Handout #12
Offshore Financial Markets
The Eurobond Market

Slides to highlight: 1-49, 52-66

Course web page:
Reading Assignments for this Week

**Levich**
Chap 10
The Eurobond Market

**Luenberger**
Chap

**Solnik**
Chap 7
Global Bond Investment
Pages 311-370

**Brandt**
Chap

http://www.duke.edu/~mbrandt/ba450.html

**Neftci**
Chaps 1-4
Pages 1-99
Midterm Exam: Friday Aug 1, 2008

Coverage: Chapters 3, 4, 5, 6, 7, 8, 9, 10 +
Ben Bernanke’s semi-annual testimony

It’s a closed-book exam. However,
a two-sided formula sheet (11 x 8.5) is required;
calculator/dictionary is okay;
notebook is NOT okay.

75 minutes, 7 questions, 100 points total;
five questions require calculation and
two questions require (short) essay writing.

Remote SCPD participants will also take the exam on Friday,
August 1, 2008
Please Submit Exam Proctor’s Name, Contact info as SCPD
requires, also c.c. to yeetienfu@yahoo.com a week before the exam.
Final Exam MS&E 247S
Fri Aug 15 2008 12:15PM-3:15PM Gates B01
Or Saturday Aug 16 2008 12:15PM-3:15PM Gates B01

Remote SCPD participants will also take the exam on Friday, 8/15

Please Submit Exam Proctor’s Name, Contact info as SCPD requires, also c.c. to yeetienfu@yahoo.com a week before the exam.

Local SCPD students please come to Stanford to take the exam. Light refreshments will be served.
Offshore Financial Markets
The Eurobond Market

MS&E 247S International Investments
Yee-Tien Fu
Introduction

It is paradoxical that a law which was intentionally prejudicial to the interests of foreign borrowers, had the effect of creating the largest international capital market the world has known.

- Frederick G. Fisher, III
The Eurobond market is the market for long-term debt instruments issued and traded in the offshore market.

Like the Eurocurrency market, the necessary condition for the development of a Eurobond market is differences in national regulations.

Increasing capital mobility and greater ease in telecommunications have provided the sufficient conditions, allowing the Eurobond market to flourish.
Introduction

From a base of zero in the late 1950s, the Eurobond market has grown to an annual volume of new issues that often nears or surpasses the annual volume of new US corporate bond issues.

Through regulatory differences as well as innovations in market processes and product offerings, the Eurobond market has carved out an important niche in the international capital market providing benefits to investors and borrowers – and on occasion profits to the parties who intermediate the transactions.
Introduction

Similar to the Eurocurrency market, the Eurobond market is in effect a parallel market, but one that has not put its chief rivals – the onshore markets for domestic and foreign bonds – out of business.

A Eurobond was once defined as a debt instrument (1) underwritten by an international syndicate, and (2) offered for sale immediately in a number of countries.
A Eurobond is usually denominated in a currency (or unit of account) that is foreign to a large number of buyers.

A domestic bond is an obligation of a domestic issuer that is underwritten by a syndicate of domestic investment banks, denominated in domestic currency, and offered for sale in the domestic market.

A foreign bond is similar to a domestic bond except that the issuer of the foreign bond is a foreign entity, which may be beyond the legal reach of investors in the event of default.
The definition of a “domestic” or “foreign” bond that we adopt comes from the nationality of the *issuer* in relation to the *marketplace*.

The term foreign may lead to some confusion in this context.

A US$ bond issued in the United States by General Motors and a ¥ bond issued in Japan by Toyota are both domestic bonds from the standpoint of the regulations that govern their initial offering and secondary market trading.
Introduction

From the investor perspective, Americans (Japanese) would view the Toyota (General Motors) bond as “foreign” in the sense that investment is denominated in a foreign currency and traded in a foreign marketplace.

Foreign currency denominated bonds play an important role in international portfolio diversification.

Particular segments of the foreign bond market (as defined from the issuer perspective) sometimes take on colorful names.
For example, US$ obligations of non-US firms that are underwritten and issued in the US market are called Yankee bonds. Japanese yen obligations of non-Japanese firms that are underwritten and issued in the Japanese market are called Samurai bonds. And British pound sterling obligations of non-UK firms that are underwritten and issued in the UK market are called Bulldog bonds.

These names and others have proliferated along with the development of international financial markets.
## Comparative Characteristics of Bond Issues in the International Bond Market

<table>
<thead>
<tr>
<th></th>
<th>U.S. Market</th>
<th>Non-U.S. Market</th>
<th>Eurobond Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory Bodies</td>
<td>Securities and Exchange Commission</td>
<td>Official agency approval</td>
<td>Minimum regulatory control</td>
</tr>
<tr>
<td>Disclosure requirements</td>
<td>More detailed</td>
<td>Variable</td>
<td>Determined by market practices</td>
</tr>
<tr>
<td></td>
<td>• High initial and ongoing expense</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Onerous to non-US firms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issuing costs</td>
<td>0.75-1.00%</td>
<td>Variable to 4.0%</td>
<td>2.0-2.5%</td>
</tr>
<tr>
<td>Rating requirements</td>
<td>Yes</td>
<td>Usually not</td>
<td>No, but commonly done</td>
</tr>
</tbody>
</table>
## Comparative Characteristics of Bond Issues in the International Bond Market

<table>
<thead>
<tr>
<th></th>
<th>U.S. Market</th>
<th>Non-U.S. Market</th>
<th>Eurobond Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exchange listing</strong></td>
<td>Usually not listed</td>
<td>Listing is usual</td>
<td>Listing is usual</td>
</tr>
<tr>
<td><strong>Queuing</strong></td>
<td>No queue</td>
<td>Queuing is common</td>
<td>No queue</td>
</tr>
<tr>
<td><strong>Currency of denomination</strong></td>
<td>United States does not restrict the use of US$</td>
<td>Part of queuing • Many countries have in the past or now restrict use of currency</td>
<td>No restrictions on use of US$ or C$</td>
</tr>
<tr>
<td><strong>Speed of issuance</strong></td>
<td>Relatively slow until Rule 415 on shelf registration</td>
<td>Variable</td>
<td>Usually fast - bought deal leads to fast issuance</td>
</tr>
</tbody>
</table>
## Comparative Characteristics of Bond Issues in the International Bond Market

<table>
<thead>
<tr>
<th></th>
<th>U.S. Market</th>
<th>Non-U.S. Market</th>
<th>Eurobond Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Borrower / Issuer</strong></td>
<td>+ Large market, great depth</td>
<td>+ Local visibility, diversification of funding sources</td>
<td>+ Lower annual interest expense, speed of placement</td>
</tr>
<tr>
<td><strong>Issuer incentives</strong></td>
<td>– Disclosure is costly to foreigners, speed</td>
<td>– Markets may be small, queuing may prevail</td>
<td>– Cannot sell issue in U.S. until seasoned</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lender / Investor</strong></td>
<td>+ Great depth &amp; liquidity, appeal of standardized</td>
<td>+ Diversified currency portfolio</td>
<td>+ Diversified currency portfolio, bearer bonds, no</td>
</tr>
<tr>
<td><strong>Investor incentives</strong></td>
<td>information</td>
<td>– Reporting to tax authorities, withholding tax</td>
<td>withholding tax</td>
</tr>
<tr>
<td></td>
<td>– Reporting to tax authorities, withholding tax</td>
<td>– Reporting to tax authorities, withholding tax</td>
<td>– Less liquidity &amp; information disclosures</td>
</tr>
<tr>
<td></td>
<td>prior to 1984</td>
<td>may apply</td>
<td></td>
</tr>
</tbody>
</table>
Eurobond Underwriting

A Eurobond offering brings together the bond issuer and the bond investor.

The supply side (the issuer) and the demand side (the investor) are brought together by intermediaries that fulfill some or all of the following services: lead management, underwriting, and bond sales.
Eurobond Underwriting

In the case of a bought deal, all of these services are provided by a single intermediary.

In a bought deal, the lead manager approaches the issuer with a proposal to raise funds under specific terms: issue size, currency, maturity, coupon payments, and other features that may enhance the volume or price of the issue.

Once the manager commits to raise funds on specific terms, the manager assumes the underwriting risks of the issue.
Underwriting risk reflects the possibility that the sales price of the bonds may not match the price promised to the issuer.

In other words, if the manager commits to raise $100 million in a seven-year bond issue with 8 percent annual coupons, she must provide this amount even if investors are willing to pay only $98 million for the bonds.

A sudden rise in interest rates, a decline in the issuer’s credit quality, or a shift away from US$-denominated investments are but three examples of underwriting risks.
Four Types of Market

direct search, brokered, dealer, auction markets

A direct search market is the least organized market -- buyers and sellers must seek each other out directly (e.g., the sale of a used refrigerator).

In markets where trading in a good is sufficiently active, brokers can find it profitable to offer search services to buyers and sellers (e.g., real estate market).

An important brokered investment market is the so-called primary market, where new issues of securities are offered to the public. In the primary market investment bankers act as brokers.
Four Types of Market

direct search, brokered, dealer, auction markets

When trading activity in a particular type of asset increases, dealer markets (e.g., over-the-counter securities market) arise.

Dealers specialize in various assets, purchasing them for their own inventory and selling them for a profit from their inventory.

Dealers, unlike brokers, trade assets for their own accounts. The dealer’s profit margin is the “bid-asked” spread.
Trading among investors of already issued securities is said to take place in secondary markets.

Therefore, the over-the-counter market is one example of a secondary market. The organized stock exchanges are also secondary markets.

Trading in secondary markets does not affect the outstanding amount of securities; ownership is simply transferred from one investor to another.
Four Types of Market

direct search, brokered, dealer, auction markets

The most integrated market is an auction market, in which all transactors in a good converge at one place to bid on or offer a good.

The New York Stock Exchange (NYSE) is an example of an auction market.

An advantage of auction markets over dealer markets is that one need not search to find the best price of a good.

Many assets trade in more than one type of market.
A diagram of a typical Eurobond offering is shown in Figure 10.4.

The “management group” organizes most of the activities related to the initial bond offering. The group meets with the issuer to design the bond issue – issue size, currency, maturity, coupon, and so forth – and assembles other firms (labeled “underwriters”) to share in the underwriting risks of the issue. Finally, the management group organizes a “selling group” of firms that place the bonds with the ultimate investors in the issue.
Structure of a Eurobond Syndication

1. Issuer
2. Management Group
3. Selling Group
4. Underwriters
5. Investor
6. Fiscal Agent or Trustee and Principal Paying Agent

Figure 10.4
A Eurobond offering brings together the bond issuer and investor. The process is facilitated by intermediaries.

The *lead management group* meets with the issuer to design the issue size, currency, maturity, coupon, etc...

Finally, the management group organizes a group of firms to place the bonds with the ultimate investors.
In practice, a single firm may play more than one role.

For example, the lead management firm typically bears some of the underwriting risk and often participates in the selling group.
In the 1970s, firms started to sell their allotment of bonds forward for delivery on a when-issued basis. Once a bond issue was announced, a selling firm might decide to sell the bond immediately (for forward delivery) at 98 or 99% of par.

Excess competition => bonds decline in value in the aftermarket
The Gray Market

The practice of trading in Eurobonds on a when-issued basis, called the gray market or premarket, began with prices circulated over telephone lines. Then prices were published in newsletters and circulated across market participants.

This strategy would hedge the selling firm against further price declines but still allow the firm to participate in the syndicate, to appear in the tombstone announcing the deal, and to stay in good standing with the lead manager for the next deal.
Weyerhauser Capital Corp, NV (1983)

Amount: US$60 million
Maturity: 7 years (due Nov. 15, 1990)
Coupon: 11.5%
Issue price: 100
Fixed reoffer price: N.A.
Listing: Luxembourg Stock Exchange
Total commission: 1.875%
  Management & underwriting fees: 0.625%
  Selling concession: 1.25%
Lead manager: Morgan Stanley International
Gray market price: Minus 1.5 to 1.25
Market commentary: “A fairly priced deal, say traders …”
Weyerhauser Capital Corp, NV (1983)

The bond was issued at par (100), but it traded in the gray market at a discount of 1.25 - 1.50 percent below par.

In the row marked “total commission,” we see that the selling concession (the amount of fees allocated to a member of the selling group) was 1.25 percent.

Thus, a European trader was willing to give up his or her entire selling concession, or a bit more, to make a sale in the gray market. This bond was apparently overpriced at par, but “fairly priced” at its gray market discount.
Osaka Gas (1993)

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>US$250 million</td>
</tr>
<tr>
<td>Maturity</td>
<td>5 years (due May 26, 1998)</td>
</tr>
<tr>
<td>Coupon</td>
<td>5.75%</td>
</tr>
<tr>
<td>Issue price</td>
<td>101.489</td>
</tr>
<tr>
<td>Fixed reoffer price</td>
<td>99.889</td>
</tr>
<tr>
<td>Listing</td>
<td>London Stock Exchange</td>
</tr>
<tr>
<td>Total commission</td>
<td>1.875%</td>
</tr>
<tr>
<td>Management &amp; underwriting fees</td>
<td>0.275%</td>
</tr>
<tr>
<td>Selling concession</td>
<td>1.6%</td>
</tr>
<tr>
<td>Lead manager</td>
<td>Goldman Sachs International</td>
</tr>
<tr>
<td>Gray market price</td>
<td>100.25</td>
</tr>
<tr>
<td>Market commentary</td>
<td>“The issue blew out in 15 minutes, say traders …”</td>
</tr>
</tbody>
</table>
Osaka Gas (1993)

Although the issue price of the bond was 101.489 (percent per par), it was slated for sale initially at 99.889 (percent of par) on a fixed reoffer price basis.

Note that this 1.6 percent difference happened to be the selling concession, so again it appears that the selling group would not profit from a sale at this price.

However, the gray market price (called the premarket price in 1993) was 100.25. Thus, these bonds were apparently in heavy demand, selling for 0.361 more in the gray market than the posted initial offering price.
Another Innovation: Global Bonds

Similar to a Eurobond, a global bond issue is offered for sale in many countries simultaneously. Unlike a Eurobond however, a global bond is a registered security, usually in the US.

Global bonds are held in common depositories (such as Cedel, Euroclear, or Depository Trust Company in the US) that enhance secondary market trading in local markets and between investors in different regions.
Another Innovation: Global Bonds

The global bond strategy is designed for issuers with substantial funding needs who can benefit by reaching the widest possible investor audience.

The size of issue, combined with widespread distribution, and secondary market trading opportunities offers a liquid investment that investors find attractive.
Another Innovation: Global Bonds

The World Bank undertook the first global bond in 1989 with a $1.5 billion issue.

Since then, the global bond structure has been used by other international organizations, public enterprises, and government (sovereign) borrowers.

Global bond offerings totaled $15.4 billion in 1991 (5.0 percent of all international bonds) rising to $49.0 billion in 1994 (11.4 percent of all international bonds).
Pricing Eurobonds

As a parallel or offshore market, the Eurobond market must offer prices and terms that are advantageous to both issuers and investors to attract them from the traditional onshore markets.

In the Eurocurrency market, we saw that the wide spread between deposit and lending rates gave Eurobanks an opening to compete - offering higher rates to depositors and lower rates to borrowers, and still earning a spread for their intermediation.

The same principle could apply in the Eurobond market.
Pricing Eurobonds

Suppose that underwriting fees in the US domestic corporate bond market were 2% and our firm issues an 8% coupon bond with a seven-year maturity. After issuing the bond at par ($1,000), our firm receives only $980 after underwriting fees. The cost of funds to the firm on a current-yield basis is 8.16% (= 80/980). The cost over the seven-year period is 8.39%, acknowledging that the firm must repay $1,000 per bond at the end of year 7. The investor earns a current yield and yield-to-maturity of 8%. The effective lending and borrowing spread (for this coupon and maturity bond) is thus 8.00% – 8.39%.
Pricing Eurobonds

Suppose now that underwriting fees were only 1% in an offshore market and our firm issues a seven-year bond with a higher 8.05% coupon bond in order to attract an onshore investor. If this bond is issued at par ($1,000), the firm receives $990 after underwriting fees. This makes the cost of funds to the firm on a current basis 8.13% (= 80.5/990). The all-in-cost over the seven-year period is 8.24%. Thus, the effective lending and borrowing spread is 8.05% – 8.24%, more narrow than when underwriting fee were 2%.
Market Segmentation and the Pricing of Eurobonds

How can both issuers and investors benefit from an offshore market that typically charges higher underwriting fees than in the onshore market?

From the issuer’s side, the answer is that underwriting fees are a one-time cost and only part of the total cost. There may be certain cost savings as the Eurobond market often allows firms to issue bonds more quickly and with lower disclosure cost.
Disclosure: The submission of facts and details concerning a situation or business operation.

In general, security exchanges and the SEC require firms to disclose to the investment community the facts concerning issues that will affect the firms’ stock prices. Disclosure is also required when firms file for public offerings.
Market Segmentation and the Pricing of Eurobonds

More important is the ongoing savings that comes from a lower annual interest cost in the Eurobond market than in the onshore market.

The Eurobond market has appeared to function as a segmented capital market, where bond prices are determined primarily by Eurobond market participants who give less than full regard to how these bonds would be priced in the onshore market.
Market Segmentation and the Pricing of Eurobonds

By comparison, in an integrated capital market, a bond with specific terms and conditions would be priced identically by investors in the onshore market and in the Eurobond market. Arbitrage between the onshore and offshore bond markets leads the markets toward integration.

In the case of Eurobond market, it is often suggested that the early years of the market were dominated by smaller, retail investors who evaluated bond prices on different terms than the institutional investors who traded in the onshore markets.
Market Segmentation and the Pricing of Eurobonds

The argument is that these retail investors were less concerned about cryptic issuer ratings and more swayed by “name recognition.”

To the extent that these investors willingly paid higher prices for debt securities in the Eurobond market, issuers were offered a price incentive to issue Eurobonds instead of onshore bonds.
Eurobonds and Secrecy

Why would investors sacrifice yield by buying Eurobonds when instead they could purchase essentially identical bonds onshore?

The answer relies on the secrecy of the Eurobond market and its implication for taxes.

While essentially all securities in the US are registered securities (with the name of the owner registered on the books of the issuing company), Eurobonds are bearer securities. Possession of a bearer bond is evidence of ownership because the issuer does not maintain a list. A significant fraction of Eurobonds are held in physical form.
Suppose IBM is issuing $100 million in seven-year Eurobonds priced at U.S. Treasury minus 25 basis points. There is great demand for the issue and you are willing to bid 102 for 10 percent of the issue.

A. If you actually get your bid executed, how much will you pay for the bond?

B. A year later, the IBM Eurobonds are traded on the Luxembourg Stock Exchange at 105. What is the value of your investment? What is your capital gain (loss)?

C. You decide to sell the bond at the above price to pursue other opportunities. What amount of withholding taxes are you required to pay?
A. If you actually get your bid executed, how much will you pay for the bond?

Price is 102% of par or 1,020 per bond; $102\% \times 10\% \times 100$ million = $10.20$ million for your share of the issue.
Suppose two similar seven-year maturity bands are issued at par, one in the U.S. domestic market and the second in the Eurodollar bond market. Underwriting fees are 2.5 percent in the U.S. market and 1 percent in the Eurobond market.

A. If the U.S. domestic bond has an initial yield of 10%, what is the effective spread between lending and borrowing rates in this market?

B. If the Eurodollar bond has an initial yield of 10.5%, what is the effective spread between lending and borrowing rates in this market?

C. Suppose that the U.S. bond is subject to a withholding tax of 20% on the interest paid. What yield would an investor accept on the Eurobond issue to make him or her indifferent between the two issues?
A. If the U.S. domestic bond has an initial yield of 10%, what is the effective spread between lending and borrowing rates in this market?

In the US bond market, after underwriting fees, the firm raises $975 for a $1,000 US domestic bond issued at par. The firm repays $10 per year for six years and $1,010 in year seven for a yield-to-maturity of 10.52%. The investor earns 10.0% yield-to-maturity for a 7-year bond. The spread is 0.52%.
B. If the Eurodollar bond has an initial yield of 10.5%, what is the effective spread between lending and borrowing rates in this market?

In the Eurodollar bond market, after underwriting fees, the firm gets $990 for a $1,000 US domestic bond issued at par. The firm repays $10.50 per year for six years and $1,050 in year seven for a yield-to-maturity of 10.71%. The investor earns 10.50% yield-to-maturity for a 7-year bond. The spread is 0.21%.
C. Suppose that the U.S. bond is subject to a withholding tax of 20% on the interest paid. What yield would an investor accept on the Eurobond issue to make him or her indifferent between the two issues?

An investor will accept a lower yield in the Eurobond market if he/she does not pay the withholding tax. An 8% yield in the Eurobond market (taken as an after-tax rate) is equivalent to a 10% yield in the US bond market, on a before tax basis and subject to 20% withholding.
Yield to Maturity

• Interest rate that makes the present value of the bond’s payments equal to its price

Solve the bond formula for \( r \)

\[
P_B = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} + \frac{ParValue_T}{(1+r)^T}
\]
The yield to maturity (or "YTM") is the rate that makes the price of the bond just equal to the present value of its future cash flows. It is the unknown $r$ in:

$$932.90 = \frac{\text{_______}}{r} + \frac{\text{_______}}{(1 + r)^{10}}$$

The only way to find the YTM is trial and error:

a. Try 10%: $70 \left[\frac{1 - 1/(1.10)^{10}}{.10} + \frac{1000}{(1.10)^{10}}\right] = 816$

b. Try 9%: $70 \left[\frac{1 - 1/(1.09)^{10}}{.09} + \frac{1000}{(1.09)^{10}}\right] = 872$

c. Try 8%: $70 \left[\frac{1 - 1/(1.08)^{10}}{.08} + \frac{1000}{(1.08)^{10}}\right] = 933$

( ) The yield to maturity is 8%
Bond Pricing Theorems

• The following statements about bond pricing are always true.

  1. Bond prices and market interest rates move in opposite directions.

  2. When a bond’s coupon rate is (greater than / equal to / less than) the market’s required return, the bond’s market value will be (greater than / equal to / less than) its par value.
Bond Pricing Theorems

• The following statements about bond pricing are always true.

3 Given two bonds identical but for maturity, the price of the longer-term bond will change more than that of the shorter-term bond, for a given change in market interest rates.

4 Given two bonds identical but for coupon, the price of the lower-coupon bond will change more than that of the higher-coupon bond, for a given change in market interest rates.
If the U.S. 3-month bank deposit rate is 7%, the reserve requirement is 2.5% and FDIC fees are 0.20%,
(a) what would you expect the Eurodollar rate to be?
(b) What will happen if the reserve requirement increases by 0.2 percentage point?

(a) The effective cost of a domestic deposit is

\[
\frac{(I_{US} + \text{FDIC fees})}{(1 - \text{reserve requirements})} = \frac{(7\% + 0.20\%)}{(1 - 2.5\%)} = 7.3846\%
\]

Thus the additional cost of the reserve requirements and FDIC fees is 38 basis points and this is the extra amount the bank can afford to pay on Eurodollar deposits to achieve the same cost of funds. Competition will generally drive the Eurodollar rate to the level that equates the cost of funds to banks in the two markets, that is, to 7.38%.
(b) If the reserve requirement increases to 2.7%, the Eurodollar rate will be:

\[
\left( I_{US} + \text{FDIC fees} \right) / \left( 1 - \text{reserve requirements} \right)
\]

\[
= (7\% + 0.20\%) / (1 - 2.7\%)
\]

\[
= 7.3998\%
\]
The U.S. bank deposit rate is now 5.15%, and the Eurodollar deposit rate 5.45%. Assuming that the entire differential is attributable to the Fed's reserve requirement on bank deposits, what is likely to happen to the Eurodollar rate if the U.S. rate rises by one percentage point?

\[ I_{E\$} = 5.45\% \quad I_{US} = 5.15\% \]

Banks arbitrage their funding costs between the domestic and the Eurodollar market, so that in equilibrium:
Cost of Eurodollar deposit = Cost of domestic deposit
\[ I_{E\$} = \left( I_{US} + \text{FDIC fees} \right) / (1 - \text{reserve requirement}) \]
Assuming the differential is entirely attributable to reserve requirements, we can set FDIC fees=0 and then
\[ I_{E\$} = \left( I_{US} + 0 \right) / (1 - \text{reserve requirement}) \]
Reserve requirement = 1 - \( I_{US}/I_{E\$} \) = 1 - (5.15%/5.45%) = 5.50%.
Innovation in the Bond Market

• Issuers constantly develop innovative bonds with unusual features - bond design can be extremely flexible.
  - Issuers of *pay in kind* bonds may choose to pay interest either in cash or in additional bonds with the same face value.
  - *Reverse floaters* are floating rate bonds whereby the coupon rate on the bonds *falls* when the general level of interest rates rises.
  - Walt Disney has issued bonds with coupon rates tied to the financial performance of several of its films.
Innovation in the Bond Market

- Electrolux once issued a bond with a final payment that depended on whether there has been an earthquake in Japan. (*disaster bond*)
- Indexed bonds make payments that are tied to a general price index or the price of a particular commodity. For example, Mexico has issued bonds with payments that depend on the price of oil.

**More on indexed bonds:**
- Bonds tied to the general price level have been common in countries experiencing high inflation.
Innovation in the Bond Market

- Although Great Britain is not a country experiencing extreme inflation, about 20% of its government bonds issued in the last decade have been inflation-indexed.

- The United States Treasury started issuing such inflation-indexed bonds in January 1997. They are called Treasury Inflation Protected Securities (TIPS). By tying the par value of the bond to the general level of prices, the coupon payments, as well as the final repayment of par value, will increase in direct proportion to the consumer price index. Thus, the interest rate on these bonds is a risk-free real rate.
Innovation in the Bond Market

To illustrate how TIPS work, consider one that is maturing in one year. Assume that it offers a risk-free real coupon rate of 3% per year. The *nominal* rate of return is not known with certainty in advance because it depends on the rate of inflation.

If the inflation rate turns out to be only 2%, then the realized dollar rate of return will be approximately 5%.

If the rate of inflation turns out to be 10%, then the realized dollar rate of return will be approximately 13%, consisting of the 3% coupon plus a 10% increase in the dollar value of the bond, from $1,000 to $1,100.

In early 1997, TIPS bonds were trading at a real yield to maturity a shade below 3.5%. 
Bond Case--Swedish Lottery Bonds.

Profiling nonsystematic risk for a bond investor, the case describes lottery bond issues by the Swedish National Debt Office (SNDO). Swedish lottery bonds are a specific type of financial fixed income instrument for Swedish retail investors. The distinctive feature of lottery bonds is that, unlike traditional institutional bonds, the normally guaranteed interest—the coupon—here only is paid as "wins" to bondholders selected in drawings. The case takes place in March 2003, when Anders Holmlund, head of analysis, is reviewing the proposal for the next lottery bond issue. While reviewing the features of the bond issue, he also considers the larger picture: What are the benefits to the Debt Office of issuing lottery bonds, especially in view of a recently launched Internet-based sales system that allows retail investors to take part in government bond auctions?


Stockholm; Government & regulatory; 25 employees; 2003
Bond Case--Bank Leu’s Prima Cat Bond Fund.

In 2001, Bank Leu, a Swiss private bank, is considering creating the world's first public fund for catastrophe bonds. Cat bonds are securities whose payments depend on the probability of a catastrophe occurring, such as an earthquake or hurricane. Cat bonds are traditionally issued by large insurance or reinsurance companies. This case outlines the traditional reinsurance market and securitization efforts that have taken place in the past and focuses on Bank Leu's decision as a buy-side participant in the cat bond market.

To explore how insurance risks can be transferred to the capital markets and how risks in general can be brokered, securitized, and traded.


Zurich; Switzerland; Banking industry; 116 million CHF revenues; 600 employees; 2001
Bond Case--Catastrophe Bonds at Swiss Re.

In 2002, Swiss Re, the world's second largest insurance company, is considering securitizing parts of its risk portfolio in the capital markets. This would be a first for the company that, until then, had never transferred risk off its balance sheet. Peter Giessmann, head of the Retrocession Group, is considering catastrophe bonds as a way of transferring risk. "Cat bonds" are securities whose payments depend on the probability of a catastrophe occurring, such as an earthquake or hurricane. This case outlines the traditional reinsurance market and securitization efforts that have taken place in the past and then focuses on Swiss Re's decision as a sell-side participant in the cat bond market.

To explore how insurance risks can be transferred to the capital markets and how risks in general can be brokered, securitized, and traded.


Zurich; Switzerland; Insurance industry; 31 million Swiss francs revenues; 2002
Bond Case--Mortgage Backs at Ticonderoga.
Ticonderoga is a small hedge fund that trades in mortgage-backed securities--securities created from pooled mortgage loans. They often appear as straightforward so-called "pass-throughs," but can also be pooled again to create collateral for a mortgage security known as a collateralized mortgage obligation (CMO). CMOs allow cash flows from the underlying pass-throughs to be directed, allowing the creation of different classes of securities--tranches--with different maturities, coupons, and risk profiles. In April 2005, the general managers of Ticonderoga are looking at the market data, trying to construct a trade given their view on the prepayment speed of mortgages vs. the implied prepayment speed they derive from CMOs in the market.

To learn about the institutional details behind the mortgage-backed securities (MBS) market, covering both the actors as well as the mechanics (with special emphasis on the important prepayment feature). Also, to go through the mathematics and calculations behind MBSs--in essence, students are asked to behave as if they worked at a mortgage-back trading desk.

Derivatives, Finance, Hedging, Over the counter trading, Securities, Trade. London; Financial industry; 10 employees; 2005
KAMCO and the Cross-Border Securitization of Korean Non-Performing Loans.

Covers the first international nonperforming loan securitization done in Korea. The CEO of KAMCO is trying to dispose of a portfolio of nonperforming commercial loans that the organization acquired from a number of banks. A group of investment bankers have proposed securitizing the loans and selling them to institutional investors. Securitization of loans (or any other type of assets) is not common in Korea, so the CEO must think through several factors as he decides whether to accept this proposal, the most important of which is the recovery price.

To understand financial securitization--both structuring and valuation principles.

Capital markets, Debt management, Financial instruments, Financing.

Koreas; South Korea; $160 million; 1,500 employees; 2000
Nexgen: Structuring Collateralized Debt Obligations (CDOs).

A client asks Luc Giraud, CEO of the structured finance solutions provider Nexgen Financial Solutions, to put together a solution that allows the client to add AAA-rated bonds to its portfolio. The client cannot find suitably priced top-rated bonds in the market and wonders whether Nexgen can use lower grade bonds to create AAA-equivalent instruments. The process of securitization packages together securities to create new securities with different risk and return profiles.

To examine the process of securitization—in this case, a financial intermediary creates value by putting together a package of securities and offering the client a risk tranche that the client could not otherwise obtain. In terms of credit risk, to look at the impact of correlation in credit risk in portfolios of collateralized debt securities.

Bonds, Capital markets, Credit risk, Debt management, Derivatives, Finance, Securities, Securitization.

France; Financial industry; 20 employees; 2004
Chapter 10 (C&J)
Bond Prices and Yields

• Bond Basics
• Straight Bond Prices & Yield to Maturity
• More on Yields
• Interest Rate Risk & Malkiel’s Theorems
• Duration
• Dedicated Portfolios and Reinvestment Risk
• Immunization
• Summary & Conclusions

Source: Fundamentals of Investments: Valuation and Management
By Corrado, Charles J., and Bradford D. Jordan
Bond Basics

Straight bonds and their yields
- Straight bonds
- Notes, bonds, debentures
- Other features: convertible, putable
- Yields
  - Coupon rate or coupon yield
  - Current yield
  - Yield to maturity
Bond Calculations

Bond’s coupon rate:

\[
\text{Coupon rate} = \frac{\text{Annual coupon}}{\text{Par value}}
\]

Bond’s current yield:

\[
\text{Current yield} = \frac{\text{Annual coupon}}{\text{Bond price}}
\]

Straight bond prices:

\[
\text{Bond price} = \frac{C}{YTM} \left[ 1 - \frac{1}{\left(1 + \frac{YTM}{2}\right)^{2M}} \right] + \frac{FV}{\left(1 + \frac{YTM}{2}\right)^{2M}}
\]
Bond Prices

Straight bond prices:

\[
\text{Bond price} = \frac{C}{YTM} \left[ 1 - \frac{1}{\left( 1 + \frac{YTM}{2} \right)^{2M}} \right] + \frac{FV}{\left( 1 + \frac{YTM}{2} \right)^{2M}}
\]

\( C \) = annual coupon
\( FV \) = face value
\( M \) = maturity (years)
\( YTM \) = Yield to maturity

Assume a bond has 15 years to maturity, a 9% coupon, and the YTM is 8%. What is the price?

\[
\text{Bond price} = \frac{90}{.08} \left[ 1 - \frac{1}{\left( 1 + \frac{.08}{2} \right)^{30}} \right] + \frac{1000}{\left( 1 + \frac{.08}{2} \right)^{30}} = $1,086.46
\]
More on Bond Prices

\[
\text{Bond price} = \frac{C}{\text{YTM}} \left[ 1 - \frac{1}{\left(1 + \frac{\text{YTM}}{2}\right)^{2M}} \right] + \frac{\text{FV}}{\left(1 + \frac{\text{YTM}}{2}\right)^{2M}}
\]

Now assume a bond has 25 years to maturity, a 9% coupon, and the YTM is 8%. What is the price? Is the bond selling at premium or discount?

\[
\text{Bond price} = \frac{90}{.08} \left[ 1 - \frac{1}{\left(1 + .08/2\right)^{50}} \right] + \frac{1000}{\left(1 + .08/2\right)^{50}} = $1,107.41
\]

Now assume the same bond has a YTM of 10%. (9% coupon & 25 years to maturity) What is the price? Is the bond selling at premium or discount?

\[
\text{Bond price} = \frac{90}{.10} \left[ 1 - \frac{1}{\left(1 + .10/2\right)^{50}} \right] + \frac{1000}{\left(1 + .10/2\right)^{50}} = $908.72
\]
More on Bond Prices (cont’d)

Now assume the same bond has 5 years to maturity (9% coupon & YTM of 8%) What is the price? Is the bond selling at premium or discount?

\[
\text{Bond price} = \frac{90}{.08} \left[ 1 - \frac{1}{\left(1 + \frac{.08}{2}\right)^{10}} \right] + \frac{1000}{\left(1 + \frac{.08}{2}\right)^{10}} = \$1,040.55
\]

Now assume the same bond has a YTM of 10%. (9% coupon & 5 years to maturity) What is the price? Is the bond selling at premium or discount?

\[
\text{Bond price} = \frac{90}{.10} \left[ 1 - \frac{1}{\left(1 + \frac{.10}{2}\right)^{10}} \right] + \frac{1000}{\left(1 + \frac{.10}{2}\right)^{10}} = \$961.39
\]
More on Bond Prices (cont’d)

Where does this leave us? We found:

<table>
<thead>
<tr>
<th>Coupon</th>
<th>Years</th>
<th>YTM</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>25</td>
<td>8%</td>
<td>$1,107</td>
</tr>
<tr>
<td>9%</td>
<td>25</td>
<td>10%</td>
<td>$ 908</td>
</tr>
<tr>
<td>9%</td>
<td>5</td>
<td>8%</td>
<td>$1,040</td>
</tr>
<tr>
<td>9%</td>
<td>5</td>
<td>10%</td>
<td>$ 961</td>
</tr>
</tbody>
</table>
More on Prices

Prices and Par values
• Premium bonds
• Discount bonds
• Par bonds
• Relations among yields
• YTM > current > coupon
• YTM < current < coupon
• YTM = current = coupon
Figure 10.2: Bond prices and yields
Figure 10.1: Premium, par, and discount bond prices
Calculating Yields

The formula:

$$\text{Bond price} = \frac{C}{YTM} \left[ 1 - \left( \frac{1}{1 + \frac{YTM}{2}} \right)^{2M} \right] + \frac{FV}{\left( 1 + \frac{YTM}{2} \right)^{2M}}$$

- Use the same formula, but solve for YTM
- How?
  - Trial and error . . .
  - Financial calculator
- Prices versus yields
Assume a bond has 15 years to maturity, a 9% coupon, and the bond is selling for is $1,080. What is the YTM?

\[
\text{Bond price} = \frac{C}{YTM} \left[ 1 - \frac{1}{\left(1 + \frac{YTM}{2}\right)^{2M}} \right] + \frac{\text{FV}}{\left(1 + \frac{YTM}{2}\right)^{2M}}
\]

\[
$1,080 = \frac{90}{YTM} \left[ 1 - \frac{1}{\left(1 + \frac{YTM}{2}\right)^{30}} \right] + \frac{1000}{\left(1 + \frac{YTM}{2}\right)^{30}}
\]

\[
\text{YTM} = 4.0354\% \times 2 = 8.07\%
\]
Callable bond price = \( \frac{C}{YTC} \left[ 1 - \frac{1}{\left(1 + \frac{YTC}{2}\right)^{2T}} \right] + \frac{CP}{\left(1 + \frac{YTC}{2}\right)^{2T}} \)

Assume the previous bond has 5 years until it can be called with a $90 call premium. (9% coupon & selling for $1,080.) What is the YTM?

\[
\begin{align*}
$1,080 &= \frac{90}{YTC} \left[ 1 - \frac{1}{\left(1 + \frac{YTC}{2}\right)^{10}} \right] + \frac{1090}{\left(1 + \frac{YTC}{2}\right)^{10}} \\
YTC &= 4.243\% \times 2 = 8.49\%
\end{align*}
\]
Malkiel’s Theorems

Summarizes the relationship between bond prices, yields, coupons, and maturity:

Malkiel’s Theorems paraphrased (see text for exact wording); all theorems are ceteris paribus:

1) Bond prices move inversely with interest rates.
2) The longer the maturity of a bond, the more sensitive is its price to a change in interest rates.
3) The price sensitivity of any bond increases with its maturity, but the increase occurs at a decreasing rate.
4) The lower the coupon rate on a bond, the more sensitive is its price to a change in interest rates.
5) For a given bond, the volatility of a bond is not symmetrical, i.e. a decrease in interest rates raises bond prices more than a corresponding increase in interest rates lower prices.
### Malkiel’s Theorems (cont’d)
#### Bond Prices and Yields (8% bond)

<table>
<thead>
<tr>
<th>Yields</th>
<th>5 years</th>
<th>10 years</th>
<th>20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 percent</td>
<td>$1,041.58</td>
<td>$1,071.06</td>
<td>$1,106.78</td>
</tr>
<tr>
<td>9 percent</td>
<td>960.44</td>
<td>934.96</td>
<td>907.99</td>
</tr>
<tr>
<td>Price Difference</td>
<td>$81.14</td>
<td>$136.10</td>
<td>$198.79</td>
</tr>
</tbody>
</table>
Malkiel’s Theorems (cont’d)
20-Year Bond Prices and Yields

<table>
<thead>
<tr>
<th>Yields</th>
<th>6 percent</th>
<th>8 percent</th>
<th>10 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 percent</td>
<td>$1,000.00</td>
<td>$1,231.15</td>
<td>$1,462.30</td>
</tr>
<tr>
<td>8 percent</td>
<td>802.07</td>
<td>1,000.00</td>
<td>1,197.93</td>
</tr>
<tr>
<td>10 percent</td>
<td>656.82</td>
<td>828.41</td>
<td>1,000.00</td>
</tr>
</tbody>
</table>
Malkiel’s Theorems (cont’d)
8% coupon, 20 year bond

<table>
<thead>
<tr>
<th>Yield</th>
<th>Price</th>
<th>Falls 2%</th>
<th>Rises 2%</th>
<th>Increase</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>6%</td>
<td>$1,231</td>
<td>$1,547</td>
<td>$1,000</td>
<td>25.70%</td>
<td>18.80%</td>
</tr>
<tr>
<td>8%</td>
<td>$1,000</td>
<td>$1,231</td>
<td>$828</td>
<td>23.10%</td>
<td>17.20%</td>
</tr>
<tr>
<td>10%</td>
<td>$828</td>
<td>$1,000</td>
<td>$699</td>
<td>20.80%</td>
<td>15.60%</td>
</tr>
</tbody>
</table>
Duration

The key to bond portfolio management
• Macaulay duration: What is it?
  ▫ Measures the combined effect of maturity, coupon rate, and YTM on bond’s price sensitivity
  ▫ Measure of the bond’s effective maturity
  ▫ Measure of the average life of the security
  ▫ Weighted average maturity of the bond’s cash flows
Calculating Duration

Calculating Macaulay’s Duration for a par value bond is a special case, as follows:

$$\text{Par value bond duration} = \left( \frac{1+\frac{\text{YTM}}{2}}{\text{YTM}} \right) \left[ 1 - \frac{1}{\left( 1+\frac{\text{YTM}}{2} \right)^{2\text{M}}} \right]$$

To calculating Macaulay’s Duration for any other bond:

$$\text{MD} = \left( \frac{1+\frac{\text{YTM}}{2}}{\text{YTM}} \right) + \frac{\text{M}(\text{C} - \text{YTM})}{\text{YTM} + \frac{\text{C}}{\left( 1+\frac{\text{YTM}}{2} \right)^{2\text{M}}}}$$

- \( \text{C} = \) annual coupon rate
- \( \text{M} = \) maturity (years)
Macaulay Duration alternative formula

$$\text{Macaulay Duration} = \sum_{t=1}^{n} \frac{\text{PV(CF}_t)}{\text{Bond Price}} \times t$$
**Figure 10.3: Calculating bond duration**

<table>
<thead>
<tr>
<th>Years</th>
<th>Cash flow</th>
<th>Discount factor</th>
<th>Present value</th>
<th>Years x Present value / Bond price</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>40</td>
<td>0.96154</td>
<td>38.4615</td>
<td>0.0192</td>
</tr>
<tr>
<td>1</td>
<td>40</td>
<td>0.92456</td>
<td>36.9822</td>
<td>0.0370</td>
</tr>
<tr>
<td>1.5</td>
<td>40</td>
<td>0.88900</td>
<td>35.5599</td>
<td>0.0533</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>0.85480</td>
<td>34.1922</td>
<td>0.0684</td>
</tr>
<tr>
<td>2.5</td>
<td>40</td>
<td>0.82193</td>
<td>32.8771</td>
<td>0.0822</td>
</tr>
<tr>
<td>3</td>
<td>1040</td>
<td>0.79031</td>
<td>821.9271</td>
<td>2.4658</td>
</tr>
</tbody>
</table>

$1,000.00  2.7259

**Bond price**  **Bond duration**
Duration Example

Assume you have a par value bond with 9% coupon, 9% YTM, and 15 years to maturity. Calculate Macaulay’s Duration.

\[
\text{Mac. duration} = \frac{\left(1 + \frac{.09}{2}\right)\left[1 - \frac{1}{\left(1 + \frac{.09}{2}\right)^{30}}\right]}{.09} = 8.51 \text{ years}
\]

Assume you have a bond with 9% coupon, 8% YTM, and 15 years to maturity. Calculate Macaulay’s Duration.

\[
\text{Mac. Dur.} = \frac{1 + \frac{.08}{2} - \left(1 + \frac{.08}{2}\right)^{30} + 15(.09 - .08)}{.08 + .09\left[\left(1 + \frac{.08}{2}\right)^{30} - 1\right]} = 8.78 \text{ years}
\]
Price Change & Duration

To compute the percentage change in a bond’s price using Macaulay Duration:

\[ \% \Delta \text{ in bond price} \approx \text{MD} \times \frac{\text{Change in YTM}}{1 + \frac{\text{YTM}}{2}} \]

To compute the Modified Duration:

\[ \text{Modified duration} = \frac{\text{Macaulay duration}}{1 + \frac{\text{YTM}}{2}} \]

To compute the percentage change in a bond’s price using Modified Duration:

\[ \% \Delta \text{ in bond price} \approx \text{Modified Duration} \times \text{Change in YTM} \]
Calculating Price Change

Assume a bond with Macaulay’s duration of 8.5 years, with the YTM at 9%, but estimated the YTM will go to 11%, calculate the percentage change in bond price and the new bond price.

\[ \% \Delta \text{ in bond price} \approx 8.5 \times \left( \frac{.09 - .11}{1 + \frac{.09}{2}} \right) = -16.27\% \]

Change in bond price, assuming bond was originally at par:

Approx. new price = $1,000 + (-16.27% x $1,000) = $837.30
Price Change & Duration

Assume you have a bond with Macaulay’s duration of 8.5 years and YTM of 9%, calculate the modified duration.

\[
\text{Modified duration} = \frac{8.5}{1 + \frac{.09}{2}} = 8.134 \text{ years}
\]

Using the bond above with modified duration of 8.134 years and a change in yields from 9% to 11%, calculate the percentage change in bond price.

\[
\% \Delta \text{ in bond price} \approx 8.134 \times (.09 - .11) = -16.27\%
\]

Note this is the same percentage change as computed previously.
Duration

The key to bond portfolio management

• Properties:
  - Longer maturity, longer duration
  - Duration increases at a decreasing rate
  - Higher coupon, shorter duration
  - Higher yield, shorter duration

• Zero coupon bond: duration = maturity
Figure 10.3: Bond duration and maturity

Bond maturity (years)

Bond duration (years)

0% Coupon
5% Coupon
10% Coupon
15% Coupon
Immunization

Target date hedging:
• Dedicated portfolios
• Reinvestment rate risk vs price risk
• Duration matching
• Rebalancing
• Dynamic immunization
Figure 10.5 Bond Price and Reinvestment Rate Risk

![Graph showing bond price and reinvestment rate risk over time. The x-axis represents time in years, ranging from 0 to 6, and the y-axis represents portfolio value in millions of dollars, ranging from 60 to 130. There are four lines representing different yield rates: 6%, 8%, 10%, and 10% (slightly higher than 10%). Each line shows how portfolio value changes with time under each yield rate.]
Example of Target Date Hedging

Assume you are setting up a target portfolio. You need $1,470 in five years. You can choose a 7.9% coupon bond with 5 years to maturity or a 7.9% coupon bond with 6 years to maturity and a 5-year duration. The YTM is now 7.9%. Which do you choose?

Solution:

To compare, calculate the total wealth in five years:

If interest rates do not change the total wealth of the 5-year bond in 5 years is $1,473.14 (in five years you receive $1,000 plus 5 coupon payments of $79 each, which earn interest at 7.9%)

If interest rates change to 6%:

The 5-year bond will earn total wealth of $1,452.82 ($1,000 plus 5 coupon payments of $79, which earn interest at 6%)

The 6-year bond (MD = 5 years) will earn total wealth of $1,471.00 (5 coupon payments of $79 compounded at 6%, plus a bond with 1-year to maturity worth $1,018.18)

The duration matched bond protected your portfolio.
Problem 10-9

CIR Inc. has 7% coupon bonds on the market that have 11 years left to maturity. If the YTM on these bonds is 8.5%, what is the current bond price?

Solution:

\[
\text{Bond price} = \frac{70}{.085} \left[ 1 - \frac{1}{\left(\frac{1 + .085}{2}\right)^{22}} \right] + \frac{1000}{\left(\frac{1 + .085}{2}\right)^{22}} = 894.16
\]
Problem 10-10

Trincor Company bonds have coupon rate of 10.25%, 14 years to maturity, and a current price of $1,225. What is the YTM? The current yield?

Solution:

\[
$1,225 = \frac{102.50}{YTM} \left[ 1 - \frac{1}{\left(1 + \frac{YTM}{2}\right)^{28}} \right] + \frac{1000}{\left(1 + \frac{YTM}{2}\right)^{28}}
\]

YTM = 3.805% x 2 = 7.61%

Current yield = $102.50 / $1,225 = 8.37%
Problem 10-22

XYZ Company has a 9% callable bond outstanding on the market with 12 years to maturity, call protection for the next 5 years, and a call premium of $100. What is the YTC for this bond if the current price is 120% of par value?

Solution:

\[
1,200 = \frac{90}{YTC} \left[ 1 - \frac{1}{\left(1 + \frac{YTC}{2}\right)^{10}} \right] + \frac{1,100}{\left(1 + \frac{YTC}{2}\right)^{10}}
\]

\[YTC = 3.024\% \times 2 = 6.05\%\]

[see next slide for additional information]
Problem 10-22 (cont’d)

Since the bond sells at a premium to par, you know the coupon is greater than the yield. If interest rates stay at current levels, the bond issuer will likely call the bonds to refinance at the earliest possible time.

What is the YTM, with zero call premium?

Solution:

\[
$1,200 = \frac{90}{YTM} \left[ 1 - \left(\frac{1}{1 + \frac{YTM}{2}}\right)^{24} \right] + \frac{1000}{\left(1 + \frac{YTM}{2}\right)^{22}}
\]

YTM = 3.283% \times 2 = 6.57%

[see next slide for additional information]
Problem 10-22 (cont’d)

What would be the break-even call premium? (If interest rates don’t change, at what level would the call premium have to be to not call the bonds?)

Solution:

\[
1200 = \frac{90}{.03283} \left[ 1 - \frac{1}{\left(1 + .03283 \right)^{10}} \right] + \frac{1000 + X}{\left(1 + .03283 \right)^{10}}
\]

\[X = 134.91\]

The bond will not be called if the call premium is greater than $134.91.
Problem 10-23

What is the Macaulay duration of an 8% coupon bond with 3 years to maturity and a current price of $937.10? What is the modified duration?

Solution:
First calculate the yield:

\[
$937 = \frac{80}{YTM} \left[ 1 - \frac{1}{\left(1 + \frac{YTM}{2}\right)^6} \right] + \frac{1000}{\left(1 + \frac{YTM}{2}\right)^6}
\]

YTM = 5.249 \times 2 = 10.498\%
Problem 10-23 (cont’d)

Now calculate the Macaulay’s duration.

Solution:

\[
\text{Mac. Dur.} = \frac{1 + \frac{.10498}{2}}{.10498} - \frac{\left(1 + \frac{.10498}{2}\right)^{6} - 1}{.10498 + .08\left(1 + \frac{.10498}{2}\right)^{6}}
\]

Mac. Duration = 2.715 years

Modified duration

\[= \frac{2.715}{1 + .10498/2} = 2.58 \text{ years}\]
Assignment from Chapter 10
Exercises 1, 2.
Chapter 10, Exercise 1

1. Suppose IBM is issuing $100 million in 7-year Eurobonds priced at U.S. Treasury minus 25 basis points. There is great demand for the issue and you are willing to bid 102 for 10% of the issue.
   a. If you actually get your bid executed, how much will you pay for the bond?
   b. A year later, the IBM Eurobonds are traded on the Luxembourg Exchange at 105. What is the value of your investment? What is your capital gain (loss)?
   c. You decide to sell the bond at the above price to pursue other opportunities. What amount of withholding taxes are you required to pay?
SOLUTIONS:

a. Price is 102% of par or 1,020 per bond; $102\% \times 10\% \times 100$ million = $10.20$ million for your share of the issue.
b. Price is $105\% \times 10\% \times 100 = $10.50$ million. Gain is $300,000.
c. No withholding taxes apply in the Eurobond market.
Chapter 10, Exercise 2

2. Suppose Credit Suisse First Boston (CSFB) is the sole lead manager in a $100 million bought deal for the World Bank. CSFB decides to price the seven-year issue at par to yield 8%.

a. What will be CSFB’s position if the Fed decides to increase short-term interest rates by 50 basis points during the offering period?

b. Instead of the Fed move described in a above, suppose that international trade talks break down leading to a depreciation of the dollar on currency markets. What will be CSFB’s position in this case?

c. Calculate the gain or loss for CSFB if the seven-year Eurobond rate rises to 8.25% on the offering day. (Note: Eurobonds pay interest only once each year.)

d. Suppose CSFB collects 2% in fees for lead managing the issue. Again, calculate the overall gain or loss for CSFB if the seven-year Eurobond rate rises to 8.25% on the offering day.

e. (Optional) How could CSFB hedge the risks described in (a) and (b)?
SOLUTIONS:

a. The yield required by the market on long-term bonds may change in response to the 50 basis point increase in short-term rates. If long-term interest rates rise, then by pledging to sell the Eurobonds at par, CSFB will lose the difference between par and the new lower price of the bond. Long-term interest rates may fall, however, if the market senses that the increase in short-term rates will reduce longer-run inflationary pressures. In this case, CSFB enjoys a capital gain.

b. Same as in (a). To attract investors that shy away from dollar assets, CSFB will have to lower the Eurobond price to a level attractive to lenders.

c. The Eurobond price falls to $987.09 per $1,000.00 face value. The underwriter loses 1.291% on the $100,000,000 issue or $1,291,000.

d. If CSFB collects 2.0% in fees, it transfers only $980 per bond, or $98,000,000 on the entire issue to the World Bank. CSFB's net profit is then $2,000,000 - $1,291,000 = $709,000.

e. CSFB can hedge the increase in interest rates by selling interest rate futures.
Arbitrage in the US Treasury Market?
How?
"We firmly believe that the on-the-run issues should command a high liquidity premium in the current environment. But with very high probability, the 5 1/2s of 8/15/2028 will NOT be the current bond a month from now. The Bond/Old Bond spread is currently about 13bp. The average of this spread around auction is historically about 3bp. Hence we think that much of the premium now assigned to the current bond should be ultimately passed on to the new issue by the expected auction date. Therefore it makes sense to begin scaling into a reverse roll now, at these levels."

On-the-run: The most recently issued Treasury bond in any given sector (e.g. 10 year sector, 30 year sector) of the yield curve.

The Current Bond: the most recently issued 30 year US Treasury bond (also shortened to just "The Bond").

The Old Bond: the second most recent 30 year US Treasury issue.

Bond/Old Bond spread: the yield difference between the most recent and the previously issued 30 year Treasuries.

Basis point (bp): 1/100 * 1%
The Yield Curve

The yield on the "on-the-run" 30yr bond is lower than similar bonds => it is worth *more*:

WHY?

Different Maturity?    NO

Better Credit?         NO

Liquidity?             YES!
Properties of the on-the-run Bond

- Tighter bid-offer spread
- Transactions costs are lower for quick and easy buying & selling
- Worth more (=> lower yield)

This *Liquidity Premium* has historically been worth about 3bp

... So why is it worth 13bp today?

Why is there an extra 10bp?

Could it be *Arbitrage*?

The Goldman Sachs US Treasury bond trader thinks so!
The Arbitrage Trade

**TODAY**

Sell the 8/28 (today's "on-the-run" bond)

Buy the 5/28 (today's "old bond")

Net Profit: 13bp (because the on-the-run is 13bp more costly than the old bond).

**ONE MONTH's TIME**

Buy back the 8/28 (today's "old" bond)

Sell the 5/28 (today's "old old bond")

Net cost: zero (now the two bonds cost the same amount; liquidity premium is now on the new "on-the-run" bond)