VOLATILITY PATTERNS OF FIXED INCOME SECURITIES

by

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1. Introduction

The market for lower-grade ("junk") bonds has grown dramatically in the past decade. According to Drexel Burnham Lambert, new issues of lower-grade bonds have increased from $1.1 billion in 1977 (4.6% of total of new publicly-issued debt by U.S. corporations) to $35.8 billion in 1987 (16.3% of total new debt). Drexel estimates the size of the market to be $159 billion at year-end 1987, of which 75% are original-issue lower-grade bonds in contrast to "fallen angels" that were originally issued at investment grade. Most of the previous research in this area has tended to focus on the incidence of default (e.g., Altman (1987)), thereby placing undue emphasis on the fallen angels that used to dominate this market. The increasing size and diversity of the market, however, warrants more detailed information on the risk and return characteristics of these securities so that participants can make informed investment decisions.

One hindrance to such an examination has been the lack of reliable price quotes at which trades can be made and, therefore, prices that could be used to simulate feasible portfolio risks and returns.[1] For example, the Bank and Quotation Record is one source for bond price information that has been used in several previous studies (Weinstein (1981), Chang and Pinnegar (1986)). A price obtained from the BQR, however, may be a transaction price, an average of the bid and ask prices, or either a bid or an ask price. Returns computed with these data may involve a price change between any of the four possibilities and can create obvious statistical problems--especially for lower-rated bonds that have greater bid-ask spreads relative to their prices. Also, since this type of bias will be related to the general level of bond prices, the severity of the bias will be related to rate movements through time. Attempting to avoid these shortcomings, Blume and Keim (1987) recently constructed an extensive data file of lower-grade (e.g., rated below Baa by Moody's) bond prices based on dealer bid prices provided by Drexel Burnham Lambert and Salomon Brothers.

In this paper, we use the data described in Blume and Keim (1987) to analyze the risk and return characteristics of lower-grade bonds. More specifically, we ask whether the variability of lower-grade bond returns can be ascribed to separable factors. For example, lower-grade bonds are often described as a hybrid security: they have all the appearances of a fixed income obligation, but often do not have the cushion of equity beneath them. The question is whether the separate influences of unexpected changes in the term structure and in the equity markets can be isolated in the returns of lower-grade bonds.

2. Data

In this section we describe the lower-grade bond price file used in the paper and report some summary statistics for our sample of bonds as well as for several other asset categories. We use the file of lower-grade bond prices described in Blume and Keim (1987) that comprised the years 1982 to 1986. The analysis here extends those data to December 1987. Briefly, we obtained dealer quotes for month-end bid prices from Drexel Burnham and Lambert and Salomon Brothers for the period December 1981 to December 1987. To be included in our sample, each bond must satisfy the following criteria: (1) greater than $25 million outstanding; (2) at least ten years to maturity;[2] and (3) non-convertible.[3]

The tests reported in the following sections use the data described above for the 1982-1987 period. To provide a longer perspective for the summary statistics reported in this section, we extend the length of our sample period back to December 1976 by obtaining month-end prices from the S&P Bond Guide.

We collected prices for <u>all</u> bonds listed in the <u>Guide</u> for that month that were rated below BBB, had an outstanding value in excess of $25 million, were not convertible, and had more than ten years to maturity.[4]

Table 1 contains summary statistics based on monthly returns for an equal-weighted portfolio of the sample of lower-grade bonds described above, as well as for portfolios of high-grade long-term corporate bonds, long-term Government bonds, the S&P 500 stock index and an equal-weighted portfolio of stocks comprising the smallest quintile of size on the NYSE. Panel A reports results for the entire 1977-1987 period. The bottom three panels contain results for the entire 1982-1987 period--for which we have Drexel and Salomon lower-grade bond prices--and for two subperiods of equal length.

For the eleven-year period in Panel A, the average monthly returns of the five portfolios increase monotonically with increases in the standard deviation of these returns with the exception of lower-grade bonds. Lower-grade bonds have the smallest standard deviation among these five portfolios, but have the third greatest average return. The average return on lower-grade bonds exceeded those of both long-term government and high-grade corporate bonds. Documented previously in Blume and Keim (1987), this counter-intuitive result is at least partly attributable to these two causes: First, even though lower-grade bonds are individually risky, much of this bond-specific risk can be eliminated in a diversified portfolio. Second, the duration of lower-grade bonds is generally less than the duration of higher-grade corporate or Government bonds, and these bonds are less sensitive to unexpected interest rate movements. At the end of 1987, the 230 lower-grade bonds in our sample have an average duration to maturity of 7.63 in contrast, say, to the duration of 9.61 of a twenty-year bond selling at par with a coupon of nine percent.

TABLE 1

SUMMARY STATISTICS OF MONTHLY RETURNS FOR VARIOUS ASSET CATEGORIES

	Mean Return	Standard Deviation of Return	Autocorrelation p_1	Autocorrelation p_2	Autocorrelation p_3	Correlation between Assets: L.T. Corp.	Lower Grade Corp.	S&P 500	Small Stocks
A. 1/1977 - 12/1987									
L.T. Government Bonds	0.76	3.94	.06	.01	-.15	.95	.71	.34	.21
L.T. Hi-Grade Corp. Bonds	0.78	3.65	.15	-.01	-.11		.77	.31	.19
Lower-Grade Bonds	0.89	2.82	.19	-.06	-.12			.49	.52
S&P 500	1.14	4.76	.04	-.08	-.05				.82
Small Stocks	1.75	6.08	.14	-.05	-.12				
B. 1/1982 - 12/1987									
L.T. Government Bonds	1.39	3.64	.04	.11	-.09	.92	.61	.31	.16
L.T. Hi-Grade Corp. Bonds	1.46	3.23	.13	.14	-.04		.71	.29	.16
Lower-Grade Bonds	1.26	2.37	.31	.14	.09			.54	.52
S&P 500	1.47	5.20	.06	-.01	-.06				.87
Small Stocks	1.33	5.60	.25	.08	-.02				
C. 1/1982 - 12/1984									
L.T. Government Bonds	1.42	3.34	.15	.22	-.11	.96	.72	.45	.22
L.T. Hi-Grade Corp. Bonds	1.63	3.60	.17	.16	-.02		.79	.46	.26
Lower-Grade Bonds	1.62	2.63	.39	.17	.10			.58	.46
S&P 500	1.36	4.20	-.03	.25	-.10				.82
Small Stocks	1.80	4.86	.27	.35	.13				
D. 1/1985 - 12/1987									
L.T. Government Bonds	1.36	3.97	-.03	.03	-.09	.92	.54	.22	.12
L.T. Hi-Grade Corp. Bonds	1.28	2.86	.06	.08	-.10		.58	.17	.07
Lower-Grade Bonds	0.96	1.95	.13	.00	-.02			.57	.61
S&P 500	1.59	6.09	.10	-.11	-.04				.91
Small Stocks	0.86	6.29	.24	-.08	-.11				

In comparison to long-term governments, the shorter duration of lower-grade bonds is due to generally greater coupons and to the limited call provisions on governments. In comparison to long-term high grade corporates, the shorter duration of lower-grade bonds is due similarly to generally greater coupons, but in addition to the possibly greater probability of early exercise of the call provision on lower-grade bonds. Although the stated call provisions of high-grade and lower-grade bonds are often similar, the possibility of improvement in the quality of a lower-grade bond increases the probability of early call. If credit quality improves, an issuer may decide to call a lower-grade bond and reissue a new bond with a lesser yield differential over high-quality debt.

In general, the "maturity" of a callable bond lies somewhere between the first call date and maturity. Viewed in this way, the duration of a callable bond is, in a sense, a weighted average of the duration measured to first call and the duration measured to maturity. The possibility of quality improvements increases the likelihood of these bonds being called in contrast to investment grade corporates, so that the "expected maturity" is closer to the time to first call than to maturity, leading to a shorter duration. The average time to first call for our junk bond sample is 4.4 years, resulting in an average duration measured to first call of 1.9 years. If we adopt the perspective that the duration of a callable bond is the weighted average of the duration to first call and the duration to maturity, sensitivity of the portfolio of lower-grade bonds to interest rate movements is considerably smaller than the sensitivity implied by duration measured to maturity.

The correlations between returns on different portfolios exhibit a property noted by Keim and Stambaugh (1986)--as portfolios become farther apart on the "risk" scale, correlations decline. For example, the long-term

Government bond returns are most highly correlated with the long-term corporate bonds and display progressively lower correlations with the lower-grade bonds and then the stocks. Of particular interest for later reference, the lower-grade bond returns display a high degree of correlation with the stock portfolios, especially when compared with the correlations between the other bond portfolios and the stock portfolios. The autocorrelations tend to be positive at the first lag, and approach significance only for the lower-grade bonds and the smallest stocks.

For the more recent 1982-1987 subperiod (Panel B), the behavior of the standard deviations, correlations and the autocorrelations are similar to the longer period. However, average returns tend to be larger, the less risky is the asset. Thus, Government and high-grade corporate bonds have higher returns than lower-grade bonds, and larger stocks have greater returns than smaller stocks. These results are largely attributable to the 1985-1987 period (Panel D). In contrast, during the 1982-1984 subperiod, lower-grade bonds and small stocks tended to outperform the less "risky" securities. This behavior is consistent with the finding by Keim and Stambaugh (1986) that the premium of low-grade over high-grade bonds and the premium of small over large stocks move together through time. The finding suggests that economic factors that influence the relative prices of stocks may also influence the relative prices of bonds. Thus, equity price movements, and in particular price movements of small stocks, may play a larger role in the determination of lower-grade bond prices and their variability than might be expected given previous evidence on the risk and return of higher-grade bonds.

3. Components of Bond Price Variability

The extent to which lower-grade bonds respond to unexpected term structure shifts and stock market movements is the subject of this section.

This study employs two different stock market surrogates: (1) the S&P 500, covering the larger, actively-traded stocks; (2) an index of small stocks, covering NYSE stocks in the lowest size quintile. This second index may be more representative of the issuers of the bonds in our lower-grade bond sample.

To capture the sensitivity to term structure movements, we employ a model of bond prices based on the work of Brennan and Schwartz (1977). Briefly, the Brennan and Schwartz model assumes that the price of a bond at time t is a function of the instantaneous interest rate at time t, r_t, and the specific features of the bond including coupon levels, maturity, and call features. Brennan and Schwartz assume that the pure expectation hypothesis holds and then use this assumption to formulate a partial differential equation describing the dynamics of a default-free bond. The implementation of their model in this paper assumes that the instantaneous interest rate itself follows a lognormal process with no drift.

More formally, the price of a bond at time t is given as a function of r_t conditional on the standard deviation of r_t, $\sigma(r)$, and the specific features of the bond, θ, or $p_t(r_t|\sigma(r), \theta)$. Assuming that the coupon is zero, the return on the bond over the interval Δt will be given by

$$\frac{p_{t+\Delta t}(r_t+\Delta r|\sigma(r), \theta)}{p_t(r_t|\sigma(r), \theta)} - 1 \tag{1}$$

For any specific values of r_t and Δr, the above formula provides a predicted return for a default-free bond with characteristics θ. In actually using this formula, the returns have to be adjusted for the periodic payment of coupons.

The values of Δr are obtained as follows: Salomon Brothers publishes daily estimates of yields on newly issued 30-year governments.[5] Ibbotson

Associates provide monthly total returns on a portfolio of government bonds approximating a maturity of 20 years. These two data sources are combined to provide an estimate of Δr. To take a specific example, the yield from Salomon Brothers for the month ending April 1983 is 10.35 percent. The realized return in May 1983 is -3.91 percent. Based upon this return, a bond newly issued at par at the end of April would have a yield to maturity of 10.94 at the end of May. The difference between 10.94 and 10.59 provides an estimate of .59 percent for Δr.[6] These Δr's imply an estimate of $\sigma(r)$ of 14.66 percent per year.[7]

With this estimate of $\sigma(r)$, we then calculate the predicted return in two steps: For a specific bond at time t, we determine the value of r_t that would equate $p_t(r_t|\sigma(r), \theta)$ to the actual price of the bond. We then added Δr to this r_t. These two numbers then imply a predicted return corresponding to the return on a "default-free" government bond having coupon and call characteristics of the specific bond.

This procedure allows us to determine the monthly return for a default-free bond with maturity, coupon and call features corresponding to any lower-grade bond in our sample. For each of our lower-grade bonds for each month in our sample, we compute a series of corresponding "default-free" returns--as if the returns on the bond were determined by changes in the Treasury yield curve.

Such "default-free" returns may be useful in resolving the apples vs. oranges problem discussed above in reference to the relative variability of lower-grade bonds and default-free bonds. Section 2 contains the conjecture that the relatively lower variance of lower-grade bond returns is in part attributable to the higher coupons and shorter duration of these bonds relative to a portfolio of higher-grade bonds. The "default-free" returns for our sample of lower-grade bonds can be thought of as returns for a default-free portfolio that holds bond-specific characteristics constant. Consistent with our conjecture, the standard deviation of the returns for this "default-free" portfolio is 2.12 percent per month in contrast to 2.37 percent for the returns of the portfolio of actual lower-grade bonds.

3.1 Regression Results

The initial analysis of this paper involves regressions of monthly returns on individual bonds on various combinations of bond and stock market variables and for various time periods. The regression models themselves pool all of the data into a panel and mathematically take the form:

$$\begin{pmatrix} R_1 \\ R_2 \\ \vdots \\ R_N \end{pmatrix} = \begin{pmatrix} 1 & X_1 \\ 1 & X_2 \\ \vdots & \vdots \\ 1 & X_N \end{pmatrix} \cdot \begin{pmatrix} a \\ b \end{pmatrix} + \begin{pmatrix} e_1 \\ e_2 \\ \vdots \\ e_N \end{pmatrix} \tag{2}$$

where: R_i is a time series vector of length T_i of monthly returns for bond i; $\mathbf{X}_i$ is a matrix of bond and/or stock market returns which may include any combination of the "default-free" returns for the individual bonds, the S&P 500 returns and the returns on the index of small stocks; a and **b** are the estimated parameters constrained to be equal across all bonds; and e_i is the time series vector of residuals for each bond i. The dimensions of $\mathbf{X}_i$ may range from (T_i x 1) to (T_i x 3), and the dimensions of **b** from (1 x 1) to (3 x 1).

3.1.1 The Overall Period

For the entire period from January 1982 through December 1987, the slope coefficient in the regression of individual bond returns on the predicted return of a "default-free" equivalent bond is 0.72 with an adjusted R-squared of 0.11 (Table 2A). In contrast, the slope coefficient in the regression of individual bond returns on the 20-year government return from Ibbotson is 0.40 with an adjusted R-squared of 0.10.

Since the 20-year government returns were used to generate the changes in the yields upon which the predicted returns are based, the slightly greater R-squared using the predicted return indicates that taking into account the specific coupons and call provisions of the individual lower-grade bonds improves the fit of the regression. However, the gain is not great.[8]

If the assumptions underlying the Brennan-Schwartz model were satisfied and the empirical data used in generating the predicted return were correct, this slope coefficient on the predicted return should be 1.0, but in fact it is somewhat less than 1.0. One interpretation of this result is that the predicted returns missestimate the "true" predicted returns by a scale factor. The predicted returns as calculated are too variable. Increasing the value of $\sigma(r)$ used in the Brennan and Schwartz model would reduce this variability and thereby increase the slope coefficient. Some analyses not presented here suggest that by increasing the value of $\sigma(r)$, one could drive the slope coefficient to 1.0 with virtually no effect on the R-squared. Thus, the fit of the regression is not very sensitive to the value of $\sigma(r)$ used in the Brennan-Schwartz model although the slope coefficient itself is sensitive to $\sigma(r)$.

As a result, the R-squared is a fairly robust estimate of the amount of variability of an individual lower-quality bond attributable to interest rate movements in the government bond market. Another interpretation is that the assumptions underlying the Brennan-Schwartz model do not hold exactly, so that the predicted return is measured with error. If the predicted returns are

TABLE 2A

Regressions of Lower-Grade Bond Returns on Bond and Stock Market Returns[1]
1/1982 - 12/1987

$$R_{it} = a_{0i} + a_{1i}R_t^{BOND} + a_{2i}R_t^{STOCK} + e_{it}$$

	Bond Market Return (R_t^{BOND})		Stock Market Return (R_t^{STOCK})		
Intercept	Predicted	Government	S&P 500	Small Stock Index	Adjusted R^2
A. Stacked Individual Regressions					
0.0019 (0.0005)[2]	0.7155 (0.0214)				0.113
0.0066 (0.0005)		0.3961 (0.0136)			0.101
0.0083 (0.0005)			0.2484 (0.0092)		0.083
0.0091 (0.0005)				0.2282 (0.0090)	0.080
-0.0010 (0.0007)	1.1810 (0.1147)	-0.2786 (0.0707)			0.115
0.0011 (0.0005)	0.5838 (0.0218)		0.1770 (0.0096)		0.151
0.0006 (0.0005)	0.6362 (0.0209)			0.1900 (0.0088)	0.166
-0.0028 (0.0007)	1.1894 (0.1120)	-0.3283 (0.0698)	-0.0130 (0.0165)	0.2020 (0.0158)	0.169
B. Average Values					
0.0021 (0.0029)	0.7243 (0.1246)				0.412
0.0070 (0.0025)		0.4005 (0.0749)			0.371
0.0089 (0.0025)			0.2510 (0.0472)		0.294
0.0096 (0.0024)				0.2269 (0.0432)	0.279
-0.0045 (0.0042)	1.7827 (0.5322)	-0.6227 (0.2993)			0.426
0.0014 (0.0028)	0.5926 (0.1069)		0.1784 (0.0459)		0.547
0.0008 (0.0025)	0.6450 (0.1044)			0.1880 (0.0343)	0.602
-0.0062 (0.0035)	1.7498 (0.4505)	-0.6489 (0.2565)	-0.0059 (0.0905)	0.1936 (0.0852)	0.616

[1]Regressions are estimated using weighted least squares, where the weight is the bond's own price. Standard errors are in parentheses.

[2]All standard errors are heteroscedastic consistent.

measured with additive independent measurement errors, both the estimated coefficient and the R-squared would be biased towards zero.

Both the returns on the S&P index and the small stock index have some explanatory power, but less power than the predicted return itself. With the exception of the regression with every possible independent variable, the regression using the predicted return and the return from the small stock index has the greatest R-squared.

In total, these results suggest that over the six years ending in 1987 the returns of lower-grade bonds responded both to interest rate changes in the government bond market and to stock returns, particularly to the returns of smaller companies.

Virtually all of the coefficients in these regressions are large in comparison to their calculated standard errors. The reported standard errors are computed with the heteroscedastic-consistent method of White (1980). However, it is unlikely that the residuals in many of these equations are well behaved. For example, since the stock market return provides some additional explanatory power to the predicted return and is the same for all bonds for a particular month, there is very likely substantial correlation among the residuals in any monthly cross-section. Further, even when all the variables are included in the regression, there may still be some additional factors common to all bonds that affect their returns--a phenomenon that would induce cross correlation.

To ascertain the effect of this likely misspecification of the regressions, the independent and dependent variables in these regressions are averaged for each month, yielding one observation for each variable for each month.[9] In rerunning these regressions using the average values, one finds little change in the estimated coefficients except for those on the predicted return and the government bond return when both of these variables are in the same regression. This instability when both of these variables are included undoubtedly stems from their substantial multicollinearity. Nonetheless, the coefficient on the predicted return is still positive and significant at usual levels.

A plot of the residuals from the regression of average returns on the average predicted returns discloses two residuals greater than .04 or 4 percent in absolute values (Figure 1A). The dates of these two residuals are January 1983 and October 1987. Adding the small stock index to the regression reduces the absolute magnitude of these two residuals, substantially in the case of October 1987 and somewhat in the case of January 1983. This change in the pattern of residuals suggests that the small stock return is acting as a dummy variable for October 1987. The analysis of this possibility entails rerunning the regression using average returns but excluding the data point associated with October 1987. The resulting regressions are similar to those that include this month.[10]

3.1.2 Subperiods

The regression results for the first half of the sample, January 1982 through December 1984, reported in Table 2B, are somewhat similar to the overall period (Table 2B and Figure 1B). However, there are some differences of potential importance. The predicted return explains more of the variability in returns than in the overall period. The R-squared for individual bonds increases from 0.113 to 0.253. Like the overall period, the predicted returns have more explanatory power than the stock returns.

Similar to the overall period, the S&P 500 by itself explains slightly more variability than the small stock index. With the exception of the

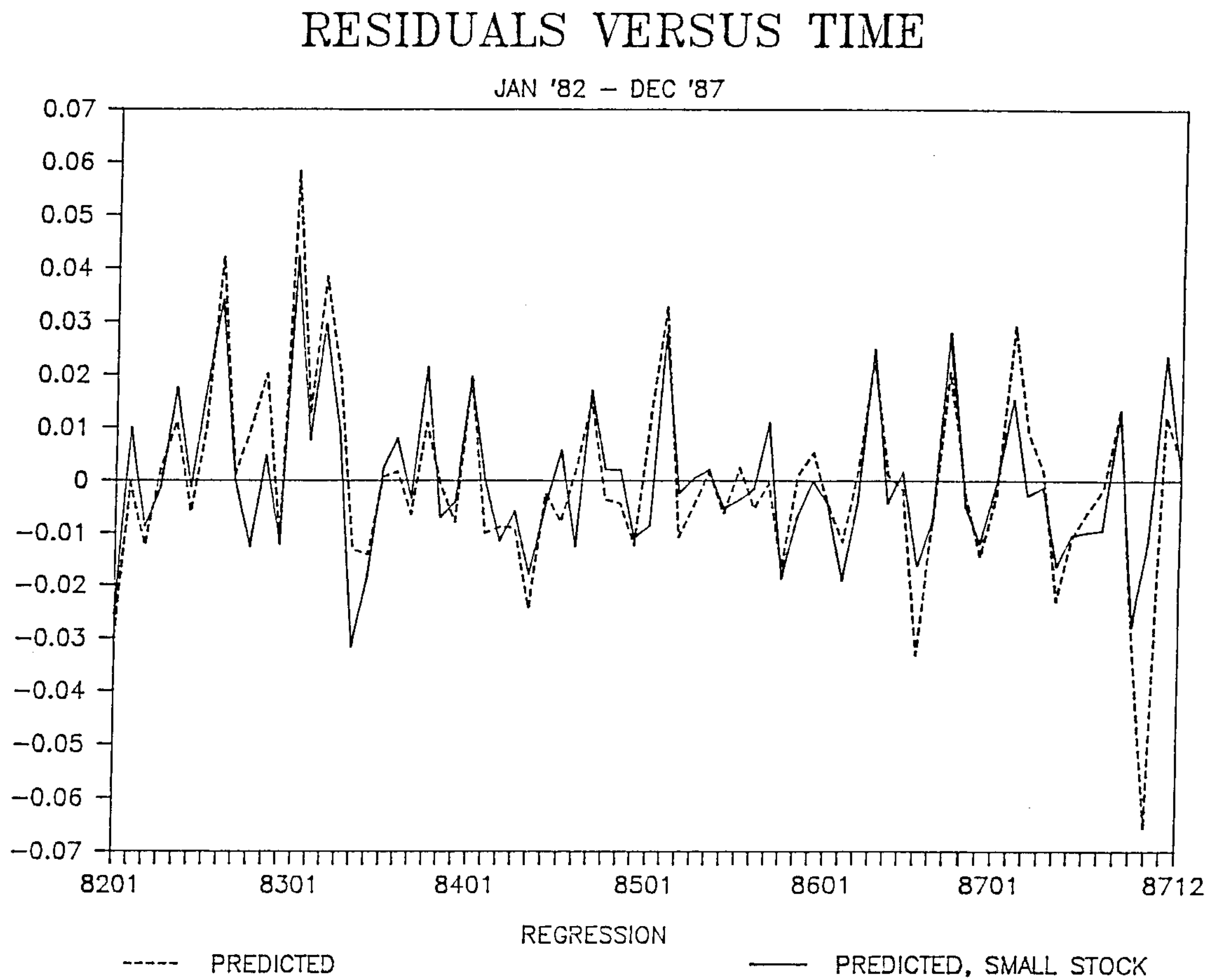
RESIDUALS VERSUS TIME
JAN '82 – DEC '87
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
–0.01
–0.02
–0.03
–0.04
–0.05
–0.06
–0.07
8201
8301
8401
8501
8601
8701
8712
REGRESSION
PREDICTED
PREDICTED, SMALL STOCK

FIGURE 1A

TABLE 2B

Regressions of Lower-Grade Bond Returns
on Bond and Stock Market Returns[1]
1/1982 - 12/1984

$$R_{it} = a_{0i} + a_{1i}R_t^{BOND} + a_{2i}R_t^{STOCK} + e_{it}$$

Intercept	Bond Market Return (R_t^{BOND})		Stock Market Return (R_t^{STOCK})		Adjusted R^2
	Predicted	Government	S&P 500	Small Stock Index	
A. Stacked Individual Regressions					
0.0019 (0.0006)[2]	0.8898 (0.0221)				0.253
0.0073 (0.0006)		0.5624 (0.0154)			0.232
0.0101 (0.0006)			0.3642 (0.0130)		0.150
0.0108 (0.0006)				0.2427 (0.0118)	0.090
-0.0059 (0.0010)	2.2805 (0.1784)	-0.9267 (0.1198)			0.265
0.0017 (0.0006)	0.7296 (0.0257)		0.1916 (0.0138)		0.286
0.0002 (0.0006)	0.8122 (0.0231)			0.1608 (0.0112)	0.290
-0.0065 (0.0009)	2.0718 (0.1709)	-0.8739 (0.1146)	0.1057 (0.0228)	0.0853 (0.0182)	0.303
B. Average Values					
0.0022 (0.0042)	0.8882 (0.1545)				0.536
0.0076 (0.0039)		0.5649 (0.1125)			0.502
0.0106 (0.0038)			0.3676 (0.0981)		0.327
0.0111 (0.0039)				0.2497 (0.0899)	0.191
-0.0161 (0.0084)	4.0634 (1.7283)	-2.0908 (1.1809)			0.578
0.0021 (0.0037)	0.7156 (0.1563)		0.1989 (0.0811)		0.608
0.0005 (0.0034)	0.8023 (0.1524)			0.1652 (0.0730)	0.616
-0.0151 (0.0065)	3.6208 (1.2934)	-1.8953 (0.8978)	0.1302 (0.1322)	0.0631 (0.1144)	0.643

[1]Regressions are estimated using weighted least squares, where the weight is the bond's own price. Standard errors are in parentheses.

[2]All standard errors are heteroscedastic consistent.

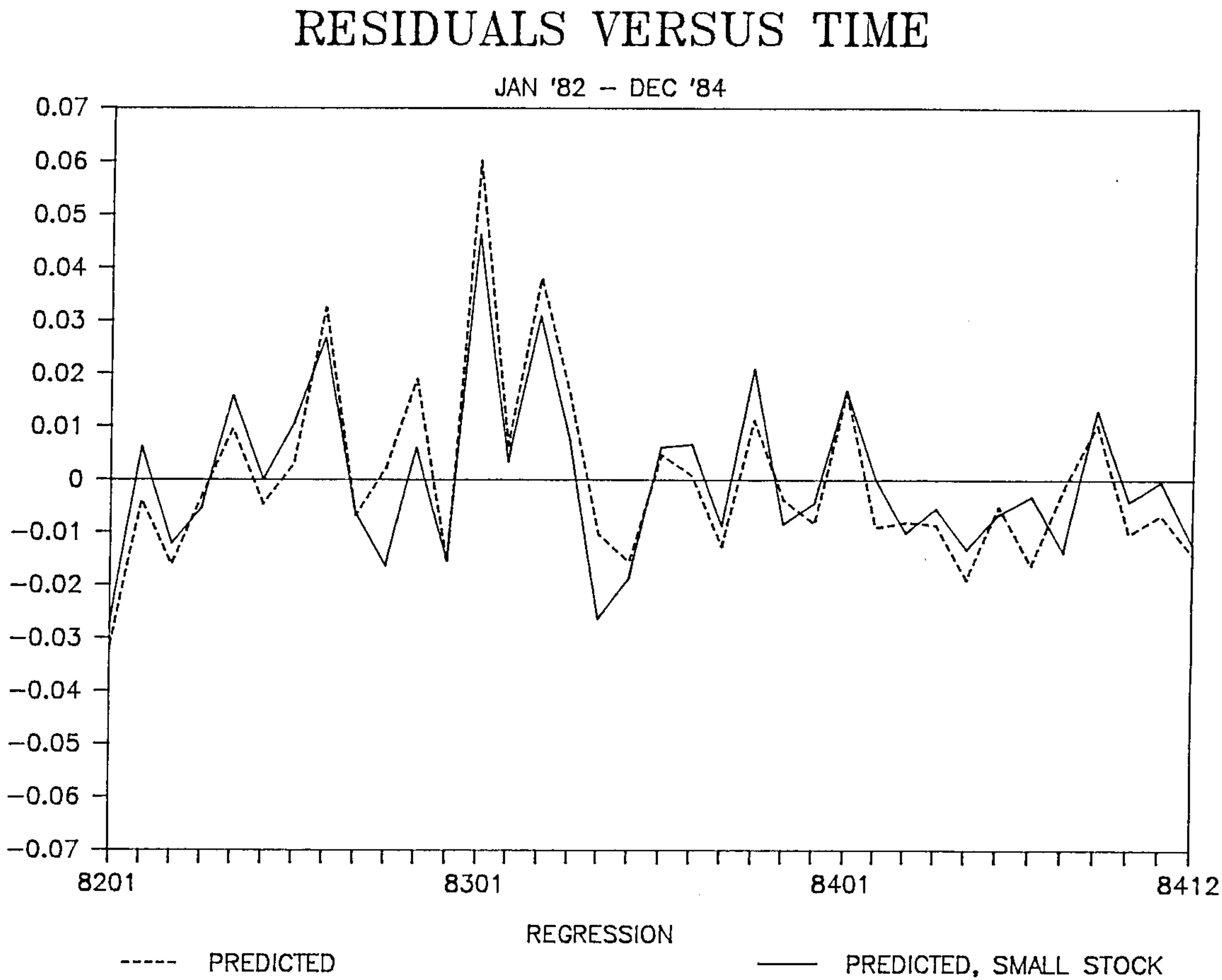
RESIDUALS VERSUS TIME
JAN '82 – DEC '84
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
−0.07
8201
8301
8401
8412
REGRESSION
PREDICTED
PREDICTED, SMALL STOCK

FIGURE 1B

regression that includes all variables, the regressions with the greatest R-squared include both the predicted return and the small stock index.

The results for the second half of the sample, January 1985 through December 1987, are quite different from those of the first half (Table 2C and Figure 1C). For individual bonds, the explanatory power of the independent variables drops considerably. In contrast to the first period, the returns on the stock market explain more of the variability than the predicted return. With the exception of the regression that includes all variables, the regression with the greatest R-squared includes both the predicted return and the small stock index.

The regressions using average values indicate that either the S&P or small stock return by itself explains more variability than the predicted return. Of interest, however, is that the regression that includes both the predicted return and the small stock return has about the same explanatory power as in the first period.[11]

4. Conclusion

This paper examines the risk and return of lower-grade (junk) bonds using an extensive file of individual bond prices developed in Blume and Keim (1987) and updated to the end of 1987 for the tests reported here. This analysis indicates that a diversified portfolio of lower-grade bonds has lower return variability than indexes of long term high-grade corporate bonds, long term Treasury bonds, S&P 500 stocks, and small stocks. This perhaps unexpected result is attributable to the diversification of bond-specific risk in the portfolio and the lower sensitivity of lower-grade bonds to unexpected interest rate movements, relative to the other bond categories.

In addition to a high correlation with the other bond market portfolios, our diversified portfolio of lower-grade bonds exhibits substantial comovement

TABLE 2C

Regressions of Lower-Grade Bond Returns on Bond and Stock Market Returns[1]
1/1985 - 12/1987

$$R_{it} = a_{0i} + a_{1i}R_t^{BOND} + a_{2i}R_t^{STOCK} + e_{it}$$

	Bond Market Return (R_t^{BOND})		Stock Market Return (R_t^{STOCK})		
Intercept	Predicted	Government	S&P 500	Small Stock Index	Adjusted R^2
A. Stacked Individual Regressions					
0.0020 (0.0008)[2]	0.5319 (0.0359)				0.047
0.0054 (0.0007)		0.2863 (0.0195)			0.049
0.0060 (0.0007)			0.2025 (0.0115)		0.060
0.0074 (0.0007)				0.2159 (0.0121)	0.071
0.0049 (0.0011)	0.0778 (0.1861)	0.2461 (0.1005)			0.049
0.0008 (0.0008)	0.4198 (0.0355)		0.1707 (0.0118)		0.088
0.0013 (0.0008)	0.4647 (0.0346)			0.1986 (0.0118)	0.107
0.0025 (0.0011)	0.3594 (0.1825)	0.0758 (0.0995)	-0.0943 (0.0233)	0.2792 (0.0242)	0.108
B. Average Values					
0.0023 (0.0037)	0.5333 (0.1698)				0.263
0.0058 (0.0031)		0.2834 (0.0814)			0.275
0.0065 (0.0030)			0.1977 (0.0400)		0.319
0.0078 (0.0027)				0.2085 (0.0382)	0.383
0.0088 (0.0085)	-0.4473 (1.1541)	0.5149 (0.5460)			0.256
0.0010 (0.0039)	0.4328 (0.1353)		0.1677 (0.0489)		0.488
0.0014 (0.0034)	0.4757 (0.1205)			0.1931 (0.0233)	0.602
0.0023 (0.0079)	0.4323 (0.9518)	0.0397 (0.4675)	-0.0942 (0.0932)	0.2741 (0.0746)	0.591

[1]Regressions are estimated using weighted least squares, where the weight is the bond's own price. Standard errors are in parentheses.

[2]All standard errors are heteroscedastic consistent.

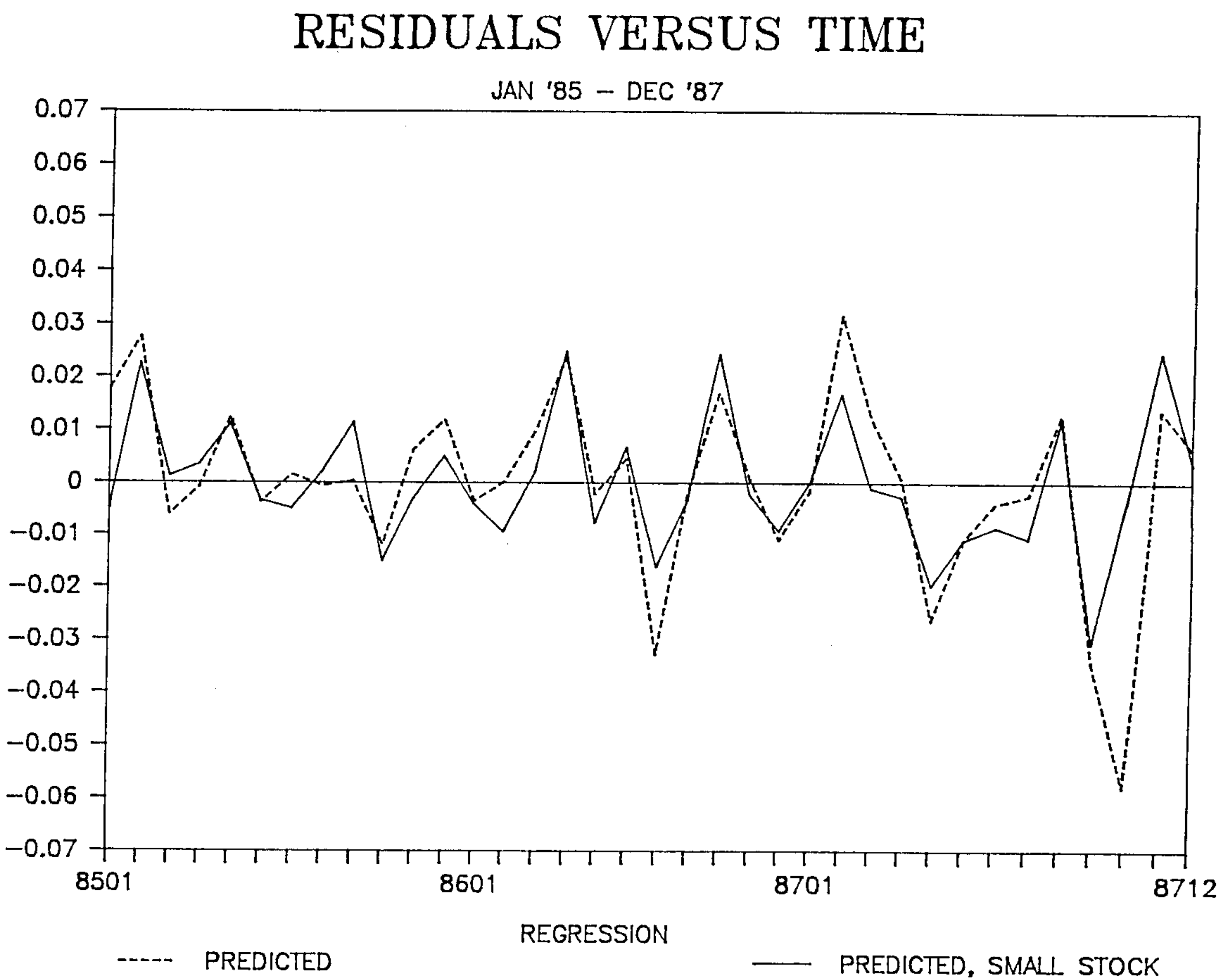
RESIDUALS VERSUS TIME
JAN '85 – DEC '87
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
−0.07
8501
8601
8701
8712
REGRESSION
PREDICTED
PREDICTED, SMALL STOCK

FIGURE 1C

with common stocks. For example, the correlation between the returns on the lower-grade bond portfolio and the small stock index is .61 over the 1985 to 1987 period. Using the bond price model of Brennan and Schwartz (1977) and stock market indexes, we try to isolate the separate influences of unexpected term structure shifts and stock market movements on lower-grade bond returns. Over the 1982-1984 period, relatively more of the variability of lower-grade bond returns is attributable to bond market movements than to stock market movements. After 1984, stock market movements appear somewhat more important than bond market movements.

Footnotes

[1]See Nunn, Hill and Schneeweiss (1986) for a discussion of the impact of the data source on the measurement of bond returns and risk.

[2]The average maturity of our sample at December 1987 is 13.9 years.

[3]To avoid any biases due to dropping a bond before it defaults, we augment the Drexel and Salomon data with total returns derived from prices in the S&P Bond Guide for the two months following the deletion of a bond from either the Drexel or Salomon samples.

[4]Note that an S&P Bond Guide price can represent a closing price on the New York Bond Exchange (if listed and traded) or the average bid price from one or more market makers, or a "matrix" price. Thus, a monthly return may reflect a price change using some combination of any of these alternatives. In Blume and Keim (1987), we compute returns on portfolios that are identical except for the source of the bond price, and find that portfolio returns computed from Drexel-Salomon prices are highly correlated (r=.92) with the portfolio returns computed from S&P Bond Guide prices.

[5]In preliminary work, we estimated Δr as the difference in the yield between the current month end and the next month end. The procedure outlined in the text produces a somewhat better fit to the regressions.

[6]A more direct approach is to use the difference in the income yields that Ibbotson Associates provide. We tried this approach but found that on occasion changes in coupon yields were inconsistent with changes in the realized returns. This inconsistency probably arises from the insertion and deletion of individual bonds in the Ibbotson data.

[7]The estimate of $\sigma(r)$ is the standard deviation of the natural logarithm of r_t plus the estimated value of Δr divided by r_t. Note that the sum of r_t and Δr may differ from the yield reported by Salomon for the next month.

[8]A standard F-test does not find the improvement significant at any usual level.

[9]Although the computer program did formally average the stock returns, the average stock return for any month is the same as the returns before averaging.

[10]The slope coefficient in the regression of the average returns on the average predicted returns is 0.78 when October 1987 is deleted. This compares to 0.72 for the entire sample. The slope coefficient in the regression of the average returns on the average predicted returns and the small stock index are respectively 0.67 and 0.16 when October 1987 is deleted. These compare to 0.65 and 0.19 for the entire sample.

[11]As with the overall period, the regressions using average returns as the dependent variable are rerun excluding the data for October 1987. Not unexpectedly in view of the overall results, there is little change in the regressions.

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