

# Credit & Bonds

## COMP0164 Lecture 4 (Week 9)

Geoff Goodell (University College London)

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# Agenda

## Readings

- Brealey Myers Allen chapters 3, 23–24
- Bodie Kane Marcus chapters 14–15
- Hull chapter 24

## Topics

- Risk of default
- Yields and spreads
- Bond ratings
- Protective covenants
- Sovereign bonds
- Corporate bonds
- Convertible bonds
- Bank loans
- Commercial paper

# Financial markets

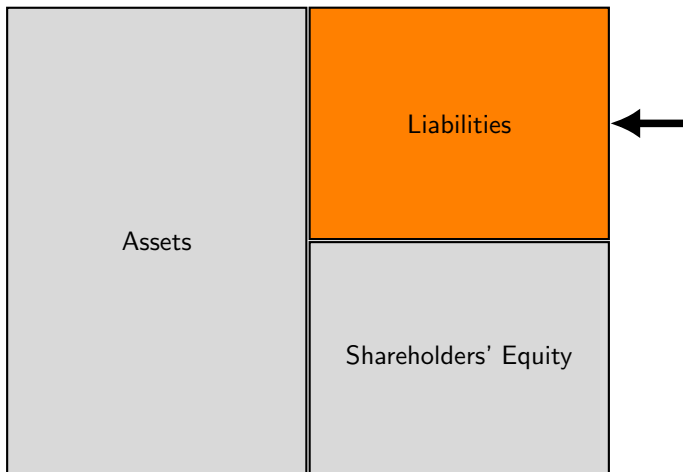
**Money markets** are markets for short-term, highly marketable, liquid, low-risk debt securities:

- Treasury bills (short-term sovereign debt)
- Certificates of deposit (a time deposit with a bank)
- Commercial paper (unsecured short-term corporate debt)
- Bankers' acceptances (promises to pay a bank in the future)
- Repos and reverse repos (selling or buying gov't securities)
- Overnight deposits (with the central bank)
- Brokers' calls (for lending to clients for margin trading)

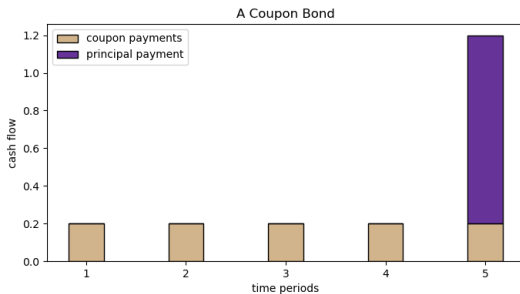
**Capital markets** are markets for longer-term and riskier securities:

- Longer-term bond markets
- Equity markets
- Derivatives markets (e.g. options, futures)

# Debt securities are liabilities of their issuers



# Recall: Coupon bonds



Coupon bonds have a fixed schedule of payments, comprising periodic **coupons** plus a return of **principal** at the end of the final period:

$$PV = c \left[ \frac{1}{r} - \frac{1}{r(1+r)^n} \right] + \frac{P}{(1+r)^n} \quad (1)$$

■  $P$  = principal

■  $r$  = discount rate

■  $c$  = coupon

■  $n$  = number of time periods

## Recall: Yield to maturity

The rate of return of a bond is its **yield to maturity**, which can be expressed in terms of periodic or continuous compounding:

$$PV = \frac{P}{(1+y)^n} + \sum_{t=1}^n \frac{c}{(1+y)^t} \quad (2)$$

$$PV = Pe^{-yn} + \sum_{t=1}^n ce^{-yt} \quad (3)$$

■  $P$  = principal

■  $y$  = **yield to maturity**

■  $c$  = coupon

■  $n$  = number of time periods

The **yield to maturity** can be found by solving for  $y$  via an iterative process. Going forward, we shall use continuous compounding unless otherwise stated.

# Bond characteristics

The **par value** of a bond is also called its **face value**, **nominal value**, or **principal**.

The **coupon rate** of a bond determines its interest payment; the annual payment is the coupon rate multiplied by the par value.

The **bond indenture** is the contract between the issuer and the **bondholder**.

**Zero-coupon bonds** make no coupon payments.

# Current yield and yield to maturity

The **current yield** of a coupon bond is its coupon divided by its current price.

As the **price** of a bond increases, its **yield** decreases.

The market price, or **asked price**, of a bond can be compared to its par value:

- If the bond is trading at a **discount** to par, then its current yield is less than its yield to maturity, and investors expect a capital gain over its lifetime.
- If the bond is trading at a **premium** to par, then its current yield is greater than its yield to maturity, and investors expect a capital loss over its lifetime.

Why buy a bond at a premium?

- Hedging or speculation, for example on interest rates or its credit risk
- Other constraints, e.g. investment mandates or commitments



# Accrued interest

**Accrued interest** is the prorated share of the upcoming coupon payment. If a bond is purchased between coupon payments, the buyer must pay accrued interest:

$$\text{accrued interest} = \frac{c}{m} \times \frac{\text{days since last coupon payment}}{\text{days separating coupon payments}} \quad (4)$$

- $c$  = coupon
- $m$  = compounding frequency

However, bonds are generally quoted without accrued interest:

- The **flat price** (or **clean price**), which is usually the price that is quoted in markets, is the price of the bond without accrued interest.
- The **invoice price** (or **dirty price**), which is usually the price that is actually paid, is the flat price plus accrued interest.

# Who issues debt securities?

Sovereign  
Governments

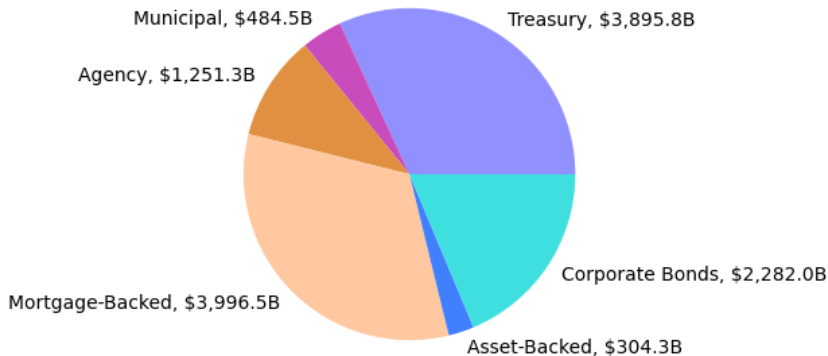
Private  
Corporations

Local  
Governments

Government  
Agencies

# The fixed-income securities market

US Fixed Income Securities Issuance by Value, 2020



Data Source: SIFMA 2021 Capital Markets Fact Book

<https://www.sifma.org/wp-content/uploads/2021/07/CM-Fact-Book-2021-SIFMA.pdf>

# Sovereign bonds and default risk

Sovereign debt is **not entirely risk-free**:

- **Foreign currency debt**: Wherein the sovereign borrows in other currencies (often US dollars), they can default (**cannot** or **will not** pay) on their commitments.
- **Own currency debt**: Wherein the sovereign borrows in its own currency, it is unlikely to default since it can **print money** to service its debt, creating inflation and reducing the value of its debt. But this has caveats (viz. US 2011 example) and limits (viz. Russia 1998 example).
- **Eurozone debt**: Fiscal policy is managed by member states, but monetary policy is managed by the ECB. So, the ECB might decide not to bail out a member state (viz. Greece 2012, 2015). (“return-free risk”?)

# Credit risk

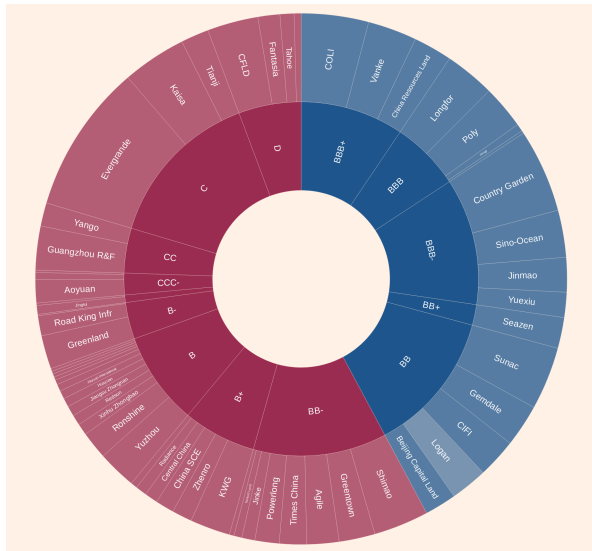
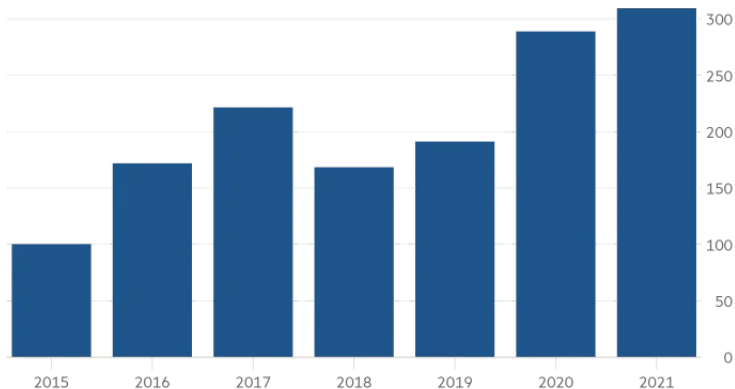


Image Source: Financial Times, 2022-01-07. <https://flo.uri.sh/visualisation/8322047/embed?auto=1>

# Emerging markets credit trends

## Developing-country bond issuance surged in the pandemic

Sovereign and corporate bonds issued by emerging, frontier and low-income countries, \$bn



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Image Source: Financial Times, 2022-01-17.

# Promised versus expected yield

A **risky** bond has a **promised** yield that is greater than its **expected** yield.

$$\text{promised yield} = \frac{1 + y}{\text{market price}} - 1 \quad (5)$$

■  $y$  = yield to maturity (expected yield)

The difference between the expected yield and the risk-free rate (or risk-free bond of equal duration) is the **risk premium**.

If a risky bond has  $\beta = 0$ , then its risk is **fully diversifiable**, and the expected yield is the same as the risk-free rate.

The difference between the promised yield and the risk-free rate (or risk-free bond of equal duration) is the **yield spread**.

# Factors affecting the yield spread

If there is an increase in:	Then the yield spread:
value of the company's assets	▼ decreases
volatility (standard deviation of asset value)	▲ increases
amount of outstanding debt	▲ increases
maturity of outstanding debt	▲ increases
default-free interest rate	▼ decreases
dividend payments	▲ increases

A greater yield spread generally indicates a greater likelihood that the issuer will default.



# Bond ratings: investment grade

Moody's	S&P	Description
Aaa	AAA	High-grade; the highest rating.
Aa	AA	High-grade; very strong capacity to pay interest and repay principal.
A	A	Strong capacity to pay interest and repay principal; somewhat more susceptible to changes in circumstances and economic conditions.
Baa	BBB	Medium-grade; changes in circumstances and economic conditions are more likely to lead to a weakened capacity to pay interest.

**Investment grade** bonds are typically quoted in terms of their yield.

## Bond ratings: high yield

Moody's	S&P	Description
Ba	BB	Speculative grade.
B	B	Speculative grade; riskier than Ba/BB.
Caa	CCC	Speculative grade; generally considered a “poor” rating.
Ca	CC	Most speculative or poorest grade; quality and protective characteristics are often outweighed by major uncertainties or risk exposures; some issues may be in default.
C	D	In default; payment of interest or repayment of principal is in arrears.

**High yield** (sometimes called **junk**) bonds are typically quoted in terms of their price.

# Determinants of bond safety

Bond rating agencies typically use the issuer's financial ratios to calculate the quality ratings of bonds:

- **coverage ratios**: ratios of company earnings to fixed costs.
- **leverage (debt-to-equity) ratios**: ratios measuring indebtedness.
- **liquidity ratios**: ratios that measure the firm's ability to pay bills coming due with its most liquid assets.
- **profitability ratios**: measures of rates of return on assets or equity.
- **cash flow to debt ratio**: the ratio of total cash flow to outstanding debt.

# Altman's Z-Score

Many studies have tested whether financial ratios can be used to predict default risk. **Altman's Z-Score**<sup>1</sup> is based upon one of the most notable examples, which combined discriminant analysis of financial ratios with historical records of corporate bankruptcies:

$$Z = 3.1 \frac{\text{EBIT}}{\text{total assets}} + 1.0 \frac{\text{sales}}{\text{assets}} + 0.42 \frac{\text{equity}}{\text{total liabilities}} + 0.85 \frac{\text{retained earnings}}{\text{total assets}} + 0.72 \frac{\text{working capital}}{\text{total assets}} \quad (6)$$

- $Z < 1.23$  : high vulnerability to bankruptcy
- $Z > 2.90$  : low vulnerability to bankruptcy

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<sup>1</sup>E Altman, "Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy." Journal of Finance 23 (1968), updated by E Altman, Corporate Financial Distress and Bankruptcy (1993).

# Hazard rate

The **hazard rate** (or **default intensity**)  $\lambda(t)$  at time  $t$  is defined so that  $\lambda(t) \Delta t$  is the probability of default between time  $t$  and  $t + \Delta t$ , conditional on no earlier default.

If  $V(t)$  is the cumulative probability of the company surviving to time  $t$ , then:

$$V(t + \Delta t) - V(t) = -\lambda(t)V(t) \Delta t \quad (7)$$

$$\frac{dV(t)}{dt} = -\lambda(t)V(t) \quad (8)$$

$$V(t) = e^{-\int_0^t \lambda(\tau) d\tau} \quad (9)$$

If  $Q(t) = 1 - V(t)$  is the probability of default by time  $t$  and  $\bar{\lambda}(t)$  is the average hazard rate between time 0 and time  $t$ , then:

$$Q(t) = 1 - e^{-\int_0^t \lambda(\tau) d\tau} \quad (10)$$

$$Q(t) = 1 - e^{-\bar{\lambda}(t)t} \quad (11)$$

The **recovery rate** for a bond is the bond's market value shortly after default, as a fraction of its face value.

The recovery rate is often assumed to be 0.4, but in practice:

- depends upon the seniority of the bond
- depends upon the collateral (if applicable)
- depends upon the market-wide default rates
  - in a good year when recovery is low, can be relatively high (0.6)
  - in a year with many defaults, forced deleveraging can push down the value of underlying assets (0.3)

# Estimating the probability of default

If we assume that the excess yield is compensation for the possibility of default, then:

$$\bar{\lambda}(T)(1 - R) = s(T) \quad (12)$$

$$\bar{\lambda}(T) = \frac{s(T)}{1 - R} \quad (13)$$

- $\bar{\lambda}(T)$  = hazard rate
- $s(T)$  = bond yield spread
- $R$  = recovery rate

(Note that  $\bar{\lambda}(T)(1 - R)$  is the average loss rate.)

# Seven-year average hazard rates

(values in % per annum)

rating	historical $\bar{\lambda}(t)$	$\bar{\lambda}(t)$ from bonds	ratio	diff
Aaa	0.04	0.67	16.8	0.63
Aa	0.06	0.78	13.0	0.72
A	0.13	1.28	9.8	1.15
Baa	0.47	2.38	5.1	1.91
Ba	2.40	5.07	2.1	2.67
B	7.49	9.02	1.2	1.53
Caa and lower	16.90	21.30	1.3	4.40

Source: Hull



# Expected excess return on bonds

(values in basis points)

rating	bond yield spread	spread for historical defaults	excess return
Aaa	40	2	38
Aa	47	4	43
A	77	8	69
Baa	143	28	115
Ba	304	144	160
B	542	449	93
Caa	1278	1014	264

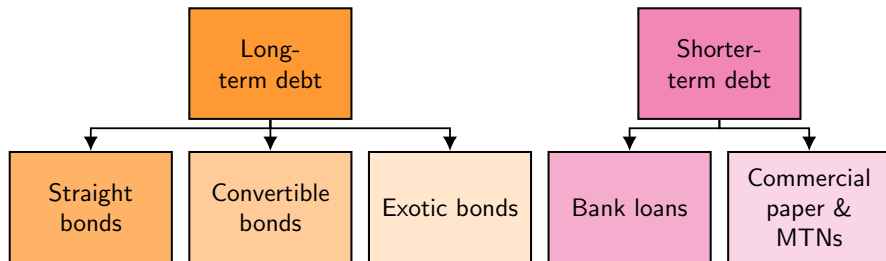
Source: Hull

# Protective covenants

Bond indentures sometimes include **protective covenants** to protect investors:

- **Subordination of further debt:** Subordination clauses restrict the amount of additional borrowing by the issuer, or can require new debt to be **subordinated** in priority to existing debt. (Recall LBO example.)
- **Collateral:** Collateral is a specified asset that bondholders receive if a firm defaults on a bond; examples of such bonds include mortgage bonds, collateral trust bonds, and equipment obligation bonds. Collateralised bonds are usually considered safer than **debentures** (bonds without collateral). (Compare to repos.)
- **Dividend restrictions:** Covenants limiting dividends are designed to prevent shareholders from implementing the “cash in and run” strategy.
- **Sinking funds:** Covenants to spread the burden of repaying the principal over a period of time (typically several years) are designed to help avoid a cash flow crisis.

# Varieties of corporate bonds



# Callable bonds

A **callable bond** is a bond that contains an **option** for the issuer to **repurchase (call)** the bond at a specified **call price before** its maturity date.

- The call feature is often used to protect an issuer from declining interest rates, wherein the issuer could call the bond and then issue new debt with a lower yield (**refunding**).
- Most callable bonds are **deferred callable bonds**, which feature a period of **call protection**, a specified length of time following issuance during which the bond is not callable.
- Because the call feature is an advantage to the issuer and a disadvantage to the investor, callable bonds generally have **lower prices** and **higher yields** than equivalent bonds without the call provision.

# Yield to call

Investors in deferred callable bonds might want to calculate the **yield to call**, which is similar to yield to maturity and can be expressed in terms of periodic or continuous compounding:

$$PV = \frac{K}{(1+y)^n} + \sum_{t=1}^n \frac{c}{(1+y)^t} \quad (14)$$

$$PV = Ke^{-yn} + \sum_{t=1}^n ce^{-yt} \quad (15)$$

■  $K$  = call price

■  $c$  = coupon

■  $y$  = **yield to call**

■  $n$  = time periods until first call

# Extendable (put) bonds

An **extendable bond** (or **put bond**) gives the bondholder (not the issuer) the option to extend or retire the bond at a specified date.

- If interest rates have fallen, then the bondholder can extend the bond and continue to receive interest payments at the rate set earlier.
- Otherwise, if the coupon is too low to justify extending, then the bondholder can opt to reclaim the principal, which can be invested elsewhere.

# Floating-rate bonds

**Floating-rate bonds** make interest payments tied to some measure of current market rates (usually a reference rate or a Treasury rate plus a fixed spread).

- Payments over the next time period are determined by the rate that is current on the **adjustment date**.
- The purpose is to separate out the risk due to interest rates, whilst retaining the risk due to a firm's financial strength.
- The **yield spread** is fixed over the life of the security.
- The coupon rate rises and falls with interest rates, but is fixed with respect to the firm's financial condition.

# Convertible bonds

**Convertible bonds** offer bondholders an option to exchange each bond for a specified number of shares of common stock of the firm.

- The **conversion ratio** is the number of shares for which each bond may be exchanged.
- The **market conversion value** is the current value of the shares for which the bonds may be exchanged. The option to convert is profitable if the market conversion value exceeds the current market value of the bond.
- The **conversion premium** is the excess of the bond's value over its conversion value.

More on convertible bonds in two weeks when we discuss options.



# International bonds

**Foreign bonds** are issued by a borrower from a country other than the one in which the borrower is sold. For example:

- Yankee bonds are sold in the US by non-US issuers.
- Samurai bonds are sold in Japan by non-Japanese issuers.
- Bulldog bonds are sold in the UK by non-UK issuers.

**Eurobonds** are denominated in a currency other than the currency of the national markets of the country in which they are sold. For example:

- Eurodollar bonds are dollar-denominated bonds sold outside the US.
- Euroyen bonds are yen-denominated bonds sold outside Japan.
- Eurosterling bonds are sterling-denominated bonds sold outside the UK.

# Innovative bond designs

- **asset-backed securities**, assets or loans, bundled and repackaged
- **catastrophe bonds**, payments are contingent upon a specified disaster
- **indexed bonds**, payments are contingent upon an index or commodity price (e.g. TIPS, equity indexes)
- **contingent convertibles**, convert to equity as the price of the firm falls
- **longevity/mortality bonds**, payments contingent upon changes in longevity or mortality rates
- **pay-in-kind bonds (PIKs)**, can be paid by issuer in more bonds rather than cash
- **credit-linked bonds**, coupon payment changes with credit rating
- **reverse floaters**, pay a higher rate of interest when rates fall, and vice-versa
- **step-up bonds**, coupon payments increase over time

# Bank loans

**Bank loans** are a private form of debt financing supplied by banks. Compared to bonds, **bank loans** are shorter-term (usually 3 years or less, compared to 10 years for typical bonds).

Bank loans are often the only source of borrowing for smaller firms, which often do not have access to public capital markets.

## Commitment:

- **revolving credit**: the company borrows for a fixed period of time (typically a year), repays the loan, and then repeats, indefinitely.
- **evergreen credit**: no fixed maturity (less common)

**Syndicated loans** are loans shared by a syndicate of banks; one or more lead banks (the **syndicate arrangers**) underwrite the loan and are generally paid an arrangement fee by the borrower.

# Bank loans: maturity

## Short-term loans:

- interest rate is generally **fixed**
- **bridge loans**: short-term loans (typically months) to provide interim financing until new financing is arranged, e.g.:
  - to finance a specific capital expenditure, such as an asset purchase
  - to finance the purchase of new inventory (**self-liquidating**)

## Longer-term loans:

- interest rate can be **fixed** or **floating**
- **term loans**: longer-maturity loans (typically 4-5 years)

# Bank loans: security and covenants

Banks concerned about the credit risk of a borrower may ask the firm to provide security:

- **specific collateral**, e.g. receivables (factoring)
- **floating lien**, a general claim if the firm defaults

Loans may contain **covenants** to restrict the company from behaving in a manner that would increase the risk of the loan:

- **incurrence covenants**, which restrict the company from taking certain actions such as issuing more debt unless conditions are satisfied.
  - limits to dividend payments
  - requirements to repay if the borrower makes a large sale or debt issuance (**sweeps**)
- **maintenance covenants**, which are **more severe** and require firms to continually maintain certain ratios or conditions, such as interest cover, over the life of the loan.

# Commercial paper and MTNs

**commercial paper (CP)**: short-term unsecured notes issued directly by borrowers (bypassing the banking system)

- typical maturity is two months or less, although can be longer
- only effective if the credit rating is sufficiently high (otherwise, bank loans are more effective)

**asset-backed commercial paper**: CP wherein the company sells its assets to a special-purpose vehicle that issues the paper

**medium-term notes (MTN)**: longer-term notes issued directly by borrowers

- typically sold through dealers but sometimes directly to investors

# Thank You



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