

## Unit 08. Government Securities

Reading: Chapter 15

## Chap. 15. Government Securities

1. The variety of federal government debt
2. Federal agency debt
3. State and local government debt
4. Authority bonds and Build America bonds
5. Foreign government debt securities
6. Government securities and investment companies



### 1. The Variety of U.S. Government Debt

- The U.S. federal government owes a substantial amount of debt.
- As of Oct. 2012 the U.S. national debt was \$16.2 trillion, approximately \$51,660 per person for the U.S. population, including infants.
- The debt was financed by a variety of investors, including individuals, corporations, financial institutions, and foreign entities.

### 1.1. Nonmarketable vs. Marketable Debt Instruments

- To induce diverse groups of investors to purchase its debt, the federal government has issued different types of debt instruments that appeal to the various potential buyers.
- One way to classify these debt instruments is to put them into two categories:
  - Nonmarketable – no secondary market trading
  - Marketable – secondary market exists

### 1.2. Nonmarketable Federal Government Debt

- Series EE bonds:
  - Issued at 50% of their face value and reach final maturity 30 years from issuance. Interest is paid semiannually and added to the current value of the bond. They are designed to reach face value in approximately 17 years although an investor can hold them for up to 30 years and continue to accrue interest.
  - Interest is taxable at the federal level only.
- Series I bonds
  - Issued at face value and have a variable yield based on inflation.
  - The interest rate consists of two components: the first is a fixed rate which will remain constant over the life of the bond and the second is a variable rate reset every six months from the time the bond is purchased based on the current inflation rate.
- For more information see [www.treasurydirect.gov](http://www.treasurydirect.gov)

### 1.3. Marketable Federal Government Securities

- Treasury bills:
  - Short-term debt instruments: 3-12 months
- Treasury notes:
  - Intermediate-term debt instruments: 2-10 years.
- Treasury bonds:
  - Long-term debt instruments: 10+ years.
- Treasury Inflation-Protected Securities (or TIPS):
  - Inflation indexed bonds

## 1.4. Treasury Bills

- Treasury bills are sold at a discount of the par value to create a positive yield to maturity.
- Many regard Treasury bills as the least risky investment available to U.S. investors.
- Treasury bills are sold by single price auctions held weekly. The minimum purchase is \$100.
- Banks and financial institutions, especially primary dealers, are the largest purchasers of T-bills.
- Treasury bills are quoted for purchase and sale in the secondary market on an annualized percentage yield to maturity.

7

## Interpretation of T-Bill Quotes

Maturity	Days to Maturity	Bid	Ask	Ask Yield
Nov29'12	50	4.81	4.77	4.84

- This T-Bill matures on Nov. 29, 2012. There are 50 days until this T-Bill matures.
- Buyers are willing to bid a discounted price that produces a **discount yield** of 4.81%. That is the same as a bid price of \$ 0.99332 on the dollar.
- Sellers are willing to sell at a discounted price that produces a **discount yield** at 4.77%. That is the same as an ask price of \$ 0.993375 on the dollar.
- Ask Yield of 4.84% is the **annualized yield to maturity** on ask price.
  - Discount yield vs. annualized yield to maturity

$$\text{Discount Yield} = \frac{\text{Par Value} - \text{Price}}{\text{Par Value}} \times \frac{360}{\text{Days to Maturity}}$$

$$\text{Yield to Maturity} = \frac{\text{Par Value} - \text{Price}}{\text{Par Value}} \times \frac{365}{\text{Days to Maturity}}$$

8

## Compound Yield on Treasury Bills

- The annualized yield to maturity in the TB quotes is not compounded. That is done by tradition. The economically correct yield to maturity computation should be compounded. Let's call that "compound yield" and denote it as  $r$ .

$$\text{Compound Yield } r = \left( \frac{\text{Par Value}}{\text{Price}} \right)^{(1/n)} - 1$$

- Where  $n = \text{Days to maturity} / 365$

9

## An Example of Discount Yield, Annualized Yield to Maturity, and Compound Yield

- If a six-month T-Bill is purchased for \$0.953 on a dollar, what are the discount yield, the annualized yield to maturity, and the compound yield? (Note here days to maturity is 180 days).
- Answer: Note  $n = \text{Days to maturity} / 365 = 180 / 365$

$$\text{Discount Yield} = \frac{\text{Par Value} - \text{Price}}{\text{Par Value}} \times \frac{360}{\text{Days to Maturity}} = \frac{1 - 0.953}{1} \times \frac{360}{180} = 9.4\%$$

$$\text{Yield to Maturity} = \frac{\text{Par Value} - \text{Price}}{\text{Par Value}} \times \frac{365}{\text{Days to Maturity}} = \frac{1 - 0.953}{1} \times \frac{365}{180} = 9.5306\%$$

$$\text{Compound Yield} = \left( \frac{\text{Par Value}}{\text{Price}} \right)^{1/n} - 1 = \left( \frac{1}{0.953} \right)^{365/180} - 1 = 10.25\%$$

10

## 1.5. Treasury Notes and Treasury Bonds

- Treasury notes (or T-Notes) mature in 2-10 years. They have a coupon payment every six months, and are commonly issued with maturity dates of 2, 5 or 10 years
- Treasury bonds (T-Bonds, or the long bond) have the longest maturity, from 10-30 years. They have coupon payment every six months like T-Notes.
- T-Notes and T-Bonds are quoted on the secondary market at percentage of par in 32<sup>nd</sup> of a point. Thus, for example, a quote of 95:07 on a note indicates that it is trading at a discount: \$952.19 (95 7/32) for a \$1000 face value note.
- The 10-year Treasury Note has become the security most frequently quoted when discussing the performance of the U.S. government-bond market and is used to convey the market's take on longer-term macroeconomic expectations.

11

## Interpreting T-Note or T-Bond Quotes

Rate	Maturity	Bid Price	Ask Price	Ask Yield
6	Feb 26	89:22	89:24	6.81

- Determine the following for a T-Bond with a face value of \$1,000:
- Ask Price =  $89 \frac{24}{32} \times 10 = \$ 897.50$
- Bid Price =  $89 \frac{22}{32} \times 10 = \$ 896.875$
- Coupon Payment =  $\$ 1,000 \times .06 = \$ 60$
- Current yield based on the ask price =  $\$ 60 / \$ 897.50 = 6.69\%$
- Yield to maturity = 6.81%

12

## 1.6. Treasury Inflation-Protected Securities (or TIPS):

- Treasury Inflation-Protected Securities (or TIPS) are the inflation-indexed bonds issued by the U.S. Treasury.
- These securities were first issued in 1997. The principal is adjusted to the Consumer Price Index (CPI).
- The coupon rate is constant, but generates a different amount of interest when multiplied by the inflation-adjusted principal, thus protecting the holder against inflation.
- TIPS are currently offered in 5-year, 10-year and 20-year maturities. 30-year TIPS are no longer offered.

13

## 1.7. An Example of Comparing Inflation-Protected Securities and Traditional Securities

- The federal government issues two two-year notes.
  - a traditional type of debt instrument that pays 5% annually (\$50 per \$1,000 note).
  - a real yield of 3% with the amount of interest being adjusted with changes in the CPI. The CPI was 100 when the notes were initially issued. Suppose the CPI for the subsequent two years are 103 for Year 1 and 105 for Year 2.
- (1) What is the annual amount of interest paid each year on each security?
- (2) What is the amount of principal repaid at maturity by each note?
- (3) What is the annual rate of return (or internal rate of return, explained in Chapter 10) on each security?
- (4) Which note is a better investment?

14

## Example continued

- Answer for (1) – Annual amount of interest paid
  - The amount of interest paid on the traditional note is the same each year at \$50 per year.
  - The amount of interest paid on the inflation-protected note changes depending on the inflation.
    - For year 1, the principal is updated to  $1000 \times (103/100) = \$1,030$ . So the interest payment is  $1030 \times 3\% = \$30.90$
    - For year 2, the principal further increases to  $1000 \times (105/100) = \$1,050$ . So year 2 interest is  $1,050 \times 3\% = \$31.50$
- Answer to (2) – Amount of principal repayment
  - For the traditional note, the amount of principal paid at maturity is \$1,000.
  - For the inflation-protected note, the amount of principal paid at maturity is \$1,050.

15

## Example Continued

- Answer to (3): Annual rate of return (internal rate of return)
  - Traditional note:
    - $1000 = 50/(1+i) + 50/(1+i) + 1000/(1+i)^2$
    - Using Excel to solve for  $i$ ,  $i = 5\%$
    - Note: The annual yield in this case is just the coupon rate because the note is assumed to be bought at par (face value).
  - Inflation-protected note:
    - $1000 = 30.90/(1+i) + 31.50/(1+i) + 1050/(1+i)^2$
    - Using Excel to solve for  $i$ ,  $i = 5.55\%$
- Answer to (4): Which one is a better investment?
  - In this particular case, the inflation-protected security has a higher internal rate of return so is a better investment.

16

## 1.7. Zero-Coupon: STRIPS

- STRIPS is the acronym for Separate Trading of Registered Interest and Principal of Securities.
- STRIPS are not issued or sold directly to investors by the Treasury. But they are registered in the governments' book-entry system.
  - STRIPS can be purchased and held through financial institutions, or
  - On TreasuryDirect through a broker.
- STRIPS are "zero-coupon" securities.
  - The only time an investor receives a payment from STRIPS is at maturity.
  - Typically used in retirement accounts.
- No reinvestment risk with STRIPS.
- The most price volatility of all Treasury securities.

17

## Federal Debt and Risk

- No default risk (at least so far it has been true):
  - Federal debts are considered the safest debt because there is no default risk. The federal government always has the capacity to refund or retire Treasury bills because it has the power to tax and the power to create money.
- Risk from price fluctuations:
  - Market interest rate changes, so all bond prices, including Treasury notes and bonds, will change. Among all treasury securities, STRIPS have the highest price volatility.
- Inflation risk:
  - There is always a risk that yield is lower than inflation. TIPS protect investors against inflation risk. However, the expected yield is lower for this protection.
- Data suggest that overtime, federal government bonds have become riskier as their returns have become more variable.

18

## Federal Debt and Tax Implications

- Interest earned on federal debt is subject to federal income taxation.
- However, these interest earnings are not subject to state income taxation.

19

## 2. Federal Agency Debt

- Certain agencies of the federal government and federally sponsored corporations issue debt.
- These agency bonds help support projects relevant to public policy, such as farming, small business, or loans to first-time home buyers.
- Among the federal agencies that issue bonds are:
  - Federal National Mortgage Association (Fannie Mae)
  - Federal Home Loan Mortgage Corporation (Freddie Mac)
  - Federal Agricultural Mortgage Corporation (Farmer Mac)
  - Student Loan Marketing Association (Sallie Mae)
  - Small Business Administration (SBA)

20

## Federal Government Agency Debt – Continued

- Federal agency bonds are not the debt of the federal government. However they may be supported by “full faith and credit” of the federal government.
  - Some are just moral backing – nonobligatory
  - Some are guaranteed by the U.S. Treasury
- Investors are likely to hold agency bonds in high regard because they have been issued by a government agency. That translates into more favorable interest rates for the agency.
- Most investors in federal agency securities are institutional.
- One of the most important federal government agency debt is mortgage backed securities.

21

## Mortgage Backed Securities

- Mortgage-backed securities (MBS) are debt obligations that represent claims to the cash flows from pools of mortgage loans.
- Mortgage loans are purchased from banks, mortgage companies, and other originators and then assembled into pools by a governmental, quasi-governmental, or private entity.
- The entity then issues securities that represent claims on the principal and interest payments made by borrowers on the loans in the pool, a process known as **securitization**.
- With this structure, all principal and interest payments (less a servicing fee) from the pool of mortgages are passed directly to investors each month.
- MBS are also called **mortgage pass through** because payments are passed from homeowners to investors.

22

## Mortgage Backed Securities - Continued

- Most MBSs are either issued or guaranteed by
  - The Government National Mortgage Association (Ginnie Mae, <http://www.ginniemae.gov>), a U.S. government agency
  - The Federal National Mortgage Association (Fannie Mae, <http://www.fanniemae.com/portal/index.html>), a U.S. government-sponsored enterprise (GSE)
  - The Federal Home Loan Mortgage Corporation (Freddie Mac, <http://www.freddiemac.com>), a U.S. government-sponsored enterprise (GSE)

23

## Ginnie Mae Securities

- Ginnie Mae does not buy or sell loans or issue mortgage-backed securities (MBS).
- It guarantees investors the timely payment of principal and interest on MBS backed by federally insured or guaranteed loans — mainly loans insured by the Federal Housing Administration (FHA) or guaranteed by the Department of Veterans Affairs (VA).
- Payments received from homeowners can vary month to month, thus a Ginnie Mae is a long-term instrument whose periodic payments are not fixed. However a minimum amount is guaranteed.
- If homeowners prepay (mostly by refinancing), additional funds are passed on to the investors. This risk is called “prepayment risk”.

24

## Freddie Mac and Fannie Mae

- Unlike Ginnie Mae, which is a wholly-owned government corporation, Fannie Mae and Freddie Mac are congressionally chartered, shareholder-owned corporations commonly known as government-sponsored enterprises (GSE).
- They share the mission of providing stability and liquidity to the housing market.
- Fannie Mae and Freddie Mac may purchase mortgages to hold in their own portfolios or to issue securities for sale to investors. Their MBSs are not explicitly guaranteed by the federal government.
- In Sept. 2008, in the midst of subprime meltdown, the Federal Housing Financing Agency (FHFA), the agency that oversees Fannie Mae and Freddie Mac, put both GSEs under conservatorship.
  - Basically, the two GSEs do not have enough capital and cannot raise enough funds to absorb their financial losses due to mortgage delinquency.

25

## An Example of MBS

- You acquire a Ginnie Mae that is a claim on a mortgage pool. The mortgages pay 8% and have an expected life of 30 years. Currently, interest rate is 8% so the cost of investment is its par value of \$150,000. For simplicity use annual compounding for this problem.
  - (1) What are the expected annual payments from the investment?
  - (2) If the interest rate declines to 6%, what is the current value of the mortgage pool based on the assumption that the loans will be retired over 30 years?
  - (3) If interest rate declines to 6%, and you expect homeowners to refinance after four years by repaying the loan, what is the current value of the mortgages if the amount owed at the end of four years is \$144,033?
  - (4) Why do the valuations in (2) and (3) differ?

26

## An Example of MBS - Continued

- Answer to (1) – Annual payment
  - Annual payment is the mortgage payment on a \$150,000 loan with a 8% interest rate. From FCS3450 or FCS 3500 you learned that mortgage payment is a PVFS computation. While actual mortgage payments are monthly compounding, for simplicity here we use annual compounding.
  - Annual payment = Loan amount / PVFS (r=8%, n=30 years)
  - =  $150000 / PVFS(r=8\%, n=30 \text{ years})$
  - =  $150000 / [(1 - (1 + 8\%)^{-30}) / 8\%] = 150000 / 11.257783 = \$13,324$
- Answer to (2) – Current value of MBS if interest rate goes down to 6% but no refinancing.
  - As discussed in previous units, discount rate = current interest rate
  - $P = 13,324 * PVFS(r=6\%, n=30 \text{ years})$
  - =  $13,324 * [(1 - (1 + 6\%)^{-30}) / 6\%] = 13,324 * 13.764831 = \$183,402$ .
  - Note if the market interest rate goes down, the value of this bond increases.

27

## An Example of MBS - Continued

- Answer to (3) – Current interest rate goes down to 6%, homeowners refinance after 4 years of holding the mortgage.
  - In this case, because homeowners refinance after four years, the investor gets a lump sum payment back after four years. That payment equals to the balance after four years, which is \$144,033.
  - The payment structure is \$13,324 for four years, then \$144,033 as a lump sum.
  - $P = 13,324 * PVFS(r=6\%, n=4 \text{ years}) + 144,033 * PVF(r=6\%, n=4)$
  - =  $13,324 * 3.465016 + 144,033 * 0.805688 = \$162,215$
- Answer to (4):
  - The valuations differ because in (2) the payments are assumed to be made for 30 years but in (3) the payments are assumed to be made over four years because the homeowner refinances.
- This example shows valuation of MBS is complicated as it depends on the refinance behavior of homeowners.

28

## Risks Associated with MBSs

- For federally backed MBSs such as Ginnie Mae, the **default risk** is close to zero. For privately backed MBSs, the default risk was initially thought to be small. However, the 2007-2008 subprime meltdown shows that the default risk for privately backed MBSs was understated.
- **Interest rate risk** is high. When market interest goes down, homeowners are likely to refinance and prepay their mortgage. For investors, this **prepayment risk** leads to **reinvestment risk**, in that investors are not able to reinvest the prepaid funds at the same interest rate.
- Payments can be uncertain on a month-to-month basis. Uncertain payments increase difficulty to value mortgage-backed securities.

29

## Collateralized Mortgage Obligations (CMOs)

- CMOs were first created in 1983. It is a type of MBS that creates separate pools of pass-through rates for different classes of bondholders with varying maturities, called tranches.
- The repayments from the pool of pass-through securities are used to retire the bonds in the order specified by the bonds' prospectus.
- Here is an example how a very simple CMO works:
  - The investors in the CMO are divided up into three classes: A, B, and C.
  - Each class differs in the order they receive principal payments, but receives interest payments as long as it is not completely paid off.
  - Class A investors are paid off first with prepayments and repayments until they are paid off. Then class B investors are paid off, followed by class C investors.
  - In a situation like this, class A investors bear most of the prepayment risk, while class C investors bear the most default risk.
- There are many forms of tranching, with some being more complicated than others. Valuation has been difficult due to the complexity of many CMOs. Overvaluation of CMOs is a contributing factor to the 2007-2008 subprime crisis.

30

## MBSs and the 2007 Subprime Crisis

- The current economic recession started with the 2007 subprime crisis that led to the conservatorship of both Freddie Mac and Fannie Mae, the collapse of all five major U.S. investment banks, and the downfall of the financial market worldwide.
- The over-valuation of MBS is a major contributor to this subprime crisis.
  - Overvaluation of MBS given risk.
- When the housing market took a downturn in mid 2006, foreclosure rates increased, leading to high mortgage default rates.
  - Banks and GSEs using leverages meant that their capitals were not adequate to cover the financial losses due to mortgage default.
- There are multiple factors that led to the subprime crisis and experts disagree as to what the main causes and the remedies are. However, there is not much disagreement that MBS as a debt instrument played an important role in this crisis.

31

## 3. State and Local Government Debt

- State and local governments also issue debt to financial various projects.
- State and local government debt enjoys tax advantage
  - Interest earned on state and municipal debt is exempt from federal income taxation.
  - In many cases the earned interest is also exempt from state income taxation for bonds issued in that state. E.g., Utah municipal bonds interest are exempt from Utah income tax. However, if you purchase New York state municipal bonds but live in Utah, interest earned is subject to Utah state income tax.
- This advantage is valued differently for taxpayers with different marginal tax rates. The higher one's marginal tax rate, the more beneficial this tax exemption is.

32

## State and Local Government Debt

- The individual investor may determine the equivalent yields on tax-exempt bonds and non-exempt bonds by using the following equation:  
$$im = ic(1 - tf - ts)$$
- Where
  - $im$  = yield on municipal bonds (exempt)
  - $ic$  = yield on nonexempt bonds
  - $tf$  = federal marginal tax rate
  - $ts$  = state marginal tax rate
- If one knows  $im$  and need to figure out  $ic$ , one can transform the formula to  
$$ic = im / (1 - tf - ts)$$

33

## An Example of Comparable Yield of Taxable vs. Tax-exempt Bonds

- An investor is in the 28% federal marginal tax bracket and 6% state marginal tax bracket. He can earn 6.5% on a municipal bond that is nontaxable. What is the comparable yield on a taxable bond?
- Answer:  $ic = im / (1 - tf - ts)$   
$$= 6.5\% / (1 - 28\% - 6\%)$$
  
$$= 9.85\%$$

That means, if a corporate bond of the same risk level pays anything less than 9.85%, this investor is better off purchase this municipal bond and take the tax exemption.

34

## Yield and Price of State and Local Government Bonds

- Yields have varied over time, similar to patterns in the corporate bond market (Figure 15.2 on P524 in textbook)
- In general, because state and local government bonds are federal tax exempt, they offer a lower yield.
- When yield on bonds is high in general, such as in the early 1980s, the spread between yield on corporate bonds and state/local bonds are large. When yield on bonds are low in general, the spread is smaller.

35

## Types of Tax Exempt Securities

- Generally, state and local bonds are supported in two ways:
  - (1) General obligation bond (GOs)
    - Supported by "full faith and credit" (Taxing authority of issuing government)
    - E.g. The renovation of Utah state capital.
  - (2) Revenue Bond
    - Supported by revenues generated by project financed by the debt
    - E.g., The renovation of Hogle Zoo
- GO bonds are safer than revenue bonds.

36

## Risks Associated with Tax Exempt Securities

- Interest rate risk: Changes in interest rates can cause bond value to increase or decrease, just like all other bonds.
- Default risk: There is a chance that a state or local bond can default. That is especially true for revenue bonds. If not enough revenue is generated from the project, the bond may default. Some bonds are insured so default risk is reduced. However a lower yield is offered for this insurance.
- Inflation risk: The yield may be lower than inflation rate.
- Liquidity risk - Lack of marketability: Secondary market of many state/local bonds may be small so liquidity risk is high.

37

## Taxable Municipal Securities

- State and local governments sometimes may issue taxable bonds to finance private enterprises that are deemed to be beneficial to the public, such as a hospital.
- Such bonds are liabilities of the private enterprise, not the government's.

38

## 4. Authority Bonds and Build America Bonds

- Some local and state governments have created authorities that issue bonds to build facilities and lease them to firms or for public purpose.
  - For example, Utah Transit Authority (UTA) may issue bonds.
- Build America Bonds were authorized by the American Recovery and Reinvestment Act of 2009
  - These are taxable bonds issued by state and local governments during 2009 and 2010 with a 35% federal government subsidy.

39

## 5. Foreign Government Bonds

- U.S. investors can also buy foreign government issued securities.
  - Because of the added risk of exchange rate, the yields need to be higher for such investment to be worthwhile.
- Brady bonds:
  - Brady bonds were created in March 1989 in order to convert bonds issued by mostly Latin American countries into a variety of new bonds after many of those countries defaulted on their debt in the 1980's.
  - Goal was to standardize the emerging-market debt, and facilitate risk-spreading and trading.
  - In exchange for commercial bank loans, the countries issued new bonds for the principal and, in some cases, unpaid interest.
  - They were tradable and came with some guarantees, such as the U.S. government's guarantee of principal payment.
  - For more details visit [www.brady.net](http://www.brady.net)

40

## 6. Government Securities and Investment Companies

- Instead of directly investing in government securities, investing in government security mutual funds may be a good option for many investors for several reasons:
  - Lack of marketability for some government securities, especially state and local government bonds.
  - Lack of readily available information on state and local government securities.
  - The size of trading for some government securities tend to be large, such as \$25,000 for Ginnie Mae bonds.
  - Mutual funds offer diversification and convenience.
  - Mutual funds may specialize in a specific type of government security.

41