Returns-Based Style Analysis of Convertible Bond Funds

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In the Spring 2008 issue of this journal, Domian and Reichenstein [2008] presented the results of a returns-based style analysis of high-yield bond indices and high-yield bond funds. The results indicated that high-yield bonds are hybrid securities with returns sensitive to returns on cash, high-grade bonds, and stocks. Moreover, and as expected, as the ratings of the high-yield indices fell from BB to B, and then to CCC and lower, their returns better tracked returns on portfolios with increasing allocations to common stocks and decreasing allocations to high-grade bonds. Separately, the asset allocations of the shadow portfolios that best tracked the returns of high-yield bond funds were presented. This study produces comparable results for a convertible bond index and convertible bond mutual funds.

The usefulness of the returns-based style analysis of convertible bond returns is illustrated with the following example. Suppose an investor—individual or institution—has a portfolio containing cash, high-grade bond funds, stock funds, and convertible bond funds, and the investor wants to know the portfolio's overall asset allocation. The key question is how to classify the convertible bond funds in a stocks-bonds-cash asset allocation. There is wide agreement that convertible bonds are hybrid assets whose returns are sensitive to both bond returns and stock returns. This knowledge is not sufficient, however, to allow the investor to calculate the portfolio's asset allocation. The investor also must determine whether the convertible bond funds better track the returns on a 70% bond/30% stock portfolio or perhaps a 35% bond/65% stock portfolio. Moreover, the investor would also want to know the investment styles of the underlying stock exposure. Is the stock exposure to small-cap value, large-cap value, or perhaps small-cap growth stocks?

In this article, we present the results of a returns-based style analysis of a convertible bond index and 16 convertible bond funds. These results explicitly separate the index and bond funds into underlying exposures to high-grade bonds, stocks, and sometimes cash. Furthermore, the results separate each fund's stock exposure into four asset classes—domestic small-cap value, small-cap growth, large-cap value, and large-cap growth. These results should help investors better understand their convertible bond funds' styles and, therefore, to better understand how their convertible bond funds contribute to their overall asset allocation.

The next section discusses the previous research on convertible bonds, followed by an explanation of the bondholder's embedded call option in convertible bonds. Later sections describe returns-based style analysis and present results for the style analysis. The final section concludes.

PREVIOUS RESEARCH

Brigham [1966] presented some of the basic features of convertible bonds, along with insights from a questionnaire sent to corporations that had issued these securities. In the subsequent decade, advances in theoretical models of bond and option pricing allowed for more sophisticated analyses, beginning with studies by Brennan and Schwartz [1977] and Ingersoll [1977]. Further analysis of pricing was presented by Tsiveriotis and Fernandes [1998], Takahashi, Kobayashi, and Nakagawa [2001], and Carayannopoulos and Kalimipalli [2003].

A persistent belief in fixed-income markets is that convertible bonds are underpriced, especially at the time they are issued. In their discussion of convertible bonds as an asset class, Lummer and Riepe [1993] cited underpricing as one reason for investors to hold these securities. Chan and Chen [2007] presented an explanation for the underpricing dilemma.

In the U.S., the accounting profession follows Accounting Principles Board Opinion No. 14 that states a convertible bond should be recorded solely as debt; that is, accountants do not separate a convertible bond into bond and stock components, but they do add common stock shares that would result from conversion to shares outstanding when calculating fully diluted earnings per share. Arak and Martin [2005] suggested a method for separating a convertible bond into bond and stock components, so the profession can better estimate that firm's debt, equity, leverage, and EPS. Their method provides a way to separate a single convertible bond into bond and stock components at a point in time. Our study provides a separation of convertible bond funds into stock, bond, and cash exposures for use when calculating the asset allocation. Furthermore, our estimates are designed to provide separations that should prove useful through time.

We are aware of only one other study, besides this article, with a focus on mutual funds holding convertible bonds. Amman, Kind, and Seiz [2007] examined the performance of individual funds with multivariate cross-sectional analyses. One of their factors is a convertible bond index. Thus, their results are not useful for separating a convertible bond fund into stock, bond, and cash components, which is the goal of this article. They present evidence of trading activities related to convertible arbitrage.[1] While our study also examines individual funds, we do not attempt to determine which funds outperform or underperform the market on a risk-adjusted basis.

EMBEDDED OPTIONS IN CONVERTIBLE BONDS

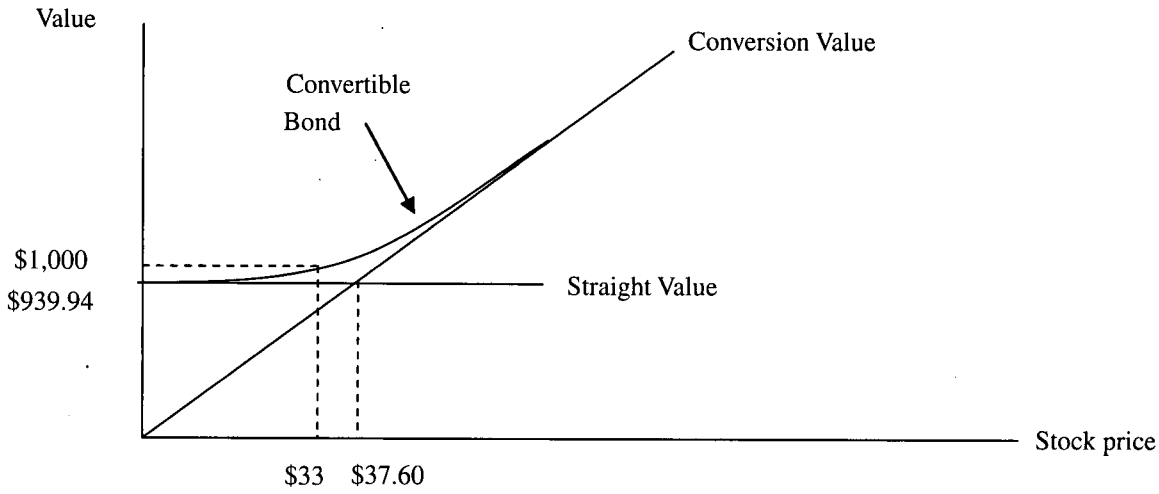
This section presents an option-based analysis of a single convertible bond. It shows that the convertible bond's price will vary with the security's underlying straight bond value and the firm's stock price. Therefore, a convertible bond fund's returns should have bond-like and stock-like return characteristics.

Consider a hypothetical convertible bond on Allied Appliances Corporation (AAC). The $1,000 par value bond has a 5% coupon rate, 10-year maturity, and is convertible into 25 shares of common stock. At issue, it sells for $1,000, and the stock price is $33. The *conversion ratio* is 25; that is, the bondholder may convert the bond into 25 shares of common stock, so the *conversion price* is $40 ($1,000/25 shares). This option to convert is essentially a call option on the stock at $40 per share. Theoretically, the callable bond's value is the *straight value* (i.e., straight bond value, ignoring the call option) plus the value of the call option on AAC stock with an exercise price of $40. That is, convertible bond value = straight value + call option on stock.[2]

The straight value is the present value of the bond's payments if the bond is not converted. If a nonconvertible AAC bond with similar terms would sell at a 5.8% yield, then the straight value is $939.94.[3] The *conversion value* is the value if the bond is converted to common stock. Since the stock price at issue is $33, the conversion value is $825, or $33 × 25 shares. The straight value is its pure bond value, while the conversion value is the pure stock value. Obviously, the minimum price of the convertible bond is the greater of the straight value and conversion value.

Exhibit 1 presents a graph that depicts the value of this convertible bond. At issue, since the convertible bond is priced at $1,000 and the straight value is $939.94, the value of the call option must be the difference, or $60.06. After issue, if the stock price falls well below the $40 conversion price, the bond will act like a straight bond. Exhibit 1 depicts the current straight value of $939.94 as a hard floor. In practice, however, this straight value can change. If interest rates rise or the creditworthiness of the issue falls, then the straight bond value will decrease. So, in practice, although the convertible bond will not sell for less than the straight value, the straight value can fall, so it is not a hard floor. If the stock price rises well above $40, the bond will act like a stock; it is said to be

EXHIBIT 1
Value of Convertible Bond



a common-stock equivalent. If the stock price remains in the range from somewhat below to slightly above $40, then the convertible bond will act like a hybrid security with bond-like and stock-like return characteristics.

Exhibit 1 illustrates the value of one callable bond. A convertible bond mutual fund's returns will reflect the bond-like and stock-like characteristics of each of its underlying convertible securities. In practice, therefore, a convertible bond fund is a hybrid security and its returns should vary with both bond returns and stock returns.

RETURNS-BASED STYLE ANALYSIS

William Sharpe [1988, 1992] developed returns-based style analysis (RBSA) to determine a mutual fund's investment style.[4] For example, RBSA might determine that a stock fund's style is 40% Russell 1000 Growth and 60% Russell 2000 Growth. That is, the stock fund's returns most closely track the shadow portfolio composed of 40% Russell 1000 Growth Index and 60% Russell 2000 Growth Index. Although Morningstar might place this fund in its small-cap growth category, a better reflection of its style would be that its style-based returns follow the returns on the 40%–60% shadow portfolio instead of following the returns on the Russell 2000 Growth Index. Similarly, the better measure of the returns attributable to the fund manager's ability would be the difference between the fund's returns and the shadow portfolio's returns rather than the difference between the fund's returns and the Russell 2000 Growth Index's returns.

RBSA estimates the following asset class factor model:

$$R_{i,t} = [b_{i1}F_{1,t} + b_{i2}F_{2,t} + \cdots + b_{in}F_{n,t}] + e_{i,t} \qquad (1)$$

$R_{i,t}$ denotes the return on asset i for period t. In this study, the dependent variable, R_{it}, is the return on a convertible bond index or mutual fund. $F_{1,t}$ denotes the return on factor 1 for period t; $F_{2,t}$ the return on factor 2 for period t; $F_{n,t}$ the return on factor n for period t; and $e_{i,t}$ the nonfactor component of the return on asset i for period t. The values b_{i1} through b_{in} denote the sensitivities (a.k.a., factor loadings, factor weights, and implied exposures) of $R_{i,t}$ to factors $F_{1,t}$ through $F_{n,t}$. In RBSA, the factors are asset class returns, and the goal of RBSA is to determine a mutual fund's effective allocation across asset classes.

To be operational, we must define the asset classes. From Sharpe [1992], each asset class should 1) be mutually exclusive, 2) be exhaustive, and 3) have returns that differ. Each asset class should be a cap-weighted portfolio of securities, with as many securities as possible considered, but no security should be included in more than one asset class. Furthermore, it is important that investors could feasibly attain the approximate return on each asset class.

Exhibit 2 presents the factors or asset classes used to evaluate convertible bond returns. There are four stock and five fixed-income asset classes. The stock asset classes are Russell 1000 Value, Russell 1000 Growth, Russell

EXHIBIT 2

Asset Classes Used in Returns-Based Style Analysis of Convertible Bonds

Asset Class	Index (Abbreviation)
Large- and mid-cap value stocks	Russell 1000 Value (R1000 Value)
Large- and mid-cap growth stocks	Russell 1000 Growth (R1000 Growth)
Small-cap value stocks	Russell 2000 Value (R2000 Value)
Small-cap growth stocks	Russell 2000 Growth (R2000 Growth)
AAA corporate bonds	LB AAA Corporate Bond (AAA Corp)
Long-term government bonds	LB Long-Term Government (LT Gov)
Intermediate-term government bonds	LB Intermediate-Term Government (IT Gov)
Mortgage-backed securities	LB Mortgage-Backed Securities (MBS)
Cash	One-month Treasury bills (Tbills)

LB denotes Lehman Brothers. Due to infrequent trading on convertible bonds, the returns-based style analysis uses current and one-month lagged values of each asset class return.

2000 Value, and Russell 2000 Growth. These are components of the Russell 3000 Index, a measure of the total U.S. stock market that is especially popular with institutional investors. These four components separate the Russell 3000 into four exhaustive and non-overlapping indices by size and style. The fixed-income market is separated into five segments: Lehman Brothers (LB) AAA Corporate, LB Long-term Government, LB Intermediate-term Government, LB Mortgage-backed Securities, and one-month Treasury bills. These indices satisfy the goals of being non-overlapping and exhaustive, and investors can feasibly attain the approximate return on each index.

Convertible bond funds contain, in addition to convertible bonds, both preferred and common stocks, straight (i.e., nonconvertible) bonds, cash, and a fraction of "other" assets. Some of these assets, especially the preferred stocks and convertible bonds, may be subject to infrequent trading. The observed return on a convertible bond fund in month t could thus be related to the returns on some of these nine asset classes in month t and the returns on some of these nine asset classes in the prior month. Therefore, RBSAs for the index and convertible bond funds use 18 independent variables—the current monthly return and the lagged monthly return on the nine asset classes.

RBSA requires minimizing the sum of squared errors, where each error is

$$e_{i,t} = R_{i,t} - [b_{i1}F_{1,t} + b_{i2}F_{2,t} + \cdots + b_{in}F_{n,t}]. \qquad (2)$$

The b_i coefficients in Equation (2) are constrained as $0 \le b_i \le 1$ for all b_i, and $\sum b_i = 1$. In words, there is no short selling (b_i cannot be negative) and the sum of the coefficients must equal 1. R^2 denotes the percent of the variance of $R_{i,t}$ that is explained by the style-based shadow portfolio (the bracketed expression in Equation (2)). In common usage, R^2 denotes the percentage of returns attributed to the mutual fund's style, and $(1 - R^2)$ denotes the return attributed to selection.[5]

DATA

This study examines returns-based style analysis for a convertible bond index and 16 convertible bond funds for the 1998–2007 period and its two subperiods. The index is the Merrill Lynch Convertible Bonds All Quality Index (ML Index). The sample of bond funds includes all convertible bond funds with a Morningstar category of convertible bonds and with monthly returns from January 1998 through December 2007. The returns data come from Morningstar. Some bond funds have multiple share classes with different load structures, but only one share class for each fund was examined. Sixteen separate convertible bond funds met the criteria.

Morningstar defines funds in its convertible bonds category as follows:

> Convertible bond portfolios are designed to offer some of the capital-appreciation potential of stock portfolios while also supplying some of the safety

and yield of bond portfolios. To do so, they focus on convertible bonds and convertible preferred stocks. Convertible bonds allow investors to convert the bonds into shares of stock, usually at a preset price. These securities thus act a bit like stocks and a bit like bonds.

As suggested by this definition, convertible bond funds contain more than just convertible bonds.

Exhibit 3 presents the average allocation of each convertible bond fund across cash, stocks, bonds, preferred stocks, convertible bonds, and other assets over the 2005–2007 period. For this period, the average convertible bond fund only invested 41.2% of its assets in convertible bonds. Preferred stocks, including preferred convertibles, represented 17.6% of assets, while stocks and bonds represented 12.2% and 25.1%, respectively.[6]

Our data also include monthly returns for the asset classes described in an earlier section. The asset classes include four stock indices: Russell 1000 Value, Russell 1000 Growth, Russell 2000 Value, and Russell 2000 Growth. There are also returns from five fixed-income segments: Lehman Brothers AAA Corporate (AAA Corp), LB Long-term Government (LT Gov), LB Intermediate-term Government (IT Gov), LB Mortgage-backed Securities (MBS), and one-month Treasury bills (Tbills). Because the RBSAs use both current and lagged monthly returns for these asset classes, the series are obtained for the period December 1997 through December 2007.

EXHIBIT 3

Expense Ratios and Average Allocations to Asset Classes, 2005–2007

Convertible Bond Fund	Expense Ratio	Cash	Stocks	Bonds	Pref.	Conv.	Other
Calamos Convertible A	1.12%	0.6%	18.6%	33.3%	10.8%	36.1%	0.6%
Columbia Convertible Securities A	1.05	1.0	47.8	23.6	5.6	21.3	0.6
Davis Appreciation & Income A	1.06	20.2	29.2	11.4	6.8	30.0	2.4
Fidelity Convertible Securities	0.83	2.1	13.2	22.7	17.4	44.4	0.1
Franklin Convertible Securities A	0.87	4.5	7.2	19.3	33.0	36.0	0.0
GAMCO Global Convertible Secs AAA	2.00	2.2	2.2	17.1	17.3	61.2	0.0
Legg Mason Partners Convertible B	1.83	1.1	11.9	32.5	12.9	40.6	1.0
MainStay Convertible B	1.95	2.1	10.0	25.9	13.3	48.4	0.4
Morgan Stanley Convertible Secs B	1.88	0.5	5.7	27.7	22.5	43.3	0.3
Nicholas-Applegate U.S. Convertible I	0.84	1.9	5.1	28.1	15.9	49.0	0.0
Oppenheimer Convertible Securities M	0.91	3.0	9.6	22.6	26.6	37.9	0.2
Putnam Convertible Income-Growth A	1.05	1.0	9.5	29.5	28.0	28.9	3.1
Value Line Convertible	1.18	5.0	14.1	24.2	17.3	39.1	0.2
Van Kampen Harbor A	1.05	2.5	4.5	24.8	22.9	45.0	0.3
Vanguard Convertible Securities	0.79	2.6	1.3	42.5	10.1	43.5	0.0
Victory Investment-Grade Convertible A	1.36	3.1	5.2	16.2	21.2	54.3	0.0
Averages	**1.24**	**3.3**	**12.2**	**25.1**	**17.6**	**41.2**	**0.6**

Three-year average allocations by asset class from January 2008 issue of Morningstar Principia. The ticker symbols are CCVIX, PACIX, RPFCX, FCVSX, FISCX, GAGCX, SCVSX, MCSVX, CNSBX, NIGIX, RCVGX, PCONX, VALCX, ACHBX, VCVSX, and SBFCX.

COMPARATIVE STATISTICS

Exhibit 4 presents average monthly returns, standard deviations, and other statistics for the ML Index, four Russell stock indices, four high-grade bond series, and Treasury bills for the period from January 1998 through December 2007. The average monthly return for the ML Index is 0.66%. As expected, this is higher than the average returns on the high-grade bond series. The 0.66% return is competitive with returns on many of the stock series, which have average returns of 0.46% to 0.83% per month. The standard deviation of monthly returns on the ML Index is 3.73%, and as expected, is between the standard deviations of returns of high-grade bonds and stocks.

The autocorrelation coefficient measures the correlation between a series' monthly returns and one-month lagged returns for that series. Although the 0.11 autocorrelation coefficient on the ML Index suggests that there may be some infrequent trading concerns, it is insignificant at the 5% level. As expected, none of the autocorrelation coefficients on the stock or high-grade bond series is significant, which is consistent with the absence of infrequent trading problems for these series.

The ML Index, Russell stock series, and high-grade bond series have negative skewness and positive kurtosis. The positive kurtosis implies fat tails in the distribution, and the negative skewness implies a tendency for more large losses than expected from normally distributed returns. As shown in Exhibit 4, the ML Index, Russell 1000 Value, Russell 2000 Value, AAA Corp, and LT Gov returns series exhibit strong kurtosis.[7] In mean-variance analysis, investors are assumed to care only about the mean and variance (or standard deviation, the square root of the variance). Because investors dislike negative skewness and positive kurtosis, convertible bonds should be less desirable than implied by mean-variance analysis.

Exhibit 5 presents statistics for the 16 convertible bond funds. The average net monthly return on the convertible funds is 0.64%.[8] All 16 convertible bond funds have a positive autocorrelation coefficient, and one of the autocorrelation coefficients is significant at the 5% level. These results suggest that infrequent trading may be a minor problem for convertible bond returns as a group.

Twelve of 16 bond funds' returns exhibit negative skewness and all 16 exhibit positive kurtosis. The average fund has skewness of –0.26 and kurtosis of 1.97. These statistics suggest that convertible bond funds are prone to more large losses than would occur if returns were normally distributed.

RETURNS-BASED STYLE ANALYSIS OF CONVERTIBLE BOND FUNDS

As discussed earlier, based on option theory a convertible bond is a hybrid asset; that is, its returns are similar to the returns of a combination of bonds and

EXHIBIT 4
Summary Statistics of Monthly Returns on Bonds and Stocks

Series	Mean	Standard Deviation	Auto-Correlation	Skewness	Kurtosis
ML Index	0.66%	3.73%	0.11	–0.13	2.92
R1000 Value	0.70	4.02	0.03	–0.49	1.93
R1000 Growth	0.46	5.39	0.04	–0.61	0.85
R2000 Value	0.83	4.59	0.15	–0.70	1.69
R2000 Growth	0.62	7.33	0.04	–0.27	0.79
AAA Corp	0.51	1.26	0.03	–0.81	2.96
LT Gov	0.61	2.39	0.00	–0.72	1.71
IT Gov	0.45	0.87	0.10	–0.36	0.88
MBS	0.48	0.74	0.13	–0.47	0.52
Tbills	0.29	0.14	0.96*	–0.23	–1.35

**Denotes significance at 5% level.*

EXHIBIT 5

Summary Statistics of Monthly Returns on Convertible Bond Funds

Convertible Bond Fund	Mean	Standard Deviation	Auto-Correlation	Skewness	Kurtosis
Calamos	0.80%	3.21%	0.05	0.34	2.15
Columbia	0.69	2.91	0.15	–0.27	2.35
Davis	0.53	3.10	0.14	–0.87	2.21
Fidelity	1.06	4.63	0.06	–0.18	2.22
Franklin	0.68	3.56	0.15	–0.47	1.08
GAMCO	0.59	3.54	0.18*	–0.19	1.21
Legg Mason	0.46	2.93	0.17	–0.05	0.88
MainStay	0.65	2.94	0.05	–0.35	0.88
Morgan Stanley	0.52	3.15	0.14	0.11	2.80
Nicholas-App	0.91	4.63	0.08	0.00	2.96
Oppenheimer	0.53	2.97	0.14	–0.48	1.07
Putnam	0.54	3.43	0.08	–0.79	1.49
Value Line	0.48	3.44	0.12	–0.26	2.37
Van Kampen	0.63	4.29	0.03	0.31	4.77
Vanguard	0.75	3.65	0.15	–0.48	1.72
Victory	0.47	2.63	0.08	–0.57	1.44
Averages of Funds	**0.64**	**3.44**	**0.11**	**–0.26**	**1.97**

**Denotes significance at the 5% level.*

stocks. The returns on a convertible bond fund should be sensitive to returns on stocks, high-grade bonds, and, perhaps, cash. This section examines RBSA results for the ML Index and the 16 bond funds for the full period (1998–2007) and the two five-year subperiods (1998–2002 and 2003–2007). The first subperiod included two excellent years followed by the stock market crash of 2000–2002. The 2003–2007 subperiod began with an excellent year, which was followed by four more positive years with S&P 500 returns between 4.9% and 15.8%.

ML Index. Exhibit 6 presents RBSA results for the ML Index for the period 1998–2007 and the two subperiods 1998–2002 and 2003–2007. For the period 1998–2007, the returns on the ML Index are similar to the returns on a portfolio consisting of 60% stocks and 40% bonds. To be more precise, the shadow portfolio that most closely tracks the returns on ML Index contains 16.2% large-cap growth, 2.6% small-cap value, and 41.2% small-cap growth stocks, while the bond portion contains 6.9% AAA Corp and 33.1% MBS.[9] About three-fourths of the implied stock exposure (43.8% of 60%) is to small-cap stocks. Because small-cap stocks represent about 10% of the market cap of all stocks, this suggests that smaller firms are the primary issuers of convertible bonds. Some 95% (57.4% of 60%) of the implied stock exposure is to growth stocks. In total, the shadow portfolio explains 87.8% of the variance of monthly returns. So, for the full period, the index fund's returns are similar to those achievable with a portfolio of 40% high-grade bonds and 60% stocks, especially small-cap growth stocks.

The subperiod results are similar, especially for the subperiod 1998–2002. From 1998 to 2002, the Sum of Stocks factor loading is 64.7%, which consists primarily of exposure to small-cap growth stocks. From 2003 to 2007, the Sum of Stocks loading fell to 55.3% with small-cap stock exposure falling to about 50% (27.9% of 55.3%). Because the Russell 2000 represents about 10% of the value of the entire stock market, there is a strong small-cap tilt in all periods. In short, for the full period and both subperiods, the ML Index had an implied stock

EXHIBIT 6

Returns-Based Style Analysis of ML Index

	R1000 Value	R1000 Growth	R2000 Value	R2000 Growth	Sum of Stocks	AAA Corp	LT Gov	IT Gov	MBS	Sum of Bonds	Tbills	R^2
1998–2007	0	0.162	0.026	0.412	**0.600**	0.069	0	0	0.331	**0.400**	0	0.878
1998–2002	0	0.148	0.046	0.454	**0.647**	0	0.035	0.214	0.103	**0.353**	0	0.903
2003–2007	0.126	0.149	0.109	0.170	**0.553**	0.291	0	0.115	0	**0.406**	0.041	0.824

ML Index is the Merrill Lynch Convertible Bonds All Quality Index. The column "Sum of Stocks" reports the sums of the coefficients on the four Russell stock indices. The column "Sum of Bonds" reports the sums of the coefficients on AAA Corp, LT Gov, IT Gov, and MBS.

exposure of about 60%; thus, the index behaved more like stocks than bonds.

Exhibit 7 presents the correlation coefficients between the ML Index and the returns on stocks, high-grade bonds, and cash. For reference, correlation coefficients of 0.18 or higher and 0.24 or higher are significant at the 5% and 1% levels, respectively. It is useful to separate the series into the ML Index, stocks (Russell series), high-grade bonds (AAA Corp, LT Gov, IT Gov, and MBS), and cash (Tbills). The correlations indicate convertible bond returns are strongly correlated with stock returns, especially growth stock returns. Separately, the correlations are stronger between the ML Index and a small-cap stock index than between the ML Index and the corresponding large-cap stock index.

Convertible bond returns are negatively correlated with monthly returns on high-grade bonds. All four of these correlations are negative, but only the correlation coefficient with IT Gov is significant at the 5% level. As expected, the correlation coefficient between the ML Index and Treasury bill returns is essentially zero.

For this period, all of the correlation coefficients between stocks and high-grade bonds are negative, with most of these correlations being significant at the 5% level or better.

The high correlation coefficients (0.80 to 0.94) between high-grade bond returns suggest that they are all one asset class,[10] which, in turn, suggests that the distribution of bond factor weightings is not important, but the sum of bond weights is important. For example, consider the bond factor loadings for the two subperiods

EXHIBIT 7

Correlation Coefficients, 1998–2007

		Stocks				High-Grade Bonds				Cash
	ML Index	R1000 Value	R1000 Growth	R2000 Value	R2000 Growth	AAA Corp	LT Gov	IT Gov	MBS	Tbills
ML Conv. Index	1	0.52	0.83	0.64	0.92	–0.07	–0.17	–0.23	–0.09	–0.03
R1000 Value		1	0.68	0.73	0.55	–0.18	–0.28	–0.33	–0.19	–0.01
R1000 Growth			1	0.56	0.81	–0.15	–0.25	–0.30	–0.17	0.00
R2000 Value				1	0.78	–0.12	–0.22	–0.31	–0.18	–0.09
R2000 Growth					1	–0.15	–0.24	–0.31	–0.19	–0.07
AAA Corp						1	0.94	0.92	0.86	0.07
LT Gov							1	0.89	0.80	0.03
IT Gov								1	0.88	0.18
MBS									1	0.16
Tbills										1

Correlation coefficients of 0.18 or higher and 0.24 or higher are significant at the 5% and 1% levels, respectively.

reported in Exhibit 6. The factor loadings appear to move primarily from IT Gov and MBS bonds in the 1998–2002 subperiod to AAA Corp and IT Gov in the 2003–2007 subperiod. But the high correlations imply that shadow portfolios using any of these high-grade bond series would have tracked the ML Index's returns almost as well. So, the Sum of Bonds is important, but their allocation across the four high-grade bond indices is not important.

In short, the correlation coefficients indicate that monthly returns on the ML Index have strong positive correlations with stock returns. For this period, the average correlation coefficient between stock and high-grade bond returns has been significantly negative at –0.22. Consequently, the ML Index returns have exhibited a weak, usually insignificant, negative correlation with high-grade bond returns.

Convertible bond funds. Exhibit 8 summarizes the RBSA results for the 16 bond funds for the period 1998–2007. The average results across bond funds presented in the exhibit are similar to the results for the ML Index. Over this period, the average sum of stock weights is 60.2%, essentially the same as for the ML Index. The average convertible bond funds' returns behave as if about 60% is invested in stocks, 30% in high-grade bonds, and 10% in cash. On average, over half (32.6% out of 60.2%) of the stock sensitivity is to small-cap growth stocks. Because the Russell 2000 Growth represents some 5% of the weight in the stock market, the average convertible bond fund has a strong tilt toward small-cap growth stocks.

Exhibits 9 and 10 present the results for the subperiods 1998–2002 and 2003–2007. The 1998–2002 subperiod results are similar to the full period results.

EXHIBIT 8

Returns-Based Style Analysis of Convertible Bond Funds, 1998–2007

Fund	R1000 Value	R1000 Growth	R2000 Value	R2000 Growth	Sum of Stocks	AAA Corp	LT Gov	IT Gov	MBS	Sum of Bonds	Tbills	R^2
Calamos	0.156	0.057	0.000	0.336	**0.550**	0.000	0.007	0.000	0.443	**0.450**	**0.000**	0.787
Columbia	0.217	0.001	0.000	0.328	**0.546**	0.000	0.131	0.000	0.198	**0.328**	**0.126**	0.833
Davis	0.221	0.098	0.160	0.163	**0.642**	0.224	0.000	0.000	0.000	**0.224**	**0.133**	0.770
Fidelity	0.004	0.185	0.021	0.519	**0.729**	0.271	0.000	0.000	0.000	**0.271**	**0.000**	0.860
Franklin	0.136	0.114	0.237	0.260	**0.746**	0.010	0.091	0.138	0.000	**0.240**	**0.014**	0.847
GAMCO	0.011	0.058	0.000	0.429	**0.498**	0.002	0.133	0.000	0.000	**0.135**	**0.367**	0.699
Legg Mason	0.084	0.214	0.391	0.011	**0.699**	0.014	0.053	0.163	0.000	**0.229**	**0.071**	0.767
MainStay	0.109	0.160	0.058	0.224	**0.550**	0.000	0.067	0.000	0.105	**0.173**	**0.277**	0.831
Morgan Stanley	0.000	0.020	0.053	0.413	**0.487**	0.000	0.098	0.000	0.216	**0.314**	**0.199**	0.849
Nicholas-App	0.000	0.165	0.000	0.515	**0.680**	0.000	0.137	0.000	0.183	**0.320**	**0.000**	0.850
Oppenheimer	0.052	0.173	0.092	0.255	**0.572**	0.031	0.000	0.000	0.397	**0.428**	**0.000**	0.873
Putnam	0.226	0.082	0.074	0.313	**0.695**	0.209	0.000	0.000	0.000	**0.209**	**0.097**	0.904
Value Line	0.000	0.165	0.021	0.346	**0.532**	0.000	0.024	0.000	0.444	**0.468**	**0.000**	0.817
Van Kampen	0.000	0.093	0.000	0.494	**0.587**	0.000	0.081	0.090	0.243	**0.413**	**0.000**	0.791
Vanguard	0.038	0.058	0.059	0.455	**0.610**	0.000	0.287	0.000	0.103	**0.390**	**0.000**	0.862
Victory	0.126	0.132	0.101	0.157	**0.515**	0.000	0.029	0.000	0.177	**0.206**	**0.279**	0.838
Minimum	0.000	0.001	0.000	0.011	**0.487**	0.000	0.000	0.000	0.000	**0.135**	**0.000**	0.699
Maximum	0.226	0.214	0.391	0.519	**0.746**	0.271	0.287	0.163	0.444	**0.468**	**0.367**	0.904
Average	0.086	0.111	0.079	0.326	**0.602**	0.047	0.071	0.024	0.157	**0.300**	**0.098**	0.824

The column "Sum of Stocks" reports the sums of the coefficients on the four Russell stock indices. The column "Sum of Bonds" reports the sums of the coefficients on AAA Corp, LT Gov, IT Gov, and MBS.

EXHIBIT 9

Returns-Based Style Analysis of Convertible Bond Funds, 1998–2002

Fund	R1000 Value	R1000 Growth	R2000 Value	R2000 Growth	Sum of Stocks	AAA Corp	LT Gov	IT Gov	MBS	Sum of Bonds	Tbills	R^2
Calamos	0.139	0.048	0.007	0.348	**0.542**	0.000	0.011	0.000	0.446	**0.458**	**0.000**	0.774
Columbia	0.208	0.000	0.000	0.343	**0.552**	0.000	0.180	0.000	0.145	**0.326**	**0.122**	0.837
Davis	0.159	0.140	0.274	0.143	**0.716**	0.000	0.104	0.000	0.023	**0.127**	**0.157**	0.795
Fidelity	0.015	0.170	0.045	0.554	**0.784**	0.018	0.143	0.000	0.056	**0.216**	**0.000**	0.905
Franklin	0.117	0.106	0.272	0.267	**0.762**	0.000	0.092	0.074	0.000	**0.166**	**0.072**	0.853
GAMCO	0.000	0.088	0.000	0.434	**0.522**	0.000	0.126	0.000	0.000	**0.126**	**0.353**	0.755
Legg Mason	0.101	0.199	0.366	0.023	**0.690**	0.000	0.091	0.043	0.000	**0.134**	**0.176**	0.757
MainStay	0.094	0.159	0.085	0.229	**0.568**	0.000	0.138	0.000	0.001	**0.140**	**0.293**	0.863
Morgan Stanley	0.000	0.005	0.082	0.442	**0.529**	0.000	0.187	0.000	0.150	**0.337**	**0.133**	0.869
Nicholas-App	0.000	0.162	0.000	0.543	**0.705**	0.000	0.212	0.083	0.000	**0.295**	**0.000**	0.859
Oppenheimer	0.023	0.164	0.124	0.281	**0.591**	0.000	0.017	0.000	0.392	**0.409**	**0.000**	0.911
Putnam	0.232	0.061	0.071	0.342	**0.705**	0.000	0.098	0.000	0.000	**0.098**	**0.196**	0.927
Value Line	0.000	0.161	0.026	0.363	**0.550**	0.000	0.055	0.000	0.395	**0.450**	**0.000**	0.820
Van Kampen	0.000	0.056	0.000	0.573	**0.628**	0.000	0.229	0.143	0.000	**0.372**	**0.000**	0.820
Vanguard	0.052	0.023	0.060	0.493	**0.629**	0.000	0.371	0.000	0.000	**0.371**	**0.000**	0.888
Victory	0.108	0.140	0.139	0.153	**0.539**	0.000	0.041	0.000	0.115	**0.156**	**0.305**	0.848
Minimum	0.000	0.000	0.000	0.023	**0.522**	0.000	0.011	0.000	0.000	**0.098**	**0.000**	0.755
Maximum	0.232	0.199	0.366	0.573	**0.784**	0.018	0.371	0.143	0.446	**0.458**	**0.353**	0.927
Average	0.078	0.105	0.097	0.346	**0.626**	0.001	0.131	0.021	0.108	**0.261**	**0.113**	0.843

The column "Sum of Stocks" reports the sums of the coefficients on the four Russell stock indices. The column "Sum of Bonds" reports the sums of the coefficients on AAA Corp, LT Gov, IT Gov, and MBS.

The bond funds' average stock exposure is 62.6% with a strong tilt toward small-cap growth stocks. For the 2003–2007 subperiod, the average stock exposure is 60.9%, but slightly less than half of this weight (26.6% out of 60.9%) is associated with small-cap stocks. Because small-cap stocks represent about 10% of the entire stock market, the average convertible bond fund exhibits a strong small-cap tilt in both periods as well as in the full period. The results for the average convertible bond fund are similar for all three periods: The average fund had implied exposures of about 60% stocks, 30% bonds, and 10% cash.

The primary values of Exhibits 8 through 10 is that they provide implied asset allocations for the 16 separate bond funds. For the 16 funds, the average R^2 across all three periods is over 81%, and an R^2 of 0.81 implies a correlation coefficient of 0.9. This indicates that these funds' returns closely follow their respective shadow portfolios of stocks, high-grade bonds, and Treasury bills. Furthermore, the Sum of Stocks weights remain relatively stable across subperiods, which suggests that the separation of convertible bond funds into the broad asset classes of stocks, bonds, and cash remains relatively stable.

For all three periods, all convertible bond funds had implied stock exposures ranging from about 50% to 80%. This is a relatively small range and implies that convertible bond funds are consistently more stock-like than bond-like or cash-like. The implied stock exposures varied by fund. For all three periods, Fidelity, Franklin, and Putnam had relatively high implied stock exposures compared to GAMCO, Morgan Stanley, Value Line, and Victory funds, which for all periods had relatively low implied stock exposures.

For the full period, all of the funds had small-cap exposures—defined as the sum of factor weights on the Russell 2000 Growth and Russell 2000 Value divided by the Sum

EXHIBIT 10

Returns-Based Style Analysis of Convertible Bond Funds, 2003–2007

Fund	R1000 Value	R1000 Growth	R2000 Value	R2000 Growth	Sum of Stocks	AAA Corp	LT Gov	IT Gov	MBS	Sum of Bonds	Tbills	R^2
Calamos	0.215	0.153	0.000	0.256	**0.625**	0.115	0.000	0.178	0.082	**0.375**	**0.000**	0.848
Columbia	0.284	0.108	0.036	0.184	**0.612**	0.219	0.000	0.137	0.032	**0.388**	**0.000**	0.846
Davis	0.211	0.111	0.225	0.000	**0.547**	0.278	0.028	0.000	0.000	**0.306**	**0.147**	0.750
Fidelity	0.289	0.019	0.007	0.348	**0.664**	0.176	0.000	0.160	0.000	**0.336**	**0.000**	0.682
Franklin	0.153	0.262	0.335	0.024	**0.773**	0.189	0.038	0.000	0.000	**0.227**	**0.000**	0.854
GAMCO	0.173	0.000	0.062	0.247	**0.482**	0.318	0.036	0.000	0.000	**0.354**	**0.163**	0.523
Legg Mason	0.167	0.216	0.201	0.143	**0.727**	0.195	0.000	0.000	0.078	**0.273**	**0.000**	0.804
MainStay	0.194	0.240	0.000	0.182	**0.616**	0.000	0.000	0.248	0.021	**0.269**	**0.115**	0.742
Morgan Stanley	0.163	0.105	0.039	0.227	**0.535**	0.238	0.000	0.056	0.000	**0.293**	**0.172**	0.830
Nicholas-App	0.187	0.192	0.011	0.308	**0.699**	0.000	0.006	0.170	0.125	**0.301**	**0.000**	0.865
Oppenheimer	0.274	0.192	0.042	0.098	**0.606**	0.228	0.000	0.063	0.000	**0.291**	**0.103**	0.788
Putnam	0.351	0.083	0.078	0.189	**0.701**	0.265	0.000	0.000	0.000	**0.265**	**0.034**	0.838
Value Line	0.173	0.117	0.033	0.220	**0.542**	0.150	0.012	0.156	0.000	**0.318**	**0.140**	0.843
Van Kampen	0.156	0.115	0.037	0.206	**0.515**	0.127	0.000	0.000	0.250	**0.378**	**0.108**	0.779
Vanguard	0.101	0.141	0.058	0.295	**0.595**	0.370	0.000	0.000	0.036	**0.405**	**0.000**	0.789
Victory	0.232	0.111	0.010	0.159	**0.512**	0.166	0.000	0.109	0.000	**0.275**	**0.213**	0.820
Minimum	0.101	0.000	0.000	0.000	**0.482**	0.000	0.000	0.000	0.000	**0.227**	**0.000**	0.523
Maximum	0.351	0.262	0.335	0.348	**0.773**	0.370	0.038	0.248	0.250	**0.405**	**0.213**	0.865
Average	0.208	0.135	0.073	0.193	**0.609**	0.190	0.007	0.080	0.039	**0.316**	**0.075**	0.788

The column "Sum of Stocks" reports the sums of the coefficients on the four Russell stock indices. The column "Sum of Bonds" reports the sums of the coefficients on AAA Corp, LT Gov, IT Gov, and MBS.

of Stocks factor weights—of at least 50%. This indicates that all of the convertible bond funds had strong small-cap tilts. The strongest small-cap tilts belong to the GAMCO, Morgan Stanley, Vanguard, and Van Kampen funds.

For the full period, funds at Fidelity, GAMCO, Morgan Stanley, Nicholas-Applegate, Value Line, Van Kampen, and Vanguard had growth exposures of at least 80%—defined as the sum of factor weights on the Russell 1000 Growth and Russell 2000 Growth divided by the Sum of Stocks factor weights—compared to the Davis and Legg Mason funds, which had growth exposures of less than 50%.

While studying and analyzing the fund-specific results, we learned that one fund—GAMCO—had a significant exposure to non-American securities. These non-American holdings averaged about 51% of fund assets in the 1998–2002 subperiod and about 40% in the 2003–2007 subperiod. A second fund, Fidelity, had modest holdings of non-American securities (averaging 13% of assets) during the 2003–2007 subperiod. No other fund had a significant holding of non-American securities. It is not surprising, therefore, that R^2 values were lowest for GAMCO over both subperiods and that the second lowest R^2 value in the 2003–2007 subperiod was for Fidelity. We would not recommend that investors use the GAMCO results because their underlying stock exposures likely include exposures to international stock indices, which were not included in this study. Due to the relatively small exposure to non-American securities, we believe the Fidelity results have merit.

INVESTMENT IMPLICATIONS

This research suggests two major investment implications. One deals with asset allocation and the other with asset location.

Asset allocation. The RBSA results suggest that returns on convertible bond funds closely track returns on portfolios of stocks, high-grade bonds, and sometimes cash. As noted earlier, for all three periods the implied stock exposure for each fund was about 50% to 80%, which indicates that most convertible bond funds should be viewed as mostly stocks in calculating an investor's asset allocation. Moreover, the implied stock exposures have a strong small-cap tilt and usually a growth-stock tilt. When calculating an individual's or an institutional investor's asset allocation, each convertible bond fund should be viewed as a portfolio of small-cap growth, large-cap growth, small-cap value, and large-cap value stocks as well as high-grade bonds, and sometimes cash.

Asset location. The second major investment implication deals with asset location and is explained in Swedroe and Kizer [2008]. This is an issue for individual investors, but generally not for institutional investors. In general, it is best for individuals to hold assets that pay interest and short-term capital gains in retirement accounts (i.e., tax-deferred accounts, such as 401(k)s, and tax-exempt accounts, such as Roth IRAs) and to hold assets, such as stocks, that pay qualified dividends and long-term capital gains in taxable accounts. Dammon, Spatt, and Zhang [2004], Reichenstein [2007, 2008], and Swedroe and Kizer [2008], among others, concluded that individual investors should hold bonds, REITs and other tax-inefficient assets in retirement accounts and stocks in taxable accounts while attaining their target asset allocation.

Convertible bond funds do not fall clearly into either camp because they pay coupon interest payments and short-term capital gains that are taxed as ordinary income and also pay qualified dividends and long-term gains that are taxed at preferential rates. Ideally, the coupon interest payments and short-term gains should be garnered in retirement accounts, while qualified dividends and long-term capital gains should be garnered in taxable accounts. By their nature, convertible bond funds do not allow investors to utilize the asset-location advantages offered by the tax code.

SUMMARY AND CONCLUSIONS

This article presented returns-based style analysis (RBSA) of a convertible bond index (ML Index) and 16 convertible bond funds. The results imply that the ML Index returns closely shadow a portfolio of 60% stocks and 40% high-grade bonds, with the stock exposure primarily associated with small-cap growth stocks. The average convertible bond fund had implied exposures of about 60% stocks, 30% bonds, and 10% cash for all periods. Furthermore, over the full period (1998–2007), there is a strong small-cap growth tilt in the convertible bond funds studied. Separately, the results imply that each convertible bond fund should be viewed as a portfolio of stocks, high-grade bonds, and sometimes cash. Although the implied exposures vary across funds, for all 16 funds and for each period examined (the full period and the two subperiods 1998–2002 and 2003–2007), each fund had an implied stock exposure ranging from about 50% to 80%. This indicates that convertible bond funds should be viewed as primarily stocks when calculating an investor's asset allocation.

The RBSA indicates the shadow portfolios of stocks, high-grade bonds, and cash that most closely track each convertible bond fund's returns. Moreover, it separates the returns into four stock styles (large-cap value, large-cap growth, small-cap value, and small-cap growth), high-grade bonds, and cash. For the full period and early subperiod, the convertible bond fund shadow portfolios have strong tilts toward small-cap growth stocks. For the latter subperiod, the shadow portfolios have strong tilts toward small-cap stocks. There are differences in the implied allocations across the convertible bond funds. The RBSA should help investors better understand their true asset allocations and better manage their portfolios.

Finally, the asset-location argument asserts that an individual investor should hold assets that generate interest and short-term capital gains in tax-deferred accounts, such as a 401(k)s, or tax-exempt accounts, such as Roth IRAs, and assets that generate qualified dividends and long-term capital gains in taxable accounts, while maintaining the investor's target asset allocation. Because convertible bond fund returns are generated from interest, qualified dividends, short-term gains, and long-term gains, they do not allow an individual to follow this ideal asset-location match. Consequently, these hybrid assets do not allow individual investors to make the best use of the tax code.

ENDNOTES

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[1]Arbitrage is more typically used by hedge funds than by mutual funds. See Agarwal, Fung, Loon, and Naik [2008] for an analysis of convertible arbitrage hedge funds.

[2]Some convertible bonds contain other options as well. For example, almost all convertible bonds are callable by the issuer and some are putable by the investor.

[3]The present value of $25 every six months for 10 years plus $1,000 principal payment in 10 years when the semiannual interest rate is 2.9% (thus, a 5.8% annual yield) is $939.94. In a financial calculator, insert n = 20 semiannual periods, i = 2.9%, PMT (payment) = $25, and FV (future value) = $1,000.

[4]This section is adopted from Domian and Reichenstein [2008].

[5]Atkinson and Choi [2001] provided a useful guide for researchers trying to perform returns-based style analysis.

[6]The names of the individual mutual funds reflect this diversity in the asset holdings. Even though the Morningstar Category is "convertible bond fund," the word "bond" is not used in any of the fund names.

[7]These reported values are formally known as excess kurtosis. Values greater than 1.0 are considered large.

[8]In any group of mutual funds for which a selection criterion is being in existence for the full sample period, the average return may have a survivorship bias.

[9]The 16.2% large-cap growth weight reflects the sum of coefficients for the current and lagged monthly returns on the Russell 1000 Growth Index. The same procedure is used for the other asset classes. The results for all current and lagged coefficients are available upon request.

[10]According to Fridson and Sterling [2006], a correlation coefficient of 0.8 or higher is commonly taken to indicate that two assets constitute the same asset class.

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