	1	.051	.06	.00	.180	.21	.00	-.051	.06	.00	-.704	1.06	.00					
	2	-4.123	1.75 [10]	.06	-2.967	3.70 [01]	.29	-2.529	3.58 [01]	.27	-2.274	3.94 [01]	.32					
MOODCH	1	.365	1.09	.01	.437	1.43	.03	.421	1.44	.03	.078	.32	.00					
	2	-.217	.21	.00	-.558	1.41	.03	-.672	2.00 [10]	.09	.669	2.43 [05]	.14					
STKCHG	1	-.419	.94	.00	-.369	.89	.00	-.399	1.01	.00	-.706	2.37 [05]	.13					
	2	1.107	.67	.00	.105	.16	.00	-.631	1.15	.01	-.566	1.23	.02					
GNPCHG	1	.292	.08	.00	-2.602	.77	.00	-2.940	.92	.00	-.660	1.03	.00					
	2	.690	.06	.00	1.865	.50	.00	.878	.27	.00	-.144	.05	.00					
ILICHG	1	-1.198	1.04	.00	-.924	.86	.00	-.947	.93	.00	-1.610	2.04 [05]	.09					
	2	-6.712	1.59	.05	-4.802	3.24 [01]	.23	-4.650	3.75 [01]	.30	-3.999	3.87 [01]	.31					
ENPCHG	1	.087	.17	.00	.195	.42	.00	.130	.29	.00	0.475	1.35	.02					
	2	1.726	1.01	.00	1.151	1.79 [10]	.07	1.539	2.99 [01]	.20	1.382	3.26 [01]	.24					
CPICHG	1	2.866	.49	.00	4.974	.93	.00	6.577	1.31	.02	7.859	1.99 [10]	.09					
	2	.426	.04	.00	8.268	2.22 [05]	.11	9.040	2.93 [01]	.20	7.346	2.80 [01]	.18					
GDPCHG	1	-2.125	.98	.00	-4.757	.87	.00	-2.248	1.18	.01	-2.500	1.65	.05					
	2	1.138	.25	.00	-1.262	.72	.00	-.976	.64	.00	-1.337	1.05	.00					
MS2CHG	1	-3.774	1.44	.03	-3.117	1.27	.02	-3.595	1.56	.05	-4.141	2.31 [05]	.13					
	2	-3.495	.46	.00	-6.212	2.26 [05]	.12	-5.312	2.22 [05]	.11	-4.852	2.43 [05]	.14					
BILLCH	1	-.091	.35	.00	-.164	.68	.00	-.062	.27	.00	-.045	.24	.00					
	2	.005	.01	.00	-.093	.45	.00	-.206	1.17	.01	-.195	1.31	.02					

[01], [05], and [10] denote statistical significance at alpha = 1%, 5%, and 10% respectively (n=32)
See pages 71-88 for independent variable definitions.

the yield spread series in the full time period. The dependent variables are defined as the percentage change between the Average Corporate yield series of the four rating categories and the yield on the S&P Long-Maturity Government Bond Index.²²

As shown in Table 17, the first period results show an almost complete absence of significant relationships regardless of the rating category of business classification of the issuer. In fact, only two of the estimated slope coefficients are significantly different from zero at $\alpha = 10$ percent. On the other hand, the second period results show many significant and relatively strong relationships.

In general, those independent variables that performed well in the full-period models performed as well or better in the second subperiod models but performed very poorly in the first subperiod models. Those variables that performed poorly in the full-period models also performed poorly in both subperiods.

For example, the change in aggregate corporate cash flow (CFCHG), which was found to have a fairly strong relationship to changes in yield spreads in the full time period but exhibited no significant relationship with any of the yield spread series in the 1969-76 period. However, CFCHG exhibited a very strong relationship to changes on the yield spreads in the 1977-84 period, showing slope coefficients significantly different from zero at

alpha = 1 percent in the lower three rating categories. In addition, the second period R^2 's were consistently very high in all but the Aaa rating category. Very similar results were observed for the change in the Index of Leading Indicators (ILICHG), the change in the Unemployment Rate (EMPCHG), the change in the Consumer Price Index (CPICHG) and the change in the Money Supply (MS2CHG).

It was noted in the discussion of Stage Ia results that the independent variable representing the change in the Index of Consumer Sentiment (MOODCH) was a poor explanatory variable in the context of the current study. In contrast, several other researchers have reported that the measure (specified in terms of the level of the index rather than as its change) provided a substantial contribution to the explanatory ability of models concerned with the behavior of yields and yield spreads. The results of the present section show that the association between MOODCH and the dependent variable series was somewhat stronger in the second period than in the first, but the performance of this variable was still dominated by the five independent variables mentioned above.

In all cases where the estimated slope coefficients are significantly different from zero at alpha = 10 percent, the actual signs are consistent with their expected values and with the values observed in the full time period analysis (see page 130).

These results imply that the conclusions of Stage Ia with respect to Hypotheses Ia and Ib are period-specific and do not hold in the subperiod representing the first half of the full sample period. Stage Ia conclusions do hold in the subperiod representing the second half of the full sample period.

Results with Respect to Hypothesis Ic:

For the convenience of the reader, Hypothesis Ic is restated here:

Ic) Characteristics of the relationship between changes in the yield spreads and changes in the selected economic factors are not homogeneous with respect to the business classification of the issuer.

Stage Ia procedures tested Hypothesis Ic using a comparative ranking of the magnitudes of the estimated slope coefficients and R^2 's produced by the full-period regression models across the three broad issuer classifications while holding the quality rating constant.²³ This procedure isolated one dominant ranking of coefficients and R^2 's with respect to the business classification of the issuer that was consistent across independent variables and

rating categories.²⁴ In order of decreasing magnitude, this ranking (in terms of the issuer classification) was Industrials - Average Corporate - Utilities. The differences in the estimated coefficients and R^2 's supported the conclusion that the characteristics of the observed relationships between changes in the yield spreads and changes in certain economic factors are not necessarily homogeneous with respect to the business classification of the issuer. In particular, the yield spread series based on the Utility bond indexes displayed much less sensitivity to changes in the economic indicators than did the Average Corporate or Industrial yield series.

To determine whether these results were consistent over time, the procedure was repeated using data from each of the two subperiods. Since almost no significant relationships were observed in the first period while many relatively strong relationships were observed in the second period, the inconsistency of results across the two time periods is immediately apparent. The lack of significant relationships in the first period renders the ranking procedure useless in that period since the magnitudes of the estimated coefficients are not dependable due to high standard errors and R^2 's that are generally zero or close to zero.

However, the ranking procedure was applicable to the second period regressions. The results were quite consistent with those reported in conjunction with the full period analysis. Table 18 summarizes the outcome of the ranking procedure for those regression models involving the five independent variables that were found to have the strongest associations with the yield spreads of the three types of issuers in the full-period and second period analysis.²⁵ As shown, the magnitudes of the estimated coefficients in the second period all rank (from highest to lowest) as Industrials - Average Corporate - Utilities. This implies that the average bond represented by the Industrial bond indexes is more sensitive to changes in expected economic conditions and interest rates than the average bond represented by the Average Corporate and Utility bond indexes, with the latter being the least sensitive of the three broad issuer classifications.

The rankings of the strength of the observed relationships in the second period, based on the adjusted R^2 's for the second period regression models, failed to show as clear or as consistent a pattern as did the rankings of the coefficient magnitudes.²⁶ However, some general conclusions are possible.

Table 18

For the regression models involving the three independent variables representing expected economic conditions (ILICHG, CFCHG, EMPCHG) the estimated relationships are consistently weakest when the dependent variable is based on the Utility yield spread series. Although the ranking of the R^2 's is mixed for the regression models involving dependent variables based on the Industrial and Average Corporate bond indexes, the magnitudes of the R^2 's for these two issuer categories are almost equal within a given rating category. That is, the relative strengths of the associations between changes in the three economic variables and changes in the yield spreads for the Industrial or Average Corporate issuer categories are essentially equal within a given rating group.

The regression models involving the two independent variables representing expected interest rates and inflation (CPICHG and MS2CHG) produced inconsistent R^2 rankings. That is, the ranking for the three issuer categories was consistent across rating classes for all regressions involving a particular independent variable, but was different for regressions involving the other independent variable. When the independent variable was MS2CHG, the R^2 for the Utilities regressions was the highest. But, when the independent variable was CPICHG, the R^2 for the Average Corporate regression was the highest.

The evidence presented above tends to support the conclusion that the characteristics of the observed relationships between changes in yield spreads and changes in the economic factors are not necessarily homogeneous across the two subperiods examined here.

2.4.3c Comparison of Multi-Factor Regression Results Across Two Subperiods

In Stage Ib analysis, four representative multiple regression models were selected from among the possible combinations of the two types of independent variables²⁷ based on the models' performance with respect to the full-period yield spread series.²⁸ The four selected models are shown below:

Model [5]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + e_t$$

Model [6]:

$$\Delta Y_{ikt} = b_0 + b_1(CFCHG_t) + b_2(MS2CHG_t) + b_3(LNGCHG_t) + e_t$$

Model [7]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + AR(4) + e_t$$

Model [8]:

$$\Delta Y_{ikt} = b_0 + b_1(ILICHG_t) + b_2(LNGCHG_t) + b_3(LNGCHG_{t-1}) + AR(4) + e_t$$

where:

$\Delta Y(ikt)$ = Percentage change in the yield spread for issuer
class (i) of rating (k) at time point (t).

ILICHG(t) = Percentage change in the Index of Leading In
Indicators

CFCHG(t) = Percentage change in Corporate Cash Flow

CPICHG(t-1) = Percentage change in Consumer Price Index
(Lag 1)

MS2CHG(t) = Percentage change in M2 Money Supply

LNGCHG(t) = Percentage change in the S&P Long Maturity
Government Bond Index between (t-1) and (t).

LNGCHG(t-1) = Percentage change in the S&P Long Maturity
Government Bond Index between (t-2) and (t-1).

AR(4) = Lag 4 autoregressive adjustment.

Regression equations were estimated for these four models in each of the 12 industry/rating groups over the full time period.²⁹ This procedure produced results that were consistent with those of Stage Ia in support of Hypotheses Ia - Ic.

The objective of Stage Ic analysis is to determine whether the characteristics of the observed relationships for the four representative models were consistent over the two subperiods 1969.Q1 to 1976.Q4 and 1977.Q1 to 1984.Q4 . To facilitate the accomplishment of this objective, the four models were used to estimate regression equations for the 12 industry/rating groups in the each of the two subperiods. The results of these regressions are summarized in Tables 19 - 22.

TABLE 19

Results of Multi-Factor Regressions in Two Subperiods Using Model [5]

$$\text{Model [5]: } \Delta Y_{ikt} = b_0 + b_1(\text{ILICHN}_t) + b_2(\text{CPICHN}_{t-1}) + b_3(\text{LNSCHN}_t) + e_t$$

Series	Prd	ILICHN(t)			CPICHN(t-1)			LNSCHN(t)			R ²	DW	F
		Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat			
Aaa Corp	1	-1.710	1.05	1.64	-.211	5.20	.04	-2.200	.45	4.87 [01]	.421	2.211	0.527 [01]
	2	-0.364	5.05	1.06	-10.703	11.63	.92	-1.572	1.26	1.23	.061	1.072	1.670
Aaa Ut1	1	-1.057	.94	1.76 [10]	-.443	4.68	.09	-1.060	.40	4.50 [01]	.396	1.771	7.700 [01]
	2	-2.059	1.83	1.56	-.037	4.21	.19	.505	.45	1.27	.033	2.219	1.349
Aaa Ind	1	-1.317	1.59	.83	2.492	7.09	.31	-2.061	.60	4.15 [01]	.324	2.543	5.950 [01]
	2	-17.000	11.04	1.51	4.970	27.51	.18	.000	3.00	.20	.021	2.790	1.223
Aa Corp	1	-.936	.89	1.05	4.322	4.40	.90	-2.273	.30	5.91 [01]	.525	1.067	12.461 [01]
	2	-3.009	1.01	2.14 [05]	3.259	4.17	.77	-.290	.45	.65	.200	2.701	3.711 [05]
Aa Ut1	1	-.932	.99	.94	3.041	4.09	.70	-1.055	.42	3.00 [01]	.300	1.970	5.603 [01]
	2	-2.003	1.62	1.70 [10]	1.195	3.73	.32	.547	.40	1.34	.101	2.260	2.163
Aa Ind	1	-.403	1.28	.32	6.045	6.32	1.00	-2.509	.55	4.54 [01]	.302	2.350	7.377 [01]
	2	-6.075	3.02	1.75 [10]	6.090	8.79	.69	-2.490	.95	2.60 [05]	.293	2.905	5.290 [05]
A Corp	1	-.040	.92	.60	6.475	4.50	1.41	-1.929	.39	4.92 [01]	.433	2.031	8.005 [01]
	2	-3.276	1.44	2.27 [05]	4.713	3.32	1.41	-.534	.36	1.47	.340	2.506	6.333 [01]
A Ut1	1	-.705	1.07	.65	6.327	5.33	1.10	-1.351	.46	2.90 [01]	.212	2.207	3.705 [05]
	2	-2.202	1.30	1.50	3.060	3.10	1.21	.064	.34	.18	.153	1.901	2.067
A Ind	1	-.404	1.10	.37	7.647	5.45	1.40	-2.150	.47	4.54 [01]	.304	2.210	7.733 [01]
	2	-5.310	2.23	2.30 [05]	6.790	5.13	1.32	-1.743	.56	3.11 [01]	.455	2.024	9.615 [01]
Baa Corp	1	-1.331	.80	1.63 [10]	5.446	3.42	1.50	-1.536	.29	5.14 [01]	.520	2.033	12.221 [01]
	2	-2.005	1.10	2.44 [05]	3.480	2.72	1.20	-.570	.29	1.94 [10]	.370	2.400	7.200 [01]
Baa Ut1	1	-1.540	.77	2.01 [10]	6.013	3.02	1.57	-1.356	.33	4.07 [01]	.447	2.393	9.349 [01]
	2	-1.504	1.21	1.31	2.770	2.79	.99	.250	.30	.85	.001	2.031	2.032
Baa Ind	1	-.921	.79	1.17	5.000	3.91	1.45	-1.554	.34	4.55 [01]	.427	2.107	8.710 [01]
	2	-4.710	1.07	2.52 [05]	6.010	4.30	1.50	-2.113	.46	4.40 [01]	.575	2.201	14.902 [01]

ΔY_{ikt} = Percentage change in the yield spread for issuer class (i) of rating (k) at time point (t).

ILICHN(t) = Percentage change in the Index of Leading Indicators

CPICHN(t-1) = Percentage change in Consumer Price Index (Lag 1)

LNSCHN(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

Prd(1) spans (t = 1...32) for quarterly observations 1969.Q1 to 1976.Q4

Prd(2) spans (t = 33...64) for quarterly observations 1977.Q1 to 1984.Q4

[01], [05], and [10] denote t-statistic or F-statistic greater than the critical value at alpha= [1%, 5%, and 10%]

TABLE 20

Results of Multi-Factor Regressions in Two Subperiods Using Model (6)

$$\text{Model (6): } \Delta Y_{ikt} = b_0 + b_1(\text{CFCNS}_t) + b_2(\text{M2CNS}_t) + b_3(\text{LMBCNS}_t) + e_t$$

Series	Prd	CFCNS(t)			M2CNS(t)			LMBCNS(t)			R ²	DW	F
		Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat			
Aaa Corp	1	.27	.88	.40	-6.581	1.95	3.37 [01]	-2.439	.41	5.87 [01]	.541	2.593	13.298 [01]
	2	-2.87	2.73	1.05	-3.983	8.57	.46	-1.723	1.45	1.10	.043	1.681	1.485
Aaa Ut1	1	.97	.56	1.82	-6.928	1.84	4.28 [01]	-2.889	.35	8.94 [01]	.576	2.121	15.844 [01]
	2	-2.42	.89	2.71 [05]	-.158	2.88	.05	.783	.47	1.63	.183	2.159	3.488 [05]
Aaa Ind	1	-.12	1.89	.11	-5.988	3.19	1.85 [10]	-3.182	.37	4.56 [01]	.377	2.853	7.266 [01]
	2	-7.48	8.25	1.18	-24.177	19.61	1.23	-.596	3.33	.17	.086	2.834	1.733
Aa Corp	1	.31	.58	.55	-5.988	1.84	3.58 [01]	-2.474	.35	7.05 [01]	.626	2.218	18.289 [01]
	2	-2.23	.90	2.47 [05]	-4.965	2.83	1.75 [10]	-.471	.48	.97	.315	2.652	5.772 [01]
Aa Ut1	1	.77	.61	1.25	-6.484	1.79	3.61 [01]	-1.845	.38	4.84 [01]	.477	2.378	18.439 [01]
	2	-1.88	.82	2.84 [05]	-2.962	2.58	1.14	.471	.43	1.07	.181	2.315	3.117
Aa Ind	1	.17	.85	.20	-6.125	2.58	2.44 [05]	-2.751	.53	5.15 [01]	.454	2.521	9.581 [01]
	2	-3.85	1.92	1.89 [10]	-18.265	6.83	1.78 [10]	2.918	1.82	2.84 [01]	.375	2.828	7.211 [01]
A Corp	1	.16	.59	.27	-5.877	1.75	3.34 [01]	-2.147	.37	5.74 [01]	.531	2.349	12.719 [01]
	2	-1.88	.78	2.11 [05]	-5.387	2.38	2.22 [05]	-.793	.48	1.95 [10]	.363	2.592	6.898 [01]
A Ut1	1	.44	.71	.62	-6.891	2.89	2.38 [01]	-1.546	.44	3.46 [01]	.313	2.645	5.714 [01]
	2	-1.22	.71	1.72 [10]	-4.312	2.23	1.92 [10]	-.135	.38	.35	.228	2.127	3.922 [05]
A Ind	1	.87	.72	.18	-6.129	2.12	2.88 [01]	-2.486	.45	5.32 [01]	.482	2.458	18.617 [01]
	2	-2.45	1.21	2.82 [10]	-7.531	3.88	1.98 [10]	2.118	.84	3.27 [01]	.439	2.764	9.181 [01]
Baa Corp	1	-.45	.44	1.83	-5.374	1.29	4.16 [01]	-1.782	.27	6.48 [01]	.615	2.879	17.561 [01]
	2	-1.34	.58	2.38 [05]	-5.148	1.83	2.88 [01]	-.837	.31	2.68 [05]	.488	2.654	18.121 [01]
Baa Ut1	1	-.32	.45	.71	-6.866	1.33	5.13 [01]	-1.632	.28	5.72 [01]	.617	2.398	17.664 [01]
	2	-.96	.61	1.56	-3.376	1.83	1.74 [10]	.112	.32	.34	.132	2.128	3.331 [05]
Baa Ind	1	-.38	.54	.72	-4.279	1.58	2.88 [05]	-1.735	.33	5.12 [01]	.486	2.294	18.843 [01]
	2	-2.37	.85	2.88 [05]	-8.838	2.88	2.88 [05]	-2.488	.58	4.91 [01]	.616	2.428	17.597 [01]

$\Delta Y(ikt)$ = Percentage change in the yield spread for issuer class (i) of rating (k) at time point (t).

CFCNS(t) = Percentage change in Corporate Cash Flow

M2CNS(t) = Percentage change in M2 Money Supply

LMBCNS(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

Prd(1) spans (t = 1...32) for quarterly observations 1989.Q1 to 1976.Q4

Prd(2) spans (t = 33...64) for quarterly observations 1977.Q1 to 1984.Q4

[01], [05], and [10] denote t-statistic or F-statistic greater than the critical value at alpha = [1%, 5%, and 10%]

TABLE 21

Results of Multi-Factor Regressions in Two Subperiods Using Model [7]

$$\text{Model [7]} \quad \Delta Y_{ikt} = b_0 + b_1(\text{ILICHN}_t) + b_2(\text{CPICHN}_{t-1}) + b_3(\text{LNBCHN}_t) + \text{AR}(4) + e_t$$

		ILICHN(t)			CPICHN(t-1)			LNBCHN(t)			AR(4)			R ²	DW	F
Series	Prd	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat			
Aaa Corp	1	-1.769	.99	1.79 [10]	.018	5.48	.00	-2.268	.46	4.96 [01]	.295	.165	1.24	.432	2.08	6.99 [01]
	2	-0.952	5.49	1.46	-10.672	12.00	.00	-1.619	1.34	1.20	.037	.305	.09	.027	1.07	1.22
Aaa Ut1	1	-1.002	.92	1.72 [10]	.016	4.91	.00	-1.061	.42	4.40 [01]	.121	.164	.73	.306	1.72	5.00 [01]
	2	-4.060	1.99	2.04 [05]	-1.005	4.01	.44	.704	.46	1.51	-.245	.219	1.11	.029	2.19	1.24
Aaa Ind	1	-1.211	1.65	.73	3.053	7.02	.39	-2.055	.60	4.17 [01]	-.070	.102	.30	.303	2.57	4.37 [01]
	2	-16.403	12.00	1.36	0.050	29.17	.27	.504	3.06	.16	.066	.210	.31	.000	2.77	.91
Aa Corp	1	-.083	.07	1.00	4.711	4.63	1.01	-2.250	.39	5.06 [01]	.110	.100	.65	.516	1.06	9.26 [01]
	2	-3.240	1.05	1.74 [10]	4.317	4.46	.96	-.233	.46	.71	.100	.193	.51	.104	2.70	2.74
Aa Ut1	1	-.592	.00	.00	5.911	5.14	1.15	-1.616	.42	3.77 [01]	.291	.165	1.76 [10]	.353	1.92	5.23 [01]
	2	-2.460	1.67	1.47	1.011	3.93	.45	.507	.42	1.20	.077	.202	.30	.071	2.27	1.50
Aa Ind	1	-.415	1.29	.32	0.051	6.55	1.06	-2.525	.57	4.42 [01]	.049	.107	.26	.360	2.34	.54
	2	-5.907	3.94	1.51	0.997	9.30	.75	-2.500	.97	2.57 [05]	.073	.230	.30	.269	2.97	3.06 [05]
A Corp	1	-.549	.03	.65	7.074	4.02	1.63	-1.093	.40	4.70 [01]	.295	.177	1.66	.465	2.05	7.74 [01]
	2	-4.539	1.06	2.72 [05]	2.063	3.41	.70	-.395	.37	1.06	.100	.205	.91	.320	2.51	4.65 [01]
A Ut1	1	-.423	.94	.45	9.151	5.61	1.63	-1.229	.46	2.66 [05]	.343	.175	1.95 [10]	.277	2.10	3.90 [05]
	2	-2.209	1.46	1.56	3.744	3.27	1.14	.077	.36	.21	-.019	.100	.10	.121	1.99	2.00
A Ind	1	-.415	1.10	.37	7.762	5.65	1.37	-2.150	.49	4.40 [01]	.059	.177	.33	.374	2.22	5.64 [01]
	2	-4.972	2.43	2.04 [05]	7.507	6.07	1.24	1.750	.57	3.07 [01]	.040	.244	.19	.434	2.01	6.97 [01]
Baa Corp	1	-1.120	.52	2.13 [05]	7.740	3.32	2.32 [05]	1.406	.26	5.24 [01]	.409	.160	2.96 [01]	.617	2.25	13.52 [01]
	2	-1.394	.92	1.51	6.247	2.83	2.20 [05]	-.606	.26	2.60 [05]	.441	.170	2.48 [05]	.444	2.41	7.21 [01]
Baa Ut1	1	-1.052	.00	1.54	9.727	4.06	2.39 [05]	-1.204	.33	3.00 [01]	.351	.174	2.01 [10]	.405	2.55	0.30 [01]
	2	-.259	.95	.27	4.995	.00	1.72 [10]	.005	.27	.01	.416	.169	2.45 [05]	.105	1.99	2.76
Baa Ind	1	-1.002	.71	1.39	5.005	4.11	1.43	-1.499	.34	4.35 [01]	.299	.105	1.61	.460	2.32	7.61 [01]
	2	-9.074	1.79	2.15 [05]	0.337	4.64	1.79 [10]	-2.070	.47	4.37 [01]	.100	.213	.00	.560	2.10	11.24 [01]

ΔY_{ikt} = Percentage change in the yield spread for issuer class (i) of rating (k) at time point (t).

ILICHN(t) = Percentage change in the Index of Leading Indicators

CPICHN(t-1) = Percentage change in Consumer Price Index (Lag 1)

LNBCHN(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

AR(4) = Lag 4 autoregressive adjustment.

Prd(1) spans (t = 1...32) for quarterly observations 1969.Q1 to 1976.Q4

Prd(2) spans (t = 33...64) for quarterly observations 1977.Q1 to 1984.Q4

[01], [05], and [10] denote t-statistic or F-statistic greater than the critical value at alpha= 1%, 5%, and 10% respectively.

TABLE 22

Results of Multi-Factor Regressions in Two Subperiods Using Model (8)

$$\text{Model (8)} \quad \Delta Y_{ikt} = b_0 + b_1(\text{ILICHB}_t) + b_2(\text{LNBCHB}_t) + b_3(\text{LNBCHB}_{t-1}) + \text{AR}(4) + \epsilon_t$$

Series	Prd	ILICHB(t)				LNBCHB(t)				LNBCHB(t-1)				AR(4)				R ²	DW	F
		Coef	SE	t-stat		Coef	SE	t-stat		Coef	SE	t-stat		Coef	SE	t-stat				
Aaa Corp	1	-1.604	.77	2.17	[05]	-2.106	.40	4.96	[01]	.63	.42	1.94	[10]	.193	.162	1.19		.582	2.05	8.04 [01]
	2	-6.575	4.60	1.42		-1.000	1.21	1.62		-1.69	1.57	1.07		.366	.406	.90		.630	1.92	1.24
Aaa Ut1	1	-1.526	.73	2.06	[05]	-1.779	.30	4.46	[01]	.71	.39	1.82	[10]	.092	.150	.57		.454	1.76	7.45 [01]
	2	-5.153	1.73	2.97	[01]	.476	.45	1.00		-1.90	.54	2.30	[05]	.000	.222	.03		.104	2.14	2.74
Aaa Ind	1	-1.457	1.32	1.10		-2.713	.61	4.04	[01]	.93	.65	1.42		-.064	.101	.35		.340	2.46	5.14 [01]
	2	-10.600	12.61	1.55		.472	3.15	.15		-.74	4.20	.17		.062	.235	.26		.600	2.77	.90
Aa Corp	1	-1.270	.65	1.94	[10]	-2.149	.31	5.94	[01]	.96	.35	2.72	[05]	.122	.173	.70		.606	1.87	12.94 [01]
	2	-4.300	1.90	2.22	[05]	-.210	.49	.43		.37	.65	.57		-.093	.215	.43		.171	2.50	2.50
Aa Ut1	1	-1.130	.73	1.53		-1.579	.46	3.70	[01]	.54	.41	1.30		.235	.164	1.43		.362	1.90	5.41 [01]
	2	-3.530	1.54	2.29	[05]	.363	.40	.93		-.60	.52	1.20		.213	.211	1.00		.110	2.20	1.96
Aa Ind	1	-1.012	.94	1.07		-2.300	.50	4.50	[01]	1.47	.50	2.90	[01]	.123	.105	.66		.492	2.27	8.52 [01]
	2	-4.405	3.97	1.12		-2.155	.91	2.36	[05]	2.55	1.22	2.07	[10]	-.215	.234	.91		.357	2.00	5.31 [01]
A Corp	1	-1.246	.67	1.83		-1.821	.34	4.73	[01]	.69	.37	2.37	[05]	.211	.177	1.19		.515	1.93	9.24 [01]
	2	-4.415	1.47	2.99	[01]	-.132	.32	.41		.63	.42	1.99	[10]	-.443	.160	2.63 [05]		.401	2.36	6.20 [01]
A Ut1	1	-1.266	.90	1.50		-1.282	.42	2.60	[05]	.76	.45	1.60		.234	.176	1.33		.204	2.11	4.07 [01]
	2	-3.190	1.50	2.12	[05]	.390	.34	1.13		.57	.43	1.30		-.307	.176	1.73		.143	1.79	2.30
A Ind	1	-1.167	.89	1.20		-2.013	.43	4.34	[01]	1.00	.45	2.20	[05]	-.006	.177	.03		.432	2.20	6.09 [01]
	2	-5.450	2.31	2.35	[05]	-1.411	.50	2.72	[05]	1.43	.66	2.14	[05]	-.320	.192	1.71		.497	2.03	8.60 [01]
Baa Corp	1	-1.821	.46	3.89	[01]	-1.402	.29	5.01	[01]	.56	.29	2.00	[10]	.373	.183	2.04 [05]		.606	2.14	12.93 [01]
	2	-2.150	1.14	1.80	[10]	-.595	.27	1.90	[10]	.53	.36	1.46		.148	.198	.74		.393	2.14	6.02 [01]
Baa Ut1	1	-2.000	.64	3.25	[01]	-1.280	.36	3.61	[01]	.20	.35	.62		.145	.183	.79		.400	2.43	6.36 [01]
	2	-1.410	1.04	1.35		-.053	.27	.10		-.25	.34	.74		.409	.176	2.32 [05]		.113	1.95	1.99
Baa Ind	1	-1.499	.55	2.69	[05]	-1.430	.36	4.54	[01]	.04	.31	2.05	[05]	.273	.190	1.43		.545	2.17	10.34 [01]
	2	-3.246	1.70	1.82	[10]	-1.940	.41	4.51	[01]	1.64	.53	3.05	[01]	-.620	.197	.14		.644	1.96	15.03 [01]

$\Delta Y(ikt)$ = Percentage change in the yield spread for issuer class (i) of rating (k) at time point (t).

ILICHB(t) = Percentage change in the Index of Leading Indicators

LNBCHB(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

LNBCHB(t-1) = Percentage change in the S&P Long Maturity Government Bond Index between (t-2) and (t-1).

AR(4) = Lag 4 autoregressive adjustment.

Prd(1) spans (t = 1...32) for quarterly observations 1969.Q1 to 1976.Q4

Prd(2) spans (t = 33...64) for quarterly observations 1977.Q1 to 1984.Q4

[01], [05], and [10] denote t-statistics and F-statistics greater than the critical value at alpha = 1%, 5%, and 10%, respectively.

Following the estimation of these regression equations, a joint F-test was performed. This test provides an estimate of the likelihood that the true parameters of the regression equation are identical in the two time periods. The theoretical basis of this test is well documented in the literature.³⁰ Therefore, only a brief review will be offered here by way of example.

Consider the following regression model, which is based on Model [5] as applied to the Aaa Utility yield spread series:

[I]

$$\Delta YS_{Aaa,Ut1,p} = b_{0,p} + b_{1,p}(X1_p) + b_{2,p}(X2_p) + b_{3,p}(X3_p) + e_p$$

where:

$\Delta YS(Aaa,Ut1,p)$

represents a vector of the percentage changes in the yield spread for the Aaa-rated Utility Index at time (t) for all (t) within the sample time period (p).

$b(0,p)$ represents the estimated regression constant for sample time period (p).

$b(q,p)$ represents the estimated regression coefficient for independent variable (q; q = 1...3) for sample time period (p).

- $e(p)$ represents the vector of regression errors for sample time period (p) .
- p denotes the sample time period with
 $p=0$ representing the full time period
 $p=1$ representing the first subperiod
 $p=2$ representing the second subperiod
- $X1(p)$ represents the vector of percentage changes in the Index of Leading Indicators between $(t-1)$ and (t) over period (p) .
- $X2(p)$ represents the vector of percentage changes in the Consumer Price Index between $(t-2)$ and $(t-1)$ over period (p) .
- $X3(p)$ represents the vector of percentage changes in the Long-Maturity Government Bond Index between $(t-1)$ and (t) over period (p) .

The Ordinary Least Squares estimation of this model for the full time period and the two subperiods produced the regression parameters and statistics shown in Table 23.

As shown, there appear to be sizable differences in the estimated coefficients between the first and second periods, but the large standard errors of $b[2]$ and $b[3]$ make a direct comparison of coefficient magnitudes of little practical use.

TABLE 23
Summary Statistics for Model [5] Regressions
in Aaa Utility Issuer Category

Time Period:	Full n=64	1st n=32	2nd n=32
b(0)	.0446 (.0639)	.0626 (.081)	.0548 (.0945)
b(1)	-1.565 (.967)	-1.657 (.943)	-2.859 (1.828)
b(2)	-.016 (3.196)	-.443 (4.67)	-.837 (4.211)
b(3)	-.415 (.335)	-1.869 (.407)	.059 (.459)
SSE	2.4078	.6471	1.244

Standard Errors of the estimated coefficients (b[0]...b[3]) are shown in parentheses.

SSE = Sum of Squared Errors for the regression.

The joint F-test provides a theoretically sound methodology through which the inequality of the regression models in the two time periods can be established. The test is based on the null hypothesis that the actual parameters of the regression model are identical in the two subperiods. The first step is to estimate the parameters for each model subperiod with Ordinary Least Squares, as shown above, and calculate the Sum of Squared Errors (SSE) for each regression.

If the null hypothesis is true, then $b(x, p=1) = b(x, p=2)$ for $(x = 0 \dots 3)$. Under this restrictive assumption, the regression models for the two subperiods could be combined into a single model spanning both subperiods without loss of explanatory power. By assumption, the estimated coefficients of the full period (restricted) model would be identical to the coefficients for either of the two subperiod models. The restricted model would have the following form:

[II]

$$\Delta YS_{Aaa, Ut1} = b_0 + b_1(X1) + b_{2,p}(X2) + b_{3,p}(X3) + e$$

where:

▲ $YS(Aaa, Ut1)$ represents the vector of percentage changes in the yield spread for the Aaa-rated Utility Index between time $(t-1)$ and (t) over the full sample time period.

$b(0)$ represents the estimated regression constant.

$b(q)$ represents the estimated regression coefficient for independent variable $(Xq; q = 0 \dots 3)$ in the full time period.

e represents the vector of regression errors.

$(X1 \dots X3)$ represent vectors of independent variables (as defined above) over the full sample time period.

The restricted model is estimated by Ordinary Least Squares and the Restricted Sum of Squares (RSS) is calculated, yielding $RSS = 2.4078$ for this example.

The Unrestricted Sum of Squares (USS) for the full time period is simply the sum of the two SSE's for the subperiod regressions. For this example, $USS = .647 + 1.244 = 1.891$

If the null hypothesis is true, then the restrictions imposed on [II] will have no impact on the model's explanatory power, and RSS will be identical to USS. If the null hypothesis is not true, then the equality restrictions will reduce the explanatory power of the restricted model, resulting in RSS greater than ESS. Thus, the joint F-test compares the relative magnitudes of RSS and USS.

The joint F-statistic is defined as:

$$F_{(k, 64-2k)} = \frac{(RSS - USS) / k}{USS / (64 - 2k)}$$

where k is the number of restrictions placed on the model. In this example $k = 4$ (four regression parameters are restricted to equality across the two time periods), and the joint F-statistic is calculated as:

$$F_{(k, 64-2k)} = \frac{(2.4078 - 1.891) / 4}{1.891 / 56} = 3.822$$

Since the calculated value of F exceeds the critical value at the 1 percent level of significance ($F^*(.01) = 3.07$), the null hypothesis could be rejected with a high level of confidence. That is, it is very unlikely that all of the regression parameters ($b[0]...b[3]$) are identical across the two time periods. Therefore, the characteristics of the observed relationship between Aaa Utility yield spreads and the three independent variables specified for this model are not homogeneous across the two time periods.

Following the procedure outlined above, joint F -statistics were calculated for the four representative models in each of the 12 industry/rating groups. The results are presented in Table 24.

This test produced results that are quite consistent across the four representative models. With respect to the yield spread series based on the Industrial indexes, there was no case for which the null hypothesis could be rejected at traditional levels of significance (i.e. 5 percent or less). Results for the yield spread series based on the Average Corporate bond indexes were mixed, showing no indication of period-specific characteristics in the Aaa and Baa rating categories, a fairly strong indication of non-homogeneous behavior in the Aa category, and a weaker indication of non-homogeneous behavior in the A rating category.

TABLE 24
 Joint F-Statistics for Multi-Factor Regressions
 Over Two Subperiods

Model:	[5]	[6]	[7]	[8]
Aaa Corporate	.84	.52	.66	.97
Aaa Industrial	.51	1.45	1.15	1.28
Aaa Utility	3.82**	6.84**	4.25**	7.14**
Aa Corporate	3.18*	4.32**	2.73*	3.33*
Aa Industrial	1.07	1.63	.86	1.08
Aa Utility	3.62*	4.93**	.33	4.25**
A Corporate	2.27	2.43*	1.95	3.89**
A Industrial	1.46	1.23	1.20	1.63
A Utility	1.68	2.05	1.48	2.34*
Baa Corporate	1.57	1.69	.95	1.03
Baa Industrial	1.78	2.24	1.37	1.59
Baa Utility	3.34*	4.05**	2.93*	2.59*

** ==> Significant at 1% level.

* ==> Significant at 5% level.

See pages 113-117 for a full description of the models.

The results for the Utility bond yield spreads are particularly interesting. There is sufficient evidence to support a strong rejection of the null hypothesis for the Aaa rating category. Joint F-statistics are significant at the 1 percent level for all four models. Although the indication of period-specific behavior is somewhat weaker for the Aa and Baa rating categories, the results would tend to support the rejection of the null hypothesis for these series as well. The A-rated Utility series showed no evidence of period-specific behavior with respect to the representative models.

This evidence supports the conclusion that the relationship between changes in the yield spreads of Aaa Utility bonds and changes in economic factors representing expected economic conditions (default risk) and interest rates (call risk) was not homogeneous across the two subperiods examined.

This result is not surprising, given the shocks to the Utility industry in the second period.³¹ Such shocks include the Three Mile Island accident and the WPSS default. Additionally, the second subperiod saw many utilities experience chronic problems in the construction of nuclear power facilities including long delays, huge cost overruns, a more restrictive regulatory environment, and increased pressure from disgruntled customers and anti-nuclear activists. Given these conditions, it would seem likely

that investors' perception of the default risk of utility bonds in general, and electric power utilities in particular, would have been affected by these events.

The existence of such a change in the perception of the risk environment of Utility bonds is supported by Figure 6 (see page 179), which shows the gap between the yield spreads of the Industrial and Utility indexes for the Aaa and Baa rating categories in the two subperiods. The gap between the Utility yield spread and the Industrial yield spread widened considerably in the second period (particularly in the 1980-84 period) relative to previous years when the gap was quite constant and of much smaller magnitude.

In addition, estimated coefficients for the independent variables representing expected economic conditions (ILICHG and CFCHG) are consistently much larger in the second period regressions involving the Utility indexes. This implies that the default risk premiums of utility bonds were much more sensitive to changes in expected economic conditions in the second subperiod than in the first.

With respect to the strength of the overall relationships in the two subperiods, the results produced by the multifactor regression models contrast sharply with the results of the single-factor models discussed in the preceding section. The first-period single-factor models produced virtually no evidence of significant associations

between changes in any of the selected independent variables and changes in the yield spread series.

However, the first-period multi-factor models show consistently strong overall relationships even in the highest rating categories, as evidenced by high R^2 's and F-statistics that are unanimously significant at the 1 percent level. In contrast, relationships estimated with second period models achieve significant explanatory power only in the lower rating categories. Even then, the magnitude of the R^2 's is generally lower for the second-period models.

Much of the strength of the first-period multi-factor models is contributed by the LNGCHG(t) series, which represents the quarterly percentage change in the Long Maturity Government Bond Index. This series was not tested in the single-factor regression analysis, but was included in the selection process for the representative models under the assumption that changes in risk premiums (yield spreads) may be related to changes in the nominal long term riskfree rate since the latter is partially a function of longterm expectations with respect to inflation and the general level of interest rates. Consequently, the series may be associated with expectations regarding call risk.

In virtually all of the estimated equations for the first-period models, the coefficient of LNGCHG(t) was significantly different from zero (and negative) at the

1 percent level. However, the estimated coefficient for LNGCHG is generally of a much smaller magnitude in the estimated equations for the second-period models, and statistical difference from zero is observed for the coefficients only in the lower rating categories and then only at the 5 percent (or 10 percent) level of significance. This result is consistent across all four representative models.

Very similar results are observed for coefficients estimated for MS2CHG(t) in conjunction with Model [6]. While this factor failed to show a significant relationship with the first-period yield spreads in the single factor regressions of the previous section, the first period coefficients in the multi-factor model are all significantly different from zero at the 1 percent level. In contrast, the estimated magnitudes of the second-period coefficients are much less dependable than those for the first period, with higher standard errors and t-statistics that reach marginal levels of significance only in the lower rating categories.

As the strength of the relationship between the yield spread series and the call risk factors declines in the second period, the independent variables representing changes in expected economic conditions (ILICHG and CFCHG) provide an increased contribution to the explanatory power of the second period models, particularly in the Industrial

and Average Corporate categories. As in the single-factor regressions of the previous section, first period coefficients for ILICHG and CFCHG are generally not significantly different from zero at traditional levels of significance although a few are marginally significant, particularly in the Baa rating category.

2.4.3d Stage IC Summary

The evidence obtained through the procedures described in this section tends to support the following conclusions:

- 1) The characteristics of the observed relationships between changes in bond yield spreads and changes in the economic factors are not necessarily homogeneous across the two subperiods:
 - a) The single-factor regression analysis in the two subperiods showed many strong relationships in the second subperiod but virtually no significant relationships in the first subperiod.
 - b) The joint F-test applied to the multi-factor models provided strong evidence in support of the rejection of the null hypothesis of no difference in the regression parameters of the four multi-factor models across the two subperiods for the yield spreads of Utility bonds. The estimated coefficients in models with dependent variables based on the Utility indexes indicated a greater sensitivity in the second subperiod to changes in

independent variables representing expected economic conditions.

- c) The joint F-test provided sufficient evidence to support the rejection of the null hypothesis of no difference in the regression parameters of the four multi-factor models across the two subperiods for the yield spreads of Aa-rated corporate bonds (as represented by the Aa Average corporate index).
- d) The strength of the multi-factor relationships, as represented by the adjusted R^2 and the regression F-statistic, was greater in the first subperiod for high-grade bonds (Aaa and Aa ratings) for all three issuer classifications. The major contribution to the explanatory power of the first subperiod models appears to come from the independent variable representing the percentage change in the S&P Long-Maturity Government Bond Index (LNGCHG). In all four multi-factor models, the estimated coefficient for this variable in the first subperiod is significantly different from zero at the 1 percent level, and its estimated magnitude is consistently greater in the first subperiod.

- 2) In general, the conclusions reached in the full-period analysis with respect to Hypotheses Ia and Ib appear to hold in both subperiods. That is:
 - a) A significant association exists between changed in bond yield spreads and changes in economic factors representing expected economic conditions and expected interest rates.
 - b) The strength of the association increases as the rated quality of the bond index decreases.
- 3) The conclusions reached in the full-period analysis with respect to Hypothesis Ic appear to hold in the second subperiod. That is, the characteristics of the observed relationships are not necessarily homogeneous with respect to the business classification of the issuer. However, the results for the first subperiod are inconclusive with respect to Hypothesis Ic due to a lack of significant relationships which renders the ranking procedure useless.

It is important to note that these conclusions are based on evidence obtained through the use of prepared yield indexes which are potentially faulty representations

of the actual behavior of bond yields and yield spreads.³² The next stage of this study will test these conclusions using yield series that are constructed in a manner that drastically reduces the technical and structural biases associated with the series, and thus produces more dependable results.

ENDNOTES

1. See pages 62-81 for a discussion of the selection process for the independent variables and pages 71-79 for a list of the selected variables. See pages 104-107 for a description of the specification process for the single-factor regression models.

See pages 44-55 for definitions of the Stage I dependent variables and a description of the underlying data.

2. See section 1.2, pages 4-10, for a discussion of the theoretical basis of this hypothesized relationship.
3. The two subsamples are 1969.Q1 to 1976.Q4 and 1977.Q1 to 1984.Q4.
4. Cook and Hendershott (1978) op. cit.
Jaffee (1975) op. cit.
5. See pages 71-79 for a listing of the selected independent variables and a discussion of their expected signs.

6. Possible reasons for this lack of significant association with the Railroad Bond Indexes are discussed later in this paper.
7. See Table 1, page 116, for a list of the selected models.
8. Since the Railroad yield spread series showed no significant associations with any independent variable in Stage Ia analysis, these series are excluded from the discussion here and in the following analysis.
9. See pages 71-79 for a discussion of the expected signs.
10. See pages 129-132.
11. For example, see:

J.C. Van Horne, Functions and Analysis of Capital Market Rates. (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970).

Michael G. Ferri, "An Examination of the Determinants of Bond Yield Spreads," Financial Management 7(Aut 78), 40-46.

12. This issue will be addressed in the second phase analysis of this paper, where technical biases such as this are corrected in the computation of the yield series.
13. It should be noted that this hypothesis does not imply an actual improvement in the quality (i.e. a reduction in default risk) of high-grade bonds relative to other investments. Rather, it implies a shift in the relative demand for fixed-income investments from higher to lower risk investments.
14. The major event concurrent with this spike is the resignation of President Nixon in August, 1974.
15. See pages 125-143 for a detailed discussion of Stage Ia procedures and results.
16. In particular, significant associations were observed for models using the change in the Index of Leading Indicators (ILICHG), the change in Aggregate Corporate Cash Flows (CFCHG), and the change in the Unemployment Rate (EMPCHG) as independent variables.

17. In particular, significant associations were observed for models using the change in the Consumer Price Index (CPICHG) and the change in the M-2 Money Supply (MS2CHG) as independent variables.

18. Defined in terms of the broad issuer classifications used by Moody's Investor Services as the basis for their bond yield series. Those classifications are Industrials, Average Corporate, Utilities, and Rails.

While the yield spread series based on the Railroad indexes were included in the single-factor regression analysis of Stage Ia, the results were consistently devoid of any evidence of significant relationships in any rating category. Single-factor regressions were also performed on the Railroad yield spread series for the two subperiods (results are shown in Appendix A), but the results were still devoid of any evidence of significant relationships. Consequently, discussion of results concerning the yield spread series based on the Railroad bond indexes is omitted in the remainder of this section.

19. See page 116 for a description of these models.

20. 10 independent variables are regressed on 12 separate dependent variables derived from the Industrial, Average Corporate, and Utility bond yield series of ratings categories Aaa - Baa. Again, the results produced in conjunction with the Railroad bond yield series show no significant associations and are excluded from this discussion.
21. See pages 125-143 for a description of these procedures and the results obtained.
22. The use of the Average Corporate indexes here follows the procedure of Stage Ia, where these indexes were assumed to be representative of corporate bonds in general.
23. See pages 153-163 for a detailed description of this procedure and the results.
24. More precisely, the ranking was consistent among those coefficients that were significantly different from zero at $\alpha=10\%$ or less. The ranking of insignificant coefficients was not considered.

25. The five independent variables are (1) the change in the Index of Leading Indicators (ILICHG), the change in Aggregate Corporate Cash Flows (CFCHG), the change in the Unemployment Rate (EMPCHG), the change in the Consumer Price Index (CPICHG), and the change in the M-2 Money Supply (MS2CHG).
26. Similar results were also observed in the full-period analysis of stage Ia.
27. The two types of independent variables are (1) those which represent current or expected economic conditions and (2) those which represent current or expected interest rates and/or inflation.
28. See pages 113-118 for a discussion of the selection process and a description of the resulting multi-factor models.
29. The resulting regression parameters are summarized in Tables 6 - 9 on pages 147-150. Also see pages 144-164 for a detailed discussion of Stage IB results.

30. For example, see Pindyck and Rubenfeld. Econometric Models and Economic Forecasts. (New York: McGraw Hill, Inc., 1981). Pages 122-126.
31. The effect of the Three Mile Island accident on Utility bond risk premiums was studied by Barrett et al. (1986). The authors concluded that the TMI accident resulted in an industry-wide increase in risk premiums, with the magnitude of the increase being primarily a function of the existence of a firm's commitment to nuclear power.
- W. Barrett, A. Heuson, and R. Kolb. "The Effect of Three Mile Island on Utility Bond Risk Premiums: A Note," Journal of Finance 41(Mar 86), 255-261.
32. The technical and structural problems that may be inherent in these yield series were discussed in detail on pages 29-41 of this paper.



2.5 Stage II: Cross-Industry Analysis

The analysis undertaken in this section involves an examination of the relationship between changes in the bond risk premiums of narrowly-defined industry groups and changes in the selected economic variables previously defined.¹

Throughout this stage of the analysis, the risk premium is defined as the difference between the average yield of a portfolio of risky bonds and the yield of a U.S. Treasury bond with duration equal to that of the risky bond portfolio.²

Given the problems inherent in popular bond yield series,³ and given the intent to test for homogeneity in the hypothesized relationships across industry/rating groups, it was necessary to create original yield series for use in this study. Twenty-nine yield series were created from quarterly price data for 296 individual bonds representing ten industry classifications and three rating categories.⁴ These yield series formed the basis of twenty-nine corresponding risk premium series spanning the time period 1973.Q4 to 1986.Q1.⁵

The primary purposes of this stage of the analysis are (1) to compare the results obtained with the original industry-specific yield series with the results obtained

with the unrefined series used in Stage I analysis, and (2) to test for differences in the observed relationships across industry classifications.

As in Stage I analysis, this section focuses on three specific hypotheses:

- IIa) Changes in corporate bond risk premiums are related to changes in the selected economic indicators.
- IIb) The strength of the observed relationships increases as the rated quality of the bonds decreases.
- IIc) Characteristics of the observed relationships, (strength of the relationship and magnitude of the estimated coefficients), are not necessarily homogeneous with respect to the industry classification of the issuer.

The aggregate analysis of Stage I, using yield series that were broadly classified by industry, produced evidence that tended to support hypotheses IIa and IIb.⁶ However, there was conflicting evidence regarding Hypothesis IIc. This is not altogether surprising given the broad scope of the industry classifications for the series used in that

section. The "Industrials" index included bonds from many different types of industries, and the same can be said of the other indexes used in Stage I analysis. In addition, the roster of bonds included in the index portfolio varies greatly over relatively short time periods. Thus, the specific industry composition of the portfolio underlying the index can change substantially from period to period. The combination of bonds of many different industries into one portfolio would be expected to produce a yield series that is smoothed with respect to industry-specific variations, if such variations do exist. Movements in the portfolio yield series would reflect only the concerted movements of the underlying securities, while movements of more narrowly defined industry groups would tend to be masked. Consequently, the industry-specific risk premium series used in Stage II analysis should allow a more reliable investigation of industry-specific influences.

The procedural format of the analysis in this section is similar to that of Stage I analysis, being composed of two major divisions. The first involves single-factor regressions of the twenty-nine risk premium series on the ten selected economic variables. These regressions provide information on the nature of the relationship between changes in the risk premiums and changes in the individual factors representing default and call risk, and allow a

comparison of the estimated relationships across industry groups.

The second part of the analysis involves the multi-factor regressions used in the analysis of Stage I,⁷ which include independent variables representing changes in expected default risk and call risk in the aggregate.

2.5.1 Stage IIA: Single-Factor Regression Analysis

This portion of the analysis explores the relationship between changes in bond risk premiums of narrowly-defined industry groups and changes in the selected economic variables previously defined. These independent variables were selected to represent changes in expected default risk and call risk in the aggregate.⁸

The single-factor regression analysis conducted in this section is based on the following general model:

$$\text{Model [3]} \quad \Delta RP_{ikt} = a_{ikt} + b_{ik}(\Delta X_{jt}) + e_{ikt}$$

where:

ΔRP_{ikt} represents the percentage change in the portfolio risk premium for industry (i) of rating group (k) between time (t-1) and (t).

i represents the ten narrowly-defined industry groups.

k represents the three rating groups:

High Quality: Aaa and Aa

Medium Quality: A and Baa

Low Quality: Below Baa

t represents quarterly time points from 1973.Q4 to 1986.Q1

▲ X_{jt} represents the percentage change in independent variable (j) between (t-1) and (t).

2.5.1a Results with Respect to Hypotheses IIa and IIb

The general model defined above was applied to each of the twenty-nine risk premium series using each of the ten selected economic variables. A detailed summary of the results is presented in Appendix C.

In general, the results of this analysis are consistent with Stage I results in most respects. As in Stage I, significant relationships are most prevalent in models using Corporate Cash Flow (CFCHG), the Index of Leading Indicators (ILICHG), the Unemployment Rate (EMPCHG), the Consumer Price Index (CPICHG), and the Money Supply (MS2CHG). Also consistent with Stage I analysis, the independent variable representing the change in the Index of Consumer Sentiment (MOODCH) had almost no explanatory power when applied to the Stage II risk premium series. This result stands in contrast to other studies where this economic series was found to have a strong relationship to the variability of bond yields and yield spreads.

The existence of many significant relationships among the estimated regression models offers general support to Hypothesis IIa -- that changes in risk premiums are

associated with changes in certain broad economic measures. Additional support for this hypothesis is obtained through a comparison of the expected and observed signs of the coefficients, as presented in Table 25. Those explanatory variables for which significant relationships are observed have signs that are consistent with expectations and with Stage I results. Among the variables representing expected default risk, the strongest and most consistent relationships are observed for Corporate Cash Flow, the Index of Leading Indicators, and the Unemployment Rate. Among the four variables representing expected interest rates and inflation, the M-2 Money Supply and the Consumer Price Index are observed to have the strongest and most consistent relationships with the dependent variable.

While the independent variable representing the level of government debt as a percentage of GNP is observed to have the largest number of significant associations with the dependent variable of all the interest rate/inflation variables, the signs of the estimated coefficients lack consistency across the industry groups. This inconsistency in sign may be attributable to non-spherical behavior in the residuals. None of the residual series produced by the regressions involving this explanatory variable show evidence of heteroscedasticity. However, serial correlation among the residuals of some industry groups could result in inefficient estimates of the coefficients. Of the ten

TABLE 25

Comparison of Observed vs. Expected Signs
for Independent Variable Coefficients

Independent Variable	Expected Sign	Number of Significant Coefficients	Observed Signs	
			+	-
Cash Flow	-	8/29	1	7
Consumer Sentiment	-	2/29	1	1
S&P 500 Stocks	-	1/29	0	1
Gross National Product	-	2/29	1	1
Leading Indicators	-	15/29	0	15
Unemployment Rate	+	6/29	6	0
Consumer Price Index	+	9/29	7	2
Government Debt/GNP	?	10/29	4	6
Money Supply	?	7/29	0	7
Treasury Bill Rate	?	6/29	1	5

See pages 71-80 for a discussion of the expectations concerning each independent variable.

Relationships are considered to be significant if the t-statistic for the estimated slope coefficient is of sufficient magnitude to reject the null hypothesis of equality with zero at the 95 percent confidence level.

industry/rating groups with significant slope coefficients for this explanatory variable, four have Durbin-Watson statistics with values outside the range for rejection of the null hypothesis of no serial correlation. All four of these have negative observed signs on the estimated slope coefficients. However, even if these four coefficients are eliminated from consideration, the remaining signs are still mixed and in disagreement with Stage I results, where the estimated slope coefficients for this variable were all observed to have negative signs.

The most likely reason for the inconsistency in results for regressions involving this variable is the fact that during the sample period the quarterly change in government debt is almost always positive and increasing. In addition, the last few years of the sample period are dominated by values of this variable that are tremendously large when compared to values from earlier periods. This has the effect of placing a very large weight on the observations of the most recent periods while very little weight is given to earlier periods, resulting in a virtual truncation of the sample time period to only the last four or five years.

Given the limited time focus of these regressions due to the extremely large values of the dependent variable in the most recent periods, and given the positive sign on the vast majority of these changes, the regressions involving

this independent variable are simply measuring the dominant direction of change in the risk premium series in the last few years of the sample period. If the risk premiums of a given industry/rating group tended to be increasing (decreasing) during that time, then the observed slope coefficient would be positive (negative). Thus, the behavior of this particular variable damages its ability to represent the economic influence that is of interest in this context, and the observed results are of no use.

With this exception noted, the results offer general support to the hypothesis that changes in the risk premiums of corporate bonds are associated with changes in certain economic factors chosen to represent expected default risk and expected interest rates and inflation. The strongest and most consistent relationships are observed for independent variables representing Corporate Cash Flows, the Index of Leading Indicators, the Unemployment Rate, the M-2 Money Supply, and the Consumer Price Index. These findings are consistent with the results of Stage I analysis.

The results of the single variable regressions also tend to support Hypothesis IIb -- that the strength of the observed relationships increases as the rated quality of the bonds decreases. Table 26 shows the number of significant slope coefficients (at the 95 percent and 99 percent confidence levels) for each of the ten independent variables.

TABLE 26

Estimated Coefficients Significantly Different from Zero
Compared Across Rating Groups

Independent Variable	Rate Group 1		Rate Group 2		Rate Group 3	
	5%	1%	5%	1%	5%	1%
Corporate Cash Flow	1			4	1	2
Consumer Sentiment				1	1	
S&P 500 Index			1			
Gross National Product	1		1			
Leading Indicators	2		4	3	2	4
Unemployment Rate			1	4	1	
Consumer Price Index	1	2	3	2	1	
Govt. Debt / GNP	2	1	4	2	1	
M-2 Money Supply			1	2	3	
T-Bill Rate			3	2	1	1
Totals	7	3	19	23	11	7

Based on t-Tests for $b(ik)$ as estimated from the general model:

$$\Delta RP_{ikt} = a_{ikt} + b_{ik} (\Delta X_{jt}) + e_{ikt}$$

where: $\Delta RP(ikt)$ represents the percentage change in the risk premium on the portfolio representing industry (i) of rating group (k) between time (t-1) and (t).

$\Delta X(jt)$ represents the percentage change in the independent variable (j) between time (t-1) and (t).

Significant slope coefficients occur much more frequently and with higher levels of significance in the Medium-quality rating category than in the High-quality category. This result is quite consistent across all independent variables.

On the other hand, the Low-quality rating category was observed to have more, and stronger, associations with the independent variables than the High-quality category, but fewer than the Medium-grade category.

While this result may at first seem surprising, it is not unreasonable given certain characteristics of the Low-grade portfolios. The Low-quality risk-premium series for five of the 10 industry categories have less than 30 observations due to a general shortage of low-quality debenture issues that conform the restrictions imposed for this study. Also, the Low-quality portfolios are composed from fewer bonds on average than the higher quality portfolios. Consequently, the effects of firm-specific factors are less likely to be diversified away, thus reducing the ability of economic factors to explain a significant amount of the total variation in the dependent variable.

Furthermore, it is not unlikely that firm-specific factors would assume a relatively great importance in investors' assessments of the default risk of the bonds in the Low rating groups, and their impact on the risk

premiums would be likely to dominate the impact of the macro factors used here as independent variables. Given that some of the Low rating portfolios are not of sufficient size to be well-diversified, this situation could produce enough noise in the data to hinder the ability of the regressions to detect significant associations.

Thus, the observed result with respect to the Low rating portfolios is not necessarily inconsistent with Hypothesis IIb, but rather could be attributable to characteristics of the data sample and the increasing importance of micro-economic factors in the risk premiums of the Low rating groups.

A slightly different point of view is presented in Table 27, where the frequency of occurrence of significant F-statistics is compared across quality and industry classifications. Again, significant associations are observed with greater strength and frequency in the Medium-quality category than in the High-quality category. This result is consistent across all of the industry classifications where any significant associations are observed.

The results presented here are consistent with Hypothesis IIa -- that changes in bond risk premiums are associated with changes in the selected economic variables, and with Hypothesis IIb -- that the strength of the associations increases as the rated quality of the bond portfolios decreases. These results are generally con-

sistent with the results reported in conjunction with Stage I analysis.

TABLE 27

Regression F-Statistics Significantly Different from Zero
Compared Across Industry/Rating Groups

	Rate Grp 1		Rate Grp 2		Rate Grp 3		Total
	5%	1%	5%	1%	5%	1%	
Aerospace			2	1			3
Automotive Mfc.	2		4				6
Computers / Elec.	1		1	1		1	4
Forest Products			2	5	1	1	9
Metals / Mining	1		2				3
Oil Producers	1		2		1		4
Air Transport			1	4	3	2	10
Retailers	2		1	3		1	7
Farm Equip. Mfc.							0
Elec. Utilities	2			3			5
	9		15	17	5	5	51

Based on F-Tests for the regression equations estimated for the following general model:

$$\Delta RP_{ikt} = a_{ikt} + b_{ik} (\Delta X_{jt}) + e_{ikt}$$

where: $\Delta RP(ikt)$ represents the percentage change in the risk premium on the portfolio representing industry (i) of rating group (k) between time (t-1) and (t).

$\Delta X(jt)$ represents the percentage change in the independent variable (j) between time (t-1) and (t).

2.5.1b Results with Respect to Hypothesis IIc

For the convenience of the reader, Hypothesis IIc is restated here:

IIc) Characteristics of the observed relationships, (strength of the relationship and magnitude of the estimated coefficients), are not homogeneous with respect to the industry classification of the issuer.

This hypothesis is tested using covariance analysis based on a series of regression models containing binary (dummy) variables. The procedure is documented in Maddala,⁹ Chow,¹⁰ and Vogel and Maddala.¹¹ The description here will therefore be brief.

Consider a group of single-factor regression models involving a given independent variable (X_t) and (n) dependent variable series ($Y_{1t}, Y_{2t}, \dots, Y_{nt}$). The regression model for each dependent variable series is of the form:

$$\begin{aligned}
 \text{(i)} \quad Y_{1t} &= a_1 + b_1(X_t) + e_{1t} \\
 Y_{2t} &= a_2 + b_2(X_t) + e_{2t} \\
 &\vdots \\
 Y_{nt} &= a_n + b_n(X_t) + e_{nt}
 \end{aligned}$$

Test I:

Consider the null hypothesis is that all (n) slopes and intercepts are identical; (i.e. $a_1 = a_2 = \dots = a_n$, $b_1 = b_2 = \dots = b_n$). If we assume that the null hypothesis is true, then the (n) individual regression equations can be combined and estimated simultaneously, without any loss of explanatory power, using the following model:

$$(ii) \quad Y_{it} = a + b(X_t) + e_{it}$$

where:

Y_{it} represents a vector of observations on the dependent variable composed via the summation of all (n) vectors ($Y_{1t} \dots Y_{nt}$).

e_{it} represents a vector of regression error terms corresponding to the vector Y_{it} .

If the null hypothesis is true, then the residual sum of squares for the combined model should be identical to the sum of the residual sums of squares for the (n) individual regression models, indicating that restricting slopes and intercepts to equality across classes of dependent variables had no negative impact on the explanatory power of the regression model.

Defining USS as the unrestricted residual sum of squares, computed as the sum of the residual sums of

squares across the (n) individual regressions of form (i), and RSS as the restricted residual sum of squares resulting from the combined regression of form (ii), the hypothesis of homogeneity of slopes and intercepts can be subjected to an F-test of the following form:

$$[I] \quad F = \frac{ (RSS - USS) / (2n - 2) }{ USS / (N - 2n) }$$

where $N =$ the total number of observations in the vector of combined dependent variables Y_{it} .

If this F ratio is significant, then the null hypothesis may be rejected on evidence that significant differences exist among the slopes and/or intercepts across groups.

Test II:

If it is desirable to test the null hypothesis that the slope coefficients are identical across groups of dependent variables, ($b_1 = b_2 = \dots = b_n$), a similar procedure is appropriate. The restricted model is estimated with a constant slope coefficient but intercepts are allowed to vary across groups of dependent variables.

The restricted model is of the following form:

$$(iii) \quad Y_{it} = a_1 D_1 + a_2 D_2 + \dots + a_n D_n + b(X_t) + e_{it}$$

where:

Y_{it} represents a vector of observations on the dependent variable composed via the summation of all (n) vectors ($Y_{1t} \dots Y_{nt}$).

$D_1 \dots D_n$ represent (n) vectors of binary variables with length (N) such that $D_1=1$ if $i=1$ and 0 otherwise, $D_2=1$ if $i=2$ and 0 otherwise, etc.

e_{it} represents a vector of regression error terms corresponding to the vector Y_{it} .

If restricting the slope coefficients to equality does not have a negative impact on the explanatory power of the regression, then the residual sum of squares for (iii) should equal the unrestricted residual sum of squares as defined previously. The hypothesis of equality among the (n) slope coefficients can therefore be subjected to an F-test as follows:

$$[II] \quad F = \frac{ (RSS - USS) / (n - 1) }{ USS / (N - 2n) }$$

If this F ratio is significant, then there is sufficient evidence to reject the null hypothesis of equality among the slope coefficients.

In the context of this study, heterogeneity in the intercept coefficients across industry groups does not imply heterogeneity in the relationship between changes in risk premiums and changes in the independent variables, but rather implies a difference in the dominant trend of movement in the dependent variable series. If a given risk premium series is dominated by relatively large positive (negative) quarterly changes, it will tend to produce a positive (negative) intercept no matter which economic factor is employed as the independent variable. If the risk premium tends to increase (decrease) over time, then independent variables with values that are correlated with time will tend to produce positive (negative) intercepts. Thus, differences in intercept coefficients across industry groups are not indicative of differential sensitivity with respect to changes in the selected economic factors.

Differences in the slope coefficients across industry groups would imply that the sensitivity of risk premiums to changes in the independent variable is not homogeneous across industry groups. Other things equal, a higher slope coefficient implies a greater percentage change in the risk premium for a given percentage change in the independent variable.

The two F-tests described above are designed to provide information regarding the likelihood of the existence of significant differences in the slope coefficients for a given independent variable across industry groups. If the F-ratio for Test I and Test II are both significant, then there is strong evidence for rejection of the null hypothesis of no difference in slope coefficients across industry groups. If the F-ratio for Test II is significant but the F-ratio Test I is not significant, then the evidence for rejection of the null hypothesis is weak. If the F-ratio for Test II is not significant and the F-ratio for Test I is significant, then there is some evidence of differences in the intercepts across industry groups. As discussed above, this result would not imply differential sensitivity across industry groups.

The tests described above were applied to each group of estimated regression equations for the single-factor regressions described previously. The general specification of the model upon which these tests were based is:

$$\begin{aligned} \Delta RP_{it} = & a_1 D_1 + a_2 D_2 + \dots + a_n D_n + \\ & b_1 (\Delta X_t D_1) + b_2 (\Delta X_t D_2) + \dots + b_n (\Delta X_t D_n) + e_{it} \end{aligned}$$

where:

ΔRP_{it} represents a vector of observations on the dependent risk-premium series as previously defined composed via the summation of all vectors $(\Delta RP_{1t} \dots \Delta RP_{nt})$ across (n) industry classifications within a given rating group (k).

$D_1 \dots D_n$ represent (n) vectors of binary variables with length (N = total number of observations) such that $D_1=1$ if $i=1$ and 0 otherwise, $D_2=1$ if $i=2$ and 0 otherwise, etc.

$a_1 \dots a_n$ represent separate intercept coefficient for each of the (n) industry classifications.

$b_1 \dots b_n$ represent separate slope coefficients for each of the (n) industry classifications.

ΔX_t represents the value of a given independent variable at time (t), as previously defined.

e_{it} represents a vector of regression error terms corresponding to the vector ΔRP_{it} .

The results of these F-tests are summarized in Table 28, and also are presented in conjunction with the results of the single-factor regressions in Appendix C.

As shown, none of the F-ratios for Test II are significantly different from zero at the 5 percent level of significance.¹² Thus, there is not sufficient evidence to reject the null hypothesis of no difference in the slope coefficients in any of the industry/rating categories.

Based on the results of these tests, there is insufficient evidence to reject the null hypothesis of no difference in the sensitivity of bond risk premiums across industry groups with respect to changes in the selected economic variables considered individually. This result is inconsistent with previous studies which were based on yield indexes for broadly-defined industry categories, where some significant differences were observed in estimated coefficients across industry groups.

TABLE 28

F-Tests for Coefficient Homogeneity Across Industry Groups

F-Tests for:		Identical Slopes?			Slopes and Intercepts?		
RATE GROUP	INDEP VAR	df Num	df Den	F	df Num	df Den	F
1	CFCHG	8	310	.8335	16	310	.7504
2	CFCHG	9	422	1.2101	18	422	1.1448
3	CFCHG	9	323	1.4179	18	323	1.0949
1	MOODCH	8	310	.6251	16	310	.4252
2	MOODCH	9	422	.9656	18	422	1.2199
3	MOODCH	9	323	.8458	18	323	.7888
1	EMPCHG	8	310	.6134	16	310	.5761
2	EMPCHG	9	422	.7583	18	422	.9699
3	EMPCHG	9	323	.9480	18	323	1.0108
1	ILICHG	8	310	.8172	16	310	.6956
2	ILICHG	9	422	1.0937	18	422	.6759
3	ILICHG	9	323	1.4707	18	323	.8492
1	GNPLAG	8	301	.7141	16	301	.9366
2	GNPLAG	9	412	.5524	18	412	.6063
3	GNPLAG	9	313	.6500	18	313	.6475
1	STKLAG	8	301	.5853	16	301	.4175
2	STKLAG	9	412	.6980	18	412	.7317
3	STKLAG	9	313	.9616	18	313	.9236
1	BILLCH	8	310	.5882	16	310	.4668
2	BILLCH	9	422	1.0550	18	422	1.5203
3	BILLCH	9	323	.9423	18	323	1.0844
1	MS2CHG	8	310	.9843	16	310	.8014
2	MS2CHG	9	422	1.2214	18	422	.7648
3	MS2CHG	9	323	1.3968	18	323	.7956
1	LNGCHG	8	310	.5437	16	310	.4737
2	LNGCHG	9	422	1.0892	18	422	1.7889*
3	LNGCHG	9	323	1.1157	18	323	1.3681
1	CPILAG	8	301	1.1480	16	301	1.5020
2	CPILAG	9	412	1.3921	18	412	2.0397**
3	CPILAG	9	313	.3206	18	323	.9119
1	GDPLAG	9	301	1.9367	16	301	1.2328
2	GDPLAG	9	412	4.2759**	18	412	2.8466**
3	GDPLAG	9	313	.4892	18	313	.9953

* (**) signifies F-ratio significant at 5% (1%) level

This result is not in conflict with the evidence obtained with respect to Hypothesis IIc in the aggregate analysis of Stage I, although the results of that section of the analysis were inconclusive with respect to this hypothesis. That is, Stage I analysis produced some evidence that would tend to support the hypothesis of a non-homogeneous relationship with respect to the industry classification. However, this evidence was relatively weak and not completely consistent across rating groups.¹³

2.4.1c Stage IIa Summary

The evidence produced in this section offers general support for Hypothesis IIa -- that changes in bond risk premiums are associated with changes in the selected economic factors. These results are consistent with the results of Stage Ia analysis in that many strong associations were observed between the dependent variables and independent variables representing changes in Corporate Cash Flow, the Index of Leading Indicators, the Unemployment Rate, the Consumer Price Index, and the Money Supply.

The evidence produced here is also consistent with Hypothesis IIb -- that the strength of the observed relationships increases as the rated quality of the bond portfolio decreases. Significant relationships were observed more frequently in the Medium rating category than in the High rating category, and the strength of the relationships was generally greater in the Medium rating category. The results with respect to the Low rating category were inconsistent with the hypothesis, since fewer significant relationships were observed in this group than in the Medium rating category, although more significant relationships were observed than in the High rating category. This conflicting result could be due to insufficient data in some

of the Low rating group portfolios, or to the dominance of micro-economic variables in this rating category.

The evidence produced through the covariance analysis performed in this section was insufficient to reject the null hypothesis of no difference in the sensitivity of risk premiums to the selected economic variables across industry groups. This result is inconsistent with previous studies using yield indexes that were broadly-defined with respect to industry.

2.5.2 Stage IIB: Multi-Factor Regression Analysis

The objective of this section is to employ multi-factor regression analysis to test for significant relationships between changes in bond risk premiums and changes in economic factors representing expected default risk and expected call risk using the industry-specific risk-premium series described in the preceding section.¹⁴ The multi-factor models used here were selected in conjunction with the aggregate analysis of Stage I based on their explanatory ability when applied to the broadly-defined yield indexes used in that section.

Stage I multi-factor regression analysis produced evidence that was consistent with the following conclusions:

- 1) Evidence supported Hypothesis Ia. Changes in the Corporate-Government yield spreads tend to be associated with changes in factors representing expected economic conditions (as a proxy for expected default risk in the aggregate) and expected interest rates and inflation (as a proxy for expected call risk).
- 2) Evidence supported Hypothesis Ib. The strength of the observed relationships tends to increase as the rated quality of the bond index decreases.

- 3) Evidence supported Hypothesis Ic. The characteristics of the relationship between changes in the yield spreads and changes in the economic variables is not necessarily homogeneous with respect to the broad industry classification of the issuer.

In the current section of this paper, these conclusions are reexamined in conjunction with the industry-specific yield of Stage II through the application of the same multi-factor regression models selected in Stage I analysis. The results are examined for evidence that is consistent with the three general hypotheses, and the results of Stage I and Stage II analysis are compared.

As defined in conjunction with Stage I analysis, the multi-factor regression models used in this section are of the following general form:

$$\text{Model [4]} \quad \Delta RP_{ikt} = b_0 + b_1(\Delta X_{dt}) + b_2(\Delta X_{ct}) + e_t$$

where:

ΔRP_{ikt} represents the percentage change from time (t-1) to (t) in the risk premium for the portfolio representing Industry (i) of Rating Group (k).

- ▲ X_{dt} represents the change in expected aggregate default risk associated with changes in current and expected economic conditions. (See pages 71 to 75 for descriptions of these independent variables.)
- ▲ X_{ct} represents the change in expected call risk associated with a change in expected interest rates and expected inflation. (See pages 76 to 81 for descriptions of these independent variables.)

Through a process described in connection with Stage I analysis,¹⁵ the following representative specifications of the general model were selected as the basis for subsequent analysis:

Model [5] :

$$\text{▲ } RP_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + e_t$$

Model [6]:

$$\text{▲ } RP_{ikt} = b_0 + b_1(CFCHG_t) + b_2(MS2CHG_t) + b_3(LNGCHG_t) + e_t$$

Model [7]:

$$\text{▲ } RP_{ikt} = b_0 + b_1(ILICHG_t) + b_2(CPICHG_{t-1}) + b_3(LNGCHG_t) + AR(4) + e_t$$

Model [8]:

$$\text{▲ } RP_{ikt} = b_0 + b_1(ILICHG_t) + b_2(LNGCHG_t) + b_3(LNGCHG_{t-1}) + AR(4) + e_t$$

where:

$ILICHG_t$ = Percentage change in the Index of Leading Indicators.

$CFCHG_t$ = Percentage change in Corporate Cash Flow.

$CPICHG_{t-1}$ = Percentage change in Consumer Price Index (Lag 1)

$MS2CHG_t$ = Percentage change in M2 Money Supply

$LNGCHG_t$ = Percentage change in the S&P Long Maturity Government Bond Index.

$LNGCHG_{t-1}$ = Percentage change in the S&P Long Maturity Government Bond Index (Lag 1).

$AR(4)$ = Autoregressive Lag 4 adjustment.

2.5.2a Results with Respect to Hypotheses IIa and IIb

As in Stage I analysis, these models were used to estimate regression equations for each of the 29 Stage II risk premium series. The results are summarized in the Tables 29 - 32 on the following pages.

The results shown in Tables 29 - 32 offer general support to Hypotheses IIa --- that changes in bond risk premiums are associated with changes in economic factors representing default risk and call risk, and Hypothesis IIb --- that the strength of the observed relationships increases as the rated quality of the bonds decreases.

TABLE 29

Results of the Regression of Model [5] on 29 Industry/Rating Groups

$$\text{Model [5]} \quad \Delta RP_{ikt} = b_0 + b_1 (ILICHG_t) + b_2 (CPICHG_{t-1}) + b_3 (LNGCHG_t) + e_t$$

Dependent Var.	N	B0	T0	B1	T1	B2	T2	B3	T3	SSE	R2A	F
Rate Group 1												
Aerospace	19	0.396	0.703	-2.568	-0.194	-16.503	-0.446	-2.320	-0.873	13.073	-0.1332	0.295
Automotive	42	-0.134	-0.377	-6.739	-0.917	22.318	1.341	-0.097	-0.056	31.437	0.0590	1.857
Computers/Elec.	45	0.305	0.547	-3.664	-0.398	-22.818	-0.850	-1.597	-0.628	90.455	-0.0406	0.428
Forest Prods	46	-0.487	-1.092	1.713	0.239	26.247	1.267	0.193	0.095	57.123	-0.0235	0.656
Metals / Mining	15	-0.036	-0.076	-2.046	-0.644	0.646	0.306	-1.196	-0.846	1.791	-0.0232	0.894
Oil Producers	45	1.129	2.847 **	-22.292	-3.495 **	-58.390	-3.070 **	-0.945	-0.554	41.484	0.2114	4.931
Retail	44	0.813	1.805 *	-6.389	-0.870	-53.405	-2.484 **	-1.030	-0.507	55.568	0.0885	2.392
Farm Equip. Mfg.	25	-0.228	-0.480	-1.891	-0.221	4.714	0.240	2.299	1.108	15.547	-0.0775	0.425
Elec. Utilities	47	-0.285	-1.440	0.875	0.276	17.813	1.942 *	-0.709	-0.772	11.407	0.0465	1.748
Rate Group 2												
Aerospace	49	0.042	0.191	-4.824	-1.336	0.102	0.788	-1.976	-1.983 *	15.512	0.1142	3.063
Automotive	49	0.058	0.391	-4.894	-2.002 **	1.839	0.264	0.774	1.148	7.105	0.0957	2.694
Computers/Elec.	46	0.366	1.956 *	-7.780	-2.588 **	-14.671	-1.587	-2.883	-3.145 **	9.930	0.2681	6.493
Forest Products	49	-0.101	-0.502	-4.019	-1.205	15.151	1.596	-3.768	-4.096 **	13.232	0.3164	8.406
Metals / Mining	47	-0.004	-0.022	-5.279	-1.540	3.601	0.362	-2.594	-2.899 **	9.528	0.1640	4.009
Oil Producers	47	0.890	2.149 **	-12.073	-1.739 *	-52.003	-2.657 **	-1.063	-0.552	52.382	0.0983	2.671
Air Transport	16	-0.085	-0.267	-6.579	-0.888	12.802	0.824	-3.744	-4.052 **	1.546	0.5752	7.770
Retail	48	-0.165	-1.328	-3.779	-1.861 *	11.769	2.023 **	-1.071	-1.860 *	4.794	0.2737	6.905
Farm Equip. Mfg.	42	0.511	1.597	-7.862	-1.484	-32.967	-2.011 *	1.888	1.356	19.675	0.0567	1.821
Elec. Utilities	49	-0.061	-0.766	-2.029	-1.541	5.480	1.463	0.037	0.102	2.060	0.1338	3.472
Rate Group 3												
Aerospace	26	0.109	0.686	-2.648	-0.819	-0.612	-0.084	0.130	0.177	2.968	-0.0936	0.287
Automotive	21	0.076	0.272	-4.380	-0.862	2.582	0.214	-0.975	-0.767	5.424	-0.0427	0.727
Computers/Elec.	49	0.070	0.880	-3.625	-2.735 **	-2.446	-0.648	0.192	0.525	2.090	0.1075	2.927
Forest Products	46	0.167	1.933 *	-4.762	-3.167 **	-5.536	-1.367	-0.367	-0.936	2.191	0.1653	3.970
Metals / Mining	31	0.111	0.953	-3.709	-1.535	-2.712	-0.498	0.467	0.852	2.119	0.0007	1.007
Oil Producers	27	0.153	1.566	-3.698	-1.790 *	-3.505	-0.754	-0.789	-1.690	1.266	0.1434	2.451
Air Transport	49	-0.009	-0.050	-4.097	-1.406	10.651	1.284	-2.611	-3.249 **	10.100	0.2452	6.197
Retail	49	0.078	0.786	-4.065	-2.411 **	-0.384	-0.080	-0.660	-1.420	3.380	0.1369	3.537
Farm Equip. Mfg.	23	0.058	0.248	-6.276	-1.259	15.593	1.227	-0.767	-0.560	5.292	0.0779	1.620
Elec. Utilities	22	0.020	0.136	-1.657	-0.356	-2.140	-0.285	0.228	0.321	0.672	-0.1554	0.058

ΔRP_{ikt} = Percentage change in the risk premium at time (t) for the portfolio representing Industry (i) and Rate Group (k).

$ILICHG(t)$ = Percentage change in the Index of Leading Indicators

$CPICHG(t-1)$ = Percentage change in Consumer Price Index (Lag 1)

$LNGCHG(t)$ = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

*** denotes statistical significance at the 99% confidence level.

** denotes statistical significance at the 95% confidence level.

* denotes statistical significance at the 90% confidence level.

TABLE 30

Results of the Regression of Model [6] on 29 Industry/Rating Groups

$$\text{Model [6]} \quad RP_{ikt} = b_0 + b_1(CFCHG_t) + b_2(MS2CHG_t) + b_3(LNGCHG_t) + e_{ikt}$$

Dependent Var.	N	B0	T0	B1	T1	B2	T2	B3	T3	SSE	R2A	F
Rate Group 1												
Aerospace	19	0.232	0.733	-1.743	-0.313	-1.214	-0.063	-2.019	-0.711	13.163	-0.1411	0.258
Automotive	42	0.336	2.101 **	-3.836	-0.945	-17.037	-1.425	-0.645	-0.325	32.184	0.0366	1.520
Computers/Elec.	45	-0.107	-0.438	-0.464	-0.090	-1.698	-0.102	-1.920	-0.716	92.014	-0.0585	0.189
Forest Products	46	0.118	0.638	4.455	1.141	-22.026	-1.789 *	-0.951	-0.451	55.055	0.0136	1.206
Metals / Mining	15	0.165	1.306	0.213	0.098	-7.513	-0.979	-1.214	-0.798	1.974	-0.1274	0.473
Oil Producers	45	-0.019	-0.099	1.358	0.309	-12.096	-0.932	-2.286	-1.110	54.316	-0.0326	0.537
Retail	44	-0.273	-1.352	6.256	1.510	9.170	0.676	-1.432	-0.648	59.077	0.0309	1.458
Farm Equip. Mfg	25	-0.137	-0.749	-2.749	-0.609	0.865	0.055	2.613	1.095	15.396	-0.0671	0.497
Elec. Utilities	47	0.104	1.237	-1.309	-0.731	-7.247	-1.256	-0.948	-0.962	11.836	0.0108	1.167
Rate Group 2												
Aerospace	49	0.223	2.623 **	-5.680	-3.068 ***	-4.440	-0.743	-1.877	-1.918 *	13.557	0.2258	5.667
Automotive	49	0.116	1.067 *	-1.255	-0.933	-8.572	-1.975 *	0.394	0.554	7.156	0.0893	2.570
Computers/Elec.	46	0.137	1.623	-0.890	-0.488	-10.780	-1.916 *	-3.862	-3.978 ***	10.415	0.2324	5.540
Forest Products	49	0.251	3.215 ***	-4.508	-2.657 **	-12.642	-2.308 **	-4.037	-4.502 ***	11.391	0.4115	12.188
Metals / Mining	47	0.094	1.223	-2.678	-1.601	-7.450	-1.386	-2.907	-3.017 ***	9.499	0.1666	4.066
Oil Producers	47	-0.147	-0.785	-3.038	-0.744	8.081	0.628	-1.243	-0.577	60.049	-0.0337	0.500
Air Transport	16	0.188	2.559 **	-6.127	-2.238 **	-11.613	-1.333	-3.412	-3.129 ***	1.001	0.7249	14.177
Retail	48	0.094	1.873 *	-3.561	-3.276 ***	-7.098	-2.030 **	-1.242	-2.126	4.524	0.3148	8.196
Farm Equip. Mfg	42	-0.084	-0.619	-1.334	-0.492	-0.007	-0.001	1.547	0.990	21.669	-0.0389	0.488
Elec. Utilities	49	0.068	2.100 **	-0.241	-0.341	-7.457	-3.267 ***	-0.273	-0.730	1.979	0.1680	4.230
Rate Group 3												
Aerospace	26	0.114	1.519	0.574	0.300	-6.347	-1.187	-0.320	-0.394	2.888	-0.0643	0.496
Automotive	21	0.190	1.462	2.114	0.726	-15.704	-1.786 *	-2.279	-1.594	4.929	0.0525	1.369
Computers/Elec.	49	0.026	0.737	-0.800	-1.052	-3.223	-1.314	0.014	0.035	2.286	0.0238	1.390
Forest Products	46	0.073	1.864 *	-0.087	-0.109	-6.838	-2.450 **	-0.789	-1.867 *	2.338	0.1091	2.838
Metals / Mining	31	0.067	1.266	0.010	0.007	-5.242	-1.336	0.057	0.091	2.147	-0.0125	0.877
Oil Producers	27	0.098	2.015 *	-1.654	-1.433	-2.895	-0.822	-0.893	-1.733 *	1.191	0.1941	3.087
Air Transport	49	0.211	2.834 ***	-3.145	-1.940 *	-5.579	-1.066	-2.660	-3.104 ***	10.397	0.2230	5.592
Retail	49	0.078	1.777	-0.065	-0.068	-6.125	-1.978 *	-0.997	-1.966 *	3.642	0.0701	2.207
Farm Equip. Mfg	23	0.409	2.919 **	-3.629	-1.306	-16.668	-1.808 *	-1.298	-0.963	4.873	0.1509	2.303
Elec. Utilities	22	-0.025	-0.400	0.189	0.103	-8.696	-0.146	0.888	0.123	0.676	-0.1617	0.026

▲ $RP(ikt)$ = Percentage change in the risk premium at time (t) for the portfolio representing Industry (i) and Rate Group (k).
 $CFCHG(t)$ = Percentage change in Corporate Cash Flow
 $MS2CHG(t)$ = Percentage change in M2 Money Supply
 $LNGCHG(t)$ = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

*** denotes statistical significance at the 99% confidence level.
 ** denotes statistical significance at the 95% confidence level.
 * denotes statistical significance at the 90% confidence level.

TABLE 31

Results of the Regression of Model [7] on 12 Industry/Rating Groups

$$\text{Model [7]} \triangleq \text{RP}_{ikt} = b_0 + b_1(\text{ILICHG}_t) + b_2(\text{CPICHG}_{t-1}) + b_3(\text{LNGCHG}_t) + \text{AR}(4)_t + e_t$$

Dep. Variable	N	B0	T0	B1	T1	B2	T2	B3	T3	AR4	T	SSE	R2	F
Rate Group 1														
Aerospace	19	0.40	0.70	-2.95	-0.21	-17.97	-0.47	-2.48	-0.89	0.06	0.23	12.97	.062	0.23
Automotive	42	-0.19	-0.57	-4.79	-0.83	25.07	1.54	-0.06	-0.03	0.10	0.61	31.05	.138	1.48
Computers/Elec.	45	0.17	0.33	-3.31	-0.34	-15.87	-0.63	-1.87	-0.75	0.16	1.06	86.99	.067	0.72
Forest Products	46	-0.51	-1.19	1.85	0.25	27.90	1.37	0.32	0.15	0.08	0.55	56.67	.052	0.56
Metals / Mining	15	-0.02	-0.05	-2.84	-0.59	8.14	0.34	-1.22	-0.84	0.06	0.20	1.78	.201	0.63
Oil Producers	45	1.15	3.06***	-22.93	-3.45***	-59.62	-3.27***	-0.77	-0.46	0.17	1.11	39.97	.291	4.12**
Retail	44	0.79	1.70*	-6.28	-0.86	-52.20	-2.35**	-1.09	-0.53	-0.06	-0.41	55.22	.157	1.82
Farm Equipment	25	-0.22	-0.46	-1.94	-0.21	4.27	0.21	2.38	1.12	0.03	0.17	15.52	.058	0.31
Elec. Utilities	47	-0.29	-1.51	1.24	0.38	18.48	2.01*	-0.69	-0.74	0.03	0.19	11.39	.109	1.29
Rate Group 2														
Aerospace	49	0.01	0.07	-4.67	-1.64	8.20	0.78	-1.90	-2.21**	-0.41	-3.05***	12.66	.322	5.22**
Automotive	49	0.05	0.39	-4.90	-1.98*	1.81	0.25	0.77	1.13	0.00	0.02	7.11	.152	1.97
Computers/Elec.	46	0.38	1.96*	-8.06	-2.71***	-15.14	-1.58	-2.89	-3.14***	-0.07	-0.46	9.84	.322	4.88**
Forest Products	49	-0.11	-0.58	-3.61	-1.05	15.89	1.69*	-3.79	-4.09***	0.05	0.39	13.17	.362	6.24**
Metals / Mining	47	0.00	0.01	-5.57	-1.64	3.18	0.31	-2.59	-2.88***	-0.06	-0.42	9.46	.223	3.02**
Oil Producers	47	0.92	2.34**	-12.34	-1.73*	-54.01	-2.88***	-1.20	-0.63	0.12	0.83	51.42	.172	2.18
Air Transport	16	-0.12	-0.37	-5.75	-0.58	14.77	0.90	-3.82	-3.97***	-0.06	-0.22	1.53	.663	5.41**
Retail	48	-0.16	-1.31	-3.76	-1.82*	11.71	2.00*	-1.08	-1.86*	0.02	0.16	4.79	.320	5.07**
Farm Equipment	42	0.47	1.44	-7.27	-1.41	-31.34	-1.87*	1.92	1.39	-0.11	-0.72	19.35	.140	1.50
Elec. Utilities	49	-0.06	-0.79	-1.96	-1.49	5.73	1.49	0.03	0.10	-0.03	-0.25	2.06	.189	2.57
Rate Group 3														
Aerospace	26	0.10	0.81	-2.75	-0.83	-0.61	-0.10	0.18	0.28	0.37	1.85*	2.34	.242	1.67
Automotive	21	0.10	0.36	-4.34	-0.87	1.26	0.10	-1.02	-0.79	-0.10	-0.41	5.33	.129	0.59
Computers/Elec.	49	0.06	0.84	-3.83	-2.81***	-1.89	-0.55	0.11	0.32	0.21	1.49	1.96	.216	3.03**
Forest Products	46	0.16	1.87*	-4.77	-3.09***	-5.14	-1.28	-0.33	-0.85	0.05	0.36	2.18	.224	2.96**
Metals / Mining	31	0.07	0.72	-3.52	-1.39	-0.52	-0.10	0.39	0.75	0.28	1.49	1.92	.184	1.47
Oil Producers	27	0.09	1.45	-3.85	-2.88*	-0.63	-0.19	-0.95	-2.53**	0.50	2.73**	0.79	.528	6.15**
Air Transport	49	-0.01	-0.05	-4.07	-1.38	10.88	1.27	-2.60	-3.20***	-0.00	-0.03	10.10	.292	4.54**
Retail	49	0.88	0.79	-4.02	-2.57**	-0.86	-0.13	-0.66	-1.47	-0.19	-1.34	3.23	.227	3.24**
Farm Equipment	23	0.01	0.07	-5.94	-1.09	17.94	1.43	-0.50	-0.35	0.16	0.69	5.11	.231	1.35
Elec. Utilities	22	0.01	0.12	-1.79	-0.38	-1.73	-0.21	0.22	0.31	-0.16	-0.66	0.65	.045	0.20

$\triangleq \text{RP}(ikt)$ = Percentage change in the risk premium at time (t) for the portfolio representing Industry (i) and Rate Group (k).

$\text{ILICHG}(t)$ = Percentage change in the Index of Leading Indicators

$\text{CPICHG}(t-1)$ = Percentage change in Consumer Price Index (Lag 1)

$\text{LNGCHG}(t)$ = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

$\text{AR}(4)$ = Autoregressive Lag 4 adjustment.

*** denotes statistical significance at the 99% confidence level.

** denotes statistical significance at the 95% confidence level.

* denotes statistical significance at the 90% confidence level.

TABLE 32

Results of the Regression of Model (8) on 29 Industry/Rating Groups

$$\text{Model (8)} \quad \text{RP}_{1kt} = b_0 + b_1 (\text{ILICHG})_t + b_2 (\text{LNGCHG})_{t-2} + b_3 (\text{LNGCHG})_{t-3} + \text{AR}(4)_t + e_t$$

Dep. Variable	N	B0	T0	B1	T1	B2	T2	B3	T3	AR4	T	SSE	R2	F
Rate Group 1														
Aerospace	19	0.18	0.92	-0.11	-0.05	-2.09	-0.09	-0.03	-2.53**	0.147	0.55	0.99	.350	1.89
Automotive	42	0.27	1.66	-10.30	-1.31	0.25	0.14	0.01	0.36	0.015	0.09	32.79	.090	0.91
Computers/Elec.	45	-0.12	-0.59	0.01	0.00	-2.20	-0.07	-0.16	-0.05	0.101	1.16	87.59	.061	0.65
Forest Products	47	-0.03	-0.17	-5.06	-0.70	-1.02	-0.30	-2.44	-0.04	0.005	0.55	101.24	.032	0.34
Metals/Mining	15	0.14	1.24	-4.00	-1.29	-1.21	-0.79	-0.00	-0.00	0.069	0.21	1.00	.192	0.59
Oil Producers	45	-0.00	-0.02	-9.97	-1.63	-1.46	-0.76	0.66	0.31	0.049	0.31	50.64	.102	1.14
Retail	44	-0.14	-0.69	0.70	0.12	-1.03	-0.06	-3.34	-1.46	-0.091	-0.56	59.46	.092	0.99
Farm Equipment	25	-0.17	-0.90	0.07	0.00	2.73	1.24	1.50	0.52	0.053	0.23	15.34	.069	0.37
Elec. Utilities	47	0.06	0.74	-2.91	-1.04	-0.69	-0.70	0.07	0.06	-0.090	-0.50	12.26	.042	0.46
Rate Group 2														
Aerospace	49	0.16	1.30	-5.51	-2.24**	-1.03	-2.10**	0.61	0.67	-0.421	-3.07**	12.71	.319	5.16*
Automotive	49	0.10	1.70**	-5.66	-2.71***	0.72	1.06	-0.59	-0.02	-0.023	-0.15	7.01	.163	2.14
Computers/Elec.	46	0.10	1.22	-5.59	-2.09**	-3.25	-3.52***	-0.12	-0.12	-0.059	-0.30	10.46	.200	4.00*
Forest Products	49	0.17	1.95**	-6.10	-2.14**	-3.44	-3.65***	1.25	1.24	-0.050	-0.33	13.52	.345	5.79*
Metals/Mining	47	0.04	0.59	-5.93	-2.31**	-2.60	-3.00***	1.57	1.60	-0.044	-0.20	0.91	.269	3.07*
Oil Producers	47	-0.11	-0.61	-1.63	-0.25	-1.70	-0.05	-0.19	-0.00	0.007	0.04	60.96	.019	0.20
Air Transport	16	0.15	1.66	-9.93	-1.62	-3.52	-3.77***	1.36	0.99	-0.005	-0.01	1.50	.670	5.59*
Retail	40	0.04	0.01	-5.15	-2.07***	-0.74	-1.26	1.27	2.03*	0.006	0.56	4.79	.320	5.06*
Farm Equipment	42	-0.09	-0.65	-1.33	-0.32	1.76	1.23	-0.20	-0.10	-0.162	-1.00	21.05	.064	0.64
Elec. Utilities	49	0.04	1.41	-3.10	-2.73***	0.09	0.24	-0.09	-0.22	-0.003	-0.01	2.16	.150	1.94
Rate Group 3														
Aerospace	26	0.08	1.50	-1.54	-0.41	0.15	0.25	0.34	0.30	0.301	1.00	2.31	.250	1.75
Automotive	21	0.04	0.31	-0.32	-0.06	-0.76	-0.60	2.00	1.23	-0.129	-0.51	4.05	.207	1.04
Computers/Elec.	49	0.03	1.12	-3.70	-3.24***	0.03	0.11	-0.39	-1.05	0.102	1.22	1.94	.224	3.19*
Forest Products	46	0.05	1.62	-3.61	-2.64**	-0.30	-0.95	0.10	0.23	0.095	0.61	2.26	.196	2.50
Metals/Mining	31	0.05	1.23	-2.29	-0.09	0.30	0.77	0.45	0.66	0.322	1.73*	1.00	.202	1.64
Oil Producers	27	0.10	3.56***	-5.61	-2.93***	-0.90	-2.93***	-0.60	-1.40	0.517	2.03**	0.71	.575	7.45*
Air Transport	49	0.10	2.59**	-5.72	-2.23**	-2.42	-2.96***	0.75	0.05	0.020	0.10	10.30	.278	4.24*
Retail	49	0.06	1.40	-3.67	-2.72***	-0.62	-1.37	0.37	0.77	-0.177	-1.19	3.19	.236	3.40*
Farm Equipment	23	0.30	2.20**	-0.25	-1.52	-0.15	-0.10	-0.40	-0.26	0.066	0.20	5.66	.140	0.78
Elec. Utilities	22	-0.01	-0.10	-1.35	-0.35	0.19	0.20	-0.11	-0.15	-0.160	-0.70	0.65	.045	0.20

▲ RP(1kt) = Percentage change in the risk premium at time (t) for the portfolio representing Industry (i) and Rate Group (k).

ILICHG(t) = Percentage change in the Index of Leading Indicators

LNGCHG(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

LNGCHG(t-1) = Percentage change in the S&P Long Maturity Government Bond Index between (t-2) and (t-1).

AR(4) = Autoregressive Lag 4 adjustment.

*** denotes statistical significance at the 99% confidence level.

** denotes statistical significance at the 95% confidence level.

* denotes statistical significance at the 90% confidence level.

First, consider the F-statistics of the estimated models. For the four multi-factor regression models taken collectively, significant associations (defined as those with regression F-statistics that are significant at the 95 percent confidence level or better) were observed in the frequencies illustrated in Table 33:

Table 33
Frequency of Significant F-Statistics
by Rating Group

Model:	I	II	III	IV	Total
Rate Group 1	1	0	1	0	2/36
Rate Group 2	7	7	6	6	26/40
Rate Group 3	4	3	5	4	18/40
All Groups	12	10	12	10	44/116

Coefficients of Determination for these estimated equations range as high as 57 percent, and average at approximately 25 percent. Given the simplicity of the models employed here, this represents a considerable level of explanatory power.

As shown in Table 33, virtually no significant relationships were observed for Rate Group I portfolios, while

the portfolios of Rate Groups 2 and 3 show many strong relationships. This result is consistent with expectations and previous results, and tends to support Hypothesis IIb. Since bonds of the highest quality tend to have lower coupon rates than bonds of lower quality, high-quality bonds would tend to have relatively low call risk, other things equal. Thus, changes in expectations regarding future interest rates and inflation would tend to have little impact on the call risk premiums of bonds within Rate Group I. Similarly, bonds that are perceived by investors to be relatively free of default risk would not be expected to exhibit great volatility in their risk default-risk premiums as economic conditions change, since such changes would not be expected to effect the credit-worthiness of the safest issuers to any appreciable extent unless the economic changes were very drastic. Thus, the risk premiums of high quality bonds would not be expected to exhibit strong relationships with the economic factors considered here.

On the other hand, the risk premiums of bonds of lower quality would be expected to exhibit more significant associations with changes in economic conditions due to changes in both expected risk of default and expected risk of call. Bonds of lower quality tend to have relatively high coupon rates and, consequently, relatively high threshold rates for refinancing. Given the higher degree

of call risk associated with the higher coupon rates, small changes in expected interest rates would be expected to be associated with relatively large changes in expected call risk. Perceptions of default risk for lower quality bonds would also be expected to be influenced more strongly by economic conditions since the margin of safety in the coverage of interest obligations tends to be narrower for bonds of lower ratings and thus small changes in economic conditions could exert a relatively large impact on the perceived creditworthiness of the issuer.

Hypothesis IIa receives additional support from a comparison of expected and observed signs for the estimated coefficients.¹⁶ Table 34 summarizes the expected and observed signs for all estimated coefficients that are significantly different from zero at the 90 percent confidence level or better. The high level of agreement between expected and observed signs supports the existence of the hypothesized relationships. Furthermore, these results are highly consistent with the results of Stage I analysis with only minor exceptions. In particular, the conflict in sign for the variable CPICHG (representing the percentage change in the Consumer Price Index) in Models I and III was not observed in Stage I results, where the sign for the estimated coefficients of this variable were consistently positive.

Table 34

Comparison Between Expected and Observed Signs
for Estimated Coefficients

Independent Variable	Expected Sign	Observed Sign	Frequency of Occurrence
Model [5]:			
Leading Indicators	-	-	9
Cons. Price Index	?	-/+	4/2
Long Gov. Bond Rate	-	-	7
Model [6]:			
Corp Cash Flow	-	-	5
M2 Money Supply	?	-	10
Long Gov. Bond Rate	-	-	9
Model [7]:			
Leading Indicators	-	-	9
Cons Price Index	?	-/+	4/3
Long Gov. Bond Rate	-	-	8
Model [8]:			
Leading Indicators	-	-	12
Long Gov. Bond Rate	-	-	7
Lagged Gov. Bond Rate	-	-/+	1/1

See pages 71-81 for a discussion of the expectations with respect to the signs of the coefficients for the independent variables listed here.

Observed signs are included in this comparison when the estimated coefficient is significantly different from zero at the 90% confidence level or better.

As discussed previously,¹⁷ a positive sign for this coefficient would imply that the impact of this factor on expected default risk dominates its impact on call risk.

However, when the dependent variable is composed from the broadly-defined yield indexes, as in Stage I analysis, a positive sign for this variable would be expected. These indexes represent the average bond within very broad issuer classifications. An increase in inflation would be expected to exert a negative impact on the operating cash flows of the average industrial or utility company as the costs of productive inputs, particularly energy and labor, rose faster than output prices which tend to be relatively sticky due to competitive or regulatory constraints. Consequently, investors' perceptions of the default risk of the average corporate issuer would be expected to exhibit a large positive association with inflationary expectations. The offsetting effect of the negative association between expected call risk and expected inflation could easily be dominated by the positive association with expected default risk for the average issuer.

On the other hand, when corporate issuers are segregated into more narrowly-defined issuer categories, as in Stage II analysis, it is less reasonable to expect that all issuers would be affected equally (or in the average amount) by changes in inflationary expectations. The effects of inflation on different classes of issuers could be

quite diverse depending on the particular production and pricing characteristics of the issuer. This reasoning is not inconsistent with the results observed for the industry-specific yield series.

For example, consider the negative signs observed for this coefficient for the Oil Producers issuer category. Since the price of oil tends to adjust rapidly, a higher (lower) rate of inflation implies a relatively quick increase (decrease) in the price of output and the corresponding cash flows to the issuer, resulting in a lower (higher) risk of default. In addition, a higher (lower) rate of inflation implies lower expected risk of call. Therefore, the combined effect of an increase (decrease) in the rate of inflation would be to decrease (increase) the risk premium for this issuer category.

The negative sign observed for the Farm Equipment issuer category can be more difficult to justify on similar reasoning. However, the coefficient is only marginally significant at the 90 percent confidence level. The production of farm equipment involves large inputs of energy and labor which tend to adjust in cost relatively swiftly in the face of inflationary pressures. Output prices, on the other hand, would tend to have less freedom for swift adjustment. Thus, an increase in the rate of inflation would be expected to squeeze cash flows in the short term, thus increasing expected default risk. However, if the

effect of increased inflation on default risk is dominated by the opposing effect on call risk, then the expected sign for the coefficient would be negative, although the coefficient would be expected to be small in absolute magnitude, as observed in the current results.

The Electric Utilities issuer category showed a positive sign for this coefficient in Rate Group I, and insignificant coefficients in the lower rating groups. This result is not surprising, given the nature of the regulatory environment and the operating characteristics of the issuers. Higher inflation implies higher energy and labor costs associated with the production of electricity. However, there is generally a significant time lag between increases in operating costs and increases in customer rates, resulting in a tightening of operating cash flow and an increase in expected risk of default. The opposing effect produced by call risk would be weak in the highest rating groups where coupon rates are relatively low, but stronger in the lower groups where coupon rates are relatively high. The combined result would be a positive coefficient in the highest rating category where the effect of default risk dominates, and less positive (or insignificant) coefficients in the lower rating categories where the opposing effects on default risk and call risk are both strong.

With the exception of the conflicting signs for the CPICHG variable discussed above, the results of this portion of the multi-factor regression analysis are largely consistent with the results of Stage I analysis.

In summary, the evidence presented here is consistent with the following conclusions:

- 1) Evidence supports Hypothesis IIa --- that changes in the risk premiums of corporate bonds tends to be associated with changes in factors representing expected economic conditions (as a proxy for expected default risk in the aggregate) and expected interest rates and inflation (as a proxy for expected call risk).
- 2) Evidence supports Hypothesis IIb --- that the strength of the observed relationships tends to increase as the rated quality of the bond portfolio decreases.
- 3) The results of this section are consistent with the results reported in conjunction with Stage I aggregate analysis using broadly-defined bond indexes and equivalent multi-factor regression models.

2.5.2b Results with Respect to Hypothesis IIc

The analysis of this section examines the estimated regression coefficients in the four representative multi-factor regression models for evidence of significant differences across industry categories. This analysis is a direct extension of the covariance analysis procedure which was described in conjunction with the single-factor regression analysis in Section 2.4.3b.¹⁸ Two additional layers of dummy variables are required in the combined model to represent the extra independent variables in the multifactor models, and the degrees of freedom in the F-ratios must be adjusted appropriately.

The general specification of the unrestricted model (v) for the multi-factor analysis of this section is:

$$\begin{aligned}
 (v) \quad \Delta RP_{it} = & a_1 D_1 + a_2 D_2 + \dots + a_n D_n + \\
 & b_{1,1}(\Delta X_{1,t} D_1) + \dots + b_{1,n}(\Delta X_{1,t} D_n) + \\
 & b_{2,1}(\Delta X_{2,t} D_1) + \dots + b_{2,n}(\Delta X_{2,t} D_n) + \\
 & b_{3,1}(\Delta X_{3,t} D_1) + \dots + b_{3,n}(\Delta X_{3,t} D_n) + e_{it}
 \end{aligned}$$

where:

ΔRP_{it} represents a vector of observations on the dependent risk-premium series as previously defined composed via the summation of all vectors (ΔRP_{1t} ... ΔRP_{nt}) across (n) industry classifications within a given rating group (k).

$D_1 \dots D_n$ represent (n) vectors of binary variables with length (N = total number of observations) such that $D_1 = 1$ if $i=1$ and 0 otherwise, $D_2 = 1$ if $i=2$ and 0 otherwise, etc.

$a_1 \dots a_n$ represent separate intercept coefficients for each of the (n) industry classifications.

$b_{j,1} \dots b_{j,n}$ represent separate slope coefficients for independent variable (j) for each of the (n) industry classifications.

$\Delta X_{j,t}$ represents the value independent variable (j) at time (t), as previously defined.

e_{it} represents a vector of regression error terms corresponding to the vector ΔRP_{it} .

Test I:

Consider the null hypothesis is that all estimated coefficients are identical across industry groups. That is:

$$\begin{aligned} a_1 &= a_2 = \dots = a_n \text{ and} \\ b_{1,1} &= b_{1,2} = \dots = b_{1,n} \text{ and} \\ b_{2,1} &= b_{2,2} = \dots = b_{2,n} \text{ and} \\ b_{3,1} &= b_{3,2} = \dots = b_{3,n} \end{aligned}$$

Under the assumption that the null hypothesis is true, then equation (v) can be estimated with the following restricted regression model (vi) without significant loss of explanatory power. The general specification of the fully restricted model is:

$$(vi) \Delta RP_{it} = a + b_1(\Delta X_{1,t}) + b_2(\Delta X_{2,t}) + b_3(\Delta X_{3,t}) + e_{it}$$

where all variables are as previously defined. This model has the effect of pooling all observations across industry groups and restricting the estimated coefficients $b_{j,1} \dots b_{j,n}$ to equality across industry groups.

If the null hypothesis is true, then the Error Sum of Squares for Equation (vi) will not be significantly larger than the Error Sum of Squares for Equation (v). Thus, to

test the null hypothesis that all estimated coefficients are identical across industry groups, the appropriate F-ratio is:

$$[I] \quad F = \frac{(RSS - USS) / (4n - 4)}{USS / (N - 4n)}$$

where:

- N = the total number of observations in the vector of combined dependent variables (ΔRP_{it}).
- n = the number of individual industry groups included in vector (ΔRP_{it}).
- RSS = the Error Sum of Squares for Equation (vi).
- USS = the Error Sum of Squares for Equation (v).

If this F ratio is significant, then the null hypothesis may be rejected on evidence that significant differences exist among the estimated coefficients across industry groups.

Test II:

Consider the null hypothesis that the coefficients for a particular independent variable (j) are identical across industry categories. That is, for a given (j):

$$b_{j,1} = b_{j,2} = \dots = b_{j,n}$$

Given a general model with three independent variables, this hypothesis can be applied to the coefficients of each of the three variables individually. The appropriate tests involve the estimation of the following three models:

(vii) Partially Restricted Model for $j=1$:

$$\begin{aligned} \Delta RP_{it} = & a_1 D_1 + a_2 D_2 + \dots + a_n D_n + \\ & b_1(\Delta X_{1,t}) + \\ & b_{2,1}(\Delta X_{2,t} D_1) + \dots + b_{2,n}(\Delta X_{2,t} D_n) + \\ & b_{3,1}(\Delta X_{3,t} D_1) + \dots + b_{3,n}(\Delta X_{3,t} D_n) + e_{it} \end{aligned}$$

(viii) Partially Restricted Model for $j=2$:

$$\begin{aligned} \Delta RP_{it} = & a_1 D_1 + a_2 D_2 + \dots + a_n D_n + \\ & b_{1,1}(\Delta X_{1,t} D_1) + \dots + b_{1,n}(\Delta X_{1,t} D_n) + \\ & b_2(\Delta X_{2,t}) + \\ & b_{3,1}(\Delta X_{3,t} D_1) + \dots + b_{3,n}(\Delta X_{3,t} D_n) + e_{it} \end{aligned}$$

(ix) Partially Restricted Model for $j=3$:

$$\begin{aligned} \Delta RP_{it} = & a_1 D_1 + a_2 D_2 + \dots + a_n D_n + \\ & b_{1,1}(\Delta X_{1,t} D_1) + \dots + b_{1,n}(\Delta X_{1,t} D_n) + \\ & b_{2,1}(\Delta X_{2,t} D_1) + \dots + b_{2,n}(\Delta X_{2,t} D_n) + \\ & b_3(\Delta X_{3,t}) + e_{it} \end{aligned}$$

Each of the models (vii)...(ix) has the effect of restricting the coefficients $b_{j,1} \dots b_{j,n}$ to equality. If this restriction does not result in a significant reduction in the explanatory power of the model, (as indicated by a

significant increase in the Error Sum of Squares), then the null hypothesis of equality of the coefficients for variable (j) across industry groups is not rejected.

The hypothesis of equality among the (n) coefficients for variable (j) across industry groups can be subjected to the following F-test:

$$[\text{II}] \quad F = \frac{(\text{RSS}(j) - \text{USS}) / (n - 1)}{\text{USS} / (N - 4n)}$$

where:

- N = the total number of observations in the vector of combined dependent variables (ΔRP_{it}).
- n = the number of individual industry groups included in vector (ΔRP_{it}).
- RSS(j) = the Error Sum of Squares for the equation (vi)...(viii) for the given (j).
- USS = the Error Sum of Squares for Equation (v).

If this F ratio is significant, then sufficient evidence exists to reject the null hypothesis of coefficient equality across industry groups.

The tests described above were applied to each of the four representative multi-factor regression models using the industry-specific Stage II risk premium series. The results are presented in Table 35.

Consider the results of the F-tests for Models [5] and [6], which have no adjustment term for serial correlation. These results are not inconsistent with the existence of industry-specific characteristics in the relationships, but the evidence in support of such a conclusion is weak.

Both models show insignificant F-ratios for the independent variables representing expected business conditions in general (ILICHG and CFCHG), implying that the sensitivity of risk premiums to changes in these factors does not differ appreciably with respect to the industry classification of the issuer.

However, both models show significant F-ratios (at the 99 percent confidence level) in Rate Group 2 for the independent variable representing changes in expected interest rates on longterm government bonds (LNGCHG). The F-ratio for this variable is also significant (at the 95 percent confidence level) for Rate Group 3 in Model [5].

TABLE 35

F-Tests for Coefficient Homogeneity Across Industry Groups

$$\text{MODEL [5]: } \Delta RP[t] = B_0 + B_1(ILICHG[t]) + B_2(CPICHG[t-1]) + B_3(LNGCHG[t]) + e[t]$$

	Identical Coefficients for ILICHG ?		Identical Coefficients for CPICHG(Lag 1) ?		Identical Coefficients for LNGCHG ?		All Coefficients Identical ?	
	df	F	df	F	df	F	df	F
Rate Group 1	(8/292)	1.1281	(8/292)	2.6365 ***	(8/292)	0.2942	(32/292)	1.0964
Rate Group 2	(9/402)	0.591	(9/402)	4.085 ***	(9/402)	3.0297 ***	(36/402)	2.1466 ***
Rate Group 3	(9/303)	0.106	(9/303)	0.908	(9/303)	2.052 **	(36/303)	1.136

$$\text{MODEL [6]: } \Delta RP[t] = B_0 + B_1(CFCHG[t]) + B_2(MS2CHG[t]) + B_3(LNGCHG[t]) + e[t]$$

	Identical Coefficients for CFCHG ?		Identical Coefficients for MS2CHG ?		Identical Coefficients for LNGCHG ?		All Coefficients Identical ?	
	df	F	df	F	df	F	df	F
Rate Group 1	(8/292)	0.652	(8/292)	0.589	(8/292)	0.283	(32/292)	0.609
Rate Group 2	(9/402)	0.751	(9/402)	0.828	(9/402)	2.552 ***	(36/402)	1.361
Rate Group 3	(9/303)	1.204	(9/303)	0.807	(9/303)	1.765	(36/303)	1.286

$$\text{MODEL [7]: } \Delta RP[t] = B_0 + B_1(ILICHG[t]) + B_2(CPICHG[t-1]) + B_3(LNGCHG[t]) + B_4(AR4) + e[t]$$

	Identical Coefficients for ILICHG ?		Identical Coefficients for CPICHG(Lag 1)?		Identical Coefficients for LNGCHG ?		All Coefficients Identical ?	
	df	F	df	F	df	F	df	F
Rate Group I	(8/283)	3.9667 ***	(8/283)	2.6916 ***	(8/283)	4.0894 ***	(40/283)	0.905
Rate Group II	(9/392)	8.7952 ***	(9/392)	5.926 ***	(9/392)	6.0134 ***	(45/392)	1.8284 ***
Rate Group III	(9/293)	4.3525 ***	(9/293)	2.5339 ***	(9/293)	2.841 ***	(45/293)	0.9176

$$\text{MODEL [8]: } \Delta RP[t] = B_0 + B_1(ILICHG[t]) + B_2(LNGCHG[t]) + B_3(LNGCHG[t-1]) + B_4(AR4) + e[t]$$

	Identical Coefficients for ILICHG ?		Identical Coefficients for LNGCHG ?		Identical Coefficients for LNGCHG(Lag 1)?		All Coefficients Identical ?	
	df	F	df	F	df	F	df	F
Rate Group I	(8/284)	2.0745 **	(8/284)	1.3401	(8/284)	2.1889 **	(40/284)	0.5235
Rate Group II	(9/392)	4.0998 ***	(9/392)	3.4665 ***	(9/392)	1.7741	(45/392)	0.8667
Rate Group III	(9/293)	4.230 ***	(9/293)	3.3542 ***	(9/293)	2.7564 ***	(45/293)	0.8989

** (***) signifies F-Ratio Significant at the 5% (1%) level.

This result offers relatively strong evidence in support of the existence of industry-specific characteristics in the sensitivity of risk premiums to changes in this factor. Since changes in expected interest rates could exert an influence on expected default risk and expected call risk, differences in coefficients for this factor across industry groups could be attributable to differences in either, or both, of these effects. However, unless there are sizable differences in the average coupon rate of the portfolios within a given rating group, then significant differences in call risk should not exist across industry groups at any given time. While the average coupon rates of the Stage II portfolios vary over time, they are generally quite consistent across industry groups within a given rating category. Consequently, the principle origin of differences in the coefficients for this factor should be differences in the sensitivity of the default risk premium to changes in expected interest rates.

With respect to the factors representing expected inflation (CPICHG and MS2CHG), the results are inconsistent between the two models. As discussed previously, the observed signs on the estimated coefficients for the change in the Consumer Price Index (CPICHG) in Model [5] were inconsistent across industry groups. This fact is again reflected in the significant F-ratios for this variable in Table 35 for Rate Groups 2 and 3, implying that the

sensitivity of risk premiums to changes in this factor are not homogeneous across the industry groups represented here.

In Model [6], however, the change in the money supply shows no significant F-ratios, implying homogeneous risk premium sensitivity across industry groups with respect to this variable. It is necessary to note that this economic factor was selected originally for inclusion in the analysis due to its controversial background and arguable connection with expected inflation and interest rates. Given the results of Stage I and Stage II analysis, there is apparently a significant association between changes in risk premiums and changes in this variable. However, it is by no means clear whether this association reflects a sensitivity in risk premiums to changes in expected inflation and/or interest rates or something quite different.

In the individual regressions for Model [6] (See Table 30 and Table 34), the observed signs for the coefficients of this variable were consistently negative. This result could be attributed to an association between this variable and expected default risk if an increase in the money supply is associated primarily with an increasing demand for money due to an increase in economic activity in an improving business environment, with a consequent reduction in default risk for most issuers. It could also be attributed to an association with expected call risk if an

increase in the money supply is associated with expectations for an increase in the rate of inflation which would tend to increase the general level of interest rates and thus reduce the expected risk of call. Obviously, these two potential avenues of influence are in almost direct conflict with each other, although both points of view are frequently represented in the literature.

Without attempting to offer any definitive conclusions regarding this controversy, since it is well beyond the scope of this study to do so, there is an interesting aspect of these results which has bearing on this argument. If growth in the money supply is primarily associated with expectations for improving business conditions and reduced default risk, then there would be a possibility of observing significant differences in the coefficients for this variable across the industry groups if differential default-risk sensitivity levels do exist. On the other hand, if growth in the money supply is primarily associated with expectations for increased inflation and higher interest rates, and thus with reduced call risk, then differential sensitivity of risk premiums across industry groups would not be expected to be observed since risk of call is not expected to have an industry-specific component. The results presented here would tend to support the second argument more than the first, since significant coefficients were observed for this variable in many of the

industry/rating groups and all were consistently negative in sign, but significant differences in the coefficients across industry groups were not detected.

The results of the covariance analysis for Model [7] and [8] offer much stronger evidence for the existence of differential sensitivity in risk premiums across industry groups. These regression models included an adjustment for serial correlation in the residuals. The effect of the inclusion of this adjustment in the specification of the models should be to filter some of the noise from the data, thus increasing the overall explanatory power of the models. As shown in Table 35, the F-tests for homogeneity of coefficients across industry groups showed sufficient evidence to reject the null hypothesis of no difference in almost every case. Model [7] in particular shows F-Ratios that are significant at the 99 percent confidence level for all of the coefficients in all three rating groups. This result stands tends to support the conclusion that significant differences do exist in the sensitivity of risk premiums to changes in the economic factors represented in these models.

2.5.2c Stage IIB Summary

The conclusions of this section can be summarized as follows:

- 1) Evidence supports Hypothesis IIa --- that changes in the risk premiums of corporate bonds tends to be associated with changes in factors representing expected economic conditions (as a proxy for expected default risk in the aggregate) and expected interest rates and inflation (as a proxy for expected call risk).
- 2) Evidence supports Hypothesis IIb --- that the strength of the observed relationships tends to increase as the rated quality of the bond portfolio decreases.
- 3) Evidence presented in this section is consistent with Hypothesis IIc --- that the relationship between changes in bond risk premiums and changes in economic factors representing expected default risk and expected call risk are not necessarily homogeneous with respect to the industry classification of the issuer.
- 4) The results of this section are generally consistent with the results reported in conjunction with Stage I aggregate analysis using broadly-defined bond indexes and equivalent multi-factor regression models.

ENDNOTES

1. See pages 71-79 for detailed definitions of the independent variables. See pages 104-112 for a description of the process through which the actual specification of the variables was determined.
2. See pages 54-61 for a description of the dependent variables used in Stage II analysis.
3. See pages 44-53 for a discussion of the technical problems inherent in the popular yield series.
4. See pages 18-22 for a description of the data underlying these series, and pages 57-61 for a description of the computations involved in the actual compilation of the series.
5. Not all series span the entire time period due to a shortage of debentures that conform to the requirements specified on pages 18-22.
6. The results of Stage I single-factor analysis are discussed on pages 125-143.

7. See pages 113-118 for a description of the selection process for multi-factor models.
8. See footnote (1).
9. Maddala, G.S. Econometrics. (New York: McGraw Hill, 1977).
10. Gregory C. Chow. "Tests of Equality Between Sets of Coefficients in Two Linear Regressions," Econometrica (July 1960), 591-605.
11. Vogel, Robert C. and G.S. Maddala. "Cross-Section Estimates of Liquid Asset Demand by Manufacturing Corporations", Journal of Finance (Dec 1967).
12. With the exception of the variable representing the change in government debt as a percentage of GNP, which has problems in interpretation as discussed on pages 226-229.
13. See pages 133-142, 153-163, and 185-190.
14. The risk premium series underlying the Stage II independent variables are described on pages 57-61.

15. See pages 113-118 for a discussion of the selection process for the multi-factor models used here and also in Stage I analysis.
16. See pages 71-81 for a discussion of the expectations with respect to the signs of the coefficients of the independent variables.
17. See pages 79-81 for a discussion of the expected sign for this variable.
18. See pages 197-208.

3. SUMMARY AND CONCLUSIONS

3.1 Stage I Aggregate Analysis

Stage I Aggregate Analysis focused on an examination of the relationship between changes in corporate-government bond yield spreads and changes in selected economic variables representing expected default risk and expected call risk.¹ Three specific hypotheses were stated with respect to this relationship:

- Ia) Changes in the corporate-government yield spread are related to changes in the selected economic indicators.
- Ib) The strength of the observed relationships increases as the rated quality of the dependent variable bond index decreases.
- Ic) Characteristics of the relationship (strength of the relationship and magnitude of the slope coefficients) are not homogeneous with respect to the business classification of the issuer.

In keeping with previous studies concerning the cyclical behavior of bond yields,² the Stage I dependent variables were defined as the spread between Moody's Corporate Bond Yield Indexes (Average Corporate, Industrials, and Utilities; Aaa to Baa ratings; quarterly observations) and the Standard and Poors Long Maturity Government Bond Index.

The analysis consisted of three primary segments. Stage Ia analysis involved single-factor regressions of the 10 selected independent variables on the 15 yield-spread series used as the dependent variables. These regressions provided information on the nature of the relationship between changes in the yield spreads and changes in the individual economic and call risk factors, and on the degree of homogeneity of the observed relationships across broadly defined industry-rating groups.

Stage Ib analysis employed multi-factor regressions which included independent variables representing expected default risk (proxied by macroeconomic factors representing current and expected economic conditions) and expected call risk (proxied by factors representing current and expected interest rates). These regressions provided information on the nature of the relationship between changes in the yield spreads and changes in expected default risk and call risk considered together. In addition, the observed relationships were compared across industry/rating groups for evidence of heterogeneous response characteristics.

Stage Ic analysis examined the extent to which the relationships observed in Stages Ia and Ib were consistent across two consecutive subsamples of the full sample time period.³ This comparison was based on the application of covariance analysis techniques to the subperiod data.

The results and conclusions of this portion of the analysis are summarized in the following pages.

3.1.1 Summary of Stage IA Results

Stage IA analysis was based on the application of the following regression model to the fifteen corporate-government yield spread series:

$$\text{Model [1]} \quad \Delta YS_{kt} = a_{jkt} + b_{jk}(\Delta X_{jt}) + e_{jkt}$$

where:

ΔYS_{kt} represents the percentage change between (t-1) and (t) in the yield spread between the Average Corporate Index of rating (k) at time (t) and the yield of the government bond index.

ΔX_{jt} is the percentage change in one of the selected independent variables. (See page 71-79 for descriptions of the independent variables.)

k represents ratings classes Aaa to Baa

j represents independent variables 1 to 10

t represents the quarterly time points from 1969.Q1 to 1984.Q4

The results of these regressions offered general support for Hypotheses Ia and Ib. The most significant relationships were produced by models containing independent variables representing Corporate Cash Flows, the Index of Leading Economic Indicators, the Unemployment Rate, the Consumer Price Index, and the Money Supply. The observed signs for the coefficients of these variables were consistent with a priori expectations. Significant relationships tended to occur with greater frequency in the lower rating categories, and the strength of the observed relationships (as indicated by the F-ratios and regression R^2 's) tended to increase as the rated quality of the corporate bond yield index decreased. This evidence was consistent with Hypotheses Ia and Ib.

While previous studies found the Index of Consumer Sentiment (MOOD) to be an important explanatory variable in regressions of this type,⁴ this result was not replicated in any part of the current study. In general, the MOOD variable performed very poorly in this study.

The evidence produced in Stage IA analysis tended to support Hypothesis Ic, although it was rather weak and not altogether consistent. Based on rankings of the magnitudes of estimated coefficients and regression R^2 's for a given independent variable, it was determined that the sensitivity of yield spreads to changes in the economic factors is not necessarily homogeneous across issuer categories.

In particular, the yield spread series derived from Moody's Industrial Bond Indexes tend to exhibit the highest level of sensitivity and the strongest relationships with respect to changes in the selected economic variables while the yield spreads based on the Utilities Indexes tend to exhibit the least sensitivity and the weakest relationships. While this tendency is not totally consistent across ratings and independent variables, it is sufficient to cast serious doubt on the null hypothesis of no difference in the relationships across issuer categories. Such a result is consistent with previous research, particularly Jaffee (1975), where the yields of Utility bonds were found to exhibit less sensitivity to changes in economic factors than the yields of other broadly-defined issuer classifications.

The conclusions that could be drawn on the basis of the tests conducted in Stage IA analysis can be summarized as follows:

- 1) Evidence supports Hypothesis Ia. That is, changes in corporate-government yield spreads are associated with changes in factors representing expectations of future economic conditions and interest rates.

- 2) Evidence supports Hypothesis Ib. That is, the strength of the association increases as the rated quality of the bond index decreases.
- 3) There is conflicting evidence regarding Hypothesis Ic. That is, the nature of the association between the yield spreads and the economic variables may differ with the business classification of the issuer. However, the evidence concerning this hypothesis was generally weak and not altogether consistent.

3.1.2 Summary of Stage IB Results:

Stage IB analysis involved the application of four selected multi-factor regression models to the 12 yield spread series. These models included terms representing changes in expected economic conditions (as a proxy for changes in expected default risk) and changes in expected interest rates (as a proxy for changes in expected call risk).

The general specification of the multi-factor model used in this section was:

$$\text{Model [2]} \quad \Delta YS_{ikt} = b_0 + b_1(\Delta X_{dt}) + b_2(\Delta X_{ct}) + e_t$$

where:

ΔYS_{ikt} represents the percentage change from time (t-1) to (t) in the spread between the reported yield on the S&P Long Maturity Government Bond Index and the reported yield on Moody's Corporate Bond Index of business class (i) and rating class (k).

ΔX_{dt} is the percentage change in an independent variable selected to represent current and expected economic conditions. (See pages 71 to 79 for descriptions of the independent variables.)

▲ X_{ct} is the percentage change in an independent variable selected to represent expected interest rates. This term is included as a control factor for yield spread fluctuations that are not associated with default risk expectations.

As discussed in Section 2.3.4, four representative specifications of the general Model [2] were selected as the basis for further analysis.⁵ Parameters for these models were estimated using the 12 Stage I yield series as independent variables.

The results produced by these regressions were consistent with the results of the single-factor analysis of Stage IA, and offered additional support for Hypotheses Ia and Ib. The overall significance and strength of many of the estimated relationships, as indicated by the F-ratios and regression R^2 's, supported Hypothesis Ia. Hypothesis Ib was supported by the increasing frequency and strength of significant relationships in the lower rating categories. The explanatory power of the estimated relationships, as indicated by the adjusted R^2 and F-statistics, consistently increased as the rated quality of the bond index decreased. These simple models were able to explain up to 60 percent of the variation in the Baa-rated yield

series but had virtually no explanatory power in the Aaa rating category. The observed signs on the significant coefficients were consistent with their expected values,⁶ and with the signs reported in conjunction with Stage IA analysis.

Of the four representative specifications of the multifactor model, Model [5] (shown below in Table 36) was marginally superior to the others in terms of overall explanatory power (indicated by the F-ratios and R^2 's), consistency of results across industry/rating groups, and conformity to the OLS assumptions of independent identically distributed residuals. This model, with only three independent variables, was able to explain as much as 50 percent of the variation in the yield spreads of the three industry categories.

In model [5], the estimated coefficient for the change in the Index of Leading Indicators (ILICHG) is significantly different from zero (at a 5 percent level or better) only in the Baa rating category. Since this factor was chosen to represent current and expected economic conditions as proxy for expected default risk, its impact on the yield spread would be expected to be negligible in the higher rating categories where the probability of default is very small. As the rated quality of the index decreases (and the average probability of default increases), the

TABLE 36

Results of the Regression of Model [5] on 12 Industry/Rating Groups

Full Time Period: 1969.Q1 to 1984.Q4

$$\text{Model [5]: } \Delta Y_{ikt} = b_0 + b_1(\text{ILICHG}_t) + b_2(\text{CPICHG}_{t-1}) + b_3(\text{LNGCHG}_t) + e_t$$

	Constant			ILICHG(t)			CPICHG(t-1)			LNGCHG(t)			R ²	DW	F
	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat	Coef	SE	t-stat			
Aaa Corp	.189	.136	1.39	-3.58	2.05	1.74	-3.89	6.81	0.57	-1.93	0.71	2.71	.108	1.79	3.53
Utl	.044	.064	0.70	-1.56	0.97	1.62	-0.02	3.19	0.00	-0.41	0.33	1.24	.031	2.29	1.69
Ind	-.024	.319	0.07	-4.70	4.83	0.97	14.37	15.96	0.97	-1.15	1.67	0.69	.016	2.53	1.34
Aa Corp	-.029	.061	0.48	-1.45	0.93	1.56	4.79	3.06	1.56	-1.16	0.32	3.61	.241	2.37	7.66
Utl	-.009	.060	0.16	-1.13	0.91	1.25	2.68	3.00	0.89	-0.37	0.31	1.18	.046	2.23	2.03
Ind	-.043	.110	0.39	-2.01	1.66	1.21	9.67	5.49	1.76	-2.65	0.57	4.60	.302	2.71	10.08
A Corp	-.057	.052	1.08	-1.21	0.79	1.52	6.15	2.63	2.34	-1.15	0.27	4.19	.322	2.22	10.98
Utl	-.048	.054	0.87	-0.99	0.82	1.21	4.94	2.72	4.81	-0.53	0.28	1.87	.136	2.22	4.29
Ind	-.074	.072	1.04	-1.69	1.08	1.56	9.10	3.57	2.54	-2.03	0.37	5.43	.411	2.40	15.64
Baa Corp	-.036	.040	0.88	-1.68	0.61	2.75	4.51	2.02	2.23	-0.99	0.21	4.70	.414	2.23	15.83
Utl	-.027	.045	0.61	-1.44	0.68	2.10	3.42	2.26	1.51	-0.37	0.24	1.57	.168	2.22	5.27
Ind	-.072	.057	1.23	-1.97	0.87	2.25	8.27	2.89	2.85	-1.99	0.30	6.57	.514	2.25	23.27

ΔY_{ikt} = Percentage change in the yield spread between Moody's yield series for issuer class (i) of rating (k) and the S&P Long-Maturity Government Bond Index over the period (t-1) to (t). (i = Industrials (Ind), Average Corporate (Corp), and Utilities (Utl)). (t = 1...64 representing quarterly time points from 1969.Q1 to 1984.Q4)

ILICHG(t) = Percentage change in the Index of Leading Indicators

CPICHG(t-1) = Percentage change in Consumer Price Index (Lag 1)

LNGCHG(t) = Percentage change in the S&P Long Maturity Government Bond Index between (t-1) and (t).

Coef, SE, and t-stat are the estimated regression coefficient, its standard error, and its t-statistic respectively. R² is the Coefficient of Determination for the estimated regression equation, adjusted for degrees of freedom. DW is the Durbin-Watson statistic. F is the regression F-statistic.

impact of this factor on yield spreads would be expected to increase as well. The results shown in Table 36 are consistent with these expectations.

The percentage change in the Consumer Price Index (lagged one quarter) was selected to represent expectations concerning inflation. On one hand, an increase in the inflation rate would be expected to be associated with an increase in the general level of interest rates, and consequently to exert negative pressure on the yield spread due to a decrease in expected risk of call. On the other hand, increasing inflation would also be expected to be associated with increasing risk of default for some issuers if costs of production and/or capital tend to increase faster than output prices. Since the change in the probability of call for a given change in expected inflation is a function of the current level of interest rates,⁷ the change in the S&P Long Maturity Government Bond Index was included as the third independent variable to capture the major portion of changes in call risk. An increase (decrease) in the general level of interest rates should be associated with a decrease (increase) in call risk for all bonds, other things equal. Consequently, this variable should capture the major portion of changes in the yield spread resulting from changes in expected call risk, allowing the coefficient on CPICHG to reflect the impact of changes in inflationary expectations on default risk.

Under these conditions, a negative sign would be expected on the coefficient for LNGCHG and a positive sign would be expected on the coefficient for CPICHG. The signs that were actually observed on significant coefficients for these variables were completely consistent with these expectations. Also, in the absence of a nonstationary mean in the dependent variable series, (and there is no evidence of nonstationary means in the yield spread series), the expected value of the constant term in Model [5] is zero. As shown in Table 36, the estimated constants are consistently very small and not significantly different from zero. These outcomes lend further credence to this model to as a reasonable characterization of the target relationships.

Stage IB analysis also produced evidence in support of Hypothesis Ic. Rankings of the magnitudes of the estimated coefficients and regression R^2 's across industry groups supported the conclusion that the yield spreads based on the Industrial bond indexes exhibit greater sensitivity to changes in aggregate economic factors than do the yield spreads based on the Utility and Average Corporate bond indexes, while the Utility based yield spreads exhibit the least sensitivity. This result serves to reinforce the similar, although weaker, evidence produced in conjunction with Stage IA analysis.

The conclusions drawn on the basis of Stage Ib analysis are summarized as follows:

- 1) Evidence supports Hypothesis Ia. That is, changes in corporate-government yield spreads are associated with changes in expectations regarding future economic conditions (representing expected default risk) and future interest rates (representing expected call risk).
- 2) Evidence supports Hypothesis Ib. That is, the strength of the observed association increases as the rated quality of the bond index decreases.
- 3) Evidence supports the hypothesis that the nature of the association between the changes in spreads and changes in economic variables is not necessarily homogeneous with respect to the business classification of the issuer.

3.1.3 Summary of Stage IC Results

Stage Ic analysis involved the repetition of Stage Ia and IB procedures using two data subsets representing the first and second halves of the full sample time period. The objective of this section was to determine whether the conclusions of Stage Ia and Ib are generally applicable in two subperiods of the full sample time period, or whether some characteristics of the observed relationships are period-dependent.

The replication of the single-factor regression analysis of Stage IA showed an almost complete lack of significant relationships in Period 1, regardless of the rating category or industry classification, while many strong relationships were observed in Period 2. In general, independent variables that performed well in the Stage IA full-period models performed as well or better in the second subperiod models but performed very poorly in the first subperiod models.

These results imply that the conclusions of Stage IA with respect to Hypotheses Ia and Ib are period-specific and do not hold in the subperiod representing the first half of the full sample period.

Rankings of the magnitudes of the estimated coefficients and regression R^2 's across issuer categories in the

second subperiod produced results consistent with Stage IA and IB analysis in their support of Hypothesis Ic.

The Stage IB multi-factor models were applied to the two data subsamples, and the consistency of the resulting parameter estimates across the two subperiods was examined using covariance analysis. The test provides an estimate of the likelihood that the true parameters of the regression equation are identical in the two time periods.

The results of this test were quite consistent across the four representative models. With respect to the yield spread series based on the Industrial indexes, there was no case for which the null hypothesis could be rejected at traditional levels of significance (i.e. 5 percent or less). Results for the yield spread series based on the Average Corporate bond indexes were mixed, showing no indication of period-specific characteristics in the Aaa and Baa rating categories, a fairly strong indication of non-homogeneous behavior in the Aa category, and a weaker indication of non-homogeneous behavior in the A rating category.

The results for the Utility bond yield spreads showed sufficient evidence to support a strong rejection of the null hypothesis for the Aaa rating category. Joint F-statistics are significant at the 1 percent level for all four models. Although the indication of period-specific behavior is somewhat weaker for the Aa and Baa rating

categories, the results would tend to support the rejection of the null hypothesis for these series as well. The A-rated Utility series showed no evidence of period-specific behavior with respect to the representative models. This evidence supports the conclusion that the relationship between changes in the yield spreads of Aaa Utility bonds and changes in economic factors representing expected economic conditions (default risk) and interest rates (call risk) was not homogeneous across the two subperiods examined.

In addition, estimated coefficients for the independent variables representing expected economic conditions (ILICHG and CFCHG) are consistently much larger in the second period regressions involving the Utility indexes. This implies that the default risk premiums of utility bonds were much more sensitive to changes in expected economic conditions in the second subperiod than in the first.

With respect to the strength of the overall relationships in the two subperiods, the results produced by the multifactor regression models in the two subperiods contrast sharply with the results of the single-factor models. The single-factor models produced virtually no evidence of significant associations between changes in any of the selected independent variables and changes in the yield spread series in the first subperiod. However, the first-

period multi-factor models produced consistently strong overall relationships, even in the highest rating categories, as evidenced by high R^2 's and F-statistics that are unanimously significant at the 1 percent level. In contrast, relationships estimated with second period models achieved significant explanatory power only in the lower rating categories.

The conclusions of this section can be summarized as follows:

- 1) The characteristics of the observed relationships between changes in bond yield spreads and changes in the economic factors are not necessarily homogeneous across the two subperiods:
 - a) The single-factor regression analysis in the two subperiods showed many strong relationships in the second subperiod but virtually no significant relationships in the first subperiod.
 - b) The joint F-test applied to the multi-factor models provided strong evidence in support of the rejection of the null hypothesis of no difference in the regression parameters of the four multi-factor models across the two subperiods for the yield spreads of Utility bonds. The estimated coefficients in models with dependent variables

based on the Utility indexes indicated a greater sensitivity in the second subperiod to changes in independent variables representing expected economic conditions.

- c) The joint F-test provided sufficient evidence to support the rejection of the null hypothesis of no difference in the regression parameters of the four multi-factor models across the two subperiods for the yield spreads of Aa-rated corporate bonds (as represented by the Aa Average corporate index).
- d) The strength of the multi-factor relationships, as represented by the adjusted R^2 and the regression F-statistic, was greater in the first subperiod for high-grade bonds (Aaa and Aa ratings) for all three issuer classifications. The major contribution to the explanatory power of the first subperiod models appears to come from the independent variable representing the percentage change in the S&P Long-Maturity Government Bond Index (LNGCHG). In all four multi-factor models, the estimated coefficient for this variable in the first subperiod is significantly different from zero at the 1 percent level, and its estimated magnitude is consistently greater in the first subperiod.

- 2) In general, the conclusions reached in the full-period analysis with respect to Hypotheses Ia and Ib appear to hold in both subperiods. That is:
 - a) A significant association exists between changes in bond yield spreads and changes in economic factors representing expected economic conditions and expected interest rates.
 - b) The strength of the association increases as the rated quality of the bond index decreases.
- 3) The conclusions reached in the full-period analysis with respect to Hypothesis Ic appear to hold in the second subperiod. That is, the characteristics of the observed relationships are not necessarily homogeneous with respect to the business classification of the issuer. However, the results for the first subperiod are inconclusive with respect to Hypothesis Ic due to a lack of significant relationships which renders the ranking procedure useless.

3.2 Stage II Cross Industry Analysis

Stage II analysis involved an examination of the relationship between changes in the bond risk premiums of narrowly-defined industry groups and changes in the selected economic variables previously defined. The risk premium is defined as the difference between the average yield of a portfolio of risky bonds and the yield of a U.S. Treasury bond with duration equal to that of the risky bond portfolio.⁸ Twenty-nine original yield series were created from quarterly price data for 296 individual bonds representing ten industry classifications and three rating categories.⁹ These yield series formed the basis of twenty-nine corresponding risk premium series spanning the time period 1973.Q4 to 1986.Q1.¹⁰

The primary objectives of this stage of the analysis were (1) to compare the results obtained with the original industry-specific yield series with the results obtained with the unrefined series used in Stage I analysis, and (2) to test for differences in the observed relationships across industry classifications.

As in Stage I analysis, this portion of the analysis focused on three specific hypotheses:

- IIa) Changes in corporate bond risk premiums are related to changes in the selected economic indicators.
- IIb) The strength of the observed relationships increases as the rated quality of the bonds decreases.
- IIc) Characteristics of the observed relationships, (strength of the relationship and magnitude of the estimated coefficients), are not necessarily homogeneous with respect to the industry classification of the issuer.

The analysis of this section was composed of two major divisions. The first involved single-factor regressions of the twenty-nine risk premium series on the ten selected economic variables. These regressions provided information on the nature of the relationship between changes in the risk premiums and changes in the individual factors representing default and call risk, and formed the basis for a comparison of the estimated relationships across industry groups.

The second division involved the four multi-factor regression models selected in conjunction with Stage I analysis,¹¹ which included independent variables representing changes in expected default risk and call risk in the aggregate.

The major results of Stage II analysis are summarized below.

3.2.1 Summary of Stage IIA Results

Stage IIA analysis employed single factor regression models to explore the relationship between changes in bond risk premiums of narrowly-defined industry groups and changes in economic variables selected to represent changes in expected default risk and call risk in the aggregate.¹² These regression models were of the following general specification:

$$\text{Model [3]} \quad \Delta RP_{ikt} = a_{ikt} + b_{ik}(\Delta X_{jt}) + e_{ikt}$$

where:

- ΔRP_{ikt} represents the percentage change in the portfolio risk premium for industry (i) of rating group (k) between time (t-1) and (t).
- i represents the ten narrowly-defined industry groups.
- k represents the three rating groups:
 - High Quality: Aaa and Aa
 - Medium Quality: A and Baa
 - Low Quality: Below Baa
- t represents quarterly time points from 1973.Q4 to 1986.Q1
- ΔX_{jt} represents the percentage change in independent variable (j) between (t-1) and (t).

The parameters of this model were estimated for each of the twenty-nine risk premium series using each of the ten selected economic variables. The complete results are presented in Appendix C.

The results were consistent with those of Stage IA in that the independent variables representing changes in Corporate Cash Flow (CFCHG), the Index of Leading Indicators (ILICHG), the Unemployment Rate (EMPCHG), the Consumer Price Index (CPICHG), and the Money Supply (MS2CHG) were observed to have the strongest and most consistent associations with changes in risk premiums. The observed signs for the coefficients of these factors were consistent with expectations and with the results of Stage IA analysis. This evidence supports Hypothesis IIb.

Also consistent with Stage IA results, but in contrast to the results of previous studies, the Index of Consumer Sentiment (MOODCH) was found to have virtually no significant association with changes in risk premiums.

It was also shown that the frequency with which significant relationships occur, and the strength of those relationships, tends to increase as the rated quality of the bond portfolio decreases. However, it was noted that the frequency of significant associations, and the strength of those associations, was greater in the Medium Quality group of portfolios (A and Baa ratings) than in the Low Quality group (rated below Baa). This result may indicate

an increasing importance of firm-specific factors, relative to general economic factors, in investors' assessments of expected default risk for speculative grade bonds relative to bonds of higher quality.

Covariance analysis was employed to test Hypothesis IIc. The evidence produced by this procedure was not sufficient to reject the null hypothesis of no difference in the slope coefficients in any of the industry/rating categories. Consequently, there was insufficient evidence to reject the null hypothesis of no difference in the sensitivity of bond risk premiums across industry groups with respect to changes in the selected economic variables considered individually. This result is inconsistent with previous studies which were based on yield indexes for broadly-defined industry categories, where some significant differences were observed in estimated coefficients across industry groups.

The conclusions of this section can be summarized as follows:

- 1) Evidence supports Hypothesis IIa. That is, changes in risk premiums are associated with changes in factors representing expectations of future economic conditions and interest rates.

- 2) Evidence supports Hypothesis IIb. That is, the strength of the association increases as the rated quality of the bond index decreases from High Grade to Investment Grade. However, the risk premiums of Speculative Grade bonds may be influenced more by firm-specific factors and less by macroeconomic factors than are the risk premiums of higher quality bonds.

- 3) Evidence failed to support Hypothesis IIc. There was insufficient evidence to reject the null hypothesis of no difference in the sensitivity of bond risk premiums across industry groups with respect to changes in the selected economic variables considered individually.

3.2.2 Summary of Stage IIB Results

The objective of Stage IIB analysis was to employ multi-factor regression analysis to test for significant relationships between changes in bond risk premiums and changes in economic factors representing expected default risk and expected call risk. The four multi-factor models that were selected in conjunction with the Stage IB analysis were used here.¹³ The general specification of these models is as follows:

$$\text{Model [4]} \quad \Delta RP_{ikt} = b_0 + b_1(\Delta X_{dt}) + b_2(\Delta X_{ct}) + e_t$$

where:

- ΔRP_{ikt} represents the percentage change from time (t-1) to (t) in the risk premium for the portfolio representing Industry (i) of Rating Group (k).
- ΔX_{dt} represents the change in expected aggregate default risk associated with changes in current and expected economic conditions. (See pages 71 to 75 for descriptions of these independent variables.)

- ▲ X_{ct} represents the change in expected call risk associated with a change in expected interest rates and expected inflation. (See pages 76 to 81 for descriptions of these independent variables.)

The application of these four models to the 29 original risk premiums series produced evidence that was consistent with Hypotheses IIa and IIb. While no significant relationships were observed for Rate Group I portfolios, many strong relationships were observed for Rate Groups 2 and 3. The observed signs for significant coefficients were consistent with expectations. The high level of agreement between expected and observed signs supports the existence of the hypothesized relationships. These results were highly consistent with the results of Stage IB analysis.

Covariance analysis was employed to test for significant differences in the estimated parameters across industry groups. This analysis produced relatively strong evidence in support of the existence of industry-specific characteristics in the sensitivity of risk premiums to changes in the economic factors represented Models [7] and [8]. The evidence in support of Hypothesis IIc was somewhat weaker with respect to Models [5] and [6], which did not contain an autoregressive adjustment term.

Models [5] and [6] showed insignificant joint F-ratios for the independent variables representing expected

business conditions in general (ILICHG and CFCHG), implying that the sensitivity of risk premiums to changes in these factors does not differ appreciably with respect to the industry classification of the issuer. However, both models showed significant joint F-ratios (at the 99 percent confidence level) in Rate Group 2 for the independent variable representing changes in expected interest rates on longterm government bonds (LNGCHG). The F-ratio for this variable was also significant (at the 95 percent confidence level) for Rate Group 3 in Model [5]. This result offered relatively strong evidence in support of the existence of industry-specific characteristics in the sensitivity of risk premiums to changes in this factor. The principle origin of differences in the coefficients for this factor should be differences in the sensitivity of the default risk premium to changes in expected interest rates.

The evidence obtained in this portion of the analysis supported the following conclusions:

- 1) Evidence supports Hypothesis IIa --- that changes in the risk premiums of corporate bonds tends to be associated with changes in factors representing expected economic conditions (as a proxy for expected default risk in the aggregate) and expected interest rates and inflation (as a proxy for expected call risk).

- 2) Evidence supports Hypothesis IIb --- that the strength of the observed relationships tends to increase as the rated quality of the bond portfolio decreases.
- 3) Evidence presented in this section is consistent with Hypothesis IIc --- that the relationship between changes in bond risk premiums and changes in economic factors representing expected default risk and expected call risk are not necessarily homogeneous with respect to the industry classification of the issuer. This result is consistent with the evidence presented in previous sections of this paper, and with related studies in the literature.
- 4) The results of this section are generally consistent with the results reported in conjunction with Stage I aggregate analysis using broadly-defined bond indexes and equivalent multi-factor regression models.

3.3 Major Conclusions and Suggestions for Further Research

The most important findings in conjunction with this research can be summarized as follows:

1. Significant associations exist between changes in bond risk premiums and changes in certain economic variables representing expected business conditions and expected interest rates and inflation. That is, significant portions of the movement in yield spreads and risk premiums can be explained by movements in simple macro-economic variables.

Changes in expectations concerning general economic conditions and aggregate default risk, with corresponding changes in risk premiums, may be represented effectively by key economic variables that can be easily followed by investment managers. In particular, the change in the Index of Leading Indicators and the change in the Consumer Price Index are able to explain a significant portion of the total variability of yield spreads and risk premiums.

Changes in expectations concerning general economic conditions and aggregate default risk can not be represented effectively by the change in the Index of Consumer Sentiment. This result is on conflict with previous studies where this variable was found to provide an important contribution to the explanatory power of models concerned with the determinants of bond yields and yield spreads.

2. The strength of the association between changes in bond risk premiums and changes in the economic variables tends to increase as the rated quality of the bonds decreases within the High-grade and Investment-grade rating groups. However, the risk premiums of speculative-grade bonds may be influenced more by firm-specific and/or issue-specific factors than macroeconomic factors.
3. The sensitivity of bond risk premiums to changes in economic factors representing expected business conditions and interest rates is not necessarily homogeneous with respect to the business classification of the issuer.

The evidence obtained in conjunction with this study suggests a need for further research in several important areas.

As noted in Section 2.5.2a, the risk premiums for the Medium Quality portfolios (containing bonds rated A and Baa) tended to exhibit significant associations with the independent variables with greater frequency and strength than did the risk premiums of the Low Quality Portfolios (containing bonds rated below Baa). This result was in conflict with Hypothesis IIb --- that the strength of the associations would tend to increase as the rated quality of the portfolios decreased. It was noted in that section that such a result could be attributable to the small number of constituent bonds in some of the Low Quality portfolios due to a shortage of issues that fulfilled the selection criteria set forth for this study. The Low-quality risk-premium series for five of the ten industry categories have fewer than 30 observations due to an absence of speculative grade debenture issues that conform to the selection criteria in some time periods (primarily the earlier portion of the sample period). Also due to the shortage of speculative grade issues, the Low-quality portfolios were composed from fewer bonds on average than were the Medium and High Quality portfolios. Consequently, the effects of firm-specific factors are less likely to be diversified away in the compilation of the portfolio risk

premium series, thus reducing the ability of macroeconomic regression variables to explain a significant amount of the total variation in the dependent variable.

In addition, it was argued that firm-specific factors would be expected to assume greater relative importance in investors' assessment of the default risk of bonds in the Low Quality portfolios, and that the impact of such firm-specific factors on risk premiums would be likely to dominate the impact of the macroeconomic factors used as independent variables in this study.¹⁴

Given the potential magnitude of the influence of firm-specific factors on the risk premiums of bonds in the Low Quality category, it would be useful to expand the scope of the analysis with respect to speculative grade bonds to include independent variables representing firm-specific factors. Potentially useful factors in this context include the coupon rate, firm cashflow, capitalization ratios, extent of senior obligations, size of the issue, and others.

The general framework of the analysis would consist of the following elements:

1. Within an appropriate time period, (say 15 years of quarterly observations), ascertain the complete sample of true debenture bonds that were rated below Baa.

2. Group the bonds by type of issuer, using broader categories than the 10 industry groups selected in this study. The objective should be to form groups of bonds which are issued by companies with similar productive inputs and outputs, without defining the criteria for inclusion in a given group so narrowly that inadequate sample sizes result.
3. Compute the portfolio risk premiums for each group in the manner described in Section 2.2.1a (page 57). Also compute the risk premiums for each individual bond.
4. Repeat the procedures described in conjunction with Stage IIA and IIB, using the portfolio risk premium series for each of the issuer categories (and only macroeconomic factors as independent variables).
5. Add firm-specific factors to the regression models and estimate parameters for each individual issue within a given industry group.

If the weak performance of the regression models in the Low Quality groups is due to the limited size and composition of the portfolios rather than the greater relative importance of firm-specific factors, then the results of Step (4) should represent an improvement over the results

reported in this study with respect to the frequency and strength of significant relationships.

If the weak performance of the regression models in the Low Quality groups is due to the increasing importance of firm-specific or bond-specific factors, then significant coefficients on the corresponding variables should be observed in Step (5).

Another important extension of this study would be to replicate the analysis using foreign market data. Given the gradual elimination of structural barriers between national markets and the emergence of truly global market environment, knowledge of the similarities and differences in the behavior of bond prices across international boundaries is extremely important to the financial managers of multinational corporations and to institutional traders. Price data for many foreign issues is readily available for recent periods (say the last five years), although dependable data is more difficult to obtain for earlier periods. Economic indicators comparable to those used in this study are readily available for virtually any country or region.

The examination could focus on issues traded in the major world markets such as London, Paris, Frankfurt, and Tokyo. The results of the analysis of individual markets would support a comparison across markets to determine the degree of homogeneity in the sensitivity of bond risk

premiums to changes in global and regional economic conditions.

The international extension would also allow an examination of the extent to which a global trading environment has actually developed by comparing results across time. If the degree of practical separation between the major national markets is indeed diminishing due to the emergence of a truly global market environment, then it would be expected that significant inter-market differences in the behavior of bond risk premiums would be more prevalent in earlier periods than in more recent periods.

Finally, the concept of a portfolio risk premium, as developed in this dissertation, has important practical implications for event studies in the area of fixed-income securities. Event studies have become one of the most important and interesting fields of research in the equity markets, but there has been relatively little corresponding activity with respect to the bond markets.

This lack of activity is certainly not due to lack of interest. There are many important questions that could be addressed in this context, such as the effect a major default or other sudden natural, political or economic event on the price and risk premium of various bond issues. The major hindrance in this area of research is the lack of dependable daily or weekly bond price data due to the infrequency with which the average bond trades. Infrequent

trading produces bond price series that are characterized by long periods of little or no change separated by occasional sharp price adjustments when a trade takes place.

Traditional event study methodologies are not applicable in an environment of discontinuous trading activity. However, by forming portfolios of similar bonds and computing risk premium series for the portfolios in the manner developed in this dissertation, the problem of discontinuous price data would be greatly reduced. Price changes in individual bonds would be smoothed across all the bonds in the portfolio, and the behavior of the resulting series should be much more amenable to the application of typical event study procedures.

ENDNOTES

1. See pages 71-80 for a description of the independent variables.
2. Such studies include:

D.W. Jaffee (1975) op. cit.
M.G. Ferri (1978) op. cit.
Cook and Hendershott (1978) op. cit.
3. The two subsamples are 1969.Q1 to 1976.Q4 and 1977.Q1 to 1984.Q4.
4. Cook and Hendershott, "The Impact of Taxes, Risk, and Relative Security Supplies on Interest Rate Differentials," Journal of Finance 33(Sep 78), 1173-1186.

Jaffee, Dwight. "Cyclical Variations in the Risk Structure," Journal of Monetary Economics 1(Jul 75), 309-325.
5. See Table 1, page 116, for a list of the selected models.
6. See pages 71-79 for a discussion of the expected signs.

7. If yields are already high relative to coupon rates, and consequently average call risk is low, then expectations for marginal changes in yields due to changes in expected inflation would not be expected to have a significant impact on call risk. On the other hand, if yields are low relative to coupon rates, and consequently average call risk is high, then marginal changes in expected inflation would be expected to have a significant impact on call risk.
8. See pages 54-61 for a description of the dependent variables used in Stage II analysis.
9. See pages 18-22 for a description of the data underlying these series, and pages 57-61 for a description of the computations involved in the actual compilation of the series.
10. Not all series span the entire time period due to a shortage of debentures that conform to the requirements specified on pages 18-22.
11. See pages 113-118 for a description of the selection process for multi-factor models.

12. See footnote (1).
13. See page 249 for a full description of the four representative multi-factor models.
14. See pages 231-234.

APPENDICES

APPENDIX A

APPENDIX A

Summary of Results for Stage Ia Single-Factor Regression Analysis

The following pages present the results of all Stage IA regressions. Each page presents the results of all single-factor regression involving a given independent variable. For each regression, reported results include the estimated slope coefficient, the t-statistic of that coefficient, and the adjusted R^2 for the single-factor regression. Each page includes results estimated for three different time periods:

Full Time Period:	1969.Q1 to 1984.Q4
First Half:	1969.Q1 to 1976.Q4
Second Half:	1977.Q1 to 1984.Q4

See pages 125-143 for the full discussion of these results.

Abbreviations used in the following pages:

Dependent Variables:

CO	Yield Spread for Moody's Average Corporate Bond Index
UT	Yield Spread for Moody's Utility Bond Index
IN	Yield Spread for Moody's Industrial Bond Index
RR	Yield Spread for Moody's Railroad Bond Index

Independent Variables representing current or expected economic conditions:

CFCHG	Percentage change in Corporate Cash Flow.
MOODCH	Percentage change in Consumer Sentiment Index.
STKCHG	Percentage change in S&P 500 Stock Index.
STKCHG(-1)	STKCHG lagged one period.
ILICHG	Percentage change in the Index of Leading Indicators
GNPCHG(-1)	Percentage change in Gross National Product, lagged one period.
EMPCHG	Percentage change in the Unemployment Rate.

Independent Variables representing current or expected interest rates:

CPICHG(-1)	Percentage change in the Consumer Price Index, lagged one period.
GDPCHG(-1)	Percentage change in the ratio of Total Government Debt to GNP.
MS2CHG	Percentage change in the U.S. Money Supply (M2).
BILLCH	Percentage change in the rate on 90-day Treasury Bills.

See pages 62-81 for and 104-112 for a discussion of the selection process and specification of the independent variables.

Independent Variable: CFCHG

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-1.994	1.543	0.022	-1.402	2.285	0.064	-1.298	2.335	0.067	-1.494	3.385	0.144
IN	-5.021	1.749	0.032	-2.988	2.626	0.087	-2.175	2.706	0.093	-2.454	3.564	0.159
RR	0.000	0.000	0.000	0.235	0.024	0.000	7.689	1.163	0.006	3.692	0.517	0.000
UT	-0.922	1.583	0.024	-0.684	1.235	0.008	-0.842	1.608	0.025	-1.027	2.360	0.069

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.051	0.055	0.000	0.180	0.207	0.000	-0.051	0.062	0.000	-0.784	1.067	0.005
IN	-0.086	0.066	0.000	0.088	0.080	0.000	-0.099	0.103	0.000	-0.512	0.742	0.000
RR	0.000	0.000	0.000	0.495	0.209	0.000	0.243	0.300	0.000	-0.368	0.495	0.000
UT	0.228	0.277	0.000	0.404	0.506	0.000	0.057	0.069	0.000	-0.797	1.158	0.011

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-4.123	1.749	0.062	-2.967	3.780	0.290	-2.530	3.579	0.276	-2.274	3.940	0.319
IN	-10.216	1.885	0.076	-6.115	3.314	0.244	-4.252	3.528	0.270	-4.407	4.016	0.328
RR	0.000	0.000	0.000	1.885	0.085	0.000	15.771	1.213	0.015	7.659	0.536	0.000
UT	-2.063	2.585	0.155	-1.752	2.348	0.127	-1.729	2.694	0.168	-1.248	2.232	0.114

Independent Variable: MDOOCH

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.121	0.024	0.000	0.009	0.038	0.000	-0.050	0.218	0.000	-0.243	1.310	0.011
IN	-0.208	0.181	0.000	-0.334	0.714	0.000	-0.404	1.228	0.008	-0.557	1.936	0.043
RR	0.000	0.000	0.000	0.925	0.247	0.000	1.137	0.435	0.000	2.660	0.957	0.000
UT	0.292	1.271	0.010	0.236	1.088	0.003	0.122	0.586	0.000	-0.097	0.547	0.000

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.365	1.090	0.006	0.437	1.428	0.034	0.421	1.446	0.035	0.079	0.320	0.000
IN	0.434	0.925	0.000	0.525	1.354	0.027	0.484	1.437	0.034	0.302	1.217	0.016
RR	0.000	0.000	0.000	0.187	0.217	0.000	0.284	0.974	0.000	-0.010	0.036	0.000
UT	0.328	1.111	0.008	0.460	1.647	0.054	0.385	1.319	0.024	-0.084	0.330	0.000

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-0.218	0.288	0.000	-0.558	1.486	0.031	-0.672	2.005	0.089	-0.669	2.434	0.137
IN	-1.104	0.457	0.000	-1.486	1.705	0.058	-1.584	2.970	0.202	-1.699	3.503	0.267
RR	0.000	0.000	0.000	2.141	0.270	0.000	2.372	0.422	0.000	6.195	1.037	0.002
UT	0.243	0.656	0.000	-0.060	0.174	0.000	-0.225	0.751	0.000	-0.112	0.441	0.000

Independent Variable: ILICH6

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-3.046	1.626	0.026	-2.222	2.513	0.079	-2.187	2.750	0.096	-2.409	3.042	0.182
IN	-6.949	1.663	0.028	-3.571	2.121	0.053	-3.140	2.687	0.091	-3.299	3.250	0.134
RR	0.000	0.000	0.000	-3.538	0.254	0.000	10.786	1.122	0.004	2.995	0.288	0.000
UT	-1.574	1.875	0.039	-1.560	1.978	0.045	-1.768	2.379	0.070	-1.980	3.245	0.133

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-1.198	1.039	0.003	-0.924	0.860	0.000	-0.947	1.020	0.000	-1.609	2.041	0.095
IN	-0.965	0.591	0.000	-0.632	0.461	0.000	-0.788	0.663	0.000	-1.228	1.457	0.036
RR	0.000	0.000	0.000	-0.802	0.271	0.000	-0.378	0.373	0.000	-1.353	1.505	0.040
UT	-1.179	1.166	0.012	-0.901	0.910	0.000	-1.115	1.103	0.007	-1.924	2.387	0.135

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-6.712	1.586	0.047	-4.802	3.239	0.234	-4.650	3.750	0.296	-3.999	3.871	0.311
IN	-18.821	1.960	0.084	-9.406	2.740	0.173	-7.812	3.692	0.290	-7.413	3.691	0.289
RR	0.000	0.000	0.000	-9.067	0.272	0.000	32.931	1.436	0.033	11.638	0.457	0.000
UT	-2.357	1.560	0.044	-2.872	2.133	0.103	-3.065	2.682	0.166	-2.091	2.082	0.097

Independent Variable: EMPCH6

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.056	0.723	0.000	0.534	1.431	0.017	0.639	1.910	0.041	0.794	2.977	0.113
IN	0.769	0.453	0.000	1.157	1.660	0.020	1.071	2.205	0.059	1.292	3.094	0.121
RR	0.000	0.000	0.000	4.509	0.797	0.000	-3.646	0.926	0.000	-3.548	0.841	0.000
UT	0.209	0.595	0.000	0.091	0.273	0.000	0.282	0.895	0.000	0.498	1.898	0.040

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.087	0.172	0.000	0.196	0.418	0.000	0.131	0.293	0.000	0.475	1.346	0.026
IN	-0.174	0.246	0.000	0.022	0.036	0.000	0.030	0.057	0.000	0.337	0.905	0.000
RR	0.000	0.000	0.000	-0.469	0.366	0.000	0.127	0.289	0.000	0.238	0.594	0.000
UT	0.190	0.427	0.000	-0.064	0.148	0.000	-0.096	0.216	0.000	0.438	1.177	0.013

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	1.726	1.015	0.001	1.151	1.791	0.066	1.539	2.907	0.201	1.382	3.262	0.237
IN	3.412	0.862	0.000	3.410	2.482	0.143	2.974	3.533	0.270	3.090	4.053	0.332
RR	0.000	0.000	0.000	0.259	0.634	0.000	-12.435	1.378	0.028	-10.638	1.017	0.001
UT	0.279	0.454	0.000	0.337	0.597	0.000	0.926	1.969	0.005	0.618	1.521	0.041

Independent Variable: STKCHG

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-0.062	0.004	0.000	-0.476	1.355	0.013	-0.364	1.137	0.005	-0.206	1.076	0.003
IN	-0.201	0.122	0.000	0.304	0.450	0.000	-0.173	0.305	0.000	0.146	0.346	0.000
RR	0.000	0.000	0.000	-0.426	0.000	0.000	-3.769	1.021	0.001	2.675	0.674	0.000
UT	-0.090	2.892	0.106	-0.071	2.907	0.113	-0.574	1.906	0.045	-0.557	2.291	0.064

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-0.957	2.265	0.121	-0.795	1.997	0.091	-0.030	2.247	0.119	-0.716	2.302	0.135
IN	-0.697	1.110	0.000	-0.666	1.276	0.021	-0.010	1.051	0.075	-0.535	1.640	0.053
RR	0.000	0.000	0.000	-0.341	0.295	0.000	-0.791	2.147	0.107	-0.505	1.602	0.057
UT	-1.061	3.011	0.212	-1.126	3.396	0.290	-1.070	3.055	0.217	-0.909	3.034	0.215

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	1.473	0.900	0.000	0.101	0.157	0.000	0.499	0.099	0.000	0.501	1.000	0.005
IN	0.421	0.111	0.000	2.000	1.443	0.034	0.900	1.040	0.003	1.361	1.565	0.045
RR	0.000	0.000	0.000	0.074	0.070	0.000	-0.596	0.007	0.000	0.594	0.012	0.000
UT	-0.615	1.069	0.005	-0.413	0.772	0.000	0.326	0.092	0.000	0.009	0.222	0.000

Independent Variable: STKCHG(-1)

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.153	0.209	0.000	-0.203	0.574	0.000	-0.479	1.510	0.021	-0.656	2.596	0.085
IN	0.489	0.301	0.000	-0.413	0.623	0.000	-0.684	1.478	0.019	-0.764	1.876	0.039
RR	0.000	0.000	0.000	5.162	0.981	0.000	1.630	0.441	0.000	0.082	0.021	0.000
UT	0.205	0.625	0.000	-0.003	0.010	0.000	-0.311	1.061	0.002	-0.553	2.292	0.064

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-0.420	0.938	0.000	-0.369	0.890	0.000	-0.399	1.015	0.000	-0.706	2.369	0.133
IN	-0.697	1.122	0.000	-0.302	0.571	0.000	-0.460	1.011	0.000	-0.498	1.533	0.043
RR	0.000	0.000	0.000	-1.528	1.376	0.029	-0.277	0.711	0.000	-0.724	2.165	0.109
UT	-0.270	0.682	0.000	-0.225	0.582	0.000	-0.248	0.627	0.000	-0.772	2.497	0.149

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	1.187	0.677	0.000	0.105	0.163	0.000	-0.631	1.148	0.010	-0.566	1.227	0.016
IN	2.366	0.624	0.000	-0.717	0.502	0.000	-1.136	1.220	0.016	-1.304	1.492	0.038
RR	0.000	0.000	0.000	19.490	1.628	0.051	5.985	0.680	0.000	1.538	0.160	0.000
UT	1.088	1.969	0.035	0.416	0.777	0.000	-0.429	0.913	0.000	-0.143	0.358	0.000

Independent Variable: STKCHG(-1)

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.153	0.209	0.000	-0.203	0.574	0.000	-0.479	1.518	0.021	-0.656	2.596	0.005
IN	0.400	0.301	0.000	-0.413	0.623	0.000	-0.604	1.478	0.019	-0.764	1.876	0.039
RR	0.000	0.000	0.000	5.162	0.981	0.000	1.630	0.441	0.000	0.002	0.021	0.000
UT	0.205	0.625	0.000	-0.003	0.010	0.000	-0.311	1.061	0.002	-0.553	2.292	0.064

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-0.420	0.938	0.000	-0.369	0.890	0.000	-0.399	1.015	0.000	-0.706	2.369	0.133
IN	-0.697	1.122	0.000	-0.302	0.571	0.000	-0.460	1.011	0.000	-0.498	1.533	0.043
RR	0.000	0.000	0.000	-1.528	1.376	0.029	-0.277	0.711	0.000	-0.724	2.165	0.109
UT	-0.270	0.682	0.000	-0.225	0.582	0.000	-0.248	0.627	0.000	-0.772	2.497	0.149

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	1.107	0.677	0.000	0.105	0.163	0.000	-0.631	1.148	0.010	-0.566	1.227	0.016
IN	2.366	0.624	0.000	-0.717	0.502	0.000	-1.136	1.220	0.016	-1.304	1.492	0.038
RR	0.000	0.000	0.000	19.490	1.628	0.051	5.985	0.680	0.000	1.530	0.160	0.000
UT	1.000	1.969	0.005	0.416	0.777	0.000	-0.429	0.913	0.000	-0.143	0.358	0.000

Independent Variable: BILLCH

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-0.005	0.016	0.000	-0.110	0.779	0.000	-0.152	1.107	0.004	-0.139	1.220	0.000
IN	0.326	0.466	0.000	-0.335	1.102	0.006	-0.414	2.112	0.053	-0.460	2.697	0.002
RR	0.000	0.000	0.000	1.231	0.540	0.000	0.309	0.194	0.000	1.932	1.145	0.005
UT	0.130	0.926	0.000	0.060	0.513	0.000	0.014	0.112	0.000	0.033	0.307	0.000

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-0.091	0.350	0.000	-0.164	0.607	0.000	-0.062	0.270	0.000	-0.045	0.243	0.000
IN	-0.249	0.609	0.000	-0.119	0.393	0.000	-0.052	0.197	0.000	-0.021	0.111	0.000
RR	0.000	0.000	0.000	-0.917	1.442	0.035	-0.026	0.114	0.000	0.030	0.145	0.000
UT	-0.060	0.261	0.000	-0.021	0.094	0.000	0.035	0.154	0.000	-0.049	0.249	0.000

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.005	0.009	0.000	-0.093	0.452	0.000	-0.206	1.166	0.011	-0.195	1.314	0.023
IN	0.550	0.449	0.000	-0.500	1.103	0.007	-0.643	2.263	0.117	-0.730	2.053	0.107
RR	0.000	0.000	0.000	3.149	0.791	0.000	0.780	0.276	0.000	3.070	1.014	0.001
UT	0.243	1.320	0.023	0.125	0.722	0.000	0.004	0.024	0.000	0.007	0.075	0.000

Independent Variable: CPICMG(-1)

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	1.917	0.303	0.000	7.042	2.394	0.071	0.012	3.085	0.121	7.216	3.401	0.146
IN	21.988	1.505	0.024	12.821	2.315	0.066	11.777	3.095	0.122	11.378	3.408	0.146
RR	0.000	0.000	0.000	51.180	1.123	0.004	-15.596	1.486	0.000	-58.399	1.736	0.031
UT	2.508	0.912	0.000	4.460	1.682	0.029	6.573	2.703	0.092	5.793	2.814	0.100

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	2.866	0.480	0.000	4.974	0.928	0.000	6.578	1.309	0.023	7.859	1.990	0.090
IN	3.757	0.459	0.000	5.949	0.878	0.000	6.979	1.195	0.014	6.803	1.629	0.052
RR	0.000	0.000	0.000	6.262	0.424	0.000	4.892	0.979	0.000	6.132	1.355	0.027
UT	2.863	0.557	0.000	4.742	0.960	0.000	7.269	1.481	0.036	9.318	2.300	0.125

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.426	0.042	0.000	0.269	2.223	0.113	9.041	2.928	0.196	7.346	2.798	0.181
IN	27.385	1.178	0.012	15.457	1.821	0.070	14.152	2.643	0.162	13.568	2.675	0.166
RR	0.000	0.000	0.000	91.297	1.201	0.014	-17.187	0.312	0.000	-89.456	1.561	0.044
UT	2.537	0.699	0.000	4.614	1.416	0.031	6.616	2.443	0.138	4.673	1.885	0.087

Independent Variable: GNPCHG(-1)

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.622	0.121	0.000	-0.330	0.133	0.000	-1.003	0.445	0.000	-1.308	0.746	0.000
IN	0.709	0.772	0.000	3.975	0.057	0.000	1.235	0.374	0.000	-0.266	0.091	0.000
RR	0.000	0.000	0.000	-37.447	31.014	0.000	-26.234	71.018	0.000	24.183	0.075	0.000
UT	-2.816	1.234	0.008	-1.757	0.011	0.000	-2.203	1.069	0.002	-2.609	1.503	0.020

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.292	0.080	0.000	-2.602	0.775	0.000	-2.944	0.925	0.000	-2.660	1.031	0.002
IN	3.549	0.699	0.000	-3.057	0.720	0.000	-2.720	0.735	0.000	-2.807	1.050	0.003
RR	0.000	0.000	0.000	7.668	0.039	0.000	-3.083	0.990	0.000	-0.415	0.112	0.000
UT	-0.984	0.306	0.000	-1.787	0.574	0.000	-3.051	0.963	0.000	-3.206	1.195	0.014

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.600	0.063	0.000	1.065	0.500	0.000	0.078	0.269	0.000	-0.144	0.053	0.000
IN	12.064	0.584	0.000	10.511	1.295	0.021	4.908	0.912	0.000	2.094	0.399	0.000
RR	0.000	0.000	0.000	-75.012	1.064	0.004	-46.367	0.912	0.000	47.000	0.072	0.000
UT	-4.611	1.394	0.030	-1.714	0.549	0.000	-1.383	0.502	0.000	-2.005	0.069	0.000

Independent Variable: MS2CH6

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-3.921	1.013	0.000	-4.514	2.502	0.078	-4.352	2.675	0.090	-4.392	3.354	0.142
IN	-16.611	1.966	0.044	-5.775	1.660	0.020	-4.700	1.924	0.042	-4.297	1.977	0.045
RR	0.000	0.000	0.000	-27.929	0.992	0.000	2.309	0.117	0.000	6.376	0.301	0.000
UT	-3.967	2.354	0.068	-4.497	2.888	0.106	-4.518	3.063	0.119	-4.952	4.166	0.209

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-3.774	1.440	0.035	-3.117	1.274	0.020	-3.595	1.566	0.046	-4.142	2.316	0.127
IN	-2.915	0.776	0.000	-3.182	1.020	0.001	-3.634	1.354	0.027	-3.066	1.584	0.048
RR	0.000	0.000	0.000	-0.809	0.118	0.000	-2.789	1.218	0.016	-3.175	1.531	0.043
UT	-4.076	1.798	0.069	-3.807	1.723	0.062	-4.027	1.779	0.067	-5.570	3.175	0.232

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-3.495	0.461	0.000	-6.212	2.258	0.117	-5.352	2.226	0.113	-4.852	2.429	0.137
IN	-30.213	1.805	0.068	-8.270	1.281	0.020	-5.900	1.381	0.028	-5.609	1.383	0.029
RR	0.000	0.000	0.000	700.873	1.246	0.018	3.180	0.078	0.000	17.520	0.398	0.000
UT	-3.939	1.506	0.039	-5.448	2.388	0.131	-5.227	2.648	0.162	-4.583	2.706	0.169

Independent Variable: GDPCHG(-1)

Full Sample Period: 1969.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	0.266	0.101	0.000	-1.401	1.184	0.004	-1.410	1.227	0.008	-1.731	1.845	0.037
IN	-3.789	0.645	0.000	-4.198	1.789	0.034	-3.678	2.244	0.061	-4.429	3.146	0.126
RR	0.000	0.000	0.000	9.172	0.478	0.000	6.466	0.484	0.000	6.024	0.421	0.000
UT	0.877	0.740	0.000	-0.089	0.079	0.000	-0.090	0.084	0.000	-0.201	0.220	0.000

First Subperiod: 1969.1 to 1976.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	-2.125	0.977	0.000	-1.758	0.869	0.000	-2.248	1.180	0.013	-2.500	1.648	0.054
IN	-3.610	1.196	0.014	-1.004	0.389	0.000	-2.589	1.175	0.013	-2.300	1.449	0.035
RR	0.000	0.000	0.000	-3.615	0.652	0.000	-1.114	0.586	0.000	-2.952	1.767	0.066
UT	-1.522	0.790	1.000	-2.125	1.149	0.011	-1.863	0.974	0.000	-2.462	1.542	0.044

Second Subperiod: 1977.1 to 1984.4

Rate Grp:	Aaa			Aa			A			Baa		
	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²	Coef	t	R ²
CO	1.138	0.253	0.000	-1.262	0.723	0.000	-0.976	0.640	0.000	-1.337	1.054	0.004
IN	-5.706	0.550	0.000	-6.712	1.802	0.068	-4.618	1.872	0.075	-6.848	2.732	0.173
RR	0.000	0.000	0.000	25.592	0.757	0.000	14.925	0.620	0.000	11.331	0.435	0.000
UT	2.302	1.486	0.038	1.130	0.773	0.000	0.961	0.746	0.000	1.174	1.091	0.006

APPENDIX B

APPENDIX B

Bonds Included in Stage II Data Sample

This appendix provides the following information for the bonds included in each of the ten industry groups for Stage II analysis:

- 1) Company name
- 2) CUSIP identification number
- 3) Valueline Industry Code (VLIC)
- 4) Coupon Rate
- 5) Maturity Date
- 6) First quarter that the bond was included in the sample.
- 7) Last quarter that the bond was included in the sample.

See pages 18-22 for a description of the criteria through which these bonds were selected.

Industry Group: Aerospace

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	Quarter OUT
Bendix Corp	81689AA	3720	6.625	12-1-92	4-73	1-84
Bendix Corp	81689AC	3720	11.200	5-15-05	1-81	1-84
Fairchild Industries	303711AB	3720	9.750	4-1-98	1-79	2-86
Loral Corp	543859AA	3720	10.750	9-15-97	4-78	2-86
Martin Marietta	573275AA	3720	5.875	4-15-92	1-76	2-86
Martin Marietta	573275AD	3720	7.000	3-15-11	1-82	2-86
Rockwell Internat'l	774347AD	3720	8.300	4-1-96	4-73	2-86
Rockwell Internat'l	774347AE	3720	8.500	12-15-95	4-73	2-86
Rockwell Internat'l	774347AH	3720	9.375	7-15-96	4-77	2-86
Rohr Ind.	775422AB	3720	13.500	3-1-98	1-84	2-86
TRW Inc.	872649AA	3720	5.500	4-1-92	4-73	2-86
TRW Inc.	872649AC	3720	8.125	1-15-04	1-75	2-86
TRW Inc.	872649AD	3720	9.875	4-15-00	2-76	2-86

Industry Group: Automotive Manufacturing

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	Quarter OUT
Chrysler Corp	171196AB	3710	8.875	3-1-95	4-73	2-86
Chrysler Corp	171196AC	3710	8.000	11-1-98	4-73	2-86
Ford Motor	345370AG	3710	9.250	7-15-94	3-75	2-86
Ford Motor	345370AH	3710	9.150	8-1-04	3-80	2-86
Fruehauf Corp.	359370AA	3710	6.000	4-1-87	4-73	2-86
Fruehauf Corp.	359370AC	3710	9.700	8-1-96	3-77	2-86
General Motors	370442AC	3710	8.625	4-1-05	2-76	2-86
Signal Cos	826622AA	3710	8.850	11-1-94	4-73	2-86

Industry Group: Air Transport

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	Quarter OUT
American Airlines	23771AC	4510	4.250	7-1-92	1-80	2-86
American Airlines	23771AG	4510	5.250	7-1-98	3-82	2-86
Braniff Airways	105421AC	4510	5.750	12-1-86	4-73	4-80
Braniff Airways	105421AF	4510	9.125	1-1-97	4-77	4-80
Pacific S.W. Airline	694835AB	4510	6.000	10-1-87	4-73	2-86
Pan American	698057AQ	4510	13.500	5-1-03	2-84	2-86

Industry Group: Forest Products

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	Quarter OUT
APL Corp	2024AB	2600	10.000	4-1-92	3-74	2-86
APL Corp	2024AC	2600	10.750	8-1-97	3-77	2-86
Crown Zellerbock	228669AA	2600	8.875	3-15-00	4-73	2-86
Crown Zellerbock	228669AB	2600	9.250	3-15-05	2-76	2-86
Georgia Pacific	373298AK	2600	12.250	3-1-13	1-84	2-86
Great North. Nakoosa	391090AB	2600	7.875	7-15-98	1-75	2-86
Great North. Nakoosa	391090AC	2600	8.700	4-1-08	2-79	2-86
Internat'l Paper	460146AA	2600	8.850	5-15-95	4-73	2-86
Internat'l Paper	460146AC	2600	8.850	12-15-00	1-77	2-86
Internat'l Paper	460146AD	2600	5.125	11-15-12	4-83	2-86
Kimberly Clark	494368AB	2600	4.625	8-1-86	4-73	3-85
Kimberly Clark	494368AC	2600	5.875	9-1-91	4-73	2-86
Kimberly Clark	494368AD	2600	5.875	8-1-92	4-73	2-86
Kimberly Clark	494368AF	2600	11.500	3-1-13	1-84	2-86
Mead Corp.	582834AB	2600	5.250	4-15-86	1-76	3-85
Mead Corp.	582834AC	2600	8.500	12-15-95	4-73	2-86
Mead Corp.	582834AD	2600	9.875	11-1-00	4-75	2-86
St. Regis Paper	793453AC	2600	10.625	6-15-10	3-81	2-86
Scott Paper	809877AB	2600	8.875	1-1-00	4-73	2-86
Scott Paper	809877AC	2600	8.750	1-15-00	1-76	2-86
Union Camp Corp.	905530AA	2600	7.500	4-1-96	4-73	2-86
Union Camp Corp.	905530AB	2600	10.875	7-1-10	3-81	2-86
Union Camp Corp.	905530AC	2600	12.750	10-1-12	4-83	2-86
Union Camp Corp.	905530AD	2600	11.000	5-1-13	2-84	2-86
Westvaco Corp.	961548AA	2600	9.750	4-1-00	2-76	2-86
Westvaco Corp.	961548AC	2600	8.125	8-15-07	3-78	2-86
Westvaco Corp.	961548AD	2600	12.125	11-1-12	4-83	2-86
Weyerhaeuser	962166AA	2600	5.200	5-1-92	4-73	2-86
Weyerhaeuser	962166AE	2600	8.900	11-15-04	4-75	2-86
Weyerhaeuser	962166AG	2600	7.950	8-15-06	4-77	2-86

Industry Group: Computers / Electronics

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	OUT
Xerox	984121AD	3570	8.625	11-1-99	4-75	2-86
Control Data Corp	212363AA	3573	5.500	12-1-87	4-73	2-86
Data General	237688AA	3573	8.375	9-15-02	3-78	2-86
Data General	237688AB	3573	13.000	5-5-05	2-81	2-86
Digital Equipment	253849AA	3573	9.375	3-15-00	2-76	2-86
Honeywell	438506AC	3573	5.600	3-1-92	4-73	2-77
Honeywell	438506AD	3573	6.100	5-1-92	1-78	2-86
Honeywell	438506AE	3573	9.375	6-1-09	2-80	2-86
Honeywell	438506AF	3573	14.125	2-1-11	1-82	2-86
IBM	459200AB	3573	9.375	10-1-04	4-80	2-86
NCR	635230AA	3573	4.750	6-1-85	4-73	4-84
NCR	635230AB	3573	4.375	4-1-87	4-73	2-86
NCR	635230AC	3573	5.600	6-1-91	4-73	2-86
NCR	635230AD	3573	7.700	7-1-94	4-73	2-86
Sperry Rand	848355AC	3573	8.200	6-1-96	4-73	2-86
Telex	879573AC	3573	9.000	11-1-96	4-73	2-86
Telex	879573AD	3573	11.750	8-15-96	3-79	2-86
Arrow Electronics	42735AA	3670	12.000	6-1-98	3-78	2-86
Arrow Electronics	42735AC	3670	12.375	6-1-99	2-79	2-86
Arrow Electronics	42735AD	3670	14.000	8-1-00	3-80	2-86
Motorola	620076AA	3670	4.750	4-1-86	1-76	3-85
Motorola	620076AB	3670	8.000	10-1-07	4-78	2-86
N. Amer. Phillips	657045AB	3670	9.750	8-1-00	3-76	2-86
Oak Industries	671400AB	3670	11.875	5-15-98	3-79	2-84
Oak Industries	671400AD	3670	13.650	4-1-01	2-82	2-84
SCM	784015AA	3670	5.750	2-1-87	4-73	2-86
SCM	784015AC	3670	7.500	5-1-88	4-73	2-86
SCM	784015AD	3670	9.250	2-1-90	4-73	2-86
SCM	784015AE	3670	10.000	5-1-96	2-77	2-86
Texas Instruments	882508AA	3670	4.800	11-1-90	4-73	2-86
Texas Instruments	882508AB	3670	12.700	2-1-05	1-81	2-86

Industry Group: Farm Equipment

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	OUT
Deere & Co	244199AC	3520	4.500	10-31-86	1-76	4-85
Deere & Co	244199AD	3520	4.500	7-1-89	1-76	2-86
Deere & Co	244199AE	3520	5.400	2-1-92	1-76	2-86
Deere & Co	244199AG	3520	8.450	3-1-00	1-76	2-86
Deere & Co	244199AJ	3520	8.000	11-1-02	4-78	2-86
Internat'l. Harvest.	638901AC	3520	4.800	3-1-91	4-73	2-86
Internat'l. Harvest.	638901AD	3520	8.625	9-1-95	4-73	2-86
Internat'l. Harvest.	638901AF	3520	6.250	3-1-98	4-73	2-86
Internat'l. Harvest.	638901AJ	3520	9.000	6-15-04	3-75	2-86

Industry Group: Metals / Mining

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	OUT
Asarco Inc.	43413AB	1000	9.750	5-1-00	2-75	2-86
Phelps Dodge	717265AB	1000	8.100	6-15-96	4-73	2-86
Hanna Mining	410522AA	1011	4.750	12-15-90	1-76	2-86
AMAX Inc	23127AB	1031	8.000	1-1-86	3-74	2-85
AMAX Inc	23127AC	1031	8.500	3-1-96	4-73	2-86
AMAX Inc	23127AF	1031	9.375	1-15-00	1-75	2-86
AMAX Inc	23127AG	1031	8.625	3-15-01	1-76	2-86
Falconbridge ltd.	306099AB	1031	8.850	5-1-96	4-73	2-86
Gulf Resources & Chm	402496AB	1031	10.875	10-15-97	4-78	2-86
Gulf Resources & Chm	402496AC	1031	12.500	9-15-04	3-80	2-86
Inco Ltd.	453258AA	1031	6.850	4-1-93	4-73	2-86
Inco Ltd.	453258AB	1031	12.375	7-15-10	3-81	2-86

Industry Group: Oil Producers

Company Name	CUSIP #	VLIC	Coupon Maturity		Quarter	
			Rate	Date	IN	OUT
Conoco	208251AA	1300	9.375	4-1-09	2-80	2-86
Conoco	208251AB	1300	13.250	1-15-11	1-82	2-86
Continental Oil	211813AA	1300	3.000	11-1-84	4-73	2-84
Continental Oil	211813AB	1300	4.500	5-1-91	4-73	2-86
Continental Oil	211813AC	1300	7.500	7-1-99	4-73	2-86
Continental Oil	211813AD	1300	9.125	11-1-99	4-75	2-86
Continental Oil	211813AE	1300	8.875	6-1-01	2-77	2-86
Enstar	293582AA	1300	12.750	6-15-99	2-80	2-86
Forest Oil	346091AB	1300	12.500	5-1-99	2-80	2-86
Forest Oil	346091AC	1300	13.875	6-1-00	2-81	2-86
Moran Energy	616457AA	1300	11.500	5-1-98	2-79	2-86
Superior Oil	868273AC	1300	9.625	9-15-99	3-80	2-86
Wainco Oil	930676AB	1300	10.750	10-1-98	4-79	2-86
Atlantic Richfield	48825AA	2900	5.625	5-15-97	4-73	2-86
Atlantic Richfield	48825AB	2900	8.625	4-1-00	4-73	2-86
Atlantic Richfield	48825AD	2900	7.700	12-15-00	4-73	2-86
Atlantic Richfield	48825AE	2900	7.750	12-15-03	1-75	2-86
Atlantic Richfield	48825AF	2900	11.375	5-1-10	2-81	2-86
Atlantic Richfield	48825AG	2900	13.625	3-15-15	1-82	2-86
Atlantic Richfield	48825AJ	2900	12.500	9-15-12	3-83	2-86
Atlantic Richfield	48825AK	2900	11.000	4-15-13	2-84	2-86
Cities Service	173036AB	2900	6.125	11-1-97	4-73	2-86
Cities Service	173036AC	2900	6.625	11-1-99	4-73	2-86
Cities Service	173036AF	2900	7.650	1-15-01	4-73	2-86
Cities Service	173036AG	2900	9.750	10-1-00	4-76	2-86
Cities Service	173036AH	2900	13.875	1-15-11	1-82	2-86
Marathon Oil	565845AA	2900	4.375	4-1-87	4-73	2-86
Marathon Oil	565845AB	2900	8.500	2-1-00	4-73	2-86
Marathon Oil	565845AC	2900	8.500	11-1-06	4-77	2-86
Phillips Petroleum	718507AA	2900	7.625	3-1-01	4-73	2-86
Phillips Petroleum	718507AB	2900	8.875	11-1-00	4-76	2-86
Phillips Petroleum	718507AD	2900	12.250	10-15-12	4-83	2-86
Phillips Petroleum	718507AE	2900	11.250	5-1-13	2-84	2-86
Standard Oil Indiana	853700AC	2900	6.000	9-15-91	4-73	2-86
Standard Oil Indiana	853700AD	2900	6.000	1-15-98	4-73	2-86
Standard Oil Indiana	853700AJ	2900	9.200	7-15-04	3-75	2-86
Standard Oil Indiana	853700AL	2900	8.375	6-15-05	3-76	2-86
Standard Oil Indiana	853700AM	2900	7.875	8-1-07	3-78	2-86
Sun Oil	866762AA	2900	7.125	5-1-02	4-73	2-86
Sun Oil	866762AD	2900	13.400	0-0-07	3-83	2-86
Sun Oil	866815AA	2900	4.625	11-15-90	4-73	2-86
Sun Oil	866815AC	2900	8.500	11-15-00	4-73	2-86

Industry Group: Retailers

Company Name	CUSIP #	VLIC	Coupon Rate	Maturity Date	Quarter IN	OUT
Carter-Hawley	146227AB	5300	9.450	12-15-00	1-77	2-86
Carter-Hawley	146227AC	5300	9.125	10-15-08	4-79	2-86
Carter-Hawley	146227AD	5300	11.875	5-15-10	2-81	2-86
Dayton-Hudson	239753AA	5300	7.750	7-15-94	4-73	2-86
Dayton-Hudson	239753AB	5300	9.750	6-1-95	4-73	2-86
Dayton-Hudson	239753AC	5300	10.875	5-1-05	2-81	2-86
Dayton-Hudson	239753AE	5300	14.750	10-1-12	2-83	2-86
Dayton-Hudson	239753AF	5300	11.875	10-15-12	4-83	2-86
Dayton-Hudson	239753AG	5300	10.750	5-1-13	2-84	2-86
Federated Dept. Stor	314099AA	5300	8.375	9-15-95	4-73	2-86
Federated Dept. Stor	314099AB	5300	7.125	3-15-02	4-73	2-86
Federated Dept. Stor	314099AC	5300	10.250	6-15-10	2-81	2-86
Federated Dept. Stor	314099AE	5300	10.625	5-1-13	2-84	2-86
MarCor Inc.	566319AA	5300	6.500	10-1-88	4-73	2-86
May Dept. Stores	577778AE	5300	13.375	9-15-92	3-83	2-86
Mccrory Corp.	579865AE	5300	10.500	8-15-85	4-74	3-84
Mccrory Corp.	579865AF	5300	7.500	5-15-94	4-73	2-86
Mccrory Corp.	579865AG	5300	7.625	12-15-97	4-73	2-86
Mercantile Stores	587533AA	5300	8.700	12-1-95	4-73	2-86
Montgomery Ward	614223AA	5300	4.875	8-1-90	4-73	2-86
Montgomery Ward	614223AB	5300	9.375	11-1-00	1-77	2-86
Penney JC	708160AB	5300	8.875	7-15-95	4-73	2-86
Penney JC	708160AC	5300	9.000	6-15-99	3-75	2-86
Penney JC	708160AE	5300	11.500	6-15-10	2-81	2-86
Penney JC	708160AF	5300	12.000	7-15-10	3-81	2-86
Pier I Imports	720279AB	5300	11.500	7-15-03	3-84	2-86
Sears Roebuck	812387AB	5300	6.375	4-1-93	4-73	2-86
Sears Roebuck	812387AD	5300	8.625	10-1-95	4-73	2-86
Sears Roebuck	812387AE	5300	7.750	3-1-85	1-76	2-84
Sears Roebuck	812387AF	5300	8.000	4-1-06	2-77	2-86
Sears Roebuck	812387AG	5300	7.875	2-1-07	1-78	2-86
Sears Roebuck	812387AN	5300	10.750	5-1-13	2-84	2-86
Woolworth F.W.	980881AA	5300	7.375	4-1-96	4-73	2-86
Woolworth F.W.	980881AB	5300	9.000	6-1-99	3-75	2-86
Zayre	989195AC	5300	8.000	8-15-96	4-73	2-86
Zayre	989195AD	5300	12.625	6-15-05	2-81	2-86

Industry Group: Electric Utilities

Company Name	CUSIP #	VLIC	Coupon Maturity		Quarter	
			Rate	Date	IN	OUT
ATLANTIC CITY ELEC	48303AJ	4911	5.250	2-1-96	1-76	2-86
ATLANTIC CITY ELEC	48303AK	4911	7.250	6-1-03	1-76	2-86
ATLANTIC CITY ELEC	48303AP	4911	8.875	9-1-00	1-76	2-86
BALTIMORE G/E	59165AC	4911	4.875	6-15-86	1-76	2-86
BALTIMORE G/E	59165AE	4911	4.625	8-1-90	1-76	2-86
BALTIMORE G/E	59165AL	4911	6.125	8-1-97	1-76	2-86
BALTIMORE G/E	59165AN	4911	8.250	9-15-99	1-76	2-86
BALTIMORE G/E	59165AV	4911	7.500	7-1-02	1-76	2-86
CAROLINA PWR/LT	144141AH	4911	6.375	10-1-97	1-76	2-86
CAROLINA PWR/LT	144141AP	4911	7.750	5-1-02	4-73	2-86
CAROLINA PWR/LT	144141AU	4911	8.500	10-1-07	2-78	2-86
CONSOL EDISON	209111AQ	4911	5.000	10-1-87	4-75	2-86
DUKE PWR	264399AJ	4911	5.375	4-1-97	1-76	2-86
DUKE PWR	264399AK	4911	6.375	2-1-98	1-76	2-86
DUKE PWR	264399AM	4911	8.000	9-1-99	1-76	2-86
DUKE PWR	264399AX	4911	9.750	5-1-04	2-75	2-86
DUQUESNE LT	266228AM	4911	6.375	2-1-98	1-76	2-86
DUQUESNE LT	266228AQ	4911	7.750	7-1-99	1-76	2-86
DUQUESNE LT	266228AY	4911	8.625	4-1-04	1-76	2-86
FLORIDA PWR/LT	341081AU	4911	6.000	12-1-96	1-76	2-86
FLORIDA PWR/LT	341081AY	4911	8.000	6-1-99	1-76	2-86
FLORIDA PWR/LT	341081BC	4911	7.625	6-1-02	1-76	2-86
FLORIDA PWR	341099AP	4911	6.125	8-1-97	1-76	2-86
FLORIDA PWR	341099AV	4911	7.750	6-1-03	1-76	2-86
LONG ISLAND LT	542671AL	4911	5.250	3-1-96	1-76	2-86
LONG ISLAND LT	542671AQ	4911	9.125	9-1-00	1-76	2-86
ORANGE AND ROCKLAND	684065AD	4911	6.500	10-1-97	1-76	2-86
ORANGE AND ROCKLAND	684065AE	4911	9.250	2-1-00	1-76	2-86
PHILADELPHIA ELEC	717537AT	4911	7.750	12-15-00	4-73	2-86
POTOMAC ELEC PWR	737679AZ	4911	10.750	8-15-04	2-75	3-80
VIRGINIA ELEC/PWR	927804AP	4911	4.875	6-1-91	1-76	2-86
VIRGINIA ELEC/PWR	927804AU	4911	6.875	12-1-97	1-76	2-86
VIRGINIA ELEC/PWR	927804AV	4911	7.125	1-1-99	1-76	2-86
CENTRAL ILL PUB SERV	153663AN	4912	5.875	5-1-97	1-76	2-86
CENTRAL ILL PUB SERV	153663AP	4912	8.750	4-1-00	1-76	2-86
CENTRAL ILL PUB SERV	153663AS	4912	7.500	5-1-02	1-76	2-86
CINCINNATI G/E	172070AH	4912	5.875	7-1-97	1-76	2-86
CINCINNATI G/E	172070AL	4912	7.375	5-1-01	1-76	2-86
CINCINNATI G/E	172070AM	4912	8.125	8-1-03	1-76	2-86
COMMONWEATH EDISON	202795AV	4912	4.625	1-1-09	1-76	2-86
COMMONWEATH EDISON	202795AW	4912	4.750	12-1-11	1-76	2-86
COMMONWEATH EDISON	202795BH	4912	7.625	2-15-03	4-73	2-86
COMMONWEATH EDISON	202795CA	4912	15.375	3-15-00	3-80	2-86

Industry Group: Electric Utilities (continued)

Company Name	CUSIP #	VLIC	Coupon Maturity		Quarter	
			Rate	Date	IN	OUT
CONSUMERS PWR	210615AQ	4912	6.000	7-1-97	1-76	2-86
CONSUMERS PWR	210615AU	4912	7.625	6-1-99	4-73	2-86
CONSUMERS PWR	210615AV	4912	8.250	11-1-99	1-76	2-86
CONSUMERS PWR	210615BC	4912	8.625	8-1-03	4-73	2-86
DETROIT EDISON	250847AK	4912	6.400	10-1-98	4-73	2-86
DETROIT EDISON	250847AL	4912	9.000	12-1-99	4-73	2-86
DETROIT EDISON	250847AM	4912	9.150	7-1-00	4-73	2-86
GULF STATE UTIL	402550AT	4912	5.375	2-1-97	1-76	2-86
GULF STATE UTIL	402550AY	4912	8.500	2-1-00	1-76	2-86
GULF STATE UTIL	402550BD	4912	10.150	5-1-05	1-76	2-86
IOWA ELEC LT/PWR	462416AB	4912	6.250	9-1-96	1-76	2-86
IOWA ELEC LT/PWR	462416AC	4912	8.625	11-1-99	1-76	2-86
KANSAS CITY PWR/LT	485134AK	4912	7.125	2-1-99	1-76	2-86
KANSAS CITY PWR/LT	485134AL	4912	9.125	6-1-00	1-76	2-86
LOUISVILLE G/E	546676AG	4912	6.750	6-1-98	1-76	2-86
LOUISVILLE G/E	546676AH	4912	9.250	7-1-00	4-73	2-86
LOUISVILLE G/E	546676AK	4912	7.500	7-1-02	4-73	2-86
NORTHERN IND PUB SER	665262AK	4912	6.375	9-1-97	1-76	2-86
NORTHERN IND PUB SER	665262AP	4912	8.125	5-1-01	1-76	2-86
NORTHERN IND PUB SER	665262AQ	4912	7.500	4-1-02	1-76	2-86
NORTHERN STATES PWR	665772AP	4912	5.875	8-1-96	1-76	2-86
NORTHERN STATES PWR	665772AR	4912	6.750	5-1-98	1-76	2-86
NORTHERN STATES PWR	665772AV	4912	8.250	6-1-01	1-76	2-86
OHIO EDISON	677347AJ	4912	4.750	6-1-91	1-76	2-86
OHIO EDISON	677347AK	4912	8.250	9-1-99	1-76	2-86
OHIO EDISON	677347AL	4912	9.250	5-1-00	1-76	2-86
OKLAHOMA GAS/ELEC	678858AL	4912	5.125	1-1-97	1-76	2-86
OKLAHOMA GAS/ELEC	678858AP	4912	8.625	1-1-00	1-76	2-86
S. CAROLINA ELEC/GAS	837004AB	4912	6.000	6-1-97	1-76	2-86
S. CAROLINA ELEC/GAS	837004AD	4912	8.000	6-1-99	1-76	2-86
S. CAROLINA ELEC/GAS	837004AE	4912	9.125	12-1-99	1-76	2-86
TOLEDO ED	889175AD	4912	6.125	8-1-97	1-76	2-86
TOLEDO ED	889175AE	4912	9.000	11-1-00	4-73	2-86
UNION ELECTRIC	906548AL	4912	5.500	5-1-96	1-76	2-86
UNION ELECTRIC	906548AN	4912	7.000	4-1-98	1-76	2-86
UNION ELECTRIC	906548AR	4912	9.000	4-1-00	1-76	2-86
WISCONSIN PWR/LT	976826AJ	4912	4.250	5-1-92	1-76	2-86
WISCONSIN PWR/LT	976826AK	4912	6.250	8-1-98	1-76	2-86
WISCONSIN PWR/LT	976826AN	4912	8.000	6-1-99	1-76	2-86
ARIZONA PUB SERV	40555AK	4913	7.450	3-15-02	4-73	2-86
ARIZONA PUB SERV	40555AN	4913	10.625	11-15-00	1-76	2-86
MONTANA POWER	612085AF	4913	7.500	8-1-01	1-76	2-86
MONTANA POWER	612085AG	4913	7.500	1-1-98	1-76	2-86

Industry Group: Electric Utilities (continued)

Company Name	CUSIP #	VLIC	Coupon Maturity		Quarter	
			Rate	Date	IN	OUT
PACIFIC G/E	694308BE	4913	5.375	6-1-98	1-76	2-86
PACIFIC G/E	694308BK	4913	6.750	12-1-00	1-76	2-86
PACIFIC G/E	694308BM	4913	9.000	12-1-01	1-76	2-86
PACIFIC G/E	694308BT	4913	7.750	6-1-05	4-73	2-86
PACIFIC PWR/LT	694784AY	4913	5.000	10-1-95	1-76	2-86
PACIFIC PWR/LT	694784BA	4913	8.000	5-1-99	1-76	2-86
PACIFIC PWR/LT	694784BC	4913	9.625	7-1-00	1-76	2-86
PORTLAND GEN ELEC	736508AC	4913	6.600	10-1-97	1-76	2-86
PORTLAND GEN ELEC	736508AF	4913	8.000	11-1-01	1-76	2-86
PUB SERV COLORADO	744448AK	4913	5.875	7-1-97	1-76	2-86
PUB SERV COLORADO	744448AM	4913	8.750	9-1-00	4-73	2-86
PUB SERV COLORADO	744448AN	4913	7.250	2-1-01	4-73	2-86
PUGET SOUND PWR/LT	745332AJ	4913	9.500	7-1-00	1-76	2-86
PUGET SOUND PWR/LT	745332AK	4913	7.750	10-1-02	1-76	2-86
SAN DIEGO G/E	797440AK	4913	5.500	3-1-97	1-76	2-86
SAN DIEGO G/E	797440AL	4913	7.000	12-1-98	1-76	2-86
SAN DIEGO G/E	797440AM	4913	8.750	2-1-00	1-76	2-86
SIERRA PAC PWR	826418AK	4913	5.000	7-1-88	1-76	2-86
SIERRA PAC PWR	826418AL	4913	6.500	7-1-97	1-76	2-86
SIERRA PAC PWR	826418AN	4913	9.875	5-1-04	1-76	2-86
SOUTHERN CAL ED	842400AX	4913	6.125	8-15-91	1-76	2-86
SOUTHERN CAL ED	842400BB	4913	8.125	10-15-94	4-73	2-86
SOUTHERN CAL ED	842400BF	4913	8.250	2-1-99	4-74	2-86

APPENDIX C

APPENDIX C

Summary of Regression Results for Stage II Cross-Industry Analysis

This Appendix contains summaries of the results of the Stage II single-factor regression analysis. See pages 224-246 for a complete discussion of the procedure and the results.

The tables contained in this Appendix make use of the following notation:

RPCHG	Percentage change in the bond risk premium between (t-1) and (t).
CFCHG	Percentage change in Corporate Cash Flow between (t-1) and (t).
MOODCH	Percentage change in the Consumer Sentiment Index between (t-1) and (t).
EMPCHG	Percentage change in the Unemployment Index between (t-1) and (t).
ILICHG	Percentage change in the Index of Leading Indicators between (t-1) and (t).

MS2CHG Percentage change in the Money Supply (M2) between
 (t-1) and (t).

BILLCH Percentage change in the Treasury Bill Rate
 (30-day) between (t-1) and (t).

GNPLAG Percentage change in Gross National Product
 between (t-2) and (t-1).

STKLAG Percentage change in S&P 500 Stock Index between
 (t-2) and (t-1).

CPILAG Percentage change in the Consumer PRice Index
 between (t-2) and (t-1).

GDPLAG Percentage change in Government Debt / GNP between
 (t-2) and (t-1).

LNGCHG Percentage change in the S&P Long Maturity
 Government Bond Index between (t) and (t-1).

****** Denotes t-statistics or F-ratios that are significantly
 different from zero at the 95 percent confidence level
 or better.

***** Denotes t-statistics or F-ratios that are significantly
 different from zero at the 90 percent confidence level.

$$\text{Model: } \Delta \text{RPCNG}_i = \beta_0 + \beta_1(\text{GRPLAS}_i) + e_i$$

Rate Group 1

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	19	0.312	0.225	1.384	-16.408	19.153	-0.857	0.734	0.041	1.597
Automotive	42	0.201	0.176	1.147	-2.192	13.556	-0.162	0.026	0.001	2.256
Electronics	45	-0.006	0.233	-0.027	-27.972	19.633	-1.425	2.030	0.045	2.071
Forest Products	46	-0.013	0.191	-0.066	4.061	14.653	0.332	0.110	0.003	1.979
Metals/Mining	15	0.000	0.116	0.775	0.644	9.459	0.060	0.005	0.000	2.480
Oil Producers	45	-0.243	0.105	-1.315	26.562	14.646	1.814*	3.289	0.071	1.889
Retail	44	-0.166	0.204	-0.814	-5.581	16.810	-0.332	0.110	0.003	1.701
Farm Equipment	25	-0.014	0.182	-0.078	-13.236	14.000	-0.945	0.894	0.037	2.509
Elec. Utilities	47	0.069	0.086	0.800	-4.701	6.664	-0.705	0.498	0.011	2.357
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	301	1.2374	0	301	.7141	16	301	.9366

Rate Group 2

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	49	0.130	0.100	1.293	1.232	7.900	0.156	0.024	0.001	2.280
Automotive	49	0.116	0.065	1.777	-0.965	5.135	-1.746*	3.048	0.061	1.936
Electronics	46	0.059	0.092	0.637	-0.616	7.235	-1.191	1.418	0.031	2.341
Forest Products	49	0.122	0.105	1.160	-2.157	8.311	-0.259	0.067	0.001	2.296
Metals/Mining	47	0.006	0.067	0.071	-1.895	7.036	-0.269	0.073	0.002	2.493
Oil Producers	47	-0.002	0.109	-0.433	-10.700	14.984	-0.715	0.511	0.011	1.602
Air Transport	16	0.105	0.178	0.591	15.418	17.424	0.805	0.703	0.053	1.256
Retail	48	0.015	0.063	0.234	-0.391	4.918	-0.080	0.006	0.000	2.059
Farm Equipment	42	-0.079	0.130	-0.604	-1.462	10.347	-0.141	0.020	0.001	2.457
Elec. Utilities	49	0.030	0.037	0.805	-0.758	2.913	-0.260	0.060	0.001	2.025
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	412	.2890	9	412	.5524	18	412	.6063

Rate Group 3

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	26	0.079	0.073	1.079	1.516	6.671	0.227	0.052	0.002	2.778
Automotive	21	0.002	0.132	0.026	-1.174	9.876	-0.119	0.014	0.001	1.920
Electronics	49	0.014	0.037	0.369	-1.073	2.880	-0.650	0.423	0.009	2.876
Forest Products	46	0.025	0.042	0.605	-0.590	3.208	-0.184	0.034	0.001	2.200
Metals/Mining	31	0.051	0.055	0.919	-1.076	4.777	-0.225	0.051	0.002	2.535
Oil Producers	27	0.071	0.054	1.317	-0.994	4.461	-0.223	0.050	0.002	2.185
Air Transport	49	0.100	0.067	1.143	5.659	6.865	0.824	0.679	0.014	2.236
Retail	49	0.048	0.047	1.013	-2.000	3.729	-0.538	0.290	0.006	2.015
Farm Equipment	29	0.247	0.122	2.027	-11.578	9.572	-1.210	1.463	0.065	1.932
Elec. Utilities	22	-0.030	0.062	-0.689	0.915	4.606	0.199	0.039	0.002	3.106
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	313	.4665	9	313	.6508	18	313	.6475

$$\text{Model: } \Delta \text{RPCNG}_i = \beta_0 + \beta_1(\text{STKLAGE}_i) + e_i$$

Rate Group 1

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	19	0.152	0.213	0.711	2.900	2.760	1.043	1.080	0.060	1.631
Automotive	42	0.222	0.153	1.450	-1.694	2.230	-0.759	0.577	0.014	2.242
Electronics	45	-0.157	0.221	-0.709	1.496	2.614	0.572	0.320	0.008	2.132
Forest Products	46	0.020	0.175	0.116	-0.320	2.056	-0.156	0.024	0.001	1.965
Metals/Mining	15	0.093	0.107	0.872	0.121	0.974	0.124	0.015	0.001	2.429
Oil Producers	45	-0.003	0.174	-0.400	-0.450	1.996	-0.226	0.051	0.001	1.881
Retail	44	-0.199	0.191	-1.041	0.405	2.212	0.183	0.034	0.001	1.736
Farm Equipment	25	-0.101	0.173	-0.584	1.100	2.794	0.422	0.170	0.000	2.392
Elec. Utilities	47	0.047	0.079	0.594	-0.302	0.944	-0.319	0.102	0.002	2.300
F-Tests:		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom., F)		0	301	.2201	0	301	.5053	16	301	.4175

Rate Group 2

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	49	0.130	0.092	1.410	0.417	1.092	0.381	0.145	0.003	2.254
Automotive	49	0.071	0.061	1.160	-0.341	0.731	-0.466	0.217	0.005	2.055
Electronics	46	0.019	0.086	0.223	-0.392	1.011	-0.380	0.151	0.003	2.363
Forest Products	49	0.123	0.096	1.202	-0.766	1.145	-0.669	0.447	0.009	2.296
Metals/Mining	47	0.001	0.077	0.010	-0.415	0.912	-0.455	0.207	0.005	2.559
Oil Producers	47	-0.123	0.175	-0.703	-0.906	2.037	-0.484	0.234	0.005	1.696
Air Transport	16	0.217	0.156	1.393	-0.490	2.442	-0.201	0.040	0.003	1.593
Retail	40	0.023	0.057	0.398	-0.674	0.605	-0.984	0.900	0.021	2.161
Farm Equipment	42	-0.046	0.113	-0.403	-2.408	1.293	-1.063*	3.469	0.000	2.565
Elec. Utilities	49	0.036	0.033	1.070	-0.591	0.394	-1.500	2.249	0.046	2.105
F-Tests:		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom., F)		9	412	.5040	9	412	.6980	10	412	.7317

Rate Group 3

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	26	0.066	0.075	0.885	0.695	1.022	0.680	0.462	0.019	2.570
Automotive	21	0.104	0.129	0.803	-1.177	1.823	-0.645	-0.417	0.022	1.943
Electronics	49	0.002	0.034	0.050	0.075	0.400	0.189	0.036	0.001	2.016
Forest Products	46	0.027	0.030	0.783	-0.241	0.454	-0.531	0.282	0.006	2.256
Metals/Mining	31	0.051	0.054	0.939	-0.196	0.751	-0.262	0.060	0.002	2.596
Oil Producers	27	0.051	0.054	0.945	0.515	0.740	0.680	0.473	0.019	2.025
Air Transport	49	0.140	0.080	1.061	-0.971	0.946	-1.027	1.054	0.022	2.430
Retail	49	0.043	0.043	0.994	-0.360	0.515	-0.714	0.510	0.011	2.006
Farm Equipment	23	0.203	0.129	1.571	-0.316	1.691	-0.187	0.035	0.002	2.047
Elec. Utilities	22	-0.033	0.041	-0.802	0.253	0.651	0.389	0.151	0.000	3.020
F-Tests:		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom., F)		9	313	.3055	9	313	.9616	10	313	.9236

$$\text{Model: } \Delta \text{RPCNG}_t = \beta_0 + \beta_1 (\text{CPILAG}_t) + e_t$$

Rate Group 1

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	19	0.329	0.359	0.917	-9.881	26.247	-0.346	0.129	0.007	1.716
Automotive	42	-0.335	0.274	-1.221	30.357	13.812	2.198*	4.838*	0.108	2.566
Electronics	45	0.182	0.440	0.413	-18.064	21.628	-0.835	0.688	0.016	2.123
Forest Products	46	-0.425	0.355	-1.197	23.596	16.754	1.408	1.984	0.043	2.084
Metals/Mining	15	-0.273	0.297	-0.919	18.479	14.099	1.311	1.718	0.117	2.883
Oil Producers	45	0.272	0.349	0.781	-20.588	17.261	-1.188	1.412	0.032	1.932
Retail	44	0.577	0.355	1.625	-43.749	17.544	-2.494**	6.218*	0.129	1.913
Farm Equipment	25	-0.168	0.422	-0.397	3.766	17.642	0.213	0.046	0.002	2.398
Elec. Utilities	47	-0.262	0.158	-1.657	16.291	7.477	2.179*	4.747*	0.095	2.599
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		8	301	2.3781	8	301	1.1488	16	301	1.5020

Rate Group 2

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	49	-0.125	0.183	-0.681	14.351	8.829	1.625	2.642	0.053	2.355
Automotive	49	-0.120	0.122	-0.988	10.174	5.894	1.726*	2.979	0.060	2.220
Electronics	46	0.163	0.177	0.924	-8.577	8.854	-0.968	0.939	0.021	2.344
Forest Products	49	-0.233	0.190	-1.228	18.832	9.136	2.061*	4.249*	0.083	2.370
Metals/Mining	47	-0.163	0.168	-1.018	9.066	8.148	1.113	1.238	0.027	2.495
Oil Producers	47	0.459	0.336	1.368	-33.451	16.338	-2.048*	4.196*	0.085	1.730
Air Transport	16	-0.149	0.288	-0.558	17.617	11.586	1.521	2.312	0.142	1.572
Retail	48	-0.307	0.106	-2.898	17.368	5.079	3.418**	11.683**	0.203	2.448
Farm Equipment	42	0.159	0.245	0.651	-14.676	12.987	-1.137	1.293	0.031	2.255
Elec. Utilities	49	-0.134	0.064	-2.082	8.732	3.092	2.824**	7.973**	0.145	2.327
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	412	3.1347 **	9	412	1.3921	18	412	2.0397 **

Rate Group 3

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	26	0.037	0.128	0.287	2.637	5.932	0.445	0.198	0.008	2.736
Automotive	21	-0.083	0.228	-0.364	8.381	10.078	0.832	0.692	0.035	1.982
Electronics	49	-0.060	0.068	-0.881	3.453	3.280	1.053	1.109	0.023	2.887
Forest Products	46	0.004	0.076	0.049	1.026	3.765	0.272	0.074	0.002	2.225
Metals/Mining	31	0.003	0.095	0.027	2.422	4.452	0.544	0.296	0.010	2.626
Oil Producers	27	0.063	0.088	0.719	0.184	4.300	0.043	0.002	0.000	2.166
Air Transport	49	-0.147	0.158	-0.932	15.286	7.612	2.008*	4.033*	0.079	2.362
Retail	49	-0.065	0.087	-0.748	5.603	4.213	1.330	1.769	0.036	2.012
Farm Equipment	23	-0.062	0.198	-0.311	18.640	11.999	1.554	2.413	0.103	2.374
Elec. Utilities	22	-0.023	0.089	-0.256	-0.386	5.618	-0.069	0.005	0.000	3.093
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	313	.8622	9	313	.3206	18	323	.9119

$$\text{Model: } \Delta \text{RPCNG}_t = \beta_0 + \beta_1(\text{GDPLAG}_t) + a_t$$

Rate Group 1

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	19	-0.201	0.416	-0.484	13.278	11.304	1.175	1.380	0.075	1.640
Automotive	42	0.293	0.205	1.432	-4.541	6.081	-0.747	0.550	0.014	2.270
Electronics	45	-0.667	0.301	-2.216	21.095	8.736	2.415*	5.831*	0.119	2.000
Forest Products	48	0.050	0.240	0.208	-1.474	7.119	-0.207	0.043	0.001	1.976
Metals/Mining	15	0.268	0.155	1.730	-8.576	5.853	-1.465	2.147	0.142	2.848
Oil Producers	45	-0.212	0.241	-0.880	5.083	7.042	0.710	0.505	0.012	1.900
Retail	44	-0.395	0.274	-1.442	7.877	7.834	1.005	1.011	0.024	1.782
Farm Equipment	25	-0.300	0.194	-1.542	11.376	6.037	1.884*	3.551	0.134	2.509
Elec. Utilities	47	0.221	0.103	2.143	-7.728	3.152	-2.452**	6.011*	0.118	2.496
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	301	1.8472	9	301	1.9367 *	16	301	1.2320

Rate Group 2

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	49	0.224	0.127	1.761	-3.662	3.799	-0.964	0.929	0.019	2.233
Automotive	49	-0.067	0.082	-0.821	5.537	2.439	2.270*	5.152*	0.099	1.669
Electronics	46	0.019	0.134	0.139	-0.234	4.054	-0.058	0.003	0.000	2.330
Forest Products	49	0.391	0.123	3.191	-11.718	3.853	-3.208**	10.290**	0.180	1.858
Metals/Mining	47	0.205	0.113	1.813	-8.315	3.465	-2.400*	5.758*	0.113	2.617
Oil Producers	47	-0.566	0.229	-2.473	17.394	6.701	2.596**	6.738*	0.130	1.513
Air Transport	16	0.408	0.144	2.823	-8.869	3.583	-2.478*	6.129*	0.305	0.790
Retail	48	0.124	0.077	1.617	-4.831	2.358	-2.049*	4.198*	0.084	1.978
Farm Equipment	42	0.012	0.185	0.066	-3.705	5.404	-0.686	0.470	0.012	2.427
Elec. Utilities	49	0.045	0.047	0.957	-0.822	1.409	-0.583	0.340	0.007	2.083
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	412	4.6892 **	9	412	4.2759 **	18	412	2.8666 **

Rate Group 3

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	26	0.052	0.100	0.519	1.156	2.538	0.455	0.207	0.009	2.683
Automotive	21	0.126	0.168	0.747	-1.830	4.316	-0.424	0.180	0.009	1.943
Electronics	49	0.086	0.047	0.135	-0.141	1.403	-0.100	0.010	0.000	2.835
Forest Products	46	0.033	0.054	0.611	-0.448	1.566	-0.286	0.082	0.002	2.218
Metals/Mining	31	-0.024	0.071	-0.335	2.622	1.919	1.366	1.867	0.061	2.349
Oil Producers	27	0.032	0.073	0.446	1.162	1.835	0.634	0.401	0.016	2.207
Air Transport	49	0.277	0.108	2.555	-6.085	3.234	-1.882*	3.541	0.070	2.205
Retail	49	0.044	0.061	0.722	-0.304	1.814	-0.167	0.028	0.001	2.019
Farm Equipment	23	0.338	0.243	1.391	-4.645	6.850	-0.678	0.460	0.021	2.055
Elec. Utilities	22	0.011	0.058	0.181	-1.951	2.206	-0.884	0.782	0.038	3.061
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	313	1.0928	9	313	1.4892	18	313	.9953

$$\text{Model: } \Delta \text{RPCMG}_i = \beta_0 + \beta_1 (\text{LNGCMG}_i) + e_i$$

Rate Group 1

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	19	0.105	0.200	0.889	-2.144	2.488	-0.862	0.743	0.042	2.003
Automotive	42	0.186	0.147	1.268	-0.093	1.792	-0.052	0.003	0.000	2.240
Electronics	45	-0.122	0.219	-0.557	-1.069	2.483	-0.753	0.567	0.013	2.232
Forest Products	46	0.011	0.173	0.063	0.403	2.017	0.200	0.040	0.001	1.970
Metals/Mining	15	0.112	0.108	1.032	-0.907	1.416	-0.697	0.486	0.036	2.514
Oil Producers	45	-0.075	0.170	-0.441	-1.671	1.914	-0.873	0.762	0.017	1.931
Retail	44	-0.174	0.189	-0.924	-1.567	2.124	-0.738	0.545	0.013	1.888
Farm Equipment	25	-0.126	0.169	-0.744	2.130	1.949	1.093	1.195	0.049	2.399
Elec. Utilities	47	0.052	0.079	0.665	-0.653	0.942	-0.693	0.480	0.011	2.292
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		8	310	.3598	8	310	.5437	16	310	.4737

Rate Group 2

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	49	0.156	0.087	1.786	-1.952	1.022	-1.911*	3.850	0.072	2.104
Automotive	49	0.058	0.060	0.969	0.735	0.762	1.047	1.097	0.023	1.976
Electronics	46	0.053	0.076	0.691	-3.152	0.930	-3.388**	11.481**	0.207	2.422
Forest Products	49	0.147	0.084	1.752	-3.666	0.979	-3.747**	14.037**	0.230	1.890
Metals/Mining	47	0.020	0.072	0.279	-2.244	0.910	-2.466**	6.083*	0.119	2.195
Oil Producers	47	-0.129	0.171	-0.754	-1.787	2.009	-0.889	0.791	0.017	1.738
Air Transport	16	0.178	0.108	1.652	-3.521	1.084	-3.249**	10.559**	0.430	0.881
Retail	48	0.026	0.056	0.469	-1.055	0.661	-1.595	2.544	0.052	1.715
Farm Equipment	42	-0.098	0.114	-0.857	1.585	1.407	1.126	1.269	0.031	2.428
Elec. Utilities	49	0.025	0.033	0.744	0.067	0.391	0.172	0.030	0.001	2.037
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	422	2.5702 **	9	422	1.0892	18	422	1.7889 *

Rate Group 3

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	26	0.084	0.070	1.199	0.064	0.705	0.091	0.008	0.000	2.735
Automotive	21	0.101	0.124	0.812	-1.131	1.241	-0.911	0.830	0.042	1.768
Electronics	49	0.002	0.033	0.053	0.126	0.307	0.325	0.106	0.002	2.837
Forest Products	46	0.026	0.037	0.699	-0.509	0.423	-1.204	1.449	0.032	2.191
Metals/Mining	31	0.044	0.051	0.874	0.351	0.544	0.645	0.416	0.014	2.548
Oil Producers	27	0.068	0.046	1.468	-0.925	0.469	-1.972*	3.890	0.135	2.288
Air Transport	49	0.157	0.073	2.158	-2.554	0.849	-3.008**	9.050**	0.162	2.153
Retail	49	0.044	0.042	1.042	-0.711	0.491	-1.449	2.099	0.043	1.958
Farm Equipment	23	0.190	0.117	1.628	-0.797	1.381	-0.577	0.333	0.016	1.955
Elec. Utilities	22	-0.027	0.040	-0.680	0.135	0.632	0.214	0.046	0.002	3.150
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	323	1.7685	9	323	1.1157	18	323	1.3681

$$\text{Model: } \Delta \text{RPCHG} = \beta_0 + \beta_1 (\text{CFCHG}_t) + e_t$$

Rate Group 1

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	19	0.271	0.223	1.220	-2.622	5.111	-0.513	0.263	0.015	1.720
Automotive	42	0.245	0.147	1.665	-5.695	3.664	-1.554	2.416	0.057	2.301
Electronics	45	-0.128	0.224	-0.573	-0.985	4.818	-0.204	0.042	0.001	2.144
Forest Products	48	-0.001	0.173	-0.004	2.332	3.740	0.624	0.389	0.009	1.923
Metals/Mining	15	0.093	0.108	0.859	0.063	2.046	0.031	0.001	0.000	2.484
Oil Producers	45	-0.085	0.177	-0.482	-0.467	4.053	-0.115	0.013	0.000	1.867
Retail	44	-0.241	0.184	-1.312	6.830	3.888	1.766*	3.119	0.069	1.742
Farm Equipment	25	-0.085	0.169	-0.504	-1.000	4.082	-0.245	0.060	0.003	2.420
Elec. Utilities	47	0.060	0.078	0.769	-2.117	1.688	-1.254	1.572	0.034	2.381
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	310	0.0774	0	310	.0335	16	310	.7504

Rate Group 2

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	49	0.188	0.081	2.317	-6.399	1.786	-3.583**	12.838**	0.215	2.273
Automotive	49	0.081	0.060	1.348	-1.915	1.321	-1.450	2.104	0.043	2.178
Electronics	46	0.028	0.088	0.320	-1.288	2.047	-0.630	0.396	0.009	2.336
Forest Products	49	0.161	0.087	1.857	-6.320	1.908	-3.313**	10.975**	0.189	2.199
Metals/Mining	47	0.024	0.076	0.315	-2.863	1.759	-1.628	2.649	0.056	2.468
Oil Producers	47	-0.116	0.174	-0.664	-2.616	3.826	-0.684	0.468	0.010	1.641
Air Transport	16	0.259	0.094	2.760	-10.754	2.479	-4.337**	18.813**	0.573	2.380
Retail	48	0.050	0.049	1.018	-4.363	1.081	-4.035**	16.278**	0.261	2.071
Farm Equipment	42	-0.071	0.119	-0.601	-1.485	2.635	-0.564	0.318	0.008	2.449
Elec. Utilities	49	0.033	0.033	0.994	-0.927	0.730	-1.270	1.613	0.033	2.092
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	422	1.3473	9	422	1.2101	18	422	1.1448

Rate Group 3

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	26	0.085	0.070	1.211	-0.407	1.645	-0.247	0.061	0.003	2.726
Automotive	21	0.081	0.124	0.655	-1.084	2.540	-0.427	0.182	0.010	1.952
Electronics	49	0.012	0.033	0.354	-1.073	0.720	-1.490	2.219	0.045	2.944
Forest Products	46	0.028	0.037	0.757	-0.882	0.888	-1.002	1.084	0.022	2.240
Metals/Mining	31	0.050	0.052	0.967	-0.584	1.228	-0.475	0.226	0.008	2.614
Oil Producers	27	0.083	0.045	1.838	-2.474	1.089	-2.452**	6.014*	0.194	2.086
Air Transport	49	0.164	0.075	2.183	-4.183	1.657	-2.477**	6.133*	0.115	2.386
Retail	49	0.043	0.043	0.987	-0.788	0.946	-0.813	0.661	0.014	2.056
Farm Equipment	23	0.261	0.115	2.264	-4.994	2.754	-1.813*	3.287	0.135	2.416
Elec. Utilities	22	-0.033	0.048	-0.682	0.292	1.676	0.174	0.038	0.002	3.086
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	323	1.2234	9	323	1.4179	18	323	1.0949

$$\text{Model: } \Delta \text{RPCNG}_i = \beta_0 + \beta_1 (\text{NOOCH}_i) + e_i$$

Rate Group 1

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	19	0.215	0.210	1.022	0.040	2.567	0.327	0.107	0.006	1.660
Automotive	42	0.100	0.147	1.276	-0.221	1.569	-0.141	0.020	0.001	2.259
Electronics	45	-0.152	0.219	-0.696	1.307	1.765	0.741	0.540	0.013	2.090
Forest Products	48	0.012	0.172	0.069	0.317	1.366	0.232	0.054	0.001	1.951
Metals/Mining	15	0.074	0.102	0.727	0.009	0.617	1.311	1.710	0.117	2.414
Oil Producers	45	-0.079	0.171	-0.461	-0.093	1.361	-0.656	0.431	0.010	1.907
Retail	44	-0.200	0.190	-1.092	0.716	1.462	0.483	0.233	0.006	1.710
Farm Equipment	25	-0.004	0.160	-0.494	0.345	1.631	0.212	0.045	0.002	2.379
Elec. Utilities	47	0.042	0.070	0.539	0.007	0.619	0.012	0.000	0.000	2.361
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	310	.2322	0	310	.6251	16	310	.4252

Rate Group 2

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	49	0.146	0.090	1.631	-0.736	0.723	-1.019	1.039	0.022	2.297
Automotive	49	0.059	0.060	0.980	0.537	0.403	1.112	1.236	0.026	1.922
Electronics	46	0.010	0.085	0.122	0.179	0.710	0.253	0.064	0.001	2.329
Forest Products	49	0.117	0.095	1.239	-0.554	0.764	-0.726	0.527	0.011	2.234
Metals/Mining	47	-0.007	0.076	-0.091	0.126	0.670	0.189	0.036	0.001	2.479
Oil Producers	47	-0.154	0.170	-0.906	1.325	1.363	0.972	0.945	0.021	1.609
Air Transport	16	0.050	0.124	0.403	-5.324	1.005	-2.950**	0.705**	0.303	1.107
Retail	40	0.016	0.057	0.270	-0.271	0.453	-0.600	0.360	0.000	2.044
Farm Equipment	42	-0.110	0.113	-0.972	1.562	0.944	1.654	2.737	0.064	2.349
Elec. Utilities	49	0.026	0.033	0.789	-0.063	0.260	-0.234	0.055	0.001	2.010
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	422	1.4694	9	422	.9656	10	422	1.2199

Rate Group 3

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	26	0.070	0.067	1.045	1.032	0.590	1.750*	3.062	0.113	2.470
Automotive	21	0.006	0.126	0.062	-0.347	1.011	-0.343	0.110	0.006	1.945
Electronics	49	0.003	0.033	0.091	-0.002	0.267	-0.007	0.000	0.000	2.838
Forest Products	46	0.024	0.037	0.666	-0.304	0.327	-1.177	1.306	0.031	2.302
Metals/Mining	31	0.030	0.050	0.763	0.653	0.431	1.514	2.292	0.073	2.275
Oil Producers	27	0.063	0.050	1.252	0.171	0.454	0.377	0.142	0.006	2.076
Air Transport	49	0.136	0.079	1.717	-0.332	0.637	-0.521	0.271	0.006	2.302
Retail	49	0.039	0.043	0.913	-0.100	0.344	-0.522	0.273	0.006	2.024
Farm Equipment	23	0.100	0.122	1.473	0.393	1.122	0.350	0.122	0.006	1.951
Elec. Utilities	22	-0.032	0.040	-0.800	-0.509	1.012	-0.503	0.253	0.013	3.159
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	323	.6659	9	323	.8450	10	323	.7000

$$\text{Model: } \Delta \text{RPCHG}_i = B_0 + B_1 (\text{ENPCHG}_i) + e_i$$

Rate Group 1

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	19	0.220	0.207	1.100	0.207	3.506	0.058	0.003	0.000	1.705
Automotive	42	0.194	0.142	1.362	3.907	2.509	1.557	2.424	0.057	2.245
Electronics	45	-0.151	0.222	-0.682	1.290	3.066	0.423	0.179	0.004	2.156
Forest Products	46	0.020	0.175	0.116	-0.391	2.446	-0.160	0.026	0.001	1.955
Metals/Mining	15	0.005	0.111	0.760	0.349	1.267	0.275	0.076	0.006	2.530
Oil Producers	45	-0.100	0.171	-0.582	1.140	2.307	0.477	0.220	0.005	1.856
Retail	44	-0.165	0.180	-0.901	-2.776	2.582	-1.083	1.174	0.027	1.720
Farm Equipment	25	-0.111	0.173	-0.639	1.775	2.091	0.614	0.377	0.016	2.475
Elec. Utilities	47	0.031	0.078	0.398	1.102	1.099	1.002	1.005	0.022	2.330
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	310	.5170	0	310	.6134	16	310	.5761

Rate Group 2

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	49	0.106	0.006	1.240	2.985	1.232	2.423**	5.069*	0.111	2.382
Automotive	49	0.049	0.059	0.835	1.626	0.843	1.930*	3.725	0.073	2.260
Electronics	46	0.000	0.003	0.000	1.833	1.205	1.427	2.035	0.044	2.956
Forest Products	49	0.070	0.007	0.810	3.927	1.249	3.145**	9.091**	0.174	2.175
Metals/Mining	47	-0.012	0.076	-0.163	1.064	1.174	0.907	0.822	0.018	2.541
Oil Producers	47	-0.149	0.173	-0.864	0.046	2.433	0.348	0.121	0.003	1.660
Air Transport	16	0.140	0.100	1.200	0.060	1.807	3.359**	11.204**	0.446	2.510
Retail	48	-0.011	0.051	-0.223	2.524	0.723	3.489**	12.171**	0.209	2.228
Farm Equipment	42	-0.095	0.116	-0.815	0.943	1.726	0.546	0.298	0.007	2.523
Elec. Utilities	49	0.021	0.033	0.629	0.457	0.477	0.950	0.910	0.019	2.109
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	422	.9660	9	422	.7503	18	422	.9699

Rate Group 3

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	26	0.095	0.074	1.292	-0.591	1.239	-0.477	0.227	0.009	2.752
Automotive	21	0.052	0.124	0.424	1.662	1.721	0.965	0.932	0.047	1.839
Electronics	49	-0.004	0.033	-0.110	0.640	0.468	1.385	1.917	0.039	3.010
Forest Products	46	0.019	0.037	0.513	0.411	0.533	0.771	0.594	0.013	2.203
Metals/Mining	31	0.047	0.052	0.900	-0.060	0.839	-0.071	0.005	0.000	2.550
Oil Producers	27	0.050	0.049	1.166	0.012	0.764	1.063	1.131	0.043	2.251
Air Transport	49	0.110	0.077	1.437	2.090	1.101	1.899*	3.606	0.071	2.430
Retail	49	0.030	0.043	0.715	0.614	0.611	1.004	1.008	0.021	2.085
Farm Equipment	23	0.196	0.111	1.770	3.297	2.060	1.594	2.541	0.100	2.001
Elec. Utilities	22	-0.050	0.043	-1.352	-1.642	1.168	-1.406	1.976	0.090	3.014
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	323	1.1070	9	323	.9400	18	323	1.0100

$$\text{Model: } \Delta \text{RPCNG}_i = \beta_0 + \beta_1 (\text{LICHG}_i) + e_i$$

Rate Group 1

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	19	0.212	0.232	0.912	1.389	9.452	0.147	0.022	0.001	1.701
Automotive	42	0.297	0.151	1.964	-11.971	6.160	-1.943*	3.776**	0.086	2.585
Electronics	45	-0.142	0.226	-0.627	0.607	7.504	0.081	0.007	0.000	2.138
Forest Products	46	0.036	0.175	0.205	-3.321	5.914	-0.562	0.315	0.007	1.968
Metals/Mining	15	0.120	0.101	1.185	-3.900	2.749	-1.419	2.012*	0.134	2.973
Oil Producers	45	-0.003	0.170	-0.018	-11.033	5.646	-1.954*	3.618**	0.082	1.803
Retail	44	-0.224	0.195	-1.149	3.743	6.412	0.584	0.341	0.008	1.737
Farm Equipment	25	-0.083	0.170	-0.487	-1.001	7.597	-0.132	0.017	0.001	2.396
Elec. Utilities	47	0.059	0.079	0.754	-2.682	2.682	-1.000	0.999	0.022	2.420
F-Tests: Identical Intercepts? Identical Slopes? Slopes and Intercepts?										
(df Numer., df Denom, F)	8	310	.7484	8	310	.8172	16	310	.6956	

Rate Group 2

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	49	0.182	0.088	2.060	-6.630	3.047	-2.176*	4.734*	0.092	2.370
Automotive	49	0.101	0.058	1.735	-5.175	2.004	-2.582**	6.669*	0.124	2.449
Electronics	46	0.048	0.085	0.566	-4.680	2.917	-1.604	2.574	0.055	2.344
Forest Products	49	0.161	0.092	1.743	-7.484	3.183	-2.326*	5.411*	0.103	2.204
Metals/Mining	47	0.027	0.076	0.351	-4.946	2.778	-1.788*	3.170	0.066	2.582
Oil Producers	47	-0.126	0.177	-0.714	-1.943	6.046	-0.321	0.103	0.002	1.638
Air Transport	16	0.195	0.128	1.525	-12.841	6.971	-1.842*	3.393	0.195	1.636
Retail	48	0.054	0.051	1.051	-6.225	1.762	-3.533**	12.482**	0.213	2.322
Farm Equipment	42	-0.074	0.120	-0.623	-1.739	4.262	-0.408	0.166	0.004	2.482
Elec. Utilities	49	0.047	0.032	1.482	-3.186	1.088	-2.856**	8.156**	0.148	2.459
F-Tests: Identical Intercepts? Identical Slopes? Slopes and Intercepts?										
(df Numer., df Denom, F)	9	422	.4396	9	422	1.0937	18	422	.6759	

Rate Group 3

Industry Group	N	B0	SE0	T0	B1	SE1	T1	F	R2	DW
Aerospace	26	0.096	0.070	1.372	-2.465	2.599	-0.948	0.899	0.000	2.782
Automotive	21	0.111	0.121	0.911	-5.331	4.111	-1.297	1.682	0.081	2.006
Electronics	49	0.024	0.031	0.779	-3.122	1.077	-2.900**	8.409**	0.152	3.038
Forest Products	46	0.057	0.036	1.576	-3.748	1.281	-2.927**	8.566**	0.163	2.457
Metals/Mining	31	0.060	0.050	1.200	-2.880	1.916	-1.503	2.260	0.072	2.795
Oil Producers	27	0.089	0.049	1.830	-3.178	1.802	-1.764*	3.110	0.111	2.299
Air Transport	49	0.176	0.076	2.302	-6.472	2.630	-2.461**	6.054*	0.114	2.562
Retail	49	0.064	0.040	1.597	-4.059	1.391	-2.918**	8.513**	0.153	2.326
Farm Equipment	23	0.302	0.124	2.433	-8.423	4.685	-1.829*	3.346	0.137	2.484
Elec. Utilities	22	-0.022	0.051	-0.443	-0.627	3.401	-0.184	0.034	0.002	3.118
F-Tests: Identical Intercepts? Identical Slopes? Slopes and Intercepts?										
(df Numer., df Denom, F)	9	323	.5951	9	323	1.4707	18	323	.8492	

$$\text{Model: } \Delta \text{RPCMG}_i = \beta_0 + \beta_1 (\text{RS2CMG}_i) + e_i$$

Rate Group 1

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	19	0.204	0.299	0.682	1.096	17.457	0.109	0.012	0.001	1.600
Automotive	42	0.303	0.156	1.951	-10.500	10.335	-1.790*	3.204	0.074	2.440
Electronics	45	-0.143	0.237	-0.604	0.954	14.980	0.064	0.004	0.000	2.140
Forest Products	46	0.110	0.179	0.613	-17.510	11.540	-1.510	2.299	0.050	2.027
Metals/Mining	15	0.136	0.114	1.101	-6.290	7.011	-0.897	0.005	0.050	3.037
Oil Producers	45	-0.052	0.101	-0.208	-7.001	11.523	-0.615	0.370	0.009	1.021
Retail	44	-0.293	0.180	-1.401	17.100	12.342	1.302	1.937	0.044	1.040
Farm Equipment	25	-0.071	0.171	-0.419	-7.037	13.720	-0.513	0.263	0.011	2.476
Elec. Utilities	47	0.077	0.001	0.951	-6.003	5.235	-1.319	1.739	0.037	2.505
F-Tests:		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	310	.9303	0	310	.9043	16	310	.0014

Rate Group 2

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	49	0.160	0.095	1.771	-6.041	6.211	-0.973	0.946	0.020	2.369
Automotive	49	0.110	0.060	1.973	-10.261	3.926	-2.613**	6.029*	0.127	2.391
Electronics	46	0.033	0.092	0.362	-3.415	5.902	-0.579	0.335	0.000	2.307
Forest Products	49	0.100	0.090	1.029	-0.705	6.442	-1.507	2.270	0.046	2.310
Metals/Mining	47	0.000	0.001	0.095	-2.400	5.283	-0.471	0.222	0.005	2.493
Oil Producers	47	-0.102	0.102	-1.000	7.557	11.724	0.645	0.416	0.009	1.603
Air Transport	16	0.199	0.142	1.401	-5.660	11.220	-0.504	0.254	0.010	1.657
Retail	40	0.053	0.057	0.940	-0.293	3.719	-2.230*	4.973*	0.090	2.249
Farm Equipment	42	-0.050	0.120	-0.456	-4.240	0.100	-0.510	0.260	0.007	2.410
Elec. Utilities	49	0.002	0.031	1.909	-7.206	2.059	-3.499**	12.246**	0.207	2.701
F-Tests:		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	422	.6403	0	422	1.2214	10	422	.7640

Rate Group 3

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	26	0.110	0.072	1.537	-5.134	4.321	-1.180	1.412	0.056	2.743
Automotive	21	0.119	0.124	0.963	-9.056	7.336	-1.234	1.524	0.074	1.895
Electronics	49	0.023	0.034	0.680	-3.900	2.222	-1.759*	3.094	0.062	2.921
Forest Products	46	0.050	0.039	1.405	-5.594	2.597	-2.154*	4.641*	0.095	2.196
Metals/Mining	31	0.060	0.051	1.341	-5.352	3.191	-1.677	2.013	0.000	2.620
Oil Producers	27	0.003	0.054	1.552	-2.619	3.200	-0.797	0.634	0.025	2.119
Air Transport	49	0.151	0.003	1.012	-3.700	5.456	-0.604	0.402	0.010	2.404
Retail	49	0.060	0.044	1.359	-4.533	2.092	-1.567	2.456	0.050	2.100
Farm Equipment	23	0.360	0.142	2.536	-16.092	0.770	-1.033*	3.361	0.130	2.171
Elec. Utilities	22	-0.021	0.050	-0.423	-0.950	4.297	-0.221	0.049	0.002	3.144
F-Tests:		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	323	.5314	0	323	1.3900	10	323	.7956

$$\text{Model: } \Delta \text{RPCNS}_t = \beta_0 + \beta_1 (\text{BILLCH}_t) + \epsilon_t$$

Rate Group 1

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	19	0.233	0.214	1.090	0.176	1.664	0.106	0.011	0.001	1.693
Automotive	42	0.175	0.146	1.197	0.516	0.779	0.663	0.440	0.011	2.256
Electronics	45	-0.130	0.220	-0.620	0.200	1.301	0.160	0.026	0.001	2.117
Forest Products	46	0.013	0.172	0.077	0.430	1.006	0.427	0.103	0.004	1.900
Metals/Mining	15	0.100	0.104	0.966	0.707	0.827	0.952	0.906	0.065	2.506
Oil Producers	45	-0.077	0.160	-0.450	-1.133	0.902	-1.256	1.570	0.035	1.999
Retail	44	-0.194	0.189	-1.027	0.072	1.007	0.071	0.005	0.000	1.731
Farm Equipment	25	-0.003	0.173	-0.002	-0.036	0.743	-0.049	0.002	0.000	2.377
Elec. Utilities	47	0.045	0.070	0.570	-0.100	0.420	-0.301	0.146	0.003	2.335
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		0	310	.3175	0	310	.5002	16	310	.4660

Rate Group 2

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	49	0.149	0.008	1.699	-0.004	0.402	-1.670 ^a	2.709	0.056	2.270
Automotive	49	0.055	0.050	0.954	0.651	0.310	2.045 ^a	4.103 ^a	0.002	1.027
Electronics	46	0.029	0.002	0.360	-1.101	0.540	-2.010 ^a	4.041 ^a	0.004	2.445
Forest Products	49	0.135	0.005	1.500	-1.576	0.460	-3.369 ^a	11.340 ^a	0.195	1.955
Metals/Mining	47	0.006	0.075	0.075	-0.627	0.496	-1.264	1.590	0.034	2.540
Oil Producers	47	-0.133	0.171	-0.775	-0.610	0.921	-0.663	0.439	0.010	1.747
Air Transport	16	0.214	0.106	2.010	-1.024	0.542	-3.367 ^a	11.338 ^a	0.440	1.274
Retail	40	0.021	0.055	0.371	-0.464	0.301	-1.541	2.375	0.049	1.905
Farm Equipment	42	-0.009	0.116	-0.772	0.337	0.751	0.449	0.202	0.005	2.364
Elec. Utilities	49	0.023	0.033	0.689	0.100	0.101	0.994	0.900	0.021	2.046
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	422	2.0409 *	9	422	1.0550	10	422	1.5203

Rate Group 3

Industry Group	N	β_0	SE0	T0	β_1	SE1	T1	F	R2	DW
Aerospace	26	0.000	0.069	1.105	0.345	0.304	1.134	1.205	0.051	2.601
Automotive	21	0.060	0.125	0.534	0.276	0.514	0.537	0.200	0.015	1.900
Electronics	49	0.002	0.033	0.060	0.065	0.101	0.350	0.120	0.003	2.024
Forest Products	46	0.020	0.037	0.547	0.105	0.199	0.530	0.201	0.006	2.193
Metals/Mining	31	0.040	0.049	0.816	0.366	0.230	1.530	2.367	0.076	2.356
Oil Producers	27	0.067	0.050	1.339	-0.037	0.225	-0.163	0.027	0.001	2.107
Air Transport	49	0.143	0.077	1.060	-0.721	0.420	-1.715 ^a	2.943	0.059	2.343
Retail	49	0.037	0.043	0.856	0.007	0.234	0.030	0.001	0.000	2.015
Farm Equipment	23	0.106	0.116	1.006	0.465	0.590	0.700	0.600	0.020	1.995
Elec. Utilities	22	-0.022	0.039	-0.552	-0.371	0.377	-0.904	0.069	0.046	2.793
F-Tests:										
		Identical Intercepts?			Identical Slopes?			Slopes and Intercepts?		
(df Numer., df Denom, F)		9	323	1.2300	9	323	.9423	10	323	1.0044

APPENDIX D

APPENDIX D

Review of Classical Studies of Bond Yields
and Yield Spreads

HICKMAN (1958):

The first empirical work relating corporate bond yields to measures representing default risk was carried out by Hickman. The study was based on data for three broad industry groups (industrials, utilities, and railroads) over the period 1900 to 1943.

While the scope of this study was much more comprehensive than any previous work, its usefulness was somewhat limited due to the methodology employed. Rather than seeking to derive an explanatory model relating yields or risk premiums to default risk factors, the study took a simple two-dimensional approach and examined one factor at a time, showing how yields had actually varied in the past as an individual that factor changed.

Hickman related promised yields and default rates to default risk (using Moody's bond ratings as a proxy for default risk). As expected, he found that lower ratings were positively associated with promised yield at time of offering. He also found that among large issues there was

a positive association between actual default rate and lower ratings at time of issue for all three issuer categories. However, ratings at the time of issue were not nearly as good at ranking small issues with respect to future default rates.

Hickman also employed a number of popular financial ratios (using five-year averages) as proxies for default risk, relating them individually to promised yields at issue. In general, the results showed an inverse relationship between promised yield and firm size (proxied by the book value of assets), and between promised yield and issue size. Also, the evidence supported the usefulness of Moody's ratings for ranking bonds of large firms in terms of their relative default risk.

FISHER (1959):

This paper is the seminal work in the area of the microeconomic determinants of bond risk premia. Fisher hypothesized a relationship between the average risk premium on a firm's bonds and two classes of micro factors; one providing information concerning risk of default and the other providing information concerning the marketability of the bonds.

A hypothesized relationship between risk premia and lenders' estimates of risk of default was not a new idea, and Fisher cites authors who made reference to this concept as early as 1830.¹ However, Fisher was the first to attempt to formulate a testable hypothesis employing objectively determinable factors as independent variables.

The choice of particular factors to include in the model was based on practical, as well as theoretical, considerations. Fisher suggested three types of factors that would be plausible indicators of default risk: measures of earnings variability, measures of past reliability in meeting debt obligations, and measures which reflect the firm's capital structure.

Earnings variability should be associated with default risk if the assumption is made that a series of observations of a firm's annual earnings constitutes a random sample from a normally distributed population of potential

annual earnings. Under this assumption, the coefficient of variation of this series would be an estimate of the coefficient of variation of the underlying population. It would be expected that a higher coefficient of variation would be associated with a higher probability of default, other things equal, since higher variability of earnings would imply a higher probability of lower-than-expected earnings and inability to meet fixed charge obligations.

If the coefficient of variation estimated from historical earnings is a gross understatement of the true coefficient, then the estimate of default risk will be much too low. However, the longer the firm has been in operation without default, the lower the likelihood of such an understatement. Therefore, the firm's past reliability in meeting its fixed charge obligations provides a correction factor for the primary estimate of default risk -- the variability of earnings.

The variability of a firm's earnings, as measured by the coefficient of variation of earnings, assumes that the earnings fluctuate randomly about a stationary mean. However, earnings variability can result from shifts in the underlying mean as well. Since the market value of an asset is based on investors' expectations regarding the asset's future earning power, a change in the mean of the distribution of expected earnings should be reflected in a change in the market value of the equity. Thus, capital

structure (in market value) provides a correction factor for shifts in the mean of the expected earnings distribution. In addition, capital structure provides important information regarding how far the value of assets can decline before the firm becomes insolvent.

Fisher defined variability of earnings as the standard deviation of after-tax earnings, using annual data over the preceding nine-year period, over the average earnings for the firm over the same period. He noted that the use of this definition requires the assumption that investors expect the future average annual earnings to equal the average annual earnings in the past nine years. Since this assumption will not hold for many firms, Fisher also included an alternate definition of this variable. The alternate definition used the market value of the equity at the end of the sample period as the denominator instead of the arithmetic average of past earnings since the market value of equity is the expected value of the firm's future earnings, and thus may provide a better scaling factor than the simple nine-year average.

As a proxy for reliability in meeting fixed obligations, Fisher used the length of time since the firm was founded, emerged from bankruptcy, or was party to a compromise in which the creditors settled for less than 100 percent of their legal claims. Capital structure was

represented by the ratio of the market value of the firm's equity to the par value of its debt.

The hypothesized relationship between risk premiums and the marketability of the firm's bonds was predicated on the possibility of imperfections in the market for some bonds.² Such imperfections would cause the price and yield to be uncertain at any point in time, and consequently, bondholders would require compensation for this additional uncertainty. It would be expected that the greater the frequency with which a bond issue trades, the greater the marketability of that issue and the less likely any price imperfections would be present.

Following this reasoning, Fisher used the total market value of the firm's bonds outstanding as a proxy for the marketability of a bond issue. It would be expected that larger (smaller) outstanding volumes would be associated with more (less) frequent trades, and thus less (more) uncertainty in the price at any moment in time, other things equal. Therefore, it would be expected that the market value of outstanding bonds would be inversely related to bond risk premiums, other things equal.

As an alternate definition of marketability, Fisher also used the market value of equity. This definition was based on the reasoning that equity value may be a more efficient measure of firm size than debt value, especially for small firms.

The general hypothesis which Fisher tested can be represented as:

$$RP_t = f(EV_t, REL_t, CS_t, MKT_t)$$

where:

RP_t = the risk premium on the firm's bonds at time t , defined as the difference between the market yield to maturity on a risky bond and the yield on a riskless bond with an term to maturity.

EV_t = the variability of earnings proxied by the coefficient of variation of the firm's annual after-tax earnings over a nine-year period.

REL_t = the firm's reliability in meeting fixed charge obligations, proxied by the length of solvent operation.

CS_t = capital structure, proxied by the ratio of the market value of equity to the par value of debt.

MKT_t = marketability of the firm's bonds, proxied by the market value of the outstanding bonds.

This hypothesis was tested using cross sectional data at five points in time: 12/31/27, 12/31/32, 12/31/37, 12/31/49, and 12/31/53. Parameters were estimated for the following regression equation:

$$\text{Log}(\text{RP}_t) = b_0 + b_1\text{Log}(\text{EV}_t) + b_2\text{Log}(\text{REL}_t) + \\ b_3\text{Log}(\text{CS}_t) + b_4\text{Log}(\text{MKT}_t)$$

The results supported the conclusion that "the partial elasticities of the risk premium with respect to the coefficient of variation of earnings, period of solvency, equity/debt ratio, and market value of publicly traded bonds outstanding are significantly different from zero and are relatively stable over time for domestic industrial corporations".³

COHAN (1967):

The Cohan study is similar to the Fisher study in that it employed regression analysis to estimate explicit parameters for a model that related changes in promised yields to specific factors representing risk of default and other characteristics. Cohan used a dependent variable defined as the promised yield to maturity at the commitment date. The data sample was composed of bonds that were newly issued and directly placed during the period 1/1/51 to 12/31/61, divided into cross-sectional batches (44 batches of industrial bonds, 22 batches of utility bonds, and 4 batches of finance company bonds).

Independent variables were divided into four groups, representing what the author considered to be the primary differentiating aspects of every bond. The group categories were:

- 1) The Promise: details of the repayment schedule and the rate of interest. Variables included average term, term to maturity, original size of the issue, and average size of the issue.
- 2) Quality of the Promise: a measure of the likelihood that the promise will be fulfilled as stated. Selected variables included the Times-Interest-Earned ratio,

the coefficient of variation of EBIT, and the growth rate of EBIT.

- 3) **Security Behind the Promise:** How would a recession affect the loan, and what are the lender's avenues of recourse in the event of a default? Variables included the ratio of working capital to long-term debt, the ratio of long-term debt to total capital, and the type of lien involved.
- 4) **Auxiliary Terms:** provisions or covenants not designed to improve the quality of the promise. The only variable included in this category was years of call protection.

The study also included a group of variables which a sample of lenders, when polled, indicated had a significant effect on their lending decisions. These variables were company size, the ratio of EBIT to sales, and type of industry of the issuer

The twenty variables described above (some as log transformations) were regressed on the log of the promised yield to maturity. For the industrial and the utility issuer categories, the following variables showed estimated coefficients that were significantly different from zero: Total Capital, Average Term, Total Interest, Type of Security, Industry Category, Years of Call Protection, Size of Issue, EBIT, Term to Maturity, and Debt to Total Capital.

Whereas the Fisher study had found earnings variability to be a highly significant explanatory variable with respect to industrial bond yields, this result was not supported in the Cohan results.

SILVERS (1973):

Silvers pointed out that there are some inherent problems involved with the use of the nominal yield spread between government and corporate bonds as a measure of the corporate risk premium. In such a context, the yield spread is an attempt to combine the contributions of many different factors into one representative measure. If this measure is then used as an indicator of risk, the implication is that the source and timing of the risk factors, which are not constant over time, are irrelevant to the investor. It also implies that the relationship between the yield spread and the risk factors is stable over the entire business cycle and the associated variations in the basic term structure.

In an attempt to reduce the impact of these problems, Silvers proposed an alternative to the use of the traditional yield spread as the independent variable in risk factor regressions. He noted that the market price of a bond is objectively observable, and in equilibrium should be a function of the risk-adjusted discounted present value of future cash flows, with possible additional (downward) price adjustments for such factors as Fisher's marketability risk, call risk, and various tax effects.

The market price therefore reflects the traditional yield to maturity in the following manner:

$$(i) \quad P_t = \sum_{t=0}^T \frac{C_t}{(1+Y_T)_t} + \frac{100}{(1+Y_T)^T}$$

where P_t = Current market price on a coupon bond with (T) payments to maturity.

C_t = Coupon payment at time (t).

Y_T = Yield to maturity.

Traditional studies, such as the Fisher study, examine the yield spread between riskless bonds and risky bonds under the assumption that a change in relative risk is reflected in a proportional change in the yield spread. That is, if the default risk of a bond is constant, then the spread between its yield and the yield of the riskless proxy will also be constant. Silvers argued that this assumption is faulty in some situations, and that a constant yield spread may be characteristic of non-constant relative risk under certain economic conditions.

An alternative to the yield-based model of bond prices (i) is the certainty-equivalent model (ii):

$$(ii) \quad P_t = \sum_{t=0}^T \frac{a(t)C_t}{(1+r_T)_t} + \frac{a(t)100}{(1+r_T)^T}$$

where P_t = Current market price on a coupon bond with (T) payments to maturity.

C_t = Promised coupon payment at time (t).

r_t = Riskless rate of interest at time (t).

$a(t)$ = Certainty Coefficient, representing the certainty equivalent of C_t as a percentage of the promised value.

The certainty coefficient provides a [standardized] measure of overall reaction to a risky future prospect at a point in time. The model (ii) allows for different certainty coefficients for different periods. Thus, the certainty-equivalent price model does not mask the effects of the business cycle on expected risk as does the traditional yield model due its implicit averaging of all factors over time.

Silvers argued that although utility functions and probability distributions of expected cash flows may differ across individual investors, in equilibrium all investors must agree on the set of certainty coefficients spanning

time or arbitrage possibilities would exist that would force the market toward such an equilibrium. Therefore, at equilibrium there exists an explicit set of certainty coefficients for each risky bond. One could represent this set of coefficients in a curve that would be similar in appearance to the traditional yield curve.

Based on this reasoning, Silvers defined a homogeneous risk class as "one in which all bonds in the grouping share a common structure of certainty coefficients at any point in time. ...The compensation for risk is proportionally identical for each bond in the risk class for all promised payments in a given future period." Silvers noted that a homogeneous risk class, as defined, does not necessarily imply a constant yield spread (relative to the risk-free yield curve) over time. He showed that if the yield curve is severely upward or downward sloping, or if the absolute level of the yield curve is erratic, then a constant yield spread over time implies a non-constant pattern of risk adjustment. Thus, the certainty-equivalent model not only accounts for differential time preference, (a duration-based model could also achieve this), it also allows for a dynamic set of basic interest rates and $a(t)$'s spanning time to account for non-constant investor risk assessments across time.

Since a change in an $a(t)$ is related to a change in the risk assessment regarding time (t) , the $a(t)$'s could

serve as independent variables representing expected default risk across future time periods.

If it were possible to compose a sample of bonds from a homogeneous risk class having maturities at precise periodic intervals until time (T), and if an acceptable proxy for the set of risk-free rates exists, then the set of all $a(t)$'s for $t=(0,T)$ could be calculated directly using a $T \times T$ matrix of simultaneous equations. However, due to the general lack of linear independence among risky bonds, this method of direct calculation is not feasible.

As a more practical alternative, Silvers proposed the use of an estimation technique developed by Almon (1965). If the $a(t)$ curve is assumed to be continuous, then a general functional form can be imposed upon it. Then, rather than solving for all values of $a(t)$ across time, it may be sufficient to solve for only a few explicit values (Silvers judged three to be optimal) and interpolate the remaining $a(t)$'s as a weighted average of the observed values. This reasoning formed the foundation of Silver's regression model.

In addition to the default risk variables described above, Silver's regression model included a independent variables representing marketability and risk of call.

The regression sample included annual data covering the period 1952-1964. Bonds rated AAA, AA, A, and BBB were included. Income bonds, convertible bonds, foreign bonds,

and bonds very near call were excluded. The actual certainty-equivalent model of bond prices was:

(iii)

$$P_t = \sum_t \frac{a(t)C_t}{(1+r_t)^t} + \frac{a(T)100}{(1+r_T)^T} - b_{q+1}\ln(v) - b_{q+2}V_C$$

where:

$\ln(v)$ is a proxy for the marketability of the bond, defined as the natural logarithm of the par value of bonds outstanding.

V_C is a proxy for the call risk of a bond, defined as the current value of call to the issuing corporation.

b_{q+1} and b_{q+2} are regression coefficients and other variables are as previously defined.

Silvers estimated this model for the four rating groups in each of the 13 time periods included in his sample, using the Almon lag interpolation procedure with three representative time points for interpolation of the $a(t)$ vector. His results supported the conclusion that there was definite correlation between movement in the corporate bond risk structure and the business cycle. Certainty

coefficients tended to move downward in anticipation of recessions, although this hypothesis was not actually tested in this study and the annual data could have given rather misleading results.

Also, the factor representing call risk was found to be highly significant in all the risk classes. As for the marketability factor, Silvers' results did not support Fisher's conclusion that this factor was highly significant. Fisher had used a heterogeneous risk sample, but Silvers attempted to hold risk relatively constant within each sample. He found that over the 13 years of the study, very few of the estimated coefficients for this factor were more than marginally significant.

COOK AND HENDERSHOTT (1978):

This study was similar to Fisher (1959) in that it sought to relate the yield spread on risky bonds to factors representing default risk and marketability. However, the approach taken was quite different in many respects.

Whereas Fisher based his analysis on the market yields of a large sample of actual bonds, Cook and Hendershott examined yield spreads between a yield index composed from Aa-rated deferred-call newly issued utility bonds and a yield series for government bonds. The motivation of the authors was to quantify the relative contributions of taxes, risk, and relative security supplies to the movement of yield spreads over time.

Cook and Hendershott argued that the methods by which the popular U.S. bond yield series were calculated produced technical anomalies in the series that could seriously bias any empirical results involving them. Potential technical anomalies included of this sort include:

- 1) Issue gaps and large discounts. Between May 1963 and May 1973, virtually no new U.S. bonds were issued with maturity greater than 20 years. Since interest rates were rising during this period, all U.S. bonds became discount bonds with sizable discounts throughout much of this period. Due to the tax advantages afforded

discount bonds (see Robichek and Niebuhr, 1970) investors would require a lower yield on such seasoned bonds than on identical new issues. The inclusion of yields on highly discounted bonds in an average yield series would therefore tend to bias the index yield in a downward direction.

- 2) A few low-coupon issues are given special tax treatment for estate planning purposes (the so-called "flower bonds".) This special treatment increases the demand for these issues relative to similar issues lacking the special status, thus increasing their relative prices and decreasing their yields. If these issues are included in the bond sample underlying a yield index, the index yield will be biased in a downward direction.
- 3) When a yield index is based on a portfolio of bonds with different maturities, the average maturity of the portfolio will vary over time. Since term to maturity exerts an influence on required yields, changes in the average maturity of the underlying portfolio could produce changes in the index yield that are strictly technical in nature and have nothing to do with actual changes in the rate structure. That is, a change in the index yield could be the result of movement along the yield curve as average maturity changed rather than

resulting from a fundamental change in the yield curve itself.

The authors argued that the existence of these technical problems requires that studies which use U.S. bond yield series should include adjustments in the yield series to compensate for these potential biases. They constructed a U.S. bond yield series that was adjusted for the technical factors described above, using a procedure originally suggested by Robichek and Niebuhr (1970). This procedure has the effect of converting the nominal yield on seasoned U.S. bonds to the equivalent yield for a new issue, thus eliminating technical anomalies in the series resulting from differential tax treatment and wandering average maturity. This adjusted yield series was used as the U.S. bond yield in the corporate-government yield spread calculations for the study.

Independent variables were selected to represent economic conditions, risk of call, and relative supply factors.

An association between cyclical economic factors and risk premiums could result from the fact that Moody's, the principal source of ratings for studies of this type, does not adjust its rating scheme over the business cycle (Jaffee 1975). Thus, the default risk of a bond with a given rating may fluctuate systematically over the business

cycle. A bonds within a given rating class could maintain the same relative risk with respect to other bonds within that rating group, but the default risk of the group (as perceived by investors) could increase and decrease over the business cycle. Alternatively, an association between risk premiums and cyclical factors for bonds of a given rating group could be attributed to a discrepancy between investors' expectations regarding default risk and Moody's assessments of default risk, the magnitude of which varies systematically over the business cycle (Kichline, Laub, and Stevens 1973).

Cook and Hendershott selected two measures to represent cyclical factors in their regression model. The first is called the Index of Consumer Sentiment (MOOD), which was originally constructed by Fair (1971). The measure is based on the responses of a sample of consumers to questions concerning their purchasing plans and general expectations with respect to economic conditions in the near future. Jaffee (1975) found this measure to be an important explanatory variable in all of his risk premium regressions.

In addition, the authors also selected the Employment Pressure Index (EPI) as an independent variable representing cyclical economic factors. This measure was originated by Cullison (1975) as a measure of excess labor supply or demand.

Independent variables representing risk of call were selected based on the following considerations. Previous studies (Jen and Wert 1967, Frankena 1971, and Pye 1967) reported that the length of call deferment affects the yield spread. Popular government bond yield series typically have average call protection of 20 years or more, while popular utility yield series have average call protection of only about 5 years and corporate yield series have average call protection that changes over time as bonds enter and leave the underlying portfolio. Consequently, if these yield series are used to define yield spreads, some of the variation in these spreads over business cycles is likely to be the result of variations in the relative risk of call of the two groups comprising the yield spread. This source of variation should be considered in any model of yield spread behavior. Additionally, the portion of the yield spread attributable to expected call risk should be related to expectations regarding the general level of interest rates. If interest rates are expected to fall (rise) in the future, then investors would expect an increasing (decreasing) risk of call and consequently would require increasing (decreasing) call risk premiums.

To include a consideration of the differential average call deferment between the utility yield series and the Government yield series, the authors chose to use the

yield spread between Salomon Brothers' indexes of 4 and 7 year U.S. Bond rates as a proxy for interest rate expectations. The rationale for the specification of this variable was that these two series were not affected by differential tax treatment, nor was either series affected significantly affected by default or call risk. On the other hand, the yield spread between the two series would be expected to provide an indication of the expected change in the general level of interest rates over the period during which call of the average utility bond be possible and most likely to occur.

Differences in relative supplies would be expected to contribute to changes in yield spreads if the demand for bonds is not homogeneous with respect to issuer type. For example, consider the government-utility yield spread. Suppose that the market for these two classes of bonds is segmented, such that investors do not view utility bonds as substitutes for government bonds and, consequently, the demand for government bonds is independent of the demand for utility bonds. Under these conditions, an increase (decrease) in the supply of utility bonds would tend to put decreasing (increasing) pressure on the price level of utility bonds without exerting a direct impact on the price level of government bonds. Changes in the supply of government bonds would exert similar pressure on the price level of government bonds without impacting utility bond

prices. Consequently, if the supply of utility bonds changes relative to the supply of government bonds while all other factors remain constant, movement in the government-utility yield spread could still occur in reaction to the change in relative supplies.

To include a consideration of the relative supplies of the various types of bonds involved in the study, the authors defined an independent variable as the difference between the book value of U.S. corporate debt and the level of long-term (i.e. maturity greater than 5 years) Treasury debt net of U.S. Government and Reserve holdings. While this measure was not highly specific with respect to particular industrial classifications of issuers, it was considered to be the best measure possible given the availability of data concerning supplies of bonds.

In addition to the independent variable described above, the authors also included a variable representing the general level of interest rates, defined as the yield on the adjusted government yield index described above. This variable was included under the assumption that the magnitude of the impact of the other variables on the yield spread may depend in part on the current level of interest rates.

The data sample for the study was composed of monthly observations over a 15-year time period. Yield spreads were computed as the difference between the reported yield

on Salomon Brothers Aa deferred-call new issue utility series and the adjusted U.S. Bond yield series described above.

The actual regression model used in the study was:

$$\begin{aligned} \text{RAa}^* - \text{RUS}^* = & \alpha + \beta_1(\text{MOOD}) + \beta_2(\text{EPI}) + \beta_3(\text{EXP}) \\ & + \beta_4(\text{RUS}^*) + \beta_5(\text{RSS}) \end{aligned}$$

where:

- RAa*** represents the reported rate on Salomon Brothers' Aa deferred call, new issue Utility series.
- RUS*** represents the new issue equivalent U.S. bond yield series described above.
- MOOD** represents the Consumer Sentiment Index as a proxy for expected default risk.
- EPI** represents the Employment Pressure Index as a proxy for expected default risk.
- EXP** represents the spread between Salomon Brothers' 7 and 4 year U.S. bond yield series as a proxy for expected interest rates.
- RSS** represents the difference between the aggregate book value of domestic corporate bonds and the aggregate value of long-term Treasury debt, net of holdings of the U.S. government and the Reserve as proxy for the impact of relative security supplies.

The best result were obtained without the relative supply variable in the model. However, the remaining five factors were found to provide valuable contributions to the explanatory power of the regression. When the relative supply variable was included, its estimated coefficient was not statistically significant. Furthermore, the variable was found to be highly collinear with the independent variable representing the general level of interest rates.

The authors also tested the relationship with a dependent variable composed of the yield spread between the utility yield series and the UNadjusted U.S. bond yield series, and found the relative supply variable to have a highly significant t-statistic and a very large coefficient. The authors attributed this result to the fact that the relative supply variable captures the tax effects on the unadjusted U.S. yield series as yields rise. Therefore, they concluded that failure to account for the tax effects on yields could account for the conflicting results of previous studies (such as Fair and Malkiel, 1971) where relative supply was found to be an important explanatory variable.

FERRI (1978):

This paper examines the determinants of the yield spreads between three broad classes of bonds; utilities, industrials, and government issues. The author tests the hypothesis that yield spreads are a function of call risk, default risk, and outstanding supplies. Data was divided by time into two subsamples (1957-69 and 1969-75) to allow for shifts in the basic relationships in response to the broad economic changes and shocks of the late 1960's and early 1970's.

Government bond yields were represented by Standard and Poor's indexed average long-term government bond yield series. Industrial and utility bond yields were represented by Moody's A-rated seasoned average yields indexes for the two classes of issuers. The A-rated yield series were chosen in deference to other risk classes so that a default risk premium would surely be present, yet the quality of the underlying bonds would still be high enough to insure an active market.

Ferri noted three possible sources of bias and/or noise in the use of these yield indexes: (1) average maturity differences across the indexes, (the average term of the government bond index is about 15 years and that of the industrial and utility index is about 20 years), (2) reported yield changes lagging actual yield changes due to

thin or sporadic trading activity, and (3) differences in sinking fund provisions across the indexes. He dismissed the first two problems as being of minimal importance due to the usually flat slope of the yield curve between 15 and 20 year maturities and the fact that Moody's indexes are composed of the most actively traded bonds. However, he noted that differences in sinking fund characteristics could represent a significant source of bias in the data.

The hypotheses under investigation in this study can be summarized as follows:

$$R_i - R_j = \alpha + \beta_1 r_D + \beta_2 r_C + \beta_3 (S_i - S_j)$$

where:

$R_i - R_j$ represents the yield spread between the indexes for industry (i) and industry (j) at a given time point.

S_i represents the outstanding supply (total par value) of bond bonds of industry (i) at given point in time. The larger the supply differential between two classes of bonds, the larger the expected yield spread, other things equal.

r_D represents expected risk of default is the risk of default. Default risk was proxied by three objective variables in the actual regression model: (1) the market value of New Orders for Durable Goods, (2) the dividend yield of the S&P 500 Index, and (3) the Index of Leading Economic

Indicators. Since this study is based on yield averages rather than individual bond yields, these default risk factors were chosen for their assumed ability to reflect investors' expectations regarding the expansion and contraction of the economy, and thus the corresponding decrease and increase of the probability of default for the average bond in the index. It is expected that risk premiums should move inversely with the business cycle.

r_C represents the expected risk of call, proxied by a measure compiled by Salomon Bros. to reflect bond traders subjective estimates of the value of five years of call protection on new utility bonds. This measure is an indirect indicator of bond traders' expectations regarding interest rate movements, and therefore should be indirectly indicative of the expected risk of call. The expected sign of this variable is positive; expectations for higher (lower) call risk should correspond to increasing (decreasing) corporate-government yield spreads since government bonds have longer call protection periods on average than the other two classes of issuers and therefore should have smaller fluctuations in expected

risk of call for a given change in the general level of interest rates.

The results for the first time subsample supported the following conclusions:

- (1) Differences in call protection across the indexes had a significant impact on the yield spreads.
- (2) The default risk factors were significant explanatory variables in regressions involving the industrial-government yield spread, but only the S&P Dividend Yield was a significant contributor in regressions involving the utility-government yield spread.
- (3) Differences in outstanding stocks have a significant impact on the industrial-government spread, and some influence on the utility-government spread and the utility-industrial spread. This result suggests that industrial and utility bonds are not perfect substitutes.

Before examining the data for the second time period, Ferri replaced two of the explanatory variables. The measure used to represent expected risk of call in the first time period was not available in the second time period, and consequently was redefined as the yield on short-term government debt (under the assumption that

short-term rates reflect investors expectations concerning long-term rates). Also, the dependent variables were re-defined in terms of Aaa yield series rather than Aa series.⁴

The results of the analysis for the second time period supported the following conclusions:

- (1) The importance of call risk in the model was confirmed. The impact of call risk was greater for the utility-government yield spread than for the industrial-government yield spread. This result would support the argument that industrial bonds have greater call protection on average than utility bonds.
- (2) The default risk hypothesis was supported. Default risk appears to play a greater role in the second period, possibly in response to the actual default of a few very large companies. The author concluded from this that potential default risk is of growing importance to investors.
- (3) The relative supply hypothesis was found to be "plausible". Ferri found that "differences in outstanding stocks exert influence on the relative price and yield of corporate and government bonds."

JAFFEE (1975):

This study examined cyclical variations in interest rate differential between various risk categories. The data used in the regression analysis were based on Moody's interest rate time series for Industrials, Utilities, Rails and Municipal issuers (Aaa to Baa ratings).

The author justified the use of Moody's bond ratings as measures of relative risk under the following assumption:

"... We assume that Moody's classifications are accurate in the sense that at any moment in time they accurately separate bonds into differential risk categories. We do not assume, however, that the risk associated with any given category remains constant over the business cycle."

This assumption allows for the possibility of systematic variations in the relative risk of rating classes over the business cycle. That is, the risk of a given firm is likely to vary over the business cycle while its rating remains fixed. In addition, the magnitude of the variation in risk would be expected to be greater for the lower rating categories than for the higher rating categories. Therefore, the differential between the yields of the

various rating groups should vary over the business cycle as well, with increasing (decreasing) yield spreads expected for contractionary (expansionary) phases.

Jaffee stresses that variations in the yield spreads over the business cycle would not necessarily be due to changes in investor risk aversion or changes in investor cash flow. Instead, the variations on the yield spreads would be primarily due to the fact that Moody's does not adjust its ratings for short-term business cycle fluctuations, even though the actual risk level of issuers may be changing.

The following cyclical measures were selected to be used as independent variables:

MOOD	The Index of Consumer Sentiment compiled by the University of Michigan Survey Research Center.
U	The Unemployment Rate; Bureau of Labor Statistics.
GR	The Growth rate of Retained earnings of corporations; National Income Accounts.
GI	The Growth rate of fixed capital Investment; National Income Accounts.
GP	The Growth rate of the output Price index; National Income Accounts.
BAA	The interest rate on Moody's Baa-rated bonds of a given issuer.

The general hypothesis is that the risk of firms varies contracyclically, and that the risk differential between firms of low and high relative risk tends to vary contracyclically as well. This hypothesis was tested by regressing risk spreads (Aaa-Baa, Aa-Baa, and A-Baa) for the four issuer classes against the cyclical variables defined above using quarterly observations from 1954 to 1969.

The results of these regression supported the hypothesis. Observed signs on all variables were consistent with expectations. In addition, the size of the coefficients, their level of significance, and the goodness-of-fit of the regression models all tended to fall as the rating gap narrowed. This result was also consistent with expectations.

Jaffee noted that MOOD (the Index of Consumer Sentiment) was by far the most significant variable in variable in the regression equations. The other variables gave rather mixed results, particularly in conjunction with the dependent series based on the Utilities indexes.

Following this portion of the analysis, the author considered behavioral sources of cyclical variations in risk spreads using regressions which included both behavioral variables and business cycle variables. Behavioral variables were selected to proxy demand and supply characteristics for bonds a given rating and issuer category. On

the basis of these tests, Jaffe concluded that the only factors that move the risk structures of corporate bonds are business cycle variables, and that supply and/or demand differentials have no significant impact.

ENDNOTES

1. McCullough, J.R. The Principles of Political Economy, With a Sketch of the Rise and Progress of Science (2nd Ed, Edinburgh, 1830).
2. Imperfection is defined here as the potential for a single investor's actions to affect the price of a bond issue.
3. Silvers (1973) tested Fisher's marketability measure for its effect on yields while holding default risk constant. His results cast serious doubt on the importance of the marketability factor as an explanatory factor.
4. Homer (1975) had argued that the occurrence of major defaults of Aaa bonds in the early 1970's (such as Penn Central) implied that Aaa bond yields would surely have begun to incorporate a risk premium.

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