LEARNING OUTCOMES

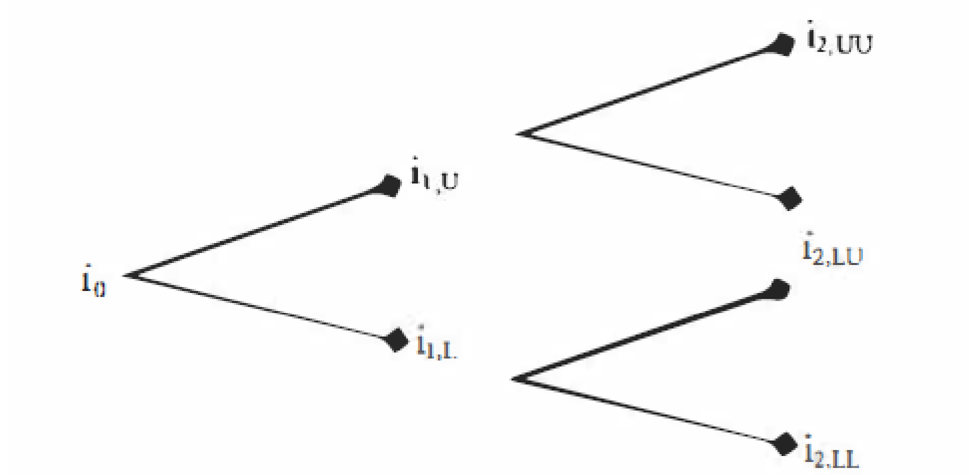
1. Using relative value analysis, evaluate whether a security is undervalued, fairly valued, or overvalued.
2. Evaluate the importance of benchmark interest rates in interpreting spread.
3. Describe the backward induction valuation methodology within the binomial interest rate tree framework.
4. Calculate the value of a callable bond from an interest rate tree.
5. Explain the relations among the values of a callable (putable) bond, the
6. Corresponding option-free bond, and the embedded option.
7. Explain the effect of volatility on the arbitrage-free value of an option.
8. Interpret an option-adjusted spread with respect to a nominal spread and to benchmark interest rates.
9. Explain how effective duration and effective convexity are calculated using the binomial model.
10. Calculate the value of a putable bond, using an interest rate tree.
11. Describe and evaluate a convertible bond and its various component values.
12. Compare the risk-return characteristics of a convertible bond with the risk-return characteristics of ownership of the underlying common stock.

- **Using relative value analysis, whether a security is undervalued, fairly valued, or overvalued.**

- Relative value analysis of bonds involves comparing the spread on the bond (over some benchmark) to the required spread and determining whether the bond is over or undervalued relative to the benchmark.
- The **required spread** is the spread available on comparable securities.
- Undervalued ("cheap") bonds have spreads larger than the required spread.
- Overvalued ("rich") bonds have spreads smaller than the required spread.
- Properly valued ("fairly priced") bonds have spreads equal to the required spread.

BINOMIAL MODELS

- A relatively simple single factor interest rate model that, given an assumed level of volatility, suggests that interest rates have an equal probability of taking on one of two possible values in the next period.
- Interest Rate Tree = a set of paths that interest rates may follow over time.

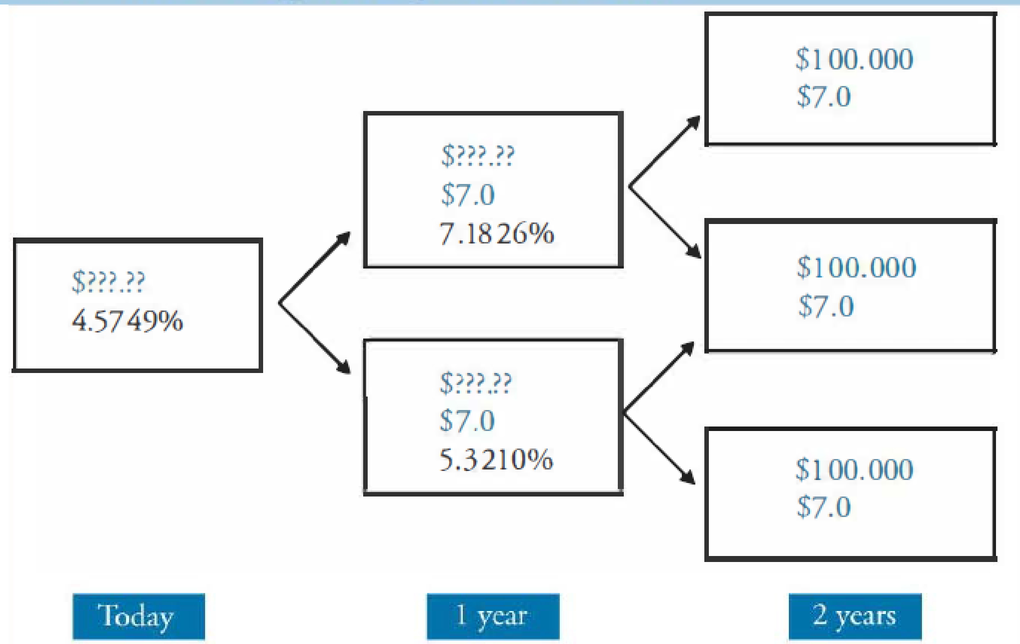


- **Uderlying rule** governing the construction of an interest rate tree: the interest rate tree should generate arbitrage-free values for on-the-run issues of the benchmark security
- **Value of on-the-run issues** produced by the interest rate tree **must** equal their market prices, which excludes arbitrage opportunities.
- **The value of a bond at a given node** in a binomial tree is the average of the present values of the two possible values from the next period, because the probabilities of an up move and a down move are both 50%.

Example: Valuing an option-free bond with the binomial model

A 7% annual coupon bond has two years to maturity. The interest rate tree is shown in the figure below. Fill in the tree and calculate the value of the bond today.

Valuing a 2-Year, 7.0% Coupon, Option-Free Bond



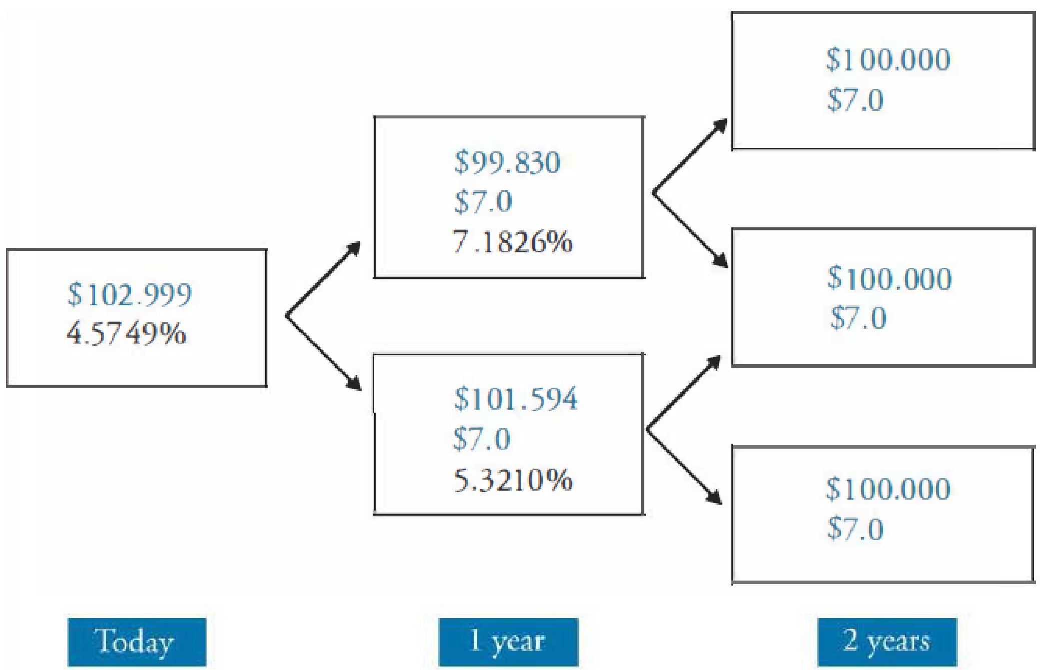
Consider the value of the bond at the *upper* node for Period 1, $V_{1,U}$:

$$V_{1,U} = \frac{1}{2} \times \left[\frac{\$100 + \$7}{1.071826} + \frac{\$100 + \$7}{1.071826} \right] = \$99.830$$

Similarly, the value of the bond at the *lower* node for Period 1, $V_{1,L}$, is:

$$V_{1,L} = \frac{1}{2} \times \left[\frac{\$100 + \$7}{1.053210} + \frac{\$100 + \$7}{1.053210} \right] = \$101.594$$

$$V_0 = \frac{1}{2} \times \left[\frac{\$99.830 + \$7}{1.045749} + \frac{\$101.594 + \$7}{1.045749} \right] = \$102.999$$



VALUING BONDS WITH EMBEDDED OPTIONS: BINOMIAL MODEL

Page 2

Q5: The on-the-run issue for the XYZ Company is shown below:

Maturity (Years)	Yield to Maturity (%)	Market Price		Coupon Rate (%)
1	${}_0Y_1 =$ 7.5	100		7.5
2	${}_0Y_2 =$ 7.6	100	$\Longrightarrow$	7.6
3	${}_0Y_3 =$ 7.7	100		7.7

STEP 1: Using Arbitrage Free Approach, calculate the spot rates:

Maturity (Years)	Spot Rate (%)
1	$\boxed{7.5} = {}_0r_1$
2	$\boxed{7.604} = {}_0r_2$
3	$\boxed{7.71} = {}_0r_3$

"Arbitrage Free"

$$\frac{7.6}{(1.076)} + \frac{107.6}{(1.076)^2} = 100 = \frac{7.6}{(1.075)} + \frac{107.6}{(1+{}_0r_2)^2}$$

$${}_0r_2 = \left(\frac{107.6}{92.93}\right)^{\frac{1}{2}} - 1 = 7.604\%$$

$$100 = \underset{\substack{\| \\ 7.1628}}{\frac{7.7}{(1.075)}} + \underset{\substack{\| \\ 6.6502}}{\frac{7.7}{(1.07604)^2}} + \frac{107.7}{(1+{}_0r_3)^3}$$

$$\therefore {}_0r_3 = \left(\frac{107.7}{86.1870}\right)^{\frac{1}{3}} - 1$$

$$= 7.710\%$$

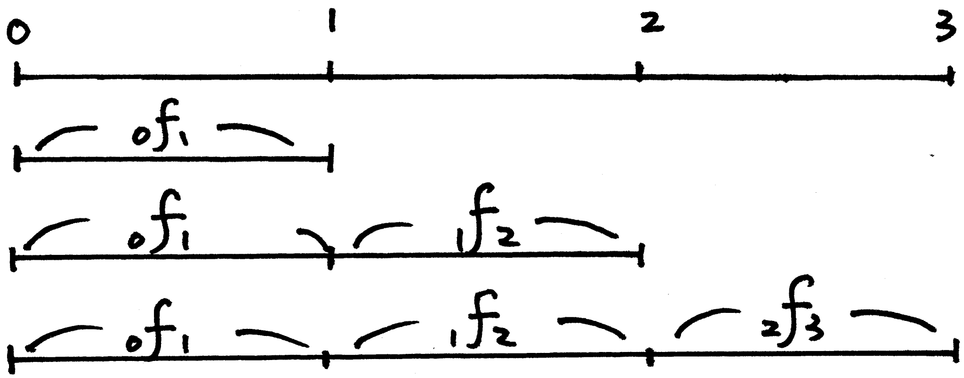
VALUING BONDS WITH EMBEDDED OPTIONS : Binomial Model

STEP 2: Calculate forward rates:

$7.5\% = {}_0r_1$

$7.604\% = {}_0r_2$

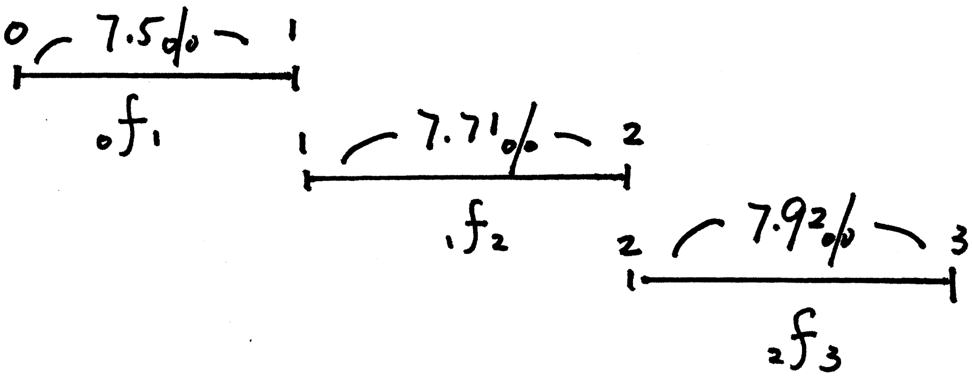
$7.71\% = {}_0r_3$



${}_0f_1 = {}_0r_1 = 7.5\%$

$$(1+{}_0r_2)^2 = (1+{}_0f_1)(1+{}_1f_2) \quad \therefore {}_1f_2 = \frac{(1.07604)^2}{(1.075)} - 1 = 7.71\%$$

$$(1+{}_0r_3)^3 = (1+{}_0f_1)(1+{}_1f_2)(1+{}_2f_3) \quad \therefore {}_2f_3 = \frac{(1.0771)^3}{(1.075)(1.0771)} - 1 = 7.92\%$$



VALUING BONDS WITH EMBEDDED OPTIONS : Binomial Model

Step 3: Develop interest rate tree assuming an interest rate volatility of $\boxed{10\%}$ for the 1-year rate:

0 — 1 — 2 — 3

$_0r_1 = {}_0f_1 = 7.5\%$ (0 to 1)

$_1f_2 = 7.71\%$ (1 to 2)

$_2f_3 = 7.92\%$ (2 to 3)

$_0f_1 = 7.5\%$

$\rightarrow$ $_1f_2\,(1.1) = 8.48\%$

$\rightarrow$ $_1f_2\,(.9) = 6.94\%$

$\rightarrow$ $_2f_3\,(1.1)^2 = 9.6\%$

$\rightarrow$ $_2f_3\,(1.1)(.9) = 7.86\%$

$\rightarrow$ $_2f_3\,(0.9)^2 = 6.4\%$

VALUING BONDS WITH EMBEDDED OPTIONS: BINOMIAL MODEL

Using the binomial tree, determine the value of an 8.5% 3-year option-free bond:

$V_3 = 100$

$c = 8.5$

${}_2f_3 = 9.6\%$ $\quad c = 8.5$

$$V_2 = \frac{1}{2}\left(\frac{108.5}{1.096} + \frac{108.5}{(1.096)}\right) = 98.99$$

${}_1f_2 = 8.48\%$ $\quad c = 8.5$

$$V_1 = \frac{1}{2}\left(\frac{98.99+8.5}{1.0848} + \frac{100.59+8.5}{1.0848}\right) = 99.83$$

$V_3 = 100$

$c = 8.5$

${}_0f_1 = 7.5\%$

$$V_0 = \frac{1}{2}\left(\frac{99.83+8.5}{1.075} + \frac{102.64+8.5}{1.075}\right)$$

$$= 102.08$$

${}_2f_3 = 7.86\%$ $\quad c = 8.5$

$$V_2 = \frac{1}{2}\left(\frac{108.5}{1.0786} + \frac{108.5}{1.0786}\right) = 100.59$$

${}_1f_2 = 6.94\%$ $\quad c = 8.5$

$$V_1 = \frac{1}{2}\left(\frac{100.59+8.5}{1.0694} + \frac{101.93+8.5}{(1.0694)}\right) = 102.64$$

$V_3 = 100$

$c = 8.5$

${}_2f_3 = 6.4\%$ $\quad c = 8.5$

$$V_2 = \frac{1}{2}\left(\frac{108.5}{(1.064)} + \frac{108.5}{(1.064)}\right) = 101.93$$

$V_3 = 100$

$c = 8.5$

$$** \quad \frac{8.5}{(1.075)} + \frac{8.5}{(1.07604)^2} + \frac{108.5}{(1.0771)^3} = 102.08$$

VALUING BONDS WITH EMBEDDED OPTIONS: BINOMIAL MODEL

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Suppose that the 3-year 8.5% coupon issue is callable starting in year 1 at par (100) (that is, the call price is 100). Also assume that the following can rule is used: **<u>if the price exceeds 100, the issue will be called</u>**. What is the value of this 3-year 8.5% coupon callable issue? Using the binomial tree, determine the value of an 8.5% 3-year option-free bond:

$V_{31} = 100$
$c = 8.5$

$V_{21} = 98.99$ $c = 8.5$
${}_2f_3 = 9.6\%$

$V_{11} = \frac{1}{2}\left(\frac{98.99+8.5}{1.0848} + \frac{100+8.5}{1.0848}\right)$
$= 99.55$ $c = 8.5$

$V_{32} = 100$
$c = 8.5$

$V_0 = \frac{1}{2}\left(\frac{99.55+8.5}{1.075} + \frac{100+8.5}{1.075}\right)$
$= 100.722$

$V_{22} = \cancel{100.59} = \boxed{100}$ CALL
${}_2f_3 = 7.86\%$ $c = 8.5$

$V_{12} = \frac{100+8.5}{(1.0694)} = \cancel{101.46} = \boxed{100}$ CALL
$c = 8.5$

$V_{33} = 100$
$c = 8.5$

$V_{23} = \cancel{101.93}$ $\boxed{100}$ CALL
${}_2f_3 = 6.4\%$ $c = 8.5$

$V_{34} = 100$
$c = 8.5$

** CALL premium = 102.08 - 100.722 = $1.36

➢ Spread Measures

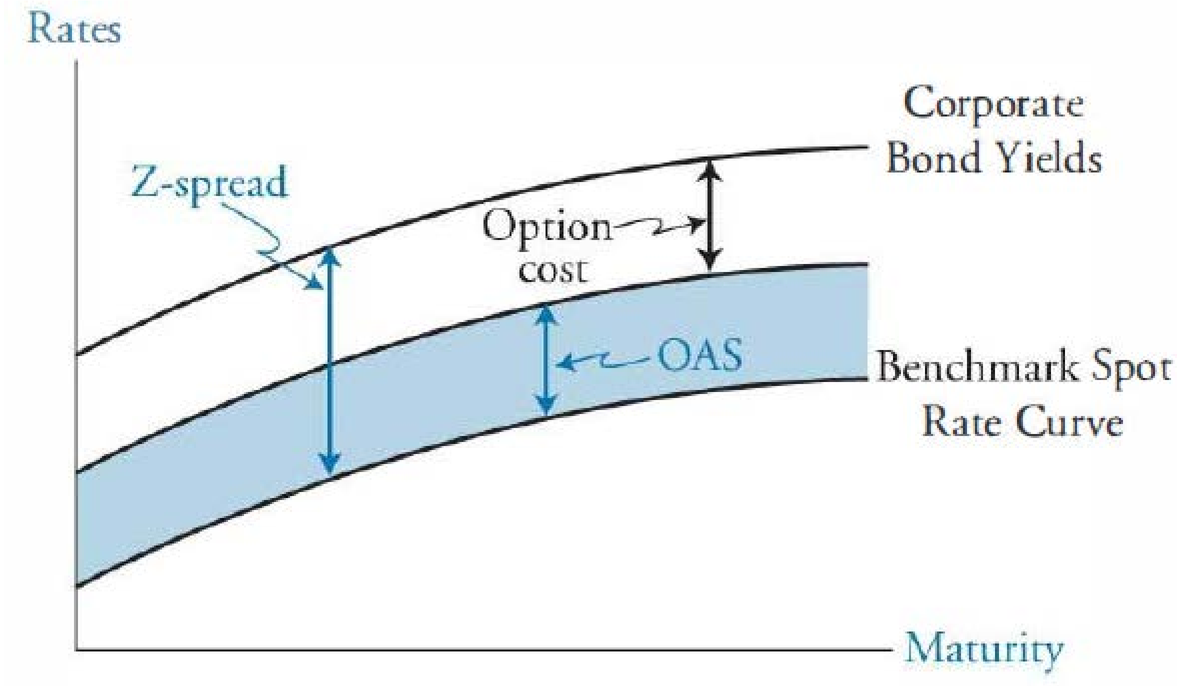
- There are three important spread measures that you must be able to interpret:.
  - ✓ **Nominal spread,**
  - ✓ **Zero-Volatility spread (Z-spread),**
  - ✓ **Option-adjusted spread (OAS)**

- **Nominal spread** = the bond's yield to maturity minus the yield on a comparable-maturity treasury benchmark security.
- **Z-spread** = the spread that when added to each spot rate on the yield curve, makes the present value of the bond's cash flows equal to the bond's market price. Therefore, it is a spread over the entire spot rate curve.
- The term zero volatility in the Z-spread refers to the fact that it assumes interest rate volatility is zero. If interest rates are volatile, the Z-spread is not appropriate to use to value bonds with embedded options because the Z-spread includes the cost of the embedded option.
- The nominal spread and the Z-spread are approximately equal to each other. The difference between the two is larger (1) if the yield curve is not flat, (2) for securities that repay principal over time such as mortgage-backed securities (MBS), and (3) for securities with longer maturities.

For example, suppose the 1-year spot rate is 4% and the 2-year spot rate is 5%. The market price of a 2-year bond with annual coupon payments of 8% is \$104.12. The Z-spread is the spread that solves the following equation:

$\$104.12 = \frac{\$8}{(1+4\%+Z)} + \frac{\$108}{(1+5\%+Z)^2}$; Solve for Z by Trial-and-Error, and Z = 0.8%

- **OAS** is the spread on a bond with an embedded option **after the embedded option cost has been removed**. It's equal to the **Z-spread minus the option cost**.



VALUING BONDS WITH EMBEDDED OPTIONS: Option-adjusted Spread (OAS)	Page

$$P_{CB} = P_{NCB} - Call\ Option$$

$$P_{PB} = P_{NPB} + Put\ Option$$

	Benchmark	Risk Compensation
1. Nominal Spread	Treasury (sector) Yield Curve	Credit, Liquidity, Option
2. Z-Spread	Treasury (sector) Spot Rate Curve	Credit, Liquidity, Option
3. OAS	Treasury (sector) Spot Rate Curve	Credit, Liquidity

- Nominal Spread = YTM on Corporate – YTM on Benchmark (Treasury)
- Z-Spread = a spread could be added to benchmark spot rate curve such that the curve would properly discount the cash flows of the bond to its current value.
- OAS = netting out the option risk from the spread.

Callable Bonds	Putable Bonds
OAS < Z-Spread	OAS > Z-Spread
Call Option Value (%) = (Z-Spread – OAS)	Put Option Value (%) = (OAS – Z-Spread)
P_{NCB} = PV of Cash Flows discounted by OAS	P_{NPB} = PV of Cash Flows discounted by OAS
➢ Undervalued (Overvalued) if the OAS is greater (smaller) than the OAS on the comparable bonds	

➢ Calculate the value of a callable bond from an interest rate tree.

- The basic process for valuing a callable bond from an interest rate tree is similar to the process for a noncallable bond. When valuing a callable bond, however, the value used at any node corresponding to the call date and beyond must be either the price at which the issuer will call the bond at that date or the computed value if the bond is not called, whichever is less.
- The price at which the bond will be called is determined using a call rule (e.g., the issue will be called if the computed price exceeds 105% of the call price).

Example: Valuing a callable bond

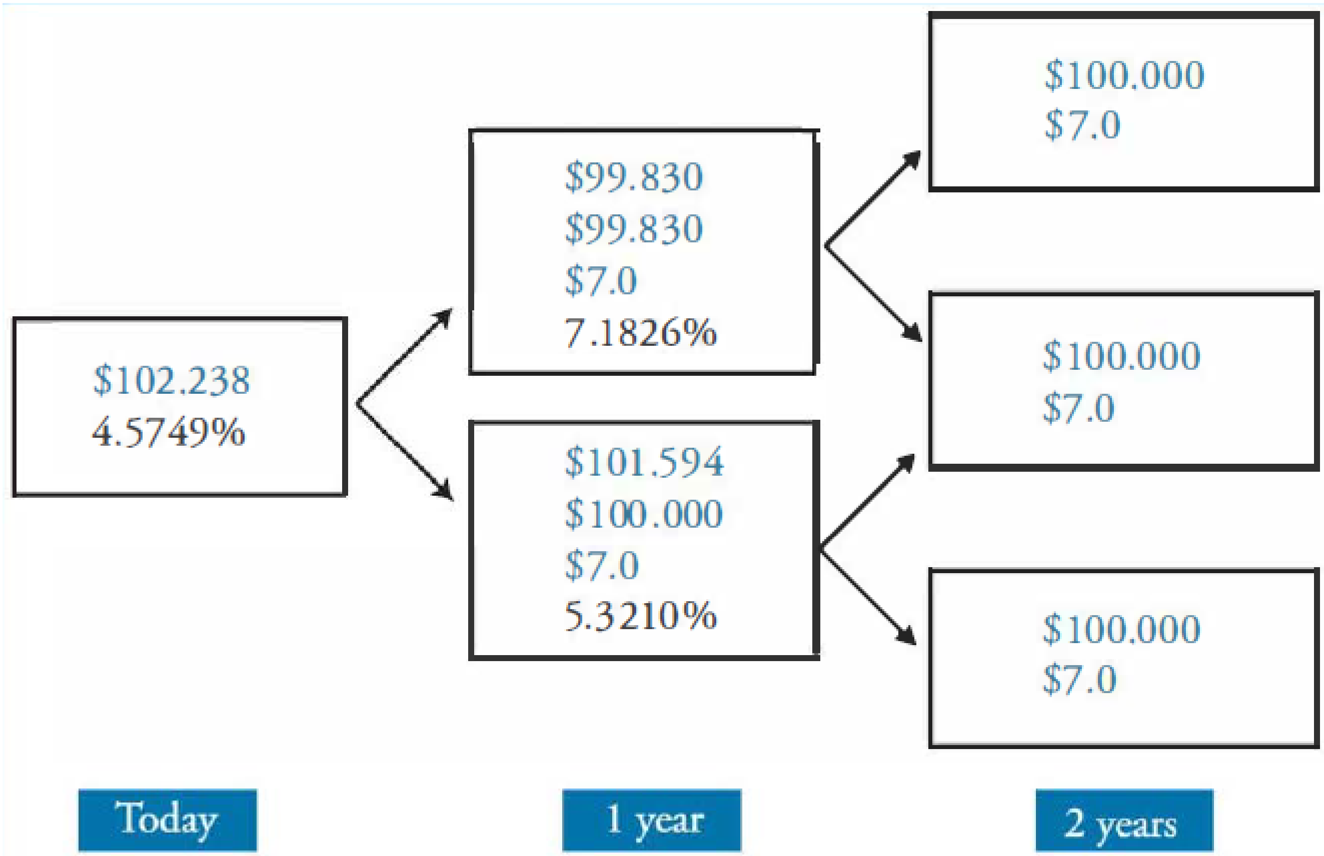
Continuing with our example, assume that the 2-year bond can be called in one year at 100. The issuer will call the bond if the computed bond price exceeds 100 one year from today (this is the call rule). Calculate the value of the callable bond today.

The call rule (call the bond if the price exceeds \$100) is reflected in the boxes in the completed binomial tree, where the second line of the boxes at the 1-year node is the lesser of the call price or the computed value. For example, the value of the bond in one year at the lower node is \$101.594. However, in this case, the bond will be called, and the investor will only receive \$100. Therefore, for valuation purposes, the value of the bond in one year at this node is \$100.

The calculation for the current value of the bond at Node 0 (today), assuming the simplified call rules of this example, is:

$$V_0 = \frac{1}{2} \times \left[\frac{\$99.830 + \$7}{1.045749} + \frac{\$100.00 + \$7}{1.045749} \right] = \$102.238$$

Valuing a 2-year, 7% coupon, Callable Bond in one Year at 100:



➢ Calculating OAS from Binomial Model

- The interest rates used to value the noncallable bond are derived to yield arbitrage-free values for on-the-run Treasury securities (i.e., the interest rates produced a theoretical value equal to the market price for Treasury securities). However, this does not mean that the interest rate tree will produce an arbitrage-free value for the callable bond. In order to produce an arbitrage-free value for a callable bond, interest rates must be adjusted for the option characteristics of the bond. The adjustment is called the option-adjusted spread (OAS).
- The OAS is the interest rate spread that must be added to all of the 1 -year rates in a binomial tree so that the theoretical value of a callable bond generated with the tree is equal to its market price (i.e., the OAS is the spread that forces the theoretical price to be arbitrage-free).
- The way to calculate the OAS from a binomial model is by trial and error.

Example: Calculating the OAS

In the previous example, the value of the 2-year, 7% bond, callable in one year, was calculated as $102.238. If the market price of this bond is $101.531, the bond is selling at a discount relative to its theoretical value computed from the binomial model. Verify that if a spread of 50 basis points is added to each of the 1-year rates in the tree, the theoretical value of this bond will equal its market price of $101.531.

Consider the value of the bond at the *upper* node for Period 1, $V_{1,U}$.

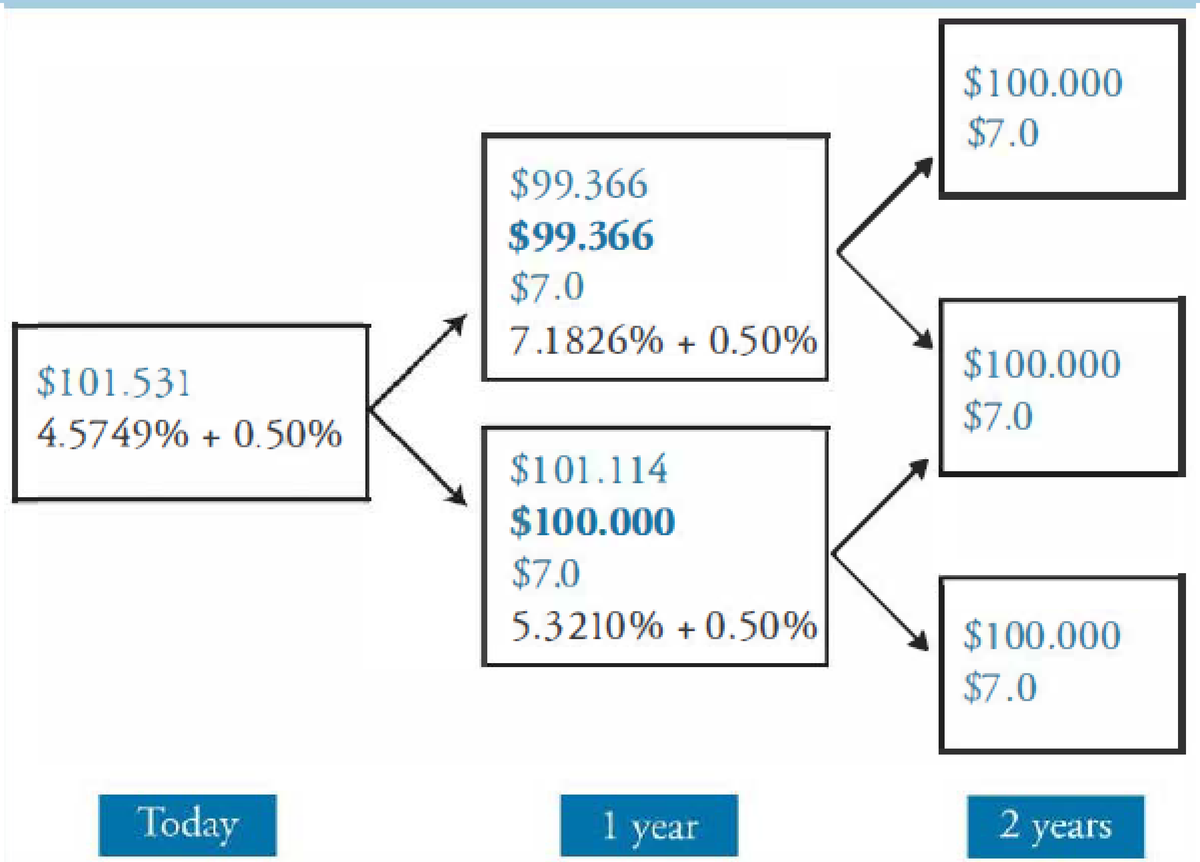
$$V_{1,U} = \frac{1}{2} \times \left[\frac{\$100 + \$7}{1.071826 + 0.005} + \frac{\$100 + \$7}{1.071826 + 0.005} \right] = \$99.366$$

Similarly, the value of the bond at the *lower* node for Period 1, $V_{1,L}$ is:

$$V_{1,L} = \frac{1}{2} \times \left[\frac{\$100 + \$7}{1.053210 + 0.005} + \frac{\$100 + \$7}{1.053210 + 0.005} \right] = \$101.114$$

Now calculate V_0, the current value of the bond at Node 0:

$$V_0 = \frac{1}{2} \times \left[\frac{\$99.366 + \$7}{1.045749 + 0.005} + \frac{\$100.000 + \$7}{1.045749 + 0.005} \right] = \$101.531$$



- **Interpret an option-adjusted spread with respect to a nominal spread and to benchmark interest rates.**

	Treasury Benchmark	*Sector Benchmark*	*Issuer-Specific Benchmark*
OAS > 0	Overvalued ("rich") if actual OAS < required OAS; undervalued ("cheap") if actual OAS > required OAS	Overvalued ("rich") if actual OAS < required OAS; undervalued ("cheap") if actual OAS > required OAS	Undervalued ("cheap")
OAS = 0	Overvalued ("rich")	Overvalued ("rich")	Fairly priced
OAS < 0	Overvalued ("rich")	Overvalued ("rich")	Overvalued ("rich")

Note that OAS contains both Credit Risk and Liquidity Risk premium under Treasury Benchmark and Sector Benchmark. It contains only Liquidity Risk Premium under the Issuer-Specific Benchmark.

Example: Relative OAS valuation

An analyst makes the following spread estimates relative to U.S. Treasuries for a callable corporate bond:

- Nominal spread relative to the Treasury yield curve: 240 basis points.
- *Z*-spread relative to the Treasury spot curve: 225 basis points.
- OAS relative to the Treasury spot curve: 190 basis points.

The analyst also determines that the *Z*-spread over Treasuries on comparable option-free bonds (i.e., bonds with the same credit rating, maturity, and liquidity) in the market is 210 basis points. Determine whether the bond is overvalued, undervalued, or properly valued.

Answer:

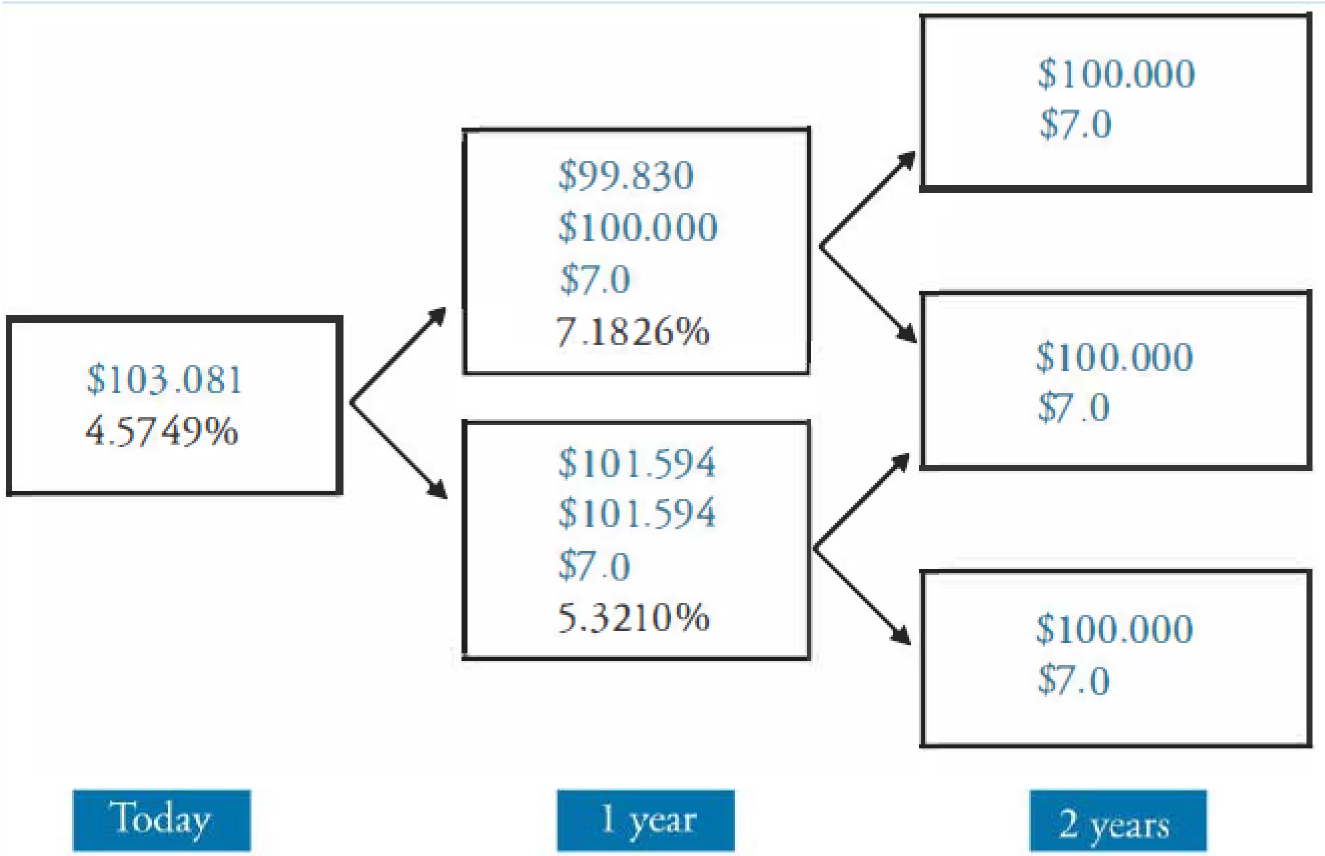
The required OAS in this case is the *Z*-spread on comparable option-free bonds (because *Z*-spread is equal to OAS for option-free bonds), which is 210 basis points. This bond is overvalued, because its OAS of 190 basis points is less than the required OAS. It is not appropriate to compare the bond's *Z*-spread or nominal spread to the required spread because the embedded option cost is not reflected in those spread measures.

➢ **Calculate the value of a putable bond, using an interest rate tree.**

- A putable bond gives the holder the right to sell (put) the bond to the issuer at a predetermined price at some time prior to the bond's maturity.

Example: Valuing a putable bond

Consider a 2-year, 7% coupon, putable bond that is putable in one year at a price of 100. Further, assume that the put option will be exercised if the value of the bond is less than 100. Calculate the value of the putable bond.



For the tree shown, the second line in the boxes at the 1-year node reflects the greater of the exercise price or the computed value. When valuing this putable bond, the value used at any node corresponding to the put date and beyond must be either the exercise price at that date or the computed value, ***whichever is greater***.

Consider the value of the bond at the ***upper*** node for Period 1, $V_{1,U}$.

$$V_{1,U} = \frac{1}{2} \times \left[\frac{\$100 + \$7}{1.071826} + \frac{\$100 + \$7}{1.071826}\right] = \$99.830$$

Similarly, the value of the bond at the ***lower*** node for Period 1, $V_{1,L}$ is:

$$V_{1,L} = \frac{1}{2} \times \left[\frac{\$100 + \$7}{1.053210} + \frac{\$100 + \$7}{1.053210}\right] = \$101.594$$

Given our put rule, the current value of the bond at Node 0 (today) is:

$$V_0 = \frac{1}{2} \times \left[\frac{\$100.000 + \$7}{1.045749} + \frac{\$101.594 + \$7}{1.045749}\right] = \$103.081$$

The \$103.0810 value here is greater than the \$102.999 value that was computed earlier for the option-free bond. Compute the value of the embedded put option.

Answer:

The value of the embedded put option (to the bondholder) is:

$103.081 – $102.999 = $0.082

➢ Evaluate a convertible bond

- The owner of a convertible bond has the right to convert the bond into a fixed number of common shares of the issuer. Hence, a convertible bond includes an embedded call option.

- The convertible bondholder owns the call option; the issuer owns the call option in a callable bond.

- The holder has the right to buy shares with a bond that changes in value, not with cash at a fixed exercise price (the call price in a callable bond).

- Almost all convertible bonds are callable, which gives the issuer the ability to force conversion. If the bond is worth more than the call price and the issuer calls the bond, it's optimal for the holder to convert the bond into shares rather than sell back to the issuer at the lower call price.

- The ***Conversion Ratio*** is the number of common shares for which a convertible bond can be exchanged. For example, a convertible bond issued at par with a conversion ratio of 10 allows its holder to convert one $1,000 par bond into 10 shares of common stock. Equivalently, the **conversion price of the bond** is *$1,000 I 10 shares= $100*. For bonds not issued at par, the conversion price is the issue price divided by the conversion ratio.

- The ***Conversion Value*** of a convertible bond is the value of the common stock into which the bond can be converted. The conversion ratio is the number of shares the holder receives from conversion for each bond. Conversion value is calculated as:

Conversion Value = Market Price of Stock x Conversion Ratio

Example: Calculating the minimum value of a convertible bond

Business Supply Company, Inc. operates retail office equipment stores in the United States and Canada. Consider a BSC convertible bond with a 7% coupon that is currently selling at $985 with a conversion ratio of 25 and a straight value of $950. Assume that the value of BSC's common stock is currently $35 per share, and that it pays $1 per share in dividends annually. Compute the bond's minimum value.

Answer:

The conversion value of this bond is 25 × $35 = $875. Since the straight value of $950 is greater than the conversion value of $875, the bond must be priced to sell for at least $950.

- The **straight value**, or **investment value**, of a convertible bond is the value of the bond, **if it were not convertible;** the present value of the bond's cash flows discounted at the required return on a comparable option-free issue.
- The **minimum value of a convertible bond** must be the <u>greater of its conversion value or its straight value.</u>

- The ***market conversion price***, or **conversion parity price**, is the price that the convertible bondholder would effectively pay for the stock if she bought the bond and immediately converted it.

$$\textbf{Market Conversion Price} = \frac{\textit{Market Price of Convertable Bond}}{\textit{Conversion Ratio}}$$

Example: Calculating market conversion price

Compute and interpret the market conversion price of the BSC bond.

Answer:

The market conversion price is: $985 / 25 = $39.40. This can be viewed as the stock price at which an investor is indifferent between selling the bond or converting it.

- ***Market Conversion Premium Per Share*** is the difference between the **market conversion price** and the **stock's** current **market price**:

Market Conversion Premium Per Share = Market Conversion Price – Market Price of Stock

Since BSC is selling for $35 per share, the market conversion premium per share for the BSC bond is: $39.40 – $35 = $4.40. This can be interpreted as the premium that investors are willing to pay for the chance that the market price of the stock will rise above the market conversion price. This is done with the assurance that even if the stock price declines, the value of the convertible bond will not fall below its straight value.

- ***Market conversion premium per share*** is usually expressed as a ratio, appropriately called the market conversion premium ratio.

$$\textit{Market Conversion Premium Ratio} = \frac{\textbf{Market Conversion Price Per Share}}{\textbf{Market Price of Stock}}$$

The BSC bond market conversion premium ratio is:

$$\frac{\$4.40}{\$35} = 12.57\%$$

- Typically, the coupon income from a convertible bond exceeds the dividend income that would have been realized if the stock were owned directly. On a per-share basis, this tends to offset the market conversion premium. The time it takes to compensate the per-share premium is known as the **premium payback period** or the **breakeven time** and is expressed as:

$$\textit{Premium Payback Period} = \frac{\textbf{Market Conversion premium Per Share}}{\textbf{Favorable Income Difference Per Share}}$$

where the favorable income difference per share is the annual per share difference in the cash flows from the convertible bond and the stock:

$$\textit{Favorable Income Difference Per Share} = \frac{\textbf{Coupon Interest} - (\textbf{Conversion Ratio} \times \textbf{Dividend per share})}{\textbf{Conversion ratio}}$$

For the BSC bond:

$$\text{coupon interest} = 0.07 \times \$1{,}000.00 = \$70.00$$

$$\text{conversion ratio} \times \text{dividends per share} = 25 \times \$1.00 = \$25.00$$

$$\text{favorable income difference per share is } \frac{\$70.00 - \$25.00}{25} = \$1.80$$

$$\text{premium payback petiod is: } \frac{\$4.40}{\$1.80} = 2.44 \text{ years}$$

- The convertible bond investor's **downside risk** is limited by the bond's underlying straight value because the price of a convertible bond will not fall below this value regardless of what happens to the price of the issuer's common stock. This downside risk is measured by the ***premium over straight value***:

$$\textit{Premium over Straight Value} = \left(\frac{\textit{Market Price of Convertable Bond}}{\textit{Straight Value}}\right) - 1$$

The premium over straight value for the BSC bond is:

$$\left(\frac{\$985.00}{\$950.00}\right) - 1 = 3.68\%$$

Holding all other factors constant, the greater the premium over straight value, the less attractive the convertible bond.

• Valuing Convertible Bond Using Option Valuation

Convertible Noncallable Bond Value = Straight Value of Bond
+ Value of Call Option on Stock

- The Black-Scholes-Merton option pricing model can be used to establish the value of the call option. A key variable in this model is stock price volatility, which is positively related to the value of the call option. Therefore, as stock price volatility increases, so does the value of the convertible.

Callable Convertible Bond Value = Straight Value of Bond
+ Value of Call Option on Stock
– Value of Call Option on Bond

- The valuation of a callable convertible bond involves the valuation of the call feature on bond, which is a function of interest rate volatility and the economic conditions that can trigger the call feature. The Black-Scholes-Merton option pricing model cannot be used in this situation.

- The valuation of convertible bonds with embedded call and/or put options requires a model that links the movement of interest rates and stock prices. Thus, valuing convertible bonds can be challenging.
  - ✓ An increase in stock price volatility will increase the value of the call on the stock and increase the value of the callable convertible bond.
  - ✓ An increase in interest rate volatility will increase the value of the call on the bond and reduce the value of the callable convertible bond.

➢ Risk-Return of Convertible Bond as compared to that of Stock investment

- Buying convertible bonds in lieu of stocks limits downside risk.
- The price floor set by the straight bond value provides this downside protection.
- The cost of the downside protection is reduced upside potential due to the conversion premium.

Example: Risk and **return of a convertible bond,** part 1

Calculate the return on the convertible bond and the common stock if the market price of BSC common stock increases to $45 per share.

Answer:

The return from investing in the convertible bond is:

$$\left(\frac{\$45.00}{\$39.40}\right)-1=14.21\%$$

The return from investing directly in the stock is:

$$\left(\frac{\$45.00}{\$35.00}\right)-1=0.2857=28.57\%$$

The lower return from the convertible bond investment is attributable to the fact that the investor effectively bought the stock at the market conversion price of $39.40 per share.

Example: **Risk** and **return** of a **convertible bond**, part **2**

Calculate the return on the convertible bond and the common stock if the market price of BSC common stock falls to $30 per share.

Answer:

Recall that the bond will trade at the greater of its straight value or its conversion value. The conversion value in this scenario is 25 × $30.00 = $750.00. Assuming the straight value of the bond does not change, the bond will trade at $950.00. So, the return from investing in the convertible bond is:

$$\left(\frac{\$950}{\$985}\right) - 1 = -3.55\%$$

The return from investing directly in the stock is:

$$\left(\frac{\$30}{\$35}\right) - 1 = -14.29\%$$

The loss is less for the convertible bond investment because we assumed that the straight value of the bond did not change. Even if it had changed, the loss would probably still be less than the loss on the straight stock investment, thus emphasizing how the straight value serves as a floor to cushion a decline, even if it is a moving floor.