EVALUATION OF BOND PORTFOLIO PERFORMANCE

BOGOJEVIC ARSIC Vesna, (SCG)

ABSTRACT
Although the techniques for evaluating equity portfolio performance have been in existence for almost 40 years, comparable techniques for examining bond portfolio performance were initiated more recently when bond market has changed considerably because of dramatically increase in interest rates and their volatility. This change created an incentive to trade bonds, and this trend toward active management led to more dispersed performance by bond portfolio managers. This dispersion in performance in turn created a demand for techniques that would help investors evaluate the performance of bond portfolio managers. The evaluation models for bonds typically consider the overall market factors and the impact of individual bond selection. The aim of the paper is to present and examine the several bond portfolio performance evaluation techniques.

KEY WORDS
portfolio, performance, evaluation, techniques

INTRODUCTION
The analysis of risk-adjusted performance for equity portfolios began in the late 1960s following the development of portfolio theory and the Capital Asset Pricing Model. The common stock risk measures have been simple—either total risk (the standard deviation of returns) or systematic risk (betas). No such development has simplified analysis for the bond market, where numerous and complex factors can influence portfolio returns. One reason for this lack of development of bond portfolio performance measures was that prior to the 1970s most bond portfolio managers followed buy-and-hold strategies, so their performance probably did not differ much. In this era, interest rates were relatively stable, so one could gain little from the active management of bond portfolios. The environment in the bond market changed considerably in the late 1970s and especially in the 1980s when interest rates increased dramatically and became more volatile. This created an incentive to trade bonds, and this trend toward more active management led to substantially more dispersed performance by bond portfolio managers. This dispersion in performance in turn created a demand for techniques that would help investors evaluate the performance of bond portfolio managers.
Having this in mind, we have to examine how performance among portfolio managers compare to the overall bond market did and to identify factors that explain or contribute to superior or inferior bond portfolio performance.

BOND PORTFOLIO PERFORMANCE EVALUATION TECHNIQUES
There are numerous attempts to develop bond portfolio performance evaluation techniques that consider multiple-risk factors, such as:

(1) Bond market line,
(2) Decomposing portfolio returns and,
(3) Analyzing sources of return.

Bond Market Line
Bond market line is a bond portfolio performance technique that attempts to apply asset-pricing techniques to evaluation of bond portfolio (5). A prime factor needed to evaluate

performance properly is a measure of risk (such as beta coefficient for equities), which is difficult because a bond's maturity and coupon have a significant effect on the volatility of its prices. Because of that, the technique uses a composite that indicates the relative volatility for bond compared to interest rate changes in bond's duration as a measure of risk. In this manner, the authors (5) derived a bond market line much like the security market line used to evaluate equity performance. Duration simply replaces beta as the risk variable. The figure 1 shows the bond market line using Lehman Brothers Bond Index. The bond market line is drawn from points defined by returns on Treasury bills to the Lehman Brother's Government-Corporate Bond Index. It would be equally reasonable to use a comparable bond market index series from Merrill Lynch or Salomon Brothers. The Lehman Brothers Index gives the market's average annual rate of return during some common period, and the duration for the index is the value-weighted duration for the individual bonds in the index.

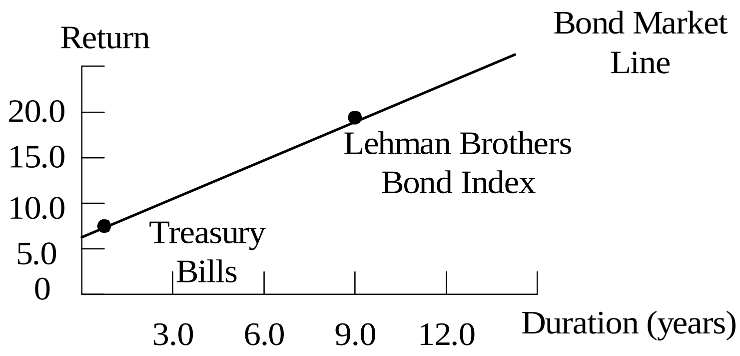

Figure 1. Specification of bond market line using Lehman Brothers Bond Index

Given the bond market line, this technique divides the portfolio return that differs from the return on the Lehman Brothers Index into four components:

- a policy effect,
- a rate anticipation effect,
- an analysis effect, and
- a trading effect.

When the latter three effects are combined, they are referred to as the management effect, which can be defined as an improvement in investment performance of a passive strategy through active bond management. In other words, management effect is the difference between total bond portfolio return and the expected return at the long-term average duration (i.e. measure of the sensitivity of a bond's price to changes in interest rates). These effects are portrayed in Figure 2.

Policy effect is the difference between long-term duration of a bond portfolio and the duration of a bond market index resulting from long-term investment policy. Measured as the return at the long-term average less the return on Lehman Brothers Index.
The policy effect measures the difference in the expected return for a given portfolio because of a difference in policy regarding the duration of this portfolio compared to the duration of the Lehman Brothers Index. It is assumed that the duration of an unmanaged portfolio would be equal to the Lehman Brothers Index. (6). The duration of a portfolio being evaluated that differs from the index duration indicates a basic policy decision regarding relative risk (measured by duration), and there should be a difference in expected return consistent with that risk policy decision.
Given the expected return and duration for this long-term portfolio, all deviations from the

index portfolio are attributable to the remaining management effect components.

The **interest rate anticipation effect** is attributable to changes in portfolio duration resulting from attempts to profit from and ability to predict bond market movements. It is the difference between the expected return at the actual portfolio duration and the expected return at the long-term duration. The manager would increase the duration of the portfolio during periods of declining interest rates to increase the price volatility (price appreciation) of a portfolio and reduce duration during periods of rising interest rates to minimize the price decline. Therefore, we would determine the duration of the actual portfolio during the period and compare this to the duration of the long-term portfolio. Then we would determine the difference in expected return for these portfolios and their two durations using the bond market line. The difference between this expected return based on the portfolio's duration and the actual return for the portfolio during this period is a combination of an analysis effect and a trading effect.

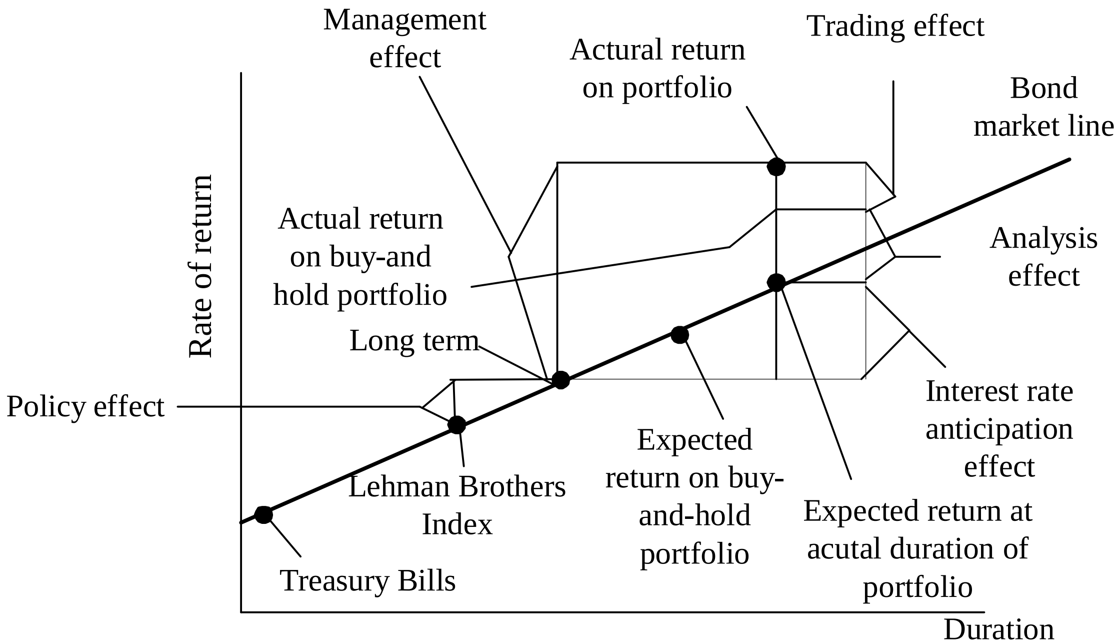

Figure 2. Bond portfolio performance breakdown

Analysis effect, attributable to the selection of issues with better-than-average long-term prospects, is the difference between the actual return of the buy-and hold portfolio (used to differentiate between trading gains secured within a quarter and long-term analysis gains) at the beginning of the quarter and the expected return of that buy-and-hold portfolio. In other words, the analysis effect is the differential return attributable to acquiring bonds that are temporarily mispriced relative to their risk level. To measure the analysis effect, we need to compare the expected return for the portfolio held at the beginning of the period (using the bond market line) to the actual return of this same portfolio. If the actual return is greater than the expected return, it implies that the portfolio manager acquired some underpriced issues that became properly priced and thus provided excess returns during the period.

Finally, the **trading effect** occurs because of short-run changes in the portfolio during the period. Trading effect is the result of the current quarter's trading, either through effective trade-desk operation or through short-term selection abilities. It is the difference between total management effect and the effects attributable to analysis and interest rate anticipation. It is

measured as the residual after taking account of the analysis effect from the total excess return based on duration.
This technique breaks down the return based on the duration as a comprehensive risk measure. The only concern is that it does not consider differences in the risk of default. Specifically, the technique does not differentiate between an Aaa bond with duration of 8 years and a Baa bond with the same duration. This could clearly affect the performance. A portfolio manager that invested in Baa bonds, for example, could experience a very positive analysis effect simply because the bonds were lower quality than the average quality implicit in the Lehman Brothers Index. The only way to avoid this would be to construct differential market lines for alternative ratings or construct a benchmark line that matchers the quality makeup of the portfolio being evaluated (6).

Decomposing portfolio returns

Decomposing portfolio returns is a technique developed by Dietz, Fogler, and Hardy (1) which attempts to decompose bond portfolio returns into maturity, sector, and quality effects. The total return for a bond during a period is composed of a known income effect (due to normal yield-to-maturity factors) and an unknown price change effect (due to an interest rate effect, a sector/quality effect, and a residual effect). The interest rate effect measures what happened to each issue because of changes in the term structure of interest rates during the period. Each bond is valued based on the Treasury yield curve at its maturity and takes account of its normal premium relative to Treasury yields (4). The sector/quality effect measures the expected impact on the returns because of the sector of the bonds (corporates, utilities, financial, etc.) and also the quality of the bonds (Aaa, Aa, A, Baa). Given this breakdown, we can determine what happened to bonds in each sector after taking account of the yield to maturity and the interest rate effect. The residual effect is what remains after taking account of the three prior factors—yield to maturity, interest rate effect, and the sector/quality effect.

The presence of a consistently large positive residual would indicate superior bond selection capabilities. Specifically, a positive residual indicates that after taking account of all market effects from interest rate changes and sector/quality, it is still possible the bond manager has helped provide positive returns due to bond selection. Alternatively, large positive interest rate effects during periods of declining interest rates and small negative interest rate effects during periods of rising interest rates would indicate a bond manager with good skills at interest rate anticipation. Consistently positive sector/quality effects would indicate the ability to make proper allocations and to anticipate shifts in this area over time.

Analyzing Sources of Return

Analyzing sources of return is the performance evaluation technique proposed by Fong, Pearson, and Visicek (3) that likewise divides the total returns into several components that affect bond returns. Their intent was to measure total realized return and attribute the return to its sources (i.e. what factor contributed to the total return). The first breakdown divides the total return (R) between the effect of the external interest rate environment (I), which is beyond the control of the portfolio manager, and the contribution of the management process (C). Thus:

$$R = I + C \tag{1}$$

Effect of external interest rate environment (I) is broken down into two parts. The first is the expected rate of return (E) on a portfolio of default-free securities, assuming no change in forward rates (i.e., no change in future one-period rates). This expected return also is referred to as the market's implicit forecast. The second component of I is U, the unexpected return on the Treasury index that is due to actual changes in forward rates.

Finally, contribution of the management process (C) is composed of three factors: return from maturity management (M), return from spread/quality management (S) and, return attributable to selection of specific securities (B). The return from maturity management is determined by how well the portfolio manager changes maturity (duration) in anticipation of interest rate changes. The component is measured by computing the default-free price of every security (at the beginning and end of the period) based on the spot rate for its maturity, as indicated by the Treasury yield curve. The total return over the evaluation period is derived from these prices, while maintaining all actual trading activity. Given this total return based on maturity yields, substract the actual return on the Treasury index to arrive at the maturity return. The spread/quality management component indicates the effect on return due to the manager's selection of bonds from various sectors and qualities. It is measured by pricing each bond at the beginning and end of the period using yields appropriate for its specific sector and quality and then computing the rate of return given these prices. This total return less the return for Treasury bonds, considering the maturity effect indicates the return attributable to sector/quality selection. The selectivity component is the remaining return. It is attributable to the selection of specific bonds after considering the maturity and sector/quality decisions—specifically, what individual bonds were selected to carry out these decisions. It is measured as the difference between the actual total return on the portfolio and the prior total return that considered maturity and sector/quality.

Having this in mind, we can rewrite the previous equation as:

$$R = (E + U) + (M + S + B) \qquad (2)$$

This analysis indicates that the portfolio manager was quite good at maturity (duration) decisions and at selecting individual bonds but did not do well in terms of sector/quality decisions. As before, you should do a similar breakdown for some market index series as a basis of comparison to an unmanaged portfolio. Also, examine these components over time to determine any consistent strengths or weaknesses for the portfolio manager.

REPORTING INVESTMENT PERFORMANCE

The performance measures just described represent the essential elements of how any investor's performance should be evaluated. Beside this, we have to examine the way in which returns upon which the performance measures are based should be reported to the investor. This could be a problem. Because of that, we have to consider the way in which returns should be computed for a portfolio that experiences infusions and withdrawals of cash during the investment period. In other words, the beginning and ending value of a portfolio can differ because of withdraws or adds of cash to initial investment capital during the period. It would be unfair to credit the manager with having produced high returns that were due to additional capital commitment. Similarly, it would be equally unfair to penalize him for reductions in the ending value of the investment that were caused by investor removing funds from his account. Consequently, an evaluation of the manager's true performance must consider these.

One common method of doing this is to calculate the internal rates of return, which are called dollar-weighted returns (2) because they are the discount rates that set the present value of future cash flows (including future investment contributions and withdrawals) equal to the level of the initial investment. This internal rate of return method could be a misleading measure of manager's performance. A better way of evaluating a manager's performance would be time-weighted average return that takes into account quality of management regardless of the size or timing of the investment funds involved. The time-weighted average return is simply the geometric average of the period returns. The dollar-weighted and time-weighted returns are the same only when there are no interim investment contributions within the evaluation period. When there are contributions (2) we should use a method for adjusting holding period yields. Where the contribution can be either positive (a new commitment) or negative (a withdrawal). This adjustment process alters the initial and terminal values of the portfolios by the weighted amount of the contribution made during the holding period.

SUMMARY
Investors are always interested in evaluating the performance of their portfolios. For an investor it is both expensive and time consuming to analyze and select securities for a portfolio. Because of this, they pay professionals, i.e. the managers who have enough knowledge and experience in creating and managing the securities portfolios. This is of an extremely importance when the portfolio consists of bonds, that have a different characteristics then equities. In other words, the factors that determine the performance of a bond portfolio differ from those that affect common stocks. Therefore, the authors started to create the models or technique to examine bond portfolio performance. Notably, the bond portfolio evaluation techniques typically consider separately the several important decisions, the influence of sector and quality factors, and the impact of individual bond selection. In this paper, we have considered bond market line, decomposing portfolio returns and analyzing sources of return. Each of these techniques has its advantages as well as limitations. Finally,

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CONTACT ADDRESS: Vesna Bogojevic Arsic PhD., assistant professor, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, 11000 Belgrade, Serbia and Montenegro; E-mail: bogojevic@fon.bg.ac.yu

Recenzent: Ing. Peter Szovics, PhD.