Markets:
Fixed Income

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FINM Intro: Markets

Outline

Asset Classes

Fixed Income	contracted payoff
Money Market	short-term, liquid, safe
Bonds	long-term
Equities	residual claimant
Preferred	specified dividend
Common	junior stakeholder

Money market securities are very short-term debt securities which are highly marketable.

Treasury bills

U.S. Treasury bills (**T-bills**) are the most liquid of money market securities.

- T-bills do not make interest payments, but rather just pay face value at maturity.
- Maturities are for 4, 13, 26, and 52 weeks.
- Face values are as low as \$100, though they typically are larger, (\$10,000.)
- T-bills are exempt from state and local taxes.

T-bill dealers

T-bills are bought by auction or in secondary markets.

- Primary dealers buy most new issues at auction and sell them all over the world.
- The New York Fed publishes a list of these dealers, along with a "Weekly Release of Primary Dealer Transactions".
- Include Citigroup, Deutsche Bank, Morgan Stanley, Nomura, UBS.
- Recent additions or removals?

T-bill yields

T-bill prices are quoted in terms of yields.

- Let P denote the price of a T-bill with face value of \$100. The yield is defined as the constant, Y which satisfies

$$P = \frac{100}{1+Y}$$

- As a standard, quoted T-bill yields are **annualized** with **simple** compounding.

T-bill yield example

Suppose that a T-bill matures in 90 days, at which point it pays \$100. Suppose that the current price is \$99.

- Using the formula on the previous slide, we find the yield is

$$Y = .0101 = 1.01\%.$$

- Yields are typically annualized, and for T-bills they are traditionally annualized using simple compounding.
- The **Bond-equivalent yield**, (also known as the investment yield,) would then be

$$1.01\% \times \frac{365}{90} = 4.10\%.$$

T-bill quoting conventions

Aside from the bond-equivalent yield, another simplified quoting convention is the discount yield.

- The **Discount yield** uses simplified compounding as does the bond-equivalent yield (BEY).
- Unlike the BEY, the discount yield simplifies by assuming 360 days in a year.
- Furthermore, the discount yield uses the face-value, rather than the market price, as the base of the calculation.

$$\text{discount yield} = \left(\frac{100 - 99}{100}\right) \times \frac{360}{90} = .04 = 4\%.$$

- No compelling reason to use now, but traditional.

Yield-to-Maturity

Quoted yields are unsatisfactory for the reasons detailed above. A more useful yield is as follows.

- Let P denote the price of a T-bill which matures in N years and has face value of \$100.
- **Yield-to-Maturity** (YTM) is defined as the constant which satisfies

$$P_N = \frac{100}{(1 + \text{YTM})^N}$$

Yield versus return

A yield is just a convenient way to quote prices.

- In general, YTM is not the same as the return on the security.
- YTM is the average annualized return on the investment *only if* the investment is held until maturity.
- Discount of bond-equivalent yields would have other differences from a return, due to their approximations in calculation.

Data: Warning!

When you are using data on Treasuries, be sure of which yield is being quoted.

- YTM is more often discussed, and is more natural.
- But raw data will often be quoted with bond-equivalent-yields or discount-yields.
- However it is quoted, can convert back to prices and go from there.

Data: T-bill quotes

Maturity	Bid	Asked	Chg	Asked yield
9/8/2011	0.025	0.005	0.0100	0.0050
9/15/2011	0.010	-0.010	0.0000	0.0000
9/22/2011	0.015	-0.005	0.0000	0.0000
9/29/2011	0.025	-0.005	0.0000	0.0000
10/6/2011	0.010	-0.010	0.0000	0.0000
10/13/2011	0.010	0.005	0.0000	0.0050
10/20/2011	0.030	0.010	0.0200	0.0100

Figure: U.S. Treasury bill quotes on Sep. 2, 2011. Quoted as discount to face-value.

Source: *Wall Street Journal.*

Certificates of deposit

A **certificates of deposit** (CD) is a time deposit where the bank pays back principal and interest at the end of a fixed term.

- A CD is considered a savings account, and are thus FDIC insured.
- Deposits can not be withdrawn on demand.
- A large enough CD, (say $100,000,) is typically transferable, so there is a market for these.
- Most traded CD's have a very short maturity, (3 months or less.)

Commercial paper

Commercial paper is short-term, unsecured debt issued by firms.

- This is an important source of funding for nonfinancial firms.
- The paper typically matures in one to two months. It must be less than 270 days in order to avoid SEC registration and regulation.
- The paper is typically issued in $100,000 denominations.
- While the paper is unsecured, its short maturity makes it relatively safe.

LIBOR

The London Interbank Offered Rate **(LIBOR)** serves as a reference short-term interest rate for the money market.

- This is a rate at which large banks in London will lend and borrow to each other.
- The rate is quoted for several currencies, with the dollar-denominated LIBOR frequently used in U.S. markets.

Eurodollars

A **Eurodollar** is a dollar deposited in a bank outside the U.S. It is widely used in interest-rate futures.

- The Eurodollar rate is the interest earned on these dollar-denominated deposits held by banks outside the U.S, (in many countries besides Europe.)
- The Federal Reserve reports of the Eurodollar rate tend to match the LIBOR rate.
- The Fed publishes the Eurodollar rate on release H.15.

Federal Funds

The **Fed Funds** rate is the rate at which one bank lends overnight Federal Reserve deposits to another.

- This rate is a key measure of monetary policy, and is used widely in discussing short-term interest rates.
- The Federal Reserve requires that banks maintain reserve deposits at a Federal Reserve bank.
- To meet the reserve requirement, banks with excess reserves lend to banks with a shortage at the Fed Funds rate.
- In practice, the Fed Funds rate is not just used by big banks to cover shortages, but actually as a funding source.

Data: Fed Funds Rate

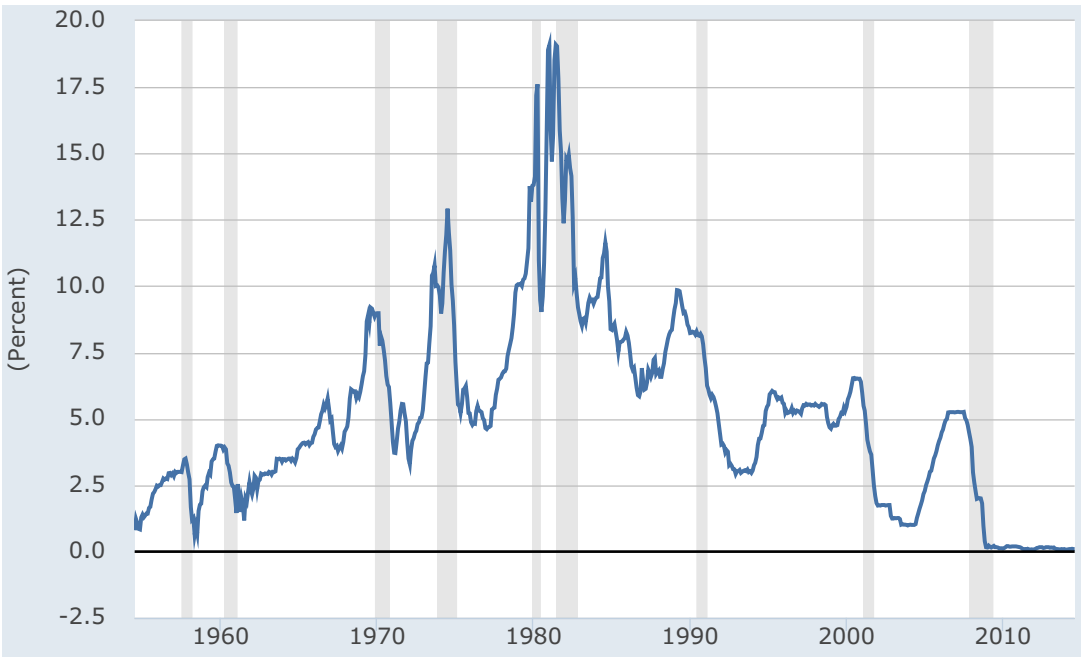

Figure: Source: St. Louis Fed.

Data: Fed Funds Rate in last two recessions

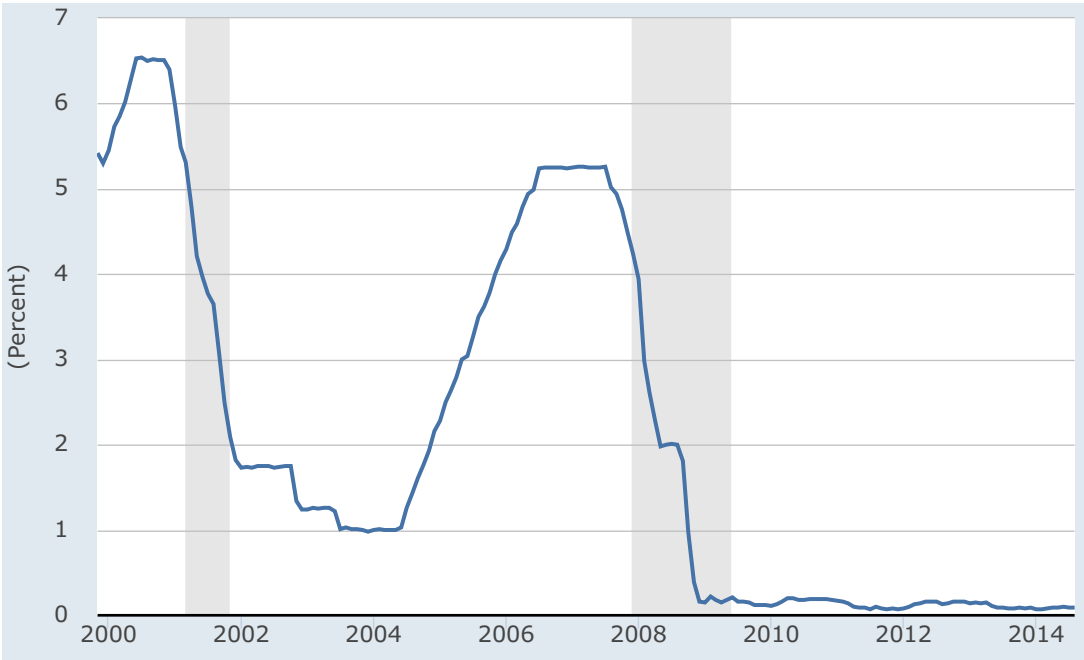

Figure: Source: St. Louis Fed.

Repo

A repurchase agreement **(repo)** is a contract where a dealer sells securities to another party with a deal to buy them back at a later date at a predetermined price.

- Repo is a common form of short-term borrowing.
- The difference between the selling price and the re-purchase price is the interest paid. This effective interest rate is the repo rate.
- The difference between the value of the collateral and the sell price is the haircut on the repo.
- The repo is, in essence, a collateralized loan.

Repo example

Example: Suppose an asset has a market value of \$100 and a bank sells it for \$80 with an agreement to repurchase it for \$88.

- The repo rate is 10%. $\left(\frac{88-80}{80}\right)$.
- The haircut is 20%. $\left(\frac{100-80}{100}\right)$.

Repo risk

Repo is considered very safe as the security transacted serves as collateral against default by either party.

- The most common repo is overnight. Longer term repos are referred to as term repo.
- Notably, the repo security is not subject to bankruptcy procedures. Either party can "walk away" if counterparty defaults.

Reverse repo

A reverse repo is the other side of the repo deal.

- Namely, the lender of funds, (borrower of the collateral,) is engaging in a reverse repo.
- A party may engage in a reverse repo in order to take a short position in the underlying collateral. ie. A dealer can do a reverse repo and immediately sell the collateral. When the repo term is up, the dealer then buys back the collateral.

Data: Money markets

	$ Billion
Savings deposits	$8,583
Treasury bills	1,547
Commercial paper	1,016
Repurchase agreements	1,245
Small-denomination time deposits (*)	391
Large-denomination time deposits (*)	1,621

Table: Money market securities - amounts outstanding in 2016.

(*) Small denominations are less than $100,000.

Source: Federal Reserve. (Aug 2016)

Money market funds

Money market funds provide small investors with access to money market securities.

- Money market mutual funds aim to keep net asset value (NAV), or share value constant at \$1. The interest rate paid out fluctuates with the return of the assets in the fund.
- Money market mutual funds have become an important funding source for money market instruments.
- As of Aug 2016, the amount outstanding was roughly \$2,730 billion.

Risk of money market funds

Money market funds have been very successful in maintaining NAV at \$1.

- Furthermore, money market funds have restrictions to enhance safety.
- Average maturity of securities had to be less than 90 days. In response to crisis, moved to 60.
- Enhanced rules on allocations, ratings of investments, etc.

Money market funds in the crisis

If the share value of the market fund falls below \$1, it is said to "break the buck."

- Given the safe assets held by the fund, this is a very unlikely event. Until 2008, it had only happened once.
- When Lehman failed, its commercial paper was worthless. This caused a fund to break the buck and another to liquidate due to redemptions.
- The U.S. Treasury intervened and offered insurance like FDIC.
- At the end of 2008, the balance in money market funds was at \$3,757. (Source: Flow of Funds. Board of Governors.)

Data: Warning!

Financial models often use a **risk-free rate**. This is often taken as a T-bill rate? Is this accurate?

- T-bills are used to fulfill a variety of regulatory requirements, and they are given preferential regulatory treatment.
- T-bills are given favorable tax treatment. (State and municipal taxes do not apply.)

These facts cause extra demand for T-bills, driving the rates (artificially?) lower.

Outline

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Money Market	short-term, liquid, safe
Bonds	long-term
Equities	residual claimant
Preferred	specified dividend
Common	junior stakeholder

Capital market securities refer to riskier and longer-term securities. (Stocks, long-term bonds, derivatives, etc.)

Bond market

The bond market is comprised of longer-term debt securities/loans than those in the money market.

- Bonds are referred to as the fixed income capital markets.
- Fixed income is a misleading term.
- As we saw with the fixed income money markets, many of the security cashflows are not actually fixed.

The term "bonds" is often used somewhat generally, referring to a range of longer maturity debt securities.

Importance of debt markets

The size of debt markets has exploded.

- No indication that it will slow given increasing government debt worldwide.
- Fixed income has been prominent in the two most important recent financial events:
  - The recent financial crisis revolved around mortgages debt.
  - The current Euro crisis is about sovereign debt.
- The recent crisis has put focus on the role of financial institutions, which are huge players in these markets.

Treasury notes and bonds

The U.S. government borrows funds largely by issuing bills, notes and bonds.

- **T-notes** have maturities from 2 years up to 10 years.
- **T-bonds** have maturities of 20 or 30 years.
- Both T-notes and T-bonds pay a semiannual coupon.

Recall that T-bills have maturity up to one year, and they do not pay a coupon.

Yield on coupon-paying securities

T-notes and T-bonds pay coupons, so the formula connecting yield and price is more complex.

- Let N denote the number of years until maturity.
- Let C denote the **annual** coupon amount, paid twice per year. $(2 \times N)$ coupons total.
- Let F denote the face value paid at maturity.

The price of the maturity-N security, (denoted P_N,) and the yield-to-maturity, (denoted Y,) of the security are related as

$$P_N = \sum_{i=1}^{2\times N} \frac{C/2}{(1+YTM)^{i/2}} + \frac{F}{(1+YTM)^N}$$

T-note and T-bond quoting conventions

Keep in mind that the coupon rate (C/F) is not the same as the return or even the yield.

- If the price equals the face value, the bond is selling at par. (This implies the YTM equals the coupon rate.)
- Price below the face value (yield above the coupon rate) is referred to as selling below par.

Data: Treasury quotes

Maturity	Coupon	Bid	Asked	Asked yield
10/31/2014	0.250	100.0234	100.0313	-0.017
10/31/2014	2.375	100.2734	100.2813	-0.032
11/15/2014	0.375	100.0469	100.0625	-0.022
11/15/2014	4.250	100.6563	100.6719	-0.013
10/31/2019	1.250	97.0547	97.1016	1.846
11/15/2019	3.375	107.4922	107.5391	1.836
11/15/2024	7.500	144.3047	144.3828	2.520
08/15/2044	3.125	95.5156	95.5781	3.360

Table: U.S. Treasury quotes on Sep. 17, 2014.

Source: *Wall Street Journal.*

Benchmark T-note rate

The ten-year T-note rate is a benchmark rate in U.S. capital markets.

- As of Aug 28, 2017, the ten-year T-note rate was 2.16%. (Source: U.S. Dept. of the Treasury.)

Data: T-note (10yr) rate

Figure: Source: St. Louis Fed.

TIPS

Since 1997, the U.S. government also issues inflation-protected bonds.

- Treasury Inflation Protected Securities **TIPS** have face values which are scaled by a measure of inflation.
- TIPS also pay a semiannual coupon.
- Both notes and bonds are issued.

Data: TIPS note (10yr) rate

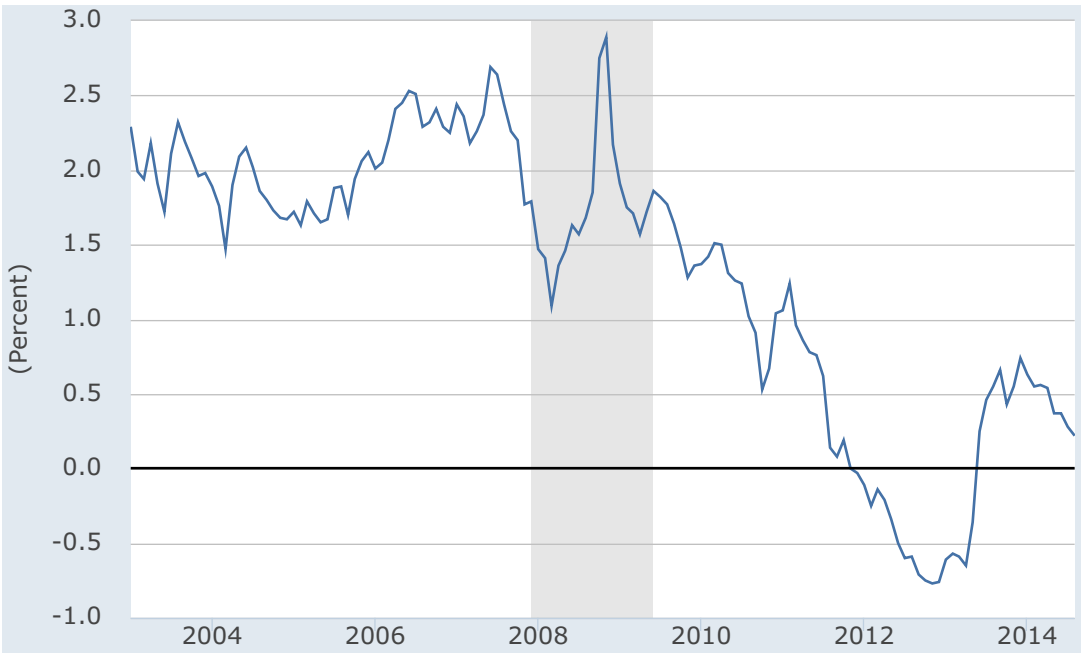

Figure: Source: St. Louis Fed.

Data: Treasury securities outstanding

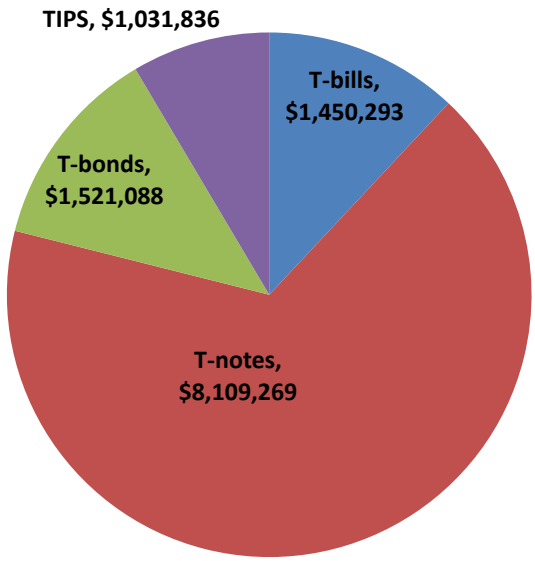

Figure: Treasury securities outstanding ($ millions). Publicly held.
Source: Monthly Statement of the Public Debt. Aug. 2014.

Data: Maturity structure of treasuries

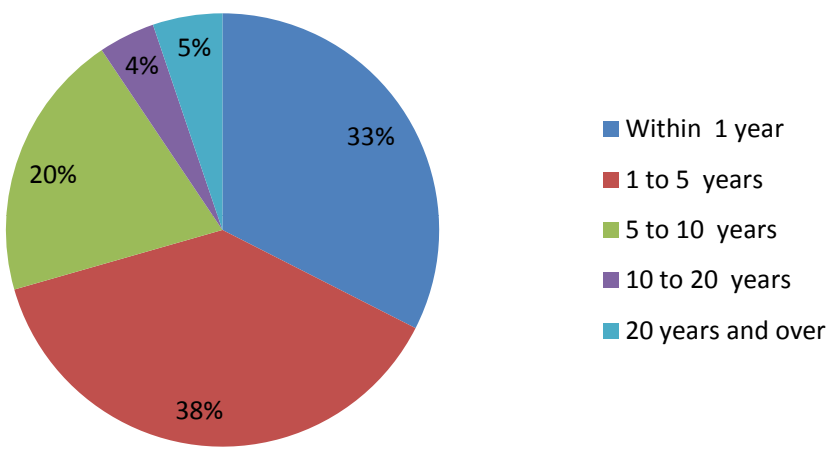

Figure: Maturity structure of publicly held treasuries.
Source: Economic Report of the President. Feb 2011.

Owners of U.S. Treasuries

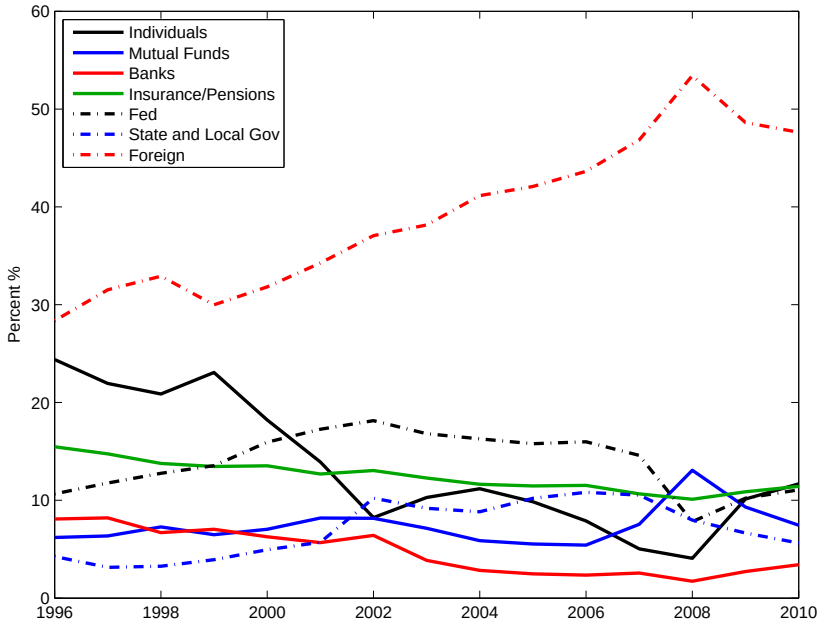

Figure: Treasury owners. Source: SIFMA

Municipal bonds

Municipal bonds are issued by state and local governments.

- Interest income is exempt from federal income taxes, as well as state and local taxes in the issuing state.
- Capital gains taxes still apply.
- Due to the Federal income tax savings, municipal bonds are particularly attractive to those with high marginal tax rates.

International bonds

Main international debt instrument has been **foreign bonds**.

- These are bonds issued by a foreign country, but denominated in the currency of the market in which they are issued.
- ie. Sony issues a dollar-denominated bond in the U.S.

More recently, **Eurobonds** have become popular.

- These bonds are denominated in a currency other than that of the country in which they are sold.
- Example: Suppose that a firm issues a bond in Japan with the bond denominated in U.S. dollars.
- The name "Eurobond" is perhaps unfortunate. It need not have anything to do with Europe or the Euro.

Corporate bond payoffs

Corporate bond payoff structure varies:

- Most pay a semiannual coupon and return face value at maturity.
- May include issuer option to call bond early at face value - manage interest rate risk.
- May include issuer or bondholder option to convert to equity.

In the U.S., issuing firms may deduct the interest payments from the firm's taxes.

Corporate bond priority

Corporate bonds for range of claim priority:

- Some corporate bonds are *secured*, meaning that they are backed by collateral.
- Unsecured corporate bonds are sometimes referred to as *debentures* in financial reporting.
- *Subordinated debentures* have a lower priority than other debt in case of bankruptcy.

Corporate financing

The size of the corporate bond market is significantly smaller than the size of the stock market.

- However, the volume of new corporate bonds issued each year is much larger than new stock issues.
- Thus, the corporate bond market may not be the most important for asset pricing, but it is pivotal for corporate finance.
- Corporate bond market is a key measure of economy-wide investment and the business cycle.

Data: Firm financing

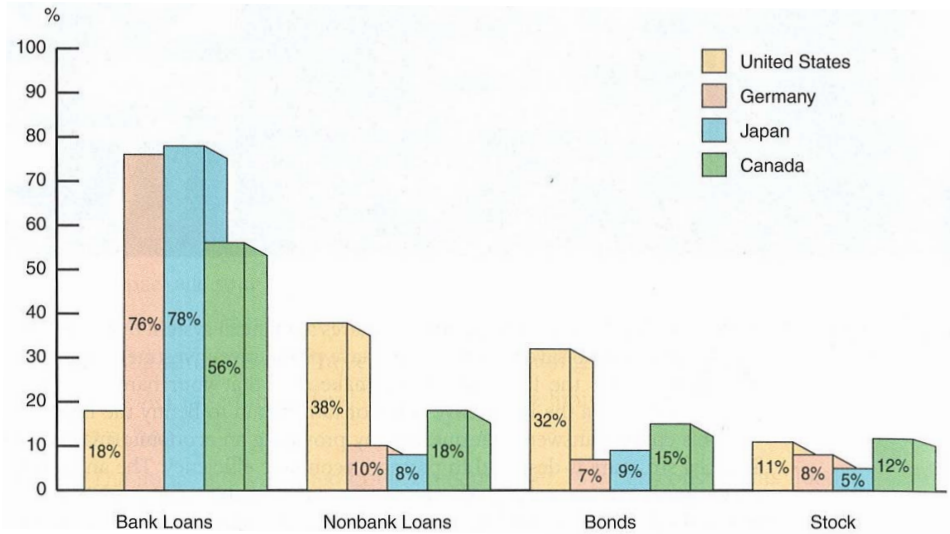

Figure: Sources of external funds for nonfinancial firms, 1970-2000.

Source: Mishkin (2010)

Mortgages

Mortgages are loans to households and firms in order to buy land, real estate, or other structures.

- The primary mortgage lenders in the U.S. have been savings and loan associations and mutual savings banks, though recently, commercial banks have increased their role.
- The federal government plays an active role in this market.
- Three agencies, (commonly referred to as Fannie Mae, Freddie Mac, and Ginnie Mae,) buy a large amount of mortgages.
- Stated goal is to provide liquidity in the market and achieve certain government objectives regarding home ownership.

Federal agency debt

Several government agencies issue their own securities.

- **Agency debt** securities are backed by specific revenue streams; it is not explicitly insured by the Federal government.
- Most of these are involved with funding U.S. mortgages. ie. Fannie Mae, Freddie Mac, and Ginnie Mae.
- Implicitly, agency debt is fully backed by the U.S. government. In 2008, the Federal government assumed responsibility for the bonds of the above agencies.

MBS

A mortgage-backed security (**MBS**) is a claim on a pool of mortgages or a claim backed by such a pool.

- The originator of the mortgage, (the lender,) usually services the loans.
- The servicing agent collects the homeowner payments and passes the principal and interest on to the MBS investment vehicle.
- The simplest MBS is a *pass-through*, a claim on a fraction of the total cash flow from the mortgages.

MBS allows for wide sharing of mortgage risk.

ABS

Besides MBS, many other loans are pooled into securities.

These asset-backed securities (**ABS**) are backed by credit-card, auto, and student loans.

U.S. Debt

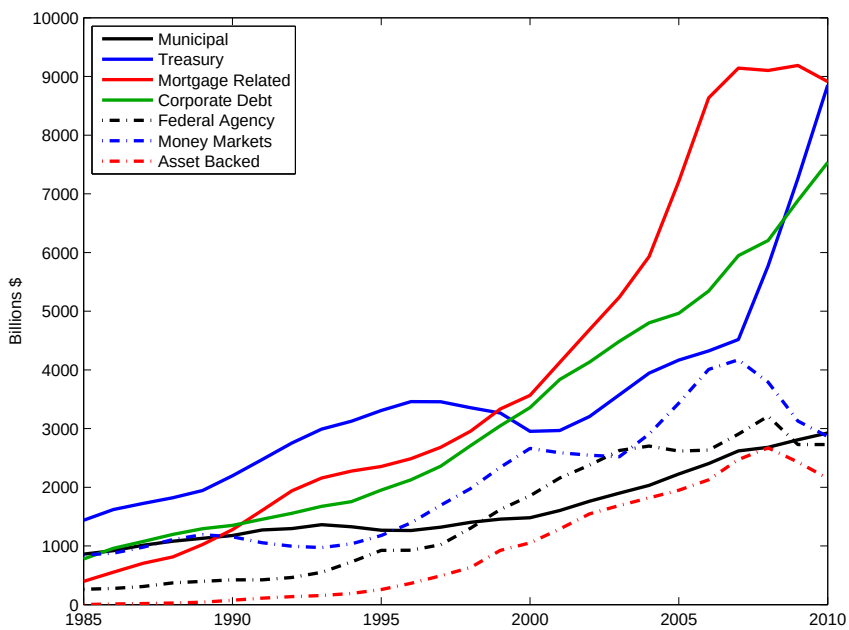

Figure: Growth in U.S. Debt. Source: SIFMA

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