Convertible Bonds as an Asset Class: 1957-1992

Scott L. Lummer, PhD, CFA

Mark W. Riepe, CFA

Ibbotson Associates

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Abstract

Convertible bonds are an important asset class, but its risk and return performance and suitability as an asset class for different types of investors has received insufficient attention. We attempt to rectify this neglect by evaluating the unique characteristics of convertibles and documenting the convertible bond market in terms of its historical return performance. We find that convertibles allow the investor to experience the benefits from both a fixed-income and equity investment, have favorable features for issuers who are consequently motivated to price the bonds attractively, and are ideally suited for an investment in firms whose future risk is difficult to assess. With respect to performance, convertibles had a compound annual total return of 8.3 percent over the years 1957 to 1992 compared with 6.8 percent for long-term corporate bonds, 7.3 percent for intermediate-term corporate bonds, and 10.5 percent for stocks.

I. Introduction

Financial folklore has it that in the 1880s, railroad magnate J.J. Hill issued the first convertible bond. Today, Altman (1989) estimates that convertibles represent about six percent of the U.S. domestic corporate bond market and Morningstar (1991) identifies twenty-six mutual funds as investing primarily in convertible bonds. Nevertheless, little research has been conducted on the risk and return performance of convertibles. We attempt to rectify this neglect by providing a rationale for holding convertible debt and by characterizing the convertible bond market in terms of its historical return performance in comparison to other assets.

Section II provides rationales for investors to consider holding convertible bonds that are independent of their particular risk and return attributes. Section III presents a convertible bond total return series that covers the most recent 36 years. Section IV summarizes our results. The appendix discusses the construction of our index in more detail.

II. A Conceptual Case for Considering Convertible Bonds

Unique asset class

The hybrid nature of a convertible makes it a unique asset class. A convertible bond grants its holder the option of exchanging the bond into a specified number of common shares at a specified price. Following Brigham (1966), a convertible is often modeled as a straight bond plus a call option on the firm's stock. The call component allows convertible holders a mechanism by which they can benefit from future capital appreciation in the firm's equity while the fixed-income component can provide a return floor. Moreover, a convertible also gives an investor the features of a puttable bond. The opportunity to convert the fixed-income instrument into shares of common stock may protect the investor from dramatic increases in interest rates.

Finance textbooks often emphasize the conceptual similarities between convertible bonds and a package of straight debt plus warrants. However, Long and Sefcik (1990) note four reasons why the existence of warrants does not eliminate the usefulness of convertibles. First, convertible offerings have been far more frequent than straight debt plus warrants offerings. Second, there has not been as much "equity" in debt-plus-warrant offerings as there has been in convertibles. Third, straight debt has a slightly shorter average maturity than convertibles and the warrants have a maturity that is one-third that of the average convertible studied. Fourth, firms issuing debt plus warrants have tended to be riskier than firms that have issued convertibles.

Companies may underprice convertibles

A common misconception regarding convertibles is that they are a less expensive source of capital for the issuing company than straight debt or equity. Melicher and Hoffmeister (1977) surveyed 118 chief financial officers to identify their reasons for issuing convertibles. The most frequently cited motives were to reduce interest expense, to enhance issue marketability, and to sell equity at a premium over the current market price. Convertibles appear to be less expensive because they have lower coupons and fewer restrictive covenants than straight debt and the conversion price is higher than the current stock price. This is a misconception because as Brennan and Schwartz (1988) point out, the cost of capital for convertible debt can be thought of as a weighted average of the actual interest charges and the opportunity costs associated with the equity option.

It is however plausible that some chief financial officers of issuing firms harbor this misconception. Consider the following scenarios:

- First, a company issues convertibles and the stock price remains stagnant or declines such that investors will not convert. The poor equity performance suggests that earnings performance has been sluggish. The low coupon rate on the convertible relative to straight debt will help the company

maintain a decent return on equity, and management will consider itself better off having issued convertibles.

- Second, a firm issues convertible debt and the stock price subsequently rises high enough for convertible holders to convert. This firm would have been better off to have issued straight debt because it sold its equity too cheaply. But consider the psychology of firm management and shareholders: if a firm's stock price is performing well enough for conversion to take place, management and shareholders are probably feeling pretty good about themselves and are unlikely to chastise the CFO for his decision. In fact, in similar situations, corporate officers have boasted about their willingness to underprice.[1]

We see that the circumstances for which convertibles are the truly the costliest to their issuers are also the situations in which management and shareholders are most able to afford, and least likely to notice, the cost. Alexander and Stover (1977) have taken an empirical approach to this question and found that convertibles are underpriced when originally issued.

Convertibles provide insurance against an increase in firm risk

One of the difficulties faced by straight debt holders is that the value of their bonds declines as the perceived financial risk or return volatility of the issuing firm increases. Such events, however, have the opposite effect on an option holder. Because convertible holders have the right, not the obligation, to convert to common stock, they are protected against stock price declines while benefiting from price increases. Because of this asymmetric payoff, the equity option portion of the convertible increases in value when the volatility of the issuing firm increases. The convertible holder is, therefore, partially insulated from increases in firm risk. Extending this argument, Brennan and Schwartz (1988, p. 59) concluded that "convertibles are most likely to be used by companies which the market perceives as risky, whose risk is hard to assess, and whose investment policy is hard to predict."

This view is consistent with the empirical findings. Typically, convertible bonds are issued as subordinated debt and do have considerable default risk. Altman (1989) finds that convertibles had an average default rate of 1.24 percent compared to 0.32 percent for total straight debt. Mikkelson (1981) has found that highly-levered firms (which tend to be riskier) and those with high-growth (which is related to future uncertainty) were more likely to issue convertibles. He also determined that convertibles are placed publicly more frequently than privately. This is also consistent with the position of Brennan and Schwartz because investors involved in private placements probably have greater knowledge of firm risk than do investors in public offerings.

Convertibles are useful for investors who are restricted in their equity holdings

Certain investors may be subjected to various restrictions regarding the percentage of their portfolios that can be invested in equities. Examples include insurance companies and perhaps public employee pension funds. An extreme case of this type of restriction is a regulation by the Florida Department of Labor which prohibits self-insurance funds from investing in any equities. These restrictions are costly in that, over the long run, equity-like instruments have higher expected returns and are excellent diversifiers for portfolios heavily skewed towards fixed-income and real estate.

Convertibles, despite their equity component, are typically classified as fixed-income instruments and thus can be used to circumvent some of these restrictions. These investors will profit from the equity-like payoffs available with convertibles and increase their diversification, because of the low correlations convertibles are expected to have with fixed-income securities and real estate.

III. Return, Risk, and Correlation

Return and risk

This section examines the performance of convertible bonds and other asset classes for the period 1957 to 1992. Since no single convertible bond index covers this entire period, we have combined three different indexes in order to obtain our results. Their characteristics are covered in the appendix.

Figure 1 plots total return wealth indexes for $1 investments (made at year-end 1956) in convertibles, S&P 500, and intermediate-[2] and long-term corporate bonds.[3] For the years 1956 to 1972, only annual return data were available for convertibles. For the purposes of this graph, we have assumed that the entire return occurred in December of each year. For the period ending year-end 1992, an investment in the S&P 500 performed the best (with an ending index value of $36.78) followed by convertibles ($17.62), intermediate-term corporates ($12.52), and long-term corporate bonds ($10.84).

The graph demonstrates that convertibles tend to track the S&P 500 much more closely than the two nonconvertible corporate series. A casual inspection reveals that most of the outperformance of the return differential between convertibles and nonconvertible bonds was generated during the years 1977 to 1980. Panel A of Table 1 provides summary statistics for the same series over the same period. It is not surprising that the compound annual return and standard deviation of convertible bond returns have been between that of corporates and the S&P 500. The equity component of a convertible will tend to enhance a convertible's return over pure debt, but the debt portion of the convertible will tend to dampen its return relative to that of the S&P.

Panel B of Table 1 provides summary statistics for convertibles, corporate bonds, and stocks between 1973 and 1992. This period has been highlighted for two reasons. First, higher quality data on convertible returns is available. Second, given the explosive growth of the convertible market, this period is perhaps

more relevant in forecasting future performance. Surprisingly, convertible bonds have outperformed common stocks in terms of return, with substantially less risk. To further investigate this divergence from expected behavior, risk and return statistics are computed for the four asset classes for five year subperiods. These results are shown in Table 2. The long-run expectation of stocks having the highest risk and return, followed by convertibles and then nonconvertible corporate bonds, is frequently violated.

To place convertibles on an equal footing with respect to risk, alphas (see Jensen [1968]) were computed over the 1973 to 1992 period for convertibles, and long- and intermediate-term corporate bonds. The results given in Table 3 indicate that both convertibles and intermediate-term corporates have had returns above that expected given their level of risk.

Figure 2 shows annual returns for S&P and convertibles over the years 1973 to 1992. This chart demonstrates that convertibles and common stocks typically move together, but the yearly fluctuations tend to be lower for convertibles. The correlation of convertible and S&P monthly total returns over the January 1973 to December 1992 period is 0.90. Table 4 provides summary statistics for convertible bonds and stocks in months when the S&P rises and months when the S&P falls. Convertibles tend to be up (down) when stocks are up (down), but the magnitude of the monthly total return is smaller for convertibles.

Correlation

One of the great insights of mean-variance optimization is that the addition of a risky asset to a portfolio can reduce portfolio risk if it has low correlations with the other portfolio assets. Table 5 shows correlations of monthly total returns for convertibles with the major U.S. asset classes. The results indicate that convertibles were relatively highly correlated with both classes of stock, but much less so with the various fixed-income asset classes and real estate. This implies that convertibles will provide more diversification to portfolios whose assets are tilted toward fixed-income and real estate.

The role of convertibles in portfolio management

Mean-variance optimization (see Markowitz 1952, 1959) derives the security or asset class weights for a portfolio that provides the maximum expected return for a given level of risk; or, conversely, the minimum risk for a given expected return. Mean-variance optimization requires estimates of expected return, standard deviation, and cross-security correlation. Our estimates (with the exception of those for convertible bonds) are given in Tables 6 and 7 and taken from Lummer, Riepe, and Siegel (1993). The balance of this section discusses our procedure for estimating the long-run expected return and standard deviation for convertible bonds and the results from an optimization run.

We model the long-run expected return on convertible bonds as follows:

$$E[\, r_{conv} \,] = r_f + DP + OP \qquad \textbf{(1)}$$

where $E[r_{conv}]$ is the expected return on convertible bonds, r_f is the risk-free rate, DP is the default premium, and OP is the option premium.

We use the current yield (7.3 percent at month-end September 1992) on long-term U.S. Treasury bonds as the risk-free rate. We use a long rather than a short maturity bond because we require a riskless security whose maturity matches the time horizon over which investors commit their capital; typically this is a long period. Moreover, long yields are more stable over time than short yields, producing more stable estimates.

Convertibles have default risk and thus must have yields high enough to both cover the expected loss from default and provide additional compensation for being exposed to the risk. Since U.S. government bonds are considered to be default-free, the yield spread (difference in yield) between a bond subject to default risk and a U.S. government bond with otherwise identical characteristics is the market's current assessment of the premium required for taking that default risk. We estimate the long-run or expected

default premium by taking the difference between the arithmetic means of annual total returns for long-term corporate and long-term Treasury bonds over the longest period for which reliable data is available. Using the years 1926 to 1991 the estimated default premium is 5.7% - 5.1% = 0.6%. Since convertibles are a class of corporate bonds, we use 0.6 percent as the default premium for convertibles as well. Since convertibles tend to be a lower credit quality than nonconvertible corporates, therefore this premium somewhat understates the default premium.

The option of exchanging a convertible bond into a given number of common shares has value. This implies that investors will have a higher expected return for a convertible bond than they would a straight bond with identical characteristics. This difference we call the *option premium* and it is added to the long-term Treasury bond yield and the default premium to obtain the expected return on convertibles.

The option premium is estimated by assuming that investors adjust their long-run expectations to that which is realizable. We therefore use the observed difference in the arithmetic means of annual total returns on straight and convertible bonds over the years 1973 to 1991 as our estimate. Note that we have not explicitly modeled either the call or put options that are attached to most convertibles. However, we have done so implicitly because the dampening effect that these options have on the expected return of a convertible should be reflected in the historical difference in total returns between convertible and nonconvertible bonds.

We do not use the entire 1957 to 1991 period because the data prior to 1973 is of insufficient quality to provide reliable estimates. The arithmetic mean total return for convertibles is 12.5 percent and 10.2 percent for long-term nonconvertibles. The option premium is therefore 12.5% - 10.2% = 2.3%. The expected return for convertible bonds is then 7.3% + 0.6% + 2.3% = 10.2%.

The historical standard deviation of annual total returns over the longest period for which is good data is available is the best estimate of expected standard deviation for asset classes that have had reasonably stable standard deviations and whose returns can be accurately measured. We believe this is the case for convertibles and therefore use the annual total returns for the years 1973 to 1991 to form our estimate. This estimate is 13.1 percent. As with our estimate of expected return, we do not use data prior to 1973.

We recognize, however, that the unique characteristics of convertibles give its historical standard deviation some interesting properties. When the embedded call option for most convertibles is out-of-the-money, convertibles are more bond-like and will have a lower standard deviation. Similarly, when the embedded call option for most convertibles is in-the-money, convertibles are more stock-like and will have a higher standard deviation. Over the years 1973 to 1991 convertibles have seen a roughly equal number of bond-like and stock-like years. Looking forward, for the long-term, we expect that the number of bond- and stock-like years would continue to be roughly equal and, therefore, our estimate is reasonable.

The role of convertibles in efficient portfolios

Using the asset classes referred to in Tables 6 and 7, we used mean-variance optimization to determine the percentage of a portfolio, if any, that was allocated to convertible bonds. The only efficient portfolio that included an allocation to convertibles was the minimum variance portfolio. This portfolio had allocations of 5 percent to convertibles, 7 percent to intermediate-term treasury bonds, and 88 percent to Treasury bills. The allocation to convertibles is provocative since the U.S. convertible bond market represents only 0.33 percent of U.S. investable wealth,[4] therefore the indicated allocations are relatively large. This allocation is due to convertibles having a relatively high expected return given its risk and low correlations with low-risk assets.

The problems associated with using unconstrained optimization (unstable solutions, unrealistic asset allocations) have been discussed frequently in the literature (see Frost and Savarino [1988], Michaud [1989], and Lummer, Riepe, and Siegel [1994]). These problems can be limited by constraining the percentage of the portfolio allocated to particular asset classes. We adopt this approach by limiting large-capitalization stocks to 40 percent of the portfolio, small-capitalization stocks to 40 percent, and real estate to 10 percent. As before, convertibles are allocated 5 percent of the minimum variance portfolio. In addition, convertibles show up at the high risk/return end of the frontier. This allocation to convertibles at the high end is driven by the constraints we placed on the optimization problem; as the constraints become active, the algorithm looks for the next available asset with the highest expected return which, in this case, is convertible bonds.

In our final run, large-capitalization stocks were limited to 10 percent of the portfolio and small-capitalization stocks and real estate were eliminated from consideration. By using these constraints we are mimicking the portfolio of a highly regulated fund, i.e., one that may be prohibited from investing a substantial amount in non-fixed-income securities. For example, new regulations proposed by the National Association of Insurance Commissioners mandate that insurance companies that invest in equities must keep a greater amount of capital in reserve. The results indicate that convertibles have a large role to play in a portfolio of this type. The allocation to convertibles ranged from 5 percent at the low end to 100 percent at the high end.

IV. Summary

This paper has highlighted both qualitative and quantitative reasons for investors to consider holding convertible bonds. On the qualitative side convertibles are a unique asset class that allows the investor to experience the benefits from both a fixed-income and equity investment. There is also reason to believe these securities are underpriced when issued by companies. Finally, convertibles are ideally suited for an investment in firms whose future risk is difficult to assess. On the quantitative side, convertibles over the long run can be expected to have return and risk between that of stocks and nonconvertible corporate bonds. This relationship does not necessarily hold up over shorter periods. As an example, over the last 20 years convertibles have had slightly better returns than stocks with substantially less risk.

Appendix A: How Our Series Was Constructed

We constructed our index by splicing together three pre-existing indexes of convertible performance. This section explains the methodology of each series and our adjustments to those series.

1957 to 1972

For the years 1957 to 1972 we used an index presented in Soldofsky (1971) and Soldofsky, Stevenson, and Phillips (1977). This choice was natural given that we know of no other convertible index that covers this period.

Soldofsky *et. al.* reports returns by rating class, not in aggregate. For example, Soldofsky (1971) presents annual returns for Baa, Ba, and B bonds as rated by Standard & Poor's. Each class typically had at least 10, but no more than 15 bonds. This lack of comprehensive market coverage is the principal weakness of this index, although the direction and magnitude of the bias it injects, if any, is unknown.[5]

Since we are interested in the performance of convertibles as an asset class we calculated a weighted average of the three Soldofsky series. The weights were determined by the amount of convertible debt outstanding for each class.[6]

1973 to 1981

The convertible proxy for these years is based on the returns to convertible bond mutual funds. For the years 1973 to 1975 our index return was based on an equal-weighted average of the monthly total returns on all such funds as reported by Lipper Analytical Services. For the years 1976 to 1981 we used the Morningstar convertible bond style benchmark (which is also calculated as an equal-weighted average of individual bond funds).

Morningstar (1991, p. ix) reports returns "by taking the change in net asset value [NAV], reinvesting all income and capital-gains distributions during the period, and dividing by the starting NAV. These returns are not adjusted for loads (i.e., initial and deferred sales charges and redemption fees), but they are adjusted for management fees, 12b-1 fees, and other costs automatically taken out of fund assets." Lipper calculates returns in a similar manner. However, asset class performance is usually studied using returns on a passive benchmark free of active management fees. As a result, the use of "raw" mutual fund returns will tend to understate the performance of convertible bonds relative to other assets whose returns are measured using passive benchmarks that are calculated before costs.

To compensate, we have assumed that our mutual fund series performs like a convertible passive index would. This assumption is supported by the fact that the correlation between the Morningstar and First Boston Convertible Bond Index (discussed below) over the period January 1982 to June 1992 is 0.96. The Morningstar series, however, persistently underperforms the First Boston series due, most likely, to the Morningstar series being quoted on an after-fees basis. This underperformance averages 0.12 percent monthly. We then add this value to the reported Morningstar total return each month over the period January 1976 to December 1981 and to the reported Lipper total return each month over the period January 1973 to December 1975.

This procedure implicitly assumes that the correlation and fees as a percentage of assets (relative to the passive benchmark) have remained stable. We believe these are realistic assumptions. First, we have no evidence or theory that would suggest a correlation significantly different from 0.96. Second, our upward adjustment for the fees is probably conservative. Prior to 1982 there were far fewer mutual funds devoted to convertible bond investments. This implies that there was less competition for fund managers that would serve to keep down fees.

1982 to 1992

Beginning in January our proxy for convertible bond performance is the First Boston Convertible Bond Index. We use this index because:

- It is market value-weighted so the index is not dominated by smaller issues that may have insufficient liquidity for an institutional investor;

- It is well-referenced;

- It is broad, covering all bonds with an issue size of at least $50 million and a rating from S&P of B- or better; and

- Where possible, direct dealer quotes are used to price issues within the index.

Endnotes

According to Brealey and Myers (1988, p. 332), "[i]n 1987 the British company Sock Shop International went public at 125p a share. First day dealings were at a price of 205p. The company's chairman was reported to be 'ecstatic' about the market's reaction. She dismissed suggestions that the issue was underpriced by saying that had the shares been more expensive, the company would 'quite justifiably' have been accused of overpricing."

The intermediate-term corporate bond series for the period January 1957 to December 1989 is from Ibbotson Associates, Inc., Chicago. For the period January 1990 to September 1992, we use Lehman Brothers' Intermediate-term Bond Index.

The long-term corporate bond series for the period 1969 to September 1992 is represented by the Salomon Brothers Long-Term High-Grade Corporate Bond Index. The returns for the years 1957 to 1968 are from Ibbotson and Sinquefield (1976).

This figure is based on Altman's (1989) estimate that convertibles constitute 6 percent of the U.S. corporate bond market and Ibbotson Associates (1992) estimate that corporate bonds represent 5.5 percent of U.S. investable wealth.

Of course, the convertible market was quite small in the late 1950s and early 1960s. For example, at year-end 1963 Moody's listed only 94 convertible bonds outstanding in the Baa, Ba, and B categories.

For the years 1957 to 1967 we used weights taken from Moody's (1964). The weights were calculated by adding up the amount outstanding for convertible bonds rated Baa, Ba, and

B. For the period 1968 to 1972 the same procedure was used, except the source for amount outstanding was Moody's (1971).

References

Alexander, Gordon J. and Roger D. Stover. “Pricing in the new issue convertible debt market,” *Financial Management*, Fall 1977.

Altman, Edward I. “The convertible bond market: Are returns worth the risk?” *Financial Analysts Journal*, July-August 1989.

Brealey, Richard A. and Stewart C. Myers. *Principles of Corporate Finance*, third ed., New York: McGraw-Hill, 1988, p. 332.

Brennan, Michael J. and Eduardo S. Schwartz. “The case for convertibles,” *Continental Bank Journal of Applied Corporate Finance*, Summer 1988.

Brigham, Eugene F. “An analysis of convertible debentures,” *Journal of Finance*, March 1966.

Frost, Peter A. and James E. Savarino. “For better performance: Constrain portfolio weights,” *The Journal of Portfolio Management*, Fall 1988.

Ibbotson, Roger G. and Rex A. Sinquefield. “Stocks, bonds, bills, and inflation: Year-by-year historical returns [1926-1974],” *Journal of Business*, January 1976.

Ibbotson Associates, Inc. "Wealth of the U.S. 1991," Chicago, 1992.

Jensen, Michael C. "The performance of mutual funds in the period 1945-1964," *Journal of Finance*, May 1968.

Long, Michael S. and Stephan E. Sefcik. "Participation financing: A comparison of the characteristics of convertible debt and straight bonds issued in conjunction with warrants," *Financial Management*, Autumn 1990.

Lummer, Scott L., Mark W. Riepe, and Laurence B. Siegel. "Taming your optimizer: A guide through the pitfalls of mean-variance optimization," in Jess Lederman and Robert A. Klein eds., *Advances in Asset Allocation: Techniques for Optimizing Portfolio Management in the U.S. and Global Markets*, New York: John Wiley & Sons, 1994.

Markowitz, Harry M. "Portfolio selection," *Journal of Finance*, March 1952.

Markowitz, Harry M. *Portfolio Selection: Efficient Diversification of Investments*, New York: John Wiley & Sons, 1959.

Melicher, Ronald W. and J. Ronald Hoffmeister. "The issue is convertible bonds," *Financial Executive*, November 1977.

Michaud, Richard O. "The Markowitz optimization enigma: Is ’optimized’ optimal?" *Financial Analysts Journal*, January-February 1989.

Mikkelson, Wayne H. "Convertible security calls and security holder returns: Evidence on agency costs, effects of capital structure change, and supply effects," *Journal of Financial Economics*, September 1981.

Moody's Investors Service. *Moody's Bond Record*, New York, January 1964.

Moody's Investors Service. *Moody's Bond Record*, New York, January 1971.

Morningstar, Inc. *Mutual Fund Sourcebook*, Chicago, 1991.

Soldofsky, Robert M. "Yield-risk performance of convertible securities," *Financial Analysts Journal*, March-April 1971.

Soldofsky, Robert M., Richard A. Stevenson, and Susan M. Phillips. "Convertible securities: New issues, conversions, and performance record," in Richard A. Stevenson, and Susan M. Phillips eds. *Investment Environment, Analysis, and Alternatives: A Book of Readings*, St. Paul, MN: West Publishing Company, 1977.

Table 1

Summary statistics

Panel A: 1957-1992

Asset class	Compound annual return	Wealth index (December 1956 = $1)	Standard deviation
Convertible bonds	8.30%	$17.62	14.07%
S&P 500	10.53	36.78	16.41
Long-term corporates	6.85	10.84	10.72
Intermediate-term corporates	7.26	12.47	8.06

Panel B: 1973-1992

Asset class	Compound annual return	Wealth index (December 1972 = $1)	Standard deviation
Convertible bonds	11.75%	$9.22	12.75%
S&P 500	11.33	8.56	17.50
Long-term corporates	9.54	6.19	12.55
Intermediate-term corporates	10.08	6.83	8.92

Note: Standard deviation is based on annual total returns.

Table 2

Risk and return for convertible bonds, S&P 500, intermediate-, and long-term corporate bonds 5-year increments 1957-1992

	Convertible bonds		S&P 500		Intermediate-term corporate bonds		Long-term corporate bonds	
Period	Compound annual return	Standard deviation	Compound annual return	Standard deviation	Compound annual return	Standard deviation	Compound annual return	Standard deviation
1957 – 62	3.19%	16.08%	8.88%	21.33%	4.26%	2.99%	4.46%	5.01%
1963 – 67	9.36	12.67	12.39	13.79	0.76	2.75	0.30	3.60
1968 – 72	0.23	17.65	7.53	10.70	6.48	7.59	5.85	9.87
1973 – 77	6.79	10.09	-0.21	17.31	7.81	5.67	6.29	8.21
1978 – 82	16.48	11.94	14.05	16.07	7.15	9.15	5.84	15.34
1983 – 87	11.45	12.70	16.49	17.92	14.35	5.69	13.78	10.67
1988 – 92	12.49	7.93	15.89	13.36	11.17	3.53	12.50	6.28

Note: Annual data is used for all periods prior to 1973, monthly data is used thereafter. Standard deviations are based on annual total returns for all periods prior to 1973. Standard deviations for subsequent periods are based on monthly total returns and annualized. The period labeled “1957 – 62” is, of course, a 6-year period, but is used so that the post-1972 period which has the highest quality data can be easily segregated.

Table 3

Convertible, long-term, and intermediate-term bonds
Calculation of Jensen's alpha and beta
1973 - 1992

Asset	Alpha	Alpha t-statistic	Beta	Beta t-statistic
Convertibles	0.13%	1.41	0.60	31.52
Long-term corporates	0.09	0.50	0.25	6.35
Intermediate-term corporates	0.13	1.23	0.18	7.73

Note: Alpha is reported in percent excess return per month. The regression was run using monthly total returns over the period 1973 to 1992. The regression was of the form:

$$r_i - r_{T\text{-}bill} = \alpha_i + \beta_i (r_{S\&P} - r_{T\text{-}bill}) + \varepsilon$$

where r_i is the monthly total return on asset i; $r_{T\text{-}bill}$ is the monthly total return on Treasury bills; and $r_{S\&P}$ is the monthly total return on the S&P 500.

Table 4

S&P 500 and convertible bonds
Analysis of monthly total returns in up and down markets
1973-1992

	In months when S&P increases		In months when S&P decreases	
	S&P	Convertibles	S&P	Convertibles
Arithmetic mean return	3.93%	2.74%	-3.08%	-1.49%
Standard deviation	3.16	2.23	3.19	2.43
Number of months	140	140	100	100

Table 5

Correlation of convertible bonds with other major U.S. asset classes

	Correlation with convertible bonds
Large-capitalization stocks	0.90
Small-capitalization stocks	0.86
Long-term Treasury bonds	0.45
Intermediate-term Treasury bonds	0.36
Treasury bills	-0.08
Long-term corporate bonds	0.47
Intermediate-term corporate bonds	0.53
Mortgage-backed securities	0.40
Real estate	-0.09

Note: Correlations are generally calculated using monthly total returns over the period 1973 to 1992. The exceptions are mortgage-backed securities which use the period 1976 to 1992 and real estate which uses quarterly returns for the period March 1978 to September 1992.

Source: Ibbotson Associates, Inc. for all series except real estate (Frank Russell Company) and mortgage-backed securities (Lehman Brothers).

Table 6

Estimates of the long-run expected return and standard deviation for convertible bonds and major U.S. asset classes

Asset class	Expected return	Standard deviation
Convertible bonds	10.2%	13.1%
Large-capitalization stocks	14.7	20.8
Small-capitalization stocks	19.8	35.3
Long-term Treasury bonds	7.3	10.4
Intermediate-term Treasury bonds	7.0	6.5
Treasury bills	6.1	3.1
Long-term corporate bonds	7.9	10.5
Mortgage-backed securities	8.1	11.2
Real estate	10.6	15.4

Source: Scott L. Lummer, Mark W. Riepe, and Laurence B. Siegel, "Taming your optimizer: A guide through the pitfalls of mean-variance optimization," in Jess B. Lederman and Robert A. Klein, eds., *Advances in Asset Allocation: Techniques for Optimizing Portfolio Management in the U.S. and Global Markets*, New York: John Wiley & Sons, 1994; and Ibbotson Associates, Inc., Chicago.

Table 7

Correlation matrix for convertible bonds and major asset classes

	Con-vertible bonds	Large-cap stocks	Small-cap stocks	Treasury Long-term	Treasury Intermediate-term	Treasury Bill	Long-term corporate	Mortgage-backed	Real estate
Convertible bonds	1.00								
Large-cap stocks	0.90	1.00							
Small-cap stocks	0.86	0.85	1.00						
Long-term Treasury	0.44	0.26	0.16	1.00					
Intermediate-term Treasury	0.37	0.18	0.10	0.85	1.00				
Treasury bill	-0.07	-0.08	0.10	0.13	0.22	1.00			
Long-term corporate	0.47	0.32	0.22	0.89	0.82	0.11	1.00		
Mortgage-backed securities	0.40	0.31	0.19	0.90	0.91	0.08	0.93	1.00	
Real estate	0.14	0.03	0.23	-0.08	-0.04	0.19	-0.05	-0.03	1.00

Source: Scott L. Lummer, Mark W. Riepe, and Laurence B. Siegel, "Taming your optimizer: A guide through the pitfalls of mean-variance optimization," in Jess B. Lederman and Robert A. Klein, eds., *Advances in Asset Allocation: Techniques for Optimizing Portfolio Management in the U.S. and Global Markets*, New York: John Wiley & Sons, 1994; and Ibbotson Associates, Inc., Chicago.