Learning Objectives

- What is a financial security?
- Identify the main differences between debt and equity securities
- Describe & price various types of debt securities
- Describe & price various types of equity securities
- Describe different types of securities markets
- Explain the risk-return relation for debt and equity securities
- Describe the concepts underlying the cost of capital

What is a financial security?

- The financial security is a contract between the provider of funds and the user of funds.
- The contract specifies:
  - The amount of money that has been provided
  - Terms & conditions: how the user is going to repay the provider (amount and timing of CFs)
- Provider: you (ordinary investor), the bank, venture capitalist, etc.
- User: entrepreneur or firm with good business idea/product but no (or not enough) money to execute the idea.

Simple example

**Bank loan as a financial security:**
You (user) borrow 7.5 million dollars, from a bank (provider) at 8 percent interest p.a. to start a new firm.

Your contract stipulates that you will repay the bank loan in 10 equal yearly installments. Each installment is approximately 1.118 million dollars.

Valuation of financial securities

For the owner of the financial security (investor):
- The security is represented by a stream of expected future cash flows
- The value of the security is the PV of the CF stream

Valuation of financial securities:
- Use the contract to determine the CF stream
- Find the required rate of return
- Use the appropriate TVM formula to calculate the PV of the CF stream

Common financial securities

<table>
<thead>
<tr>
<th>Debt Security</th>
<th>Equity Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>The owner of the security is a</td>
<td>The owner of the security is the</td>
</tr>
<tr>
<td>creditor of the firm</td>
<td>owner of the firm</td>
</tr>
<tr>
<td>Creditors have no control rights:</td>
<td>Owners have control rights: decide</td>
</tr>
<tr>
<td>no say in firm’s business decisions</td>
<td>(vote) on firm’s business decisions</td>
</tr>
<tr>
<td>The payment is fixed</td>
<td>The payment is risky, not fixed</td>
</tr>
<tr>
<td>Receives payment before anything is</td>
<td>Residual claim: receives whatever is</td>
</tr>
<tr>
<td>paid to firm owners (equity holders)</td>
<td>left after all debt holders/creditors</td>
</tr>
<tr>
<td>If the firm cannot pay, debt holders</td>
<td>If the firm cannot pay its debt,</td>
</tr>
<tr>
<td>will take over its assets</td>
<td>equity holders lose their control</td>
</tr>
<tr>
<td>Limited liability</td>
<td>Limited liability</td>
</tr>
</tbody>
</table>
Types of debt securities

- Fixed-coupon bond
- Zero-coupon bond
- Consol (Perpetual bond)
- Variable-rate bond
- Income bond
- Convertible bond
- Callable bond

Fixed-coupon bond

- Firm pays a fixed amount ('coupon') every period until the bond matures
- At maturity, firm pays the bond's face value (par value)
- The most common face value is $1,000
- The period can be one year, 6 months, one quarter (3 months) etc.

How to 'read' a fixed-coupon bond

A firm issues an 8%, 30-year bond with annual coupon payments. Par value is $1,000.

- Coupon rate = 8%
- Period = annual coupon payments
- Par (face) value CF = $1,000 paid at maturity
- Maturity, T = 30 years
- Coupon CF = Coupon rate x Par = 8% x 1,000 = $80 paid every year, at the end of the year

<table>
<thead>
<tr>
<th>$80</th>
<th>$80</th>
<th>...</th>
<th>$80</th>
<th>...</th>
<th>$1,080</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>t</td>
<td>T = 30</td>
<td></td>
</tr>
</tbody>
</table>

Example

A firm issues an 8%, 30-year bond. The par value is $1,000 and the (effective) annual cost of capital is 10%.

1. What is the value of the bond if coupon payments are annual?
2. What is the value of the bond if coupon payments are semi-annual?

Note the convention: Coupons are always annual. 8% annual coupon + semi-annual payments imply (8% / 2) = 4% semi-annual coupon.

Example

A bond with par value of $1,000 matures in 30 years.

The annual coupon rate is 10% with semiannual installments.

The bond is expected to make the next semiannual coupon payment 6 months from now.

The (effective) annual cost of capital is 8%.

What is the price of the bond today?

Read carefully: the coupon rate IS NOT the cost of capital.

Example

A $1,000 par value bond has coupon rate of 5% and the coupon is paid semi-annually.

The bond matures in 20 years and the (effective) annual required rate of return is 10%.

Compute the bond price.
Fixed Coupon Bond

- Firm pays a fixed amount (coupon) every period until the bond matures = CF
- At maturity, firm pays the bond's face value (par value) = FV
- The bond has T periods to maturity
- The effective cost of capital per period = r

\[
\text{Price} = PV = \frac{CF}{r} \left[ 1 - \left( \frac{1}{1+r} \right)^T \right] + \frac{FV}{(1+r)^T}
\]

Par value and the bond price

A $1,000 par value bond matures in 20 years. The (effective annual) required rate of return is r=10%.

1. Suppose annual coupon rate = 10%
   Verify that price = $1,000 = par value

2. Suppose annual coupon rate = 12%
   Verify that price = $1,170.27 > par value

3. Suppose annual coupon rate = 8%
   Verify that price = $829.73 < par value

Terminology

<table>
<thead>
<tr>
<th>Coupon rate</th>
<th>Discount rate</th>
<th>Price</th>
<th>Face value</th>
<th>The bond is selling at</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td></td>
<td>&lt; face value</td>
<td>&lt; value</td>
<td>at a discount</td>
</tr>
<tr>
<td>=</td>
<td></td>
<td>= face value</td>
<td>= value</td>
<td>at par</td>
</tr>
<tr>
<td>&gt;</td>
<td></td>
<td>&gt; face value</td>
<td>&gt; value</td>
<td>at a premium</td>
</tr>
</tbody>
</table>

Example

A 10-year annual-coupon bond was issued at par 4 years ago.
Since then the bond's yield to maturity (YTM) has decreased from 9% to 7%.
Which of the following statements (about the current market price of the bond) is true?

a. The bond is selling at a discount
b. The bond is selling at par
c. The bond is selling at a premium
d. The bond is selling at book value
e. Insufficient information

Example

One year ago Pell Inc. sold 20-year, $1,000 par value, annual-coupon bonds for $931.54 per bond. At that time the yield to maturity (market rate) was 9%.
Today, the yield to maturity is 9.5%; therefore the bonds are currently selling:

a. at a discount
b. at a premium
c. at par
d. above the market price
e. Insufficient information

Example: find the coupon rate

ABC Inc. just issued a twenty-year semi-annual coupon bond at a price of $787.39. The face value of the bond is $1,000, and the market required (effective annual) rate of return is 9%.

What is the annual coupon rate?

What if the bond pays coupons annually? Quarterly?
Zero-coupon bond

- No coupon payments during bond's lifetime (coupon rate = 0)
- One payment at maturity: the face (par) value = FV
- The bond has T periods to maturity
- The effective cost of capital per period = r

\[ \text{Price} = PV = \frac{FV}{(1+r)^T} \]

Examples

The (effective) annual interest rate is 12%.

1. What is the current price of a 12-month T-bill (zero-coupon bond, with face-value of $10,000 and 12 months to maturity)?
2. What is the current price of a 6-month T-bill (zero-coupon bond, with face-value of $10,000 and 6 months to maturity)?

Yield to Maturity (YTM)

If a bond has T years to maturity, a known CF-stream determined by its coupon rate and par-value, and it is traded for \( P_{\text{Market}} \), we define the yield to maturity (YTM) as the rate of return that solves the equation:

\[ P_{\text{Market}} = \frac{CF}{YTM} \left[ 1 - \frac{1}{(1+YTM)^T} \right] + \frac{FV}{(1+YTM)^T} \]

Note: we usually annualize the YTM (present it as an annual yield even if the bond pays coupons semi-annually or quarterly).

Wall Street convention: varies by bond type (coupon, discount etc.) and context (to compare one bond type to another - use the same calculation).

Examples: find the YTM

1) A 12-month T-bill (zero-coupon bond, with face-value of $10,000 and 12 months to maturity) is traded for $9,000. What is the bond's yield to maturity?
2) An 8-month T-bill (zero-coupon bond, with face-value of $10,000 and 8 months to maturity) is traded for $9,500. What is the bond's yield to maturity?
3) A $1,000 par value bond sells for $863.05. It matures in 20 years, has a 10% coupon rate paid semi-annually. What is the bond's yield to maturity?

Consol (perpetuity)

- Fixed coupon payments = CF, every period, forever
- No maturity (\( T = \infty \))
- The effective cost of capital per period = r

\[ \text{Price} = PV = \frac{CF}{r} \]

Example

Using a discount rate of 8% (effective annual rate), value the following bonds:

a. A consol that pays a coupon of $82.50 per year
b. A zero-coupon bond with 15 years to maturity and $1,000 face value (par value)
c. A 3%-coupon bond with 15 years to maturity, $1,000 face value (par value) and annual coupon payments
d. A 7%-coupon bond with 15 years to maturity, $1,000 face value and annual coupon payments
Other types of bonds

Variable-rate bond: the coupon rate is tied to a specific interest rate (not fixed)
Income bond: pays the coupon only when firm’s earnings are high enough
Convertible bond: a bond + an option to convert the it to another security (e.g., an option to convert the bond to common stock)
Callable bond: a bond + the issuer has the right to buy it back, before maturity, for a predetermined price

Equity securities: common stock

- Common stock / equity holders have control rights:
  - Have the right to decide on (control) firm’s operations
  - Exercise their control rights by voting on issues brought up at the shareholders’ meeting
- The board of directors:
  - Elected by the shareholders (owners) to be their representatives
  - Supervise the management and make sure it acts in the best interests of shareholders – maximize their wealth
- Cash flows associated with common stock:
  - Cash outflow when the investor buys shares
  - Cash inflow when the firm pays dividends
  - Cash inflow when the investor sells his shares

The Board and Maximizing Shareholder Value

NY Times, April 5, 2010
In 2007, Mr. Prince resigned from Citigroup under pressure … Mr. Rubin and Citigroup’s other directors decided to pay the $12.5 million bonus knowing very well that Citigroup’s market value had dropped by $64 billion during Mr. Prince’s tenure. So the simple question for Mr. Rubin and Mr. Prince is, Why? Why would you knowingly reward such failure?
A couple of intrepid shareholders sued Citigroup’s directors over the payment … A Delaware judge dismissed most of their complaints, ruling that the board was protected by something called the “business judgment rule.” … Ultimately, he explained, “the discretion granted directors and managers allows them to maximize shareholder value in the long term by taking risks without the debilitating fear that they will be held personally liable if the company experiences losses.

Preferred stock (perpetuity)

- Pays a fixed dividend = CF, every period, forever
- No maturity (T = ∞)
- The effective cost of capital per period = r

\[ CF \quad CF \quad \ldots \quad CF \quad \ldots \rightarrow \text{time} \]
\[ 0 \quad 1 \quad 2 \quad \ldots \quad t \quad \ldots \rightarrow \text{time} \]

\[ \text{Price} = PV = \frac{CF}{r} \]

Example

QWE Co. plans to issue preferred stock that pays a dividend of $2.25 per share per year. The company has estimated that the investors’ required rate of return is 11% (effective, annual).

a. What is the price that QWE expect to receive for the preferred stock?

b. Suppose that after issuing the preferred stock, QWE finds that the preferred stock is trading at $24 per share. What is the implied rate of return?
Common stock

For common stock, the future uncertain cash flows are:
- Dividends
- Selling price

To find the value of common stock, we make assumptions about future dividends:
- Dividends grow at a constant rate:
  - The constant dividend growth model
- Dividends grow at a variable rate first and then at a constant rate

Common Stock: Example

YUI Co. will pay dividends of $2, $1 and $3 in the next three years, respectively. You estimated that you will be able to sell your shares for $45 at the end of the third year. If the required (effective annual) rate of return is 14%, what is the current price of the stock?

Constant growth rate example 1

Johnson Foods Inc. will pay a dividend of $10 one year from now. Its dividends are expected to grow at a constant annual rate of 4% forever. If you require an (effective) annual rate of return of 15%, what is Johnson Foods current stock price?

PV of a Perpetuity with a constant growth rate g

\[ \text{PV} = \frac{CF}{r-g} \quad (\text{if} \ r > g) \]

Constant growth rate example 2

The price of a stock in the market is $62. You know that the firm has just paid a dividend of $5 per share (yesterday). The annual dividend growth rate is expected to be 6%, forever.

What is the (effective annual) required rate of return?

What if the firm is expected to pay the dividend of $5 tomorrow?

Constant growth rate example 3

A firm is expected to pay a dividend of $5 on its stock a year from now, and the firm’s dividend grows at a constant rate. The price of this stock is $40 and the investor’s required (effective) annual rate of return is 20%.

What is the annual dividend growth rate?

What if the firm is expected to pay a dividend of $5 tomorrow?
Variable growth rate example 1

*ABC Co.* is expected to pay a dividend of $2 one year from now, $3 two years from now and $3.5 three years from now. Analysts estimate that from that date and on, the dividend will grow at a constant annual rate of 5%. The required (effective) annual rate of return is 15%.

What should be ABC’s stock price?

Variable growth rate example 2

*Malcolm Manufacturing, Inc.* has just paid a $2 annual dividend (yesterday). Investors believe that the firm’s dividends will grow at 10% (annually) for the next 2 years and 6% (annually) forever thereafter.

Assuming that the annual required (effective annual) rate of return is 15%, what is the current price of the stock?

Securities markets 1

- Standardized financial securities are traded on securities markets (trade = transfer of ownership)
- **Primary market:**
  - Markets in which companies raise money by selling securities to investors – new securities
  - Every security sells only once in the primary market – new issue
  - Initial public offering (IPO) market: firms become publicly owned by issuing (selling) shares to investors for the first time
- **Secondary market:**
  - Markets in which existing securities trade
  - Most of the trading activity is among investors

Securities markets 2

- **Money market:** market for debt securities with less than one-year maturity
- **Capital market:** market for intermediate-term and long-term debt and common stock
- **Spot markets:** securities are bought and sold for ‘on-the-spot’ delivery
- **Futures markets:** trade of promises in the present, but full (promised) payment and delivery of the (promised) asset takes place in the future (e.g. deliver 1,000 oz of gold, one year from now, for $1,150 per ounce)

Valuation: Discounted CFs Approach

How much should we pay for a financial asset (security)?

1. Use the contract to determine the CF stream
2. Determine the required rate of return / cost of capital
3. Use the TVM formula to calculate the Present Value of CF stream = Value

\[
P(V) = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_t}{(1+r)^t} + \ldots + \frac{CF_T}{(1+r)^T}
\]

- \(CF_t\) = the cash flow on date \(t\) (end of year \(t\))
- \(r\) = the effective cost of capital for one period (one year)
- \(t\) = date index, \(t = 1, 2, 3, \ldots, T\)
- \(T\) = the number of periods (number of years)
Preferences: assumption 1

Magnitude: investors prefer to have more money rather than less:

$100 are "better" than $80

Value($100 today) > Value($80 today)
Value($100 tomorrow) > Value($80 tomorrow)

Preferences: assumption 2

Timing: investors prefer to get the money sooner - today rather than in the future:

$100 now are "better" than $100 one year from now

Value ($100 today) > Value ($100 one year from now)

Preferences: assumption 3

Risk: Investors dislike risk. All else equal, investors prefer a safe CF to a risky CF

$100 for sure (risk-free) are "better" than a (risky) lottery that pays $100 on average:

$50 (probability 0.5) or $150 (probability 0.5)

Value (risk-free $100) > Value (risky $100)

Terminology: investors are "risk-averse"

Risk Aversion: Implications

Example:

One year from now, project A pays exactly $100
One year from now, project B pays:

$50 w.p. 0.5 or $150 w.p. 0.5 (average CF = $___)
One year from now, project C pays:

$0 w.p. 0.5 or $200 w.p. 0.5 (average CF = $___)

If investors are risk-averse, which project should yield a higher rate of return?

$r_A$ ______ $r_B$ ______ $r_C$

Which project has the lowest price (present value)?

Risk and the Cost of Capital

Bloomberg.com, March 22, 2010


The bond market is saying that it’s safer to lend to Warren Buffett than Barack Obama.

Two-year notes sold by the billionaire’s Berkshire Hathaway Inc. in February yield 3.5 basis points less than Treasuries of similar maturity, according to data compiled by Bloomberg ... an "exceedingly rare" event in the history of the bond market ... raised concerns whether the U.S. deserves its AAA credit rating ... "It could be the moment where hopefully you realize that risk is beginning to creep into your credit profile and the costs associated with that can be pretty scary."
Risk and Return

The expected rate of return is compensation for:

1. **Waiting / Time**: since investors would rather get their money sooner
2. **Inflation**: if $i > 0$, the prices of the same products will be higher in the future
3. **Risk**: since investors are risk averse

Expected rate of return = risk-free rate + risk premium

Risk Premium: Debt Security

The risk premium for debt securities consists of two components:

\[ \text{Risk premium} = \text{DP} + \text{MP} \]

1. **Default risk premium (DP)**: compensation for the risk that the issuer may default on payments.
   
   (E.g., default risk premium is higher for a corporate bond than a US Treasury bond)

2. **Maturity risk premium (MP)**: compensation for debt maturity. Longer time to maturity implies greater risk since more unpredictable bad events may happen.
   
   (E.g., the yield of a 10-year US T-bond is higher than that of a 1-year US T-Bill, even though both are issued by the US Treasury)

Risk and Return: Debt Security

The expected rate of return on a debt security, $r_{Debt}$:

\[ r_{Debt} = r_f + \text{DP} + \text{MP} \]

- **$r_f$**: risk free rate
- **DP**: Default risk premium
- **MP**: Maturity risk premium

Bonds Example: Default Risk 1

*NY Times, March 12, 2009*

General Electric lost its coveted triple-A credit rating from Standard and Poor's on Thursday, as the credit-rating agency downgraded G.E.'s long-term debt one notch, to AA+.

In deciding to strip G.E. of its highest rating — which G.E. has held for more than 50 years — S&P analysts cited the stress that the global economic downturn was putting on the company's financial arm, GE Capital.... GE Capital, which once accounted for about half of the company’s profits, has been hit hard by the credit crisis.

Bonds Example: Default Risk 2

*The Wall Street Journal, December 8, 2009*

Greece on Tuesday became the first country in the 16-nation euro zone to see its debt rating cut to below single-A as worries mounted over its ability to fix its deteriorating finances, sending Greek shares and government bonds sharply lower and weighing on the European single currency.

Fitch Ratings cut Greece's issuer rating to BBB+ from A-, saying the downgrade "reflects concerns over the medium-term outlook for public finances given the weak credibility of fiscal institutions and the policy framework in Greece, exacerbated by uncertainty over the prospects for a balanced and sustained economic recovery."

Bonds Example: Maturity Risk

*US Treasury Yield Curve Rates: March 16, 2010*

<table>
<thead>
<tr>
<th>Time to Maturity</th>
<th>Yield (%) annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>0.41</td>
</tr>
<tr>
<td>2 years</td>
<td>0.93</td>
</tr>
<tr>
<td>3 years</td>
<td>1.47</td>
</tr>
<tr>
<td>5 years</td>
<td>2.37</td>
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<td>7 years</td>
<td>3.30</td>
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<tr>
<td>10 years</td>
<td>3.66</td>
</tr>
<tr>
<td>20 years</td>
<td>4.43</td>
</tr>
<tr>
<td>30 years</td>
<td>4.59</td>
</tr>
</tbody>
</table>

Risk Premium: Equity security

The Capital Asset Pricing Model (CAPM) implies that the risk premium for equity:

\[ \text{Risk premium} = \beta \times (r_m - r_f) \]

*Beta* (\(\beta\)) is a measure of risk - sensitivity of the stock's return to macroeconomic conditions, captured by the return of a large diversified portfolio (the market).

\(r_m\) is the expected return of the market (a large diversified portfolio).

\(r_f\) is the risk free return.

Risk and Return: Equity security

According to the Capital Asset Pricing Model (CAPM), the expected rate of return on an equity security, \(r_{Equity}\):

\[ r_{Equity} = r_f + \beta_{Equity} \times (r_m - r_f) \]

CAPM example

The beta of Goldman Sachs Group Inc. (NYSE: GS) is 1.43 (see Yahoo Finance key statistics: http://finance.yahoo.com/q/ks?s=GS).

The annual yield of a US Treasury-bill (risk free return) is 0.41% and CNBC analysts estimate that the market (effective annual) return next year will be 10%.

What is the (CAPM) expected rate of return on an investment in GS stock?

\[ r_{GS} = r_f + \beta_{GS} \times (r_m - r_f) \]

The cost of capital

- **Cost of capital** - How much the firm is willing to pay to raise funds from investors:
  - cost of debt - paid to creditors
  - cost of equity - paid to owners

- **Required rate of return** - Investors will provide funds to the firm only if they earn their required rate of return:
  - required rate of return on debt - \(r_{Debt}\)
  - required rate of return on equity - \(r_{Equity}\)

Thus we assume that:

\[
\text{Investor's required rate of return} = \text{Firm's cost of capital}
\]