Forecasting Bond Prices

To illustrate how a financial institution can assess the potential impact of interest rate movements on its bond holdings, assume that Longhorn Savings and Loan recently purchased Treasury bonds in the secondary market with a total par value of $40 million. The bonds will mature in five years and have an annual coupon rate of 10 percent. Longhorn is attempting to forecast the market value of these bonds two years from now because it may sell the bonds at that time. Therefore, it must forecast the investor’s required rate of return and use that as the discount rate to determine the present value of the bonds’ cash flows over the final three years of their life. The computed present value will represent the forecasted price two years from now.

To continue with our example, assume the investor’s required rate of return two years from now is expected to be 12 percent. This rate will be used to discount the periodic cash flows over the remaining three years. Given coupon payments of $4 million per year (10% × $40 million) and a par value of $40 million, the predicted present value is determined as follows:

\[
P_{\text{PV}} \text{ of bonds two years from now} = \frac{4,000,000}{(1.12)^1} + \frac{4,000,000}{(1.12)^2} + \frac{44,000,000}{(1.12)^3}
\]
\[
= 3,571,429 + 3,188,775 + 31,318,331
\]
\[
= 38,078,535
\]

An illustration of this exercise is provided in Exhibit 8A.1, using a time line. The market value of the bonds two years ahead is forecasted to be slightly more than $38 million. This is the amount Longhorn expects to receive if it sells the bonds then.

As a second example, assume that Aggie Insurance Company recently purchased corporate bonds in the secondary market with a par value of $20 million, a coupon rate of 14 percent (with annual coupon payments), and three years until maturity. The firm desires to forecast the market value of these bonds in one year because it may sell the bonds at that time. It expects the investor’s required rate of return on similar investments to be 11 percent in one year. Using this information, it discounts the bond’s cash flows ($2.8 million in annual coupon payments and a par value of $20 million) over the final two years at 11 percent to determine their present value (and therefore market value) one year from now:

\[
P_{\text{PV}} \text{ of bonds one year from now} = \frac{2,800,000}{(1.11)^1} + \frac{22,800,000}{(1.11)^2}
\]
\[
= 2,522,522 + 18,504,991
\]
\[
= 21,027,513
\]
Thus, the market value of the bonds is expected to be slightly more than $21 million one year from now.

**Forecasting Bond Yields**

The yield to maturity can be determined by solving for the discount rate at which the present value of future payments (coupon payments and par value) to the bondholder would equal the bond’s current price. The trial-and-error method can be used by applying a discount rate and computing the present value of the payments stream. If the computed present value is higher than the current bond price, the computation should be repeated using a higher discount rate. Conversely, if the computed present value is lower than the current bond price, try a lower discount rate. Calculators and bond tables are also available to determine the yield to maturity.

If bonds are held to maturity, the yield is known. However, if they are sold prior to maturity, the yield is not known until the time of sale. Investors can, however, attempt to forecast the yield with the methods just demonstrated, in which the forecasted required rate of return is used to forecast the market value (and therefore selling price) of the bonds. This selling price can then be incorporated into the cash flow estimates to determine the discount rate at which the present value of cash flows equals the investor’s initial purchase price. Suppose that Wildcat Bank purchases bonds with the following characteristics:

- Par value = $30 million
- Coupon rate = 15 percent (annual payments)
- Remaining time to maturity = 5 years
- Purchase price of bonds = $29 million

The bank plans to sell the bonds in four years. The investor’s required rate of return on similar securities is expected to be 13 percent at that time. Given this information, Wildcat forecasts its annualized bond yield over the four-year period in the following manner.

The first step is to forecast the present value (or market price) of the bonds four years from now. To do this, the remaining cash flows (one final coupon payment of $4.5 million plus the par value of $30 million) over the fifth and final year should be discounted (at the forecasted required rate of return of 13 percent) back to the fourth year when the bonds are to be sold:

\[
P(V \text{ of bond four years from now}) = \frac{\$34,500,000}{(1.13)^1} = \$30,530,973
\]
This predicted present value as of four years from now serves as the predicted selling price in four years.

The next step is to incorporate the forecasted selling price at the end of the bond portfolio’s cash flow stream. Then the discount rate that equates the present value of the cash flow stream to the price at which the bonds were purchased will represent the annualized yield. In our example, Wildcat Bank’s cash flows are coupon payments of $4.5 million over each of the four years it holds the bonds; the fourth year’s cash flows should also include the forecasted selling price of $30,530,973 and therefore sum to $35,030,973. Recall that Wildcat Bank purchased the bonds for $29 million. Given this information, the equation to solve for the discount rate ($k$) is

\[
\text{PV of bonds using a 17% discount rate} = \frac{4,500,000}{(1 + k)^1} + \frac{4,500,000}{(1 + k)^2} + \frac{4,500,000}{(1 + k)^3} + \frac{35,030,973}{(1 + k)^4}
\]

The trial-and-error method can be used to determine the discount rate if a calculator is not available. With a discount rate of 17 percent, the present value would be

\[
$29 \text{ million} = \frac{4,500,000}{(1 + 0.17)^1} + \frac{4,500,000}{(1 + 0.17)^2} + \frac{4,500,000}{(1 + 0.17)^3} + \frac{35,030,973}{(1 + 0.17)^4}
\]

This present value is slightly less than the initial purchase price. Thus, the discount rate at which the present value of expected cash flows equals the purchase price is just slightly less than 17 percent. Consequently, Wildcat Bank’s expected return on the bonds is just short of 17 percent.

It should be recognized that the process for determining the yield to maturity assumes that any payments received prior to the end of the holding period can be reinvested at the yield to maturity. If, for example, the payments could be reinvested only at a lower rate, the yield to maturity would overstate the actual return to the investor over the entire holding period.

With a computer program, the financial institution could easily create a distribution of forecasted yields based on various forecasts for the required rate of return four years from now. Without a computer, the process illustrated here must be completed for each forecast of the required rate of return. The computer actually follows the same steps but is much faster.

Financial institutions that forecast bond yields must first forecast interest rates for the point in time when they plan to sell their bonds. These forecasted rates can be used along with information about the securities to predict the required rate of return that will exist for the securities of concern. The predicted required rate of return is applied to cash flows beyond the time of sale to forecast the present value (or selling price) of the bonds at the time of sale. The forecasted selling price is then incorporated when estimating cash flows over the investment horizon. Finally, the yield to maturity on the bonds is determined by solving for the discount rate that equates these cash flows to the initial purchase price. The accuracy of the forecasted yield depends on the accuracy of the forecasted selling price of the bonds, which in turn depends on the accuracy of the forecasted required rate of return for the time of the sale.

**Forecasting Bond Portfolio Values**

Financial institutions can quantitatively measure the impact of possible interest rate movements on the market value of their bond portfolio by separately assessing the impact on each type of bond and then consolidating the individual impacts. Assume
that Seminole Financial, Inc. has a portfolio of bonds with the required return \( (k) \) on each type of bond as shown in the upper portion of Exhibit 8A.2. Interest rates are expected to increase, causing an anticipated increase of 1 percent in the required return of each type of bond. Assuming no adjustment in the portfolio, Seminole’s anticipated bond portfolio position is displayed in the lower portion of Exhibit 8A.2.

The anticipated market value of each type of bond in the exhibit was determined by discounting the remaining year’s cash flows beyond one year by the anticipated required return. The market value of the portfolio is expected to decline by more than $12 million as a result of the anticipated increase in interest rates.

This simplified example assumed a portfolio of only three types of bonds. In reality, a financial institution may have several types of bonds, with several maturities for each type. Computer programs are widely available for assessing the market value of portfolios. The financial institution inputs the cash flow trends of all bond holdings and the anticipated required rates of return for each bond at the future time of concern. The computer uses the anticipated rates to estimate the present value of cash flows at that future time. These present values are then consolidated to determine the forecasted value of the bond portfolio.

The key variable in forecasting the bond portfolio’s market value is the anticipated required return for each type of bond. The prevailing interest rates on short-term securities are commonly more volatile than rates on longer-term securities, so the required returns on bonds with three or four years to maturity may change to a greater degree than the longer-term bonds. In addition, as economic conditions change, the required returns of some risky securities could change even if the general level of interest rates remains stable.

### Forecasting Bond Portfolio Returns

Financial institutions measure their overall bond portfolio returns in various ways. One way is to account not only for coupon payments but also for the change in

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**Exhibit 8A.2** Forecasts of Bond Portfolio Market Value

<table>
<thead>
<tr>
<th>Present Bond Portfolio Position of Seminole Financial, Inc.:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Bonds</strong></td>
<td><strong>Present k</strong></td>
</tr>
<tr>
<td>9% coupon Treasury bonds</td>
<td>9%</td>
</tr>
<tr>
<td>14% coupon corporate bonds</td>
<td>12%</td>
</tr>
<tr>
<td>10% coupon gov’t agency bonds</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forecasted Bond Portfolio Position of Seminole Financial, Inc.:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Bonds</strong></td>
<td><strong>Forecasted k</strong></td>
</tr>
<tr>
<td>9% coupon Treasury bonds</td>
<td>10%</td>
</tr>
<tr>
<td>14% coupon corporate bonds</td>
<td>13%</td>
</tr>
<tr>
<td>10% coupon gov’t agency bonds</td>
<td>11%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
</tbody>
</table>
market value over the holding period of concern. The market value at the beginning of the holding period is perceived as the initial investment. The market value at the end of that period is perceived as the price at which the bonds would have been sold. Even if the bonds are retained, the measurement of return requires an estimated market value at the end of the period. Finally, the coupon payments must be accounted for as well. A bond portfolio’s return is measured the same way as an individual bond’s return. Mathematically, the bond portfolio return can be determined by solving for $k$ in the following equation:

$$\text{MVP} = \frac{\sum_{t=1}^{n} C_t}{(1 + k)^t} + \frac{\text{MVP}_n}{(1 + k)^n}$$

where

- $\text{MVP}$ = today’s market value of the bond portfolio
- $C_t$ = coupon payments received at the end of period $t$
- $\text{MVP}_n$ = market value of the bond portfolio at the end of the investment period of concern
- $k$ = discount rate that equates the present value of coupon payments and the future portfolio market value to today’s portfolio market value

To illustrate, recall that Seminole Financial, Inc. forecasted its bond portfolio value for one year ahead. Its annual coupon payments ($C$) sum to $32,600,000 (computed by multiplying the coupon rate of each type of bond by the respective par value). Using this information, along with today’s MVP and the forecasted MVP (called $\text{MVP}_n$), its annual return is determined by solving for $k$ as follows:

$$\text{MVP} = \frac{C_1 + \text{MVP}_n}{(1 + k)^1}$$

$$\$297,207,200 = \frac{$32,600,000 + $284,915,840}{(1 + k)^1}$$

$$\$297,207,200 = \frac{$317,515,840}{(1 + k)^1}$$

The discount rate (or $k$) is estimated to be about 7 percent. (Work this yourself for verification.) Therefore, the bond portfolio is expected to generate an annual return of about 7 percent over the one-year investment horizon. The computations to determine the bond portfolio return can be tedious, but financial institutions use computer programs. If this type of program is linked with another program to forecast future bond prices, a financial institution can input forecasted required returns for each type of bond and let the computer determine projections of the bond portfolio’s future market value and its return over a specified investment horizon.