CORPORATE FINANCE FOR LONG-TERM VALUE

Chapter 8: Valuing bonds

Part 3: Valuation of companies

Chapter 8: Valuing bonds

The BIG Picture

Corporate bonds are a key financing tool for companies

Traditional valuation

- Bond investors are more focused on downside protection
- Government bond yield (benchmark) + spread for credit & liquidity risk = corporate bond yield

New valuation

- Integrate social and environmental factors into credit risk
- Emergence of green bonds and sustainability-linked bonds

The bond market

- Bonds are certificates of debt that promise payment of the borrowed amount plus interest by a specified future date

- Bonds are issued by:
  - A government
  - A company
  - A financial institution

Type of securities	Outstanding (in trillions of USD)	
Equity markets	**112.1**	
- Public equity	105.8	
- Private equity	6.3	
Bond markets	**123.4**	
- Government bonds	62.8	
- Corporate bonds	60.6	
- Issued by companies		17.0
- Issued by financial institutions		43.6

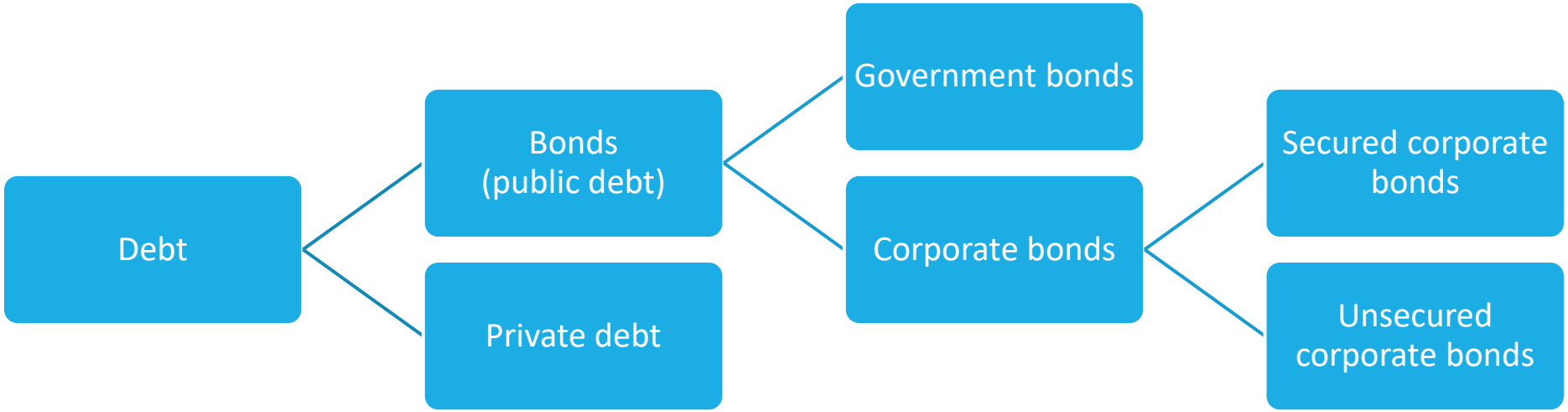
Sources: SIFMA (2021); McKinsey (2022); BIS debt securities statistics.

Bond payments

- A bond certificate indicates the amounts and dates of all payments (principal + interest) to be made
- The *maturity date* of the bond is the final repayment date, and the time until the maturity date is the *term* of the bond
- Two types of payments made on a bond:
  - Promised periodic interest payments, called *coupons*
  - *Principal / face value* of the bond, to be paid at maturity

Types of bonds

- *Government / sovereign bonds* are issued by national governments (countries)
- *Corporate bonds* are issued by companies or financial institutions
  - *Secured bonds* contain assets as collateral (i.e. mortgage bonds)
  - *Unsecured bonds* have lower seniority / priority



Bond valuation

- Bond prices result from discounting promised cash flows
- The price value of a coupon bond *P* equals the present value of its coupons plus the present value of the face value *FV* with maturity *N*

$$P = \frac{CPN}{(1 + YTM_1)} + \frac{CPN}{(1 + YTM_2)^2} + \ldots + \frac{CPN + FV}{(1 + YTM_N)^N}$$

YTM= the *yield to maturity* of a zero-coupon bond with the same maturity

CPN = the coupon payment, determined by the annual coupon rate ACR and the number of coupon payments per year Nr : $CPN = \frac{ACR * FV}{Nr}$

Bond valuation

Example

- Coupon payment (*CPN*): $30
- Annual coupon rate (*ACR*): 6%
- Number of coupon payments (*Nr*): 2

Solution

$$CPN = \frac{ACR * FV}{Nr} = \$30 = \frac{6\% * \$1{,}000}{2}$$

coupon of $30 is paid every 6 months

remember face value (*FV*) = $1,000

Bond valuation

- The coupon payments form a stream of equal cash flows paid at regular intervals, this equals an *annuity*
- The present value of a bond becomes the sum of the ‘coupon annuity’ and the face value
- The *yield to maturity (YTM)* or *yield (y)* is the discount rate that sets the present value of payments equal to its current market price
- Therefore, the price of a bond with maturity *N* is:

$$P = CPN * \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right) + \frac{FV}{(1+y)^N}$$

Bond valuation

- The relationship between bond yields and bond prices is maintained through market forces:
  - As interest rates and bond yields rise, bond prices fall
  - And vice versa: As bond yields fall, bond prices increase
  - This means bonds can trade at:
    - A premium – a price greater than face value
    - A discount – a price lower than face value
    - Par – a price equal to face value ← this is rare!

Zero-coupon bonds

- The price of a zero-coupon bond is simply the present value of the face value: $P = \frac{FV}{(1+YTM_N)^N}$
- The yield to maturity of a zero-coupon government bond is used to calculate the risk-free rate

Interest rate changes

- As interest rates change, bond prices move along with them
- The effect of interest rate changes is larger for bonds with longer terms
- The *duration* of a bond is the sensitivity of a bond's price to changes in interest rates, and the weighted average of the time-length of cash payments
- The time-length is the number of future years *n* = 1, 2, 3, .., until maturity *N*
- Duration = $1 * \frac{PV(CF_1)}{PV} + 2 * \frac{PV(CF_2)}{PV} + \cdots + N * \frac{PV(CF_N)}{PV}$
- The weight for each year is the present value $PV(CF_n)$ divided by the total present value PV

Duration

- Calculating the duration of 5% six-year bond with a *YTM* of 4%

Time	2022	2023	2024	2025	2026	2027		
Year	1	2	3	4	5	6		
Cash flow	€ 50	€ 50	€ 50	€ 50	€ 50	€ 1,050		
Discount factor	0.962	0.925	0.889	0.855	0.822	0.790		
PV(CF_n) at 4%	€ 48.1	€ 46.2	€ 44.4	€ 42.7	€ 41.1	€ 829.8	Total PV =	€ 1,057.7
Fraction of total value	**0.045**	**0.044**	**0.042**	**0.040**	**0.039**	**0.785**	**Total =**	**1.0**
Year * fraction of total value	**0.045**	**0.087**	**0.126**	**0.162**	**0.194**	**4.708**	**Total duration =**	**5.3**

- **Duration** (5.3 years) is typically close to maturity (6 years), because of large weight of face value
- Duration is good measure of **interest rate risk** of bond, where higher duration reflects higher interest rate risk

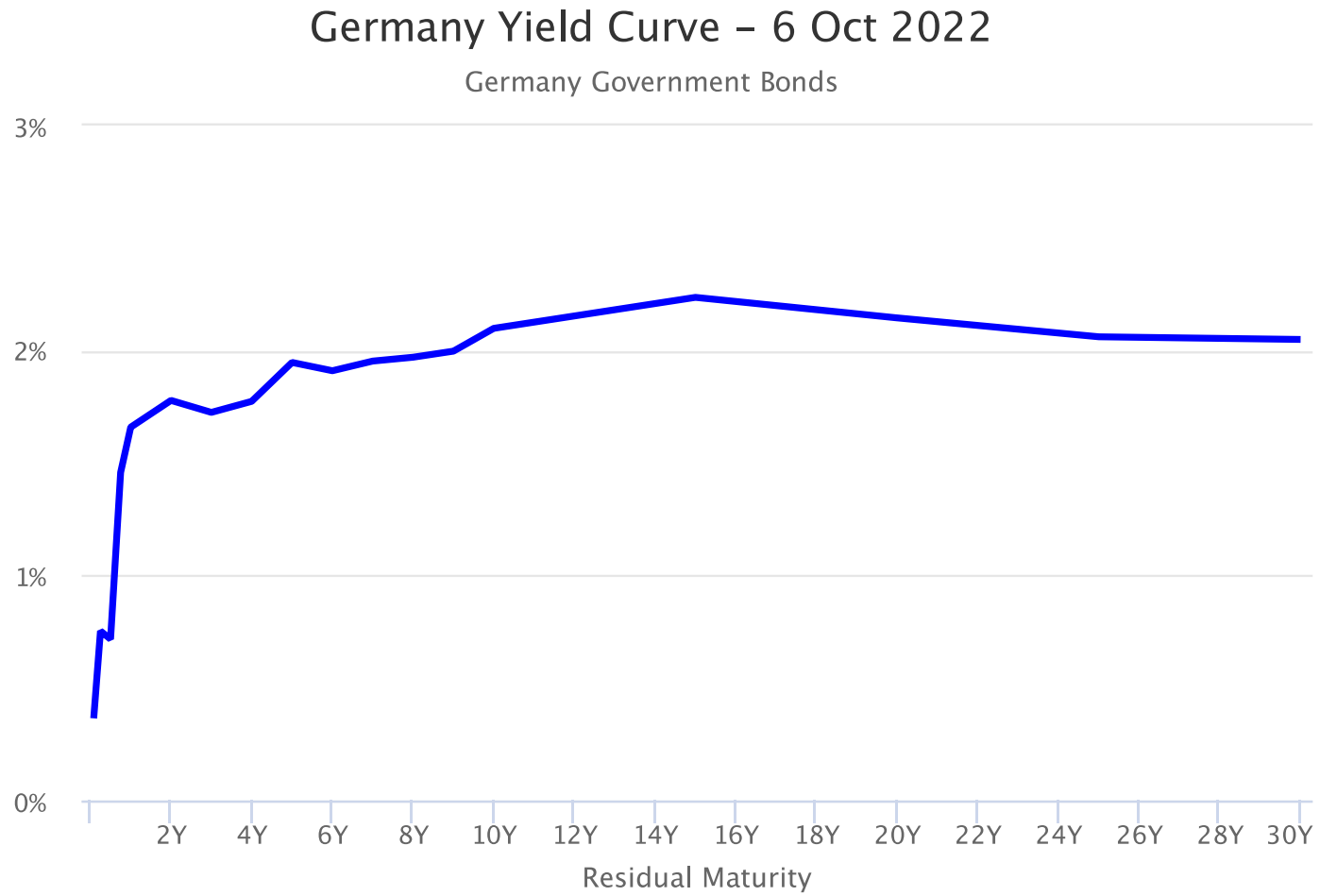
Term structure of interest rates

- The term structure of interest rates (also called yield curve) is the array of yields on bonds with different terms to maturity
- To derive a 10-year yield curve, you need the YTM_n for year 1, 2, …, 10
- The yields can be calculated using the formula for zero-coupon bonds:

$$P = \frac{FV}{(1 + YTM_n)^n}$$

- The *law of one price* can be used to calculate the yields on coupon bonds, since similar products should sell at the same price
- If they don't sell at the same price, *arbitrage* makes differences disappear

Government bond yield



Source: World Government Bonds

Government bonds are the safest and most liquid bonds

- serve as benchmark
- risk-free rate

Yields on coupon bonds with the same maturity

	Year (n)				Bond price (P)	Yield (y)
Maturity	1	2	3	4		
Zero-coupon yield	2%	3%	4%	5%		
Discount factor	0.98	0.94	0.89	0.82		
Bond A (4% coupon)						
Payment	€ 40	€ 40	€ 40	€ 1,040		
PV(CF_n)	**€ 39.22**	**€ 37.70**	**€ 35.56**	**€ 855.61**	**€ 968.09**	**4.90%**
Bond B (6% coupon)						
Payment	€ 60	€ 60	€ 60	€ 1060		
PV(CF_n)	**€ 58.82**	**€ 56.56**	**€ 53.34**	**€ 872.06**	**€ 1,040.78**	**4.85%**
Bond C (0% coupon)						
Payment	€ 0	€ 0	€ 0	€ 1,000		
PV(CF_n)	**€ 0**	**€ 0**	**€ 0**	**€ 822.70**	**€ 822.70**	**5.00%**

Bonds differ in terms of coupon rate, but have the same maturity

Yields on coupon bonds with different maturities

	Year (n)				Bond price (P)	Yield (y)
Maturity	1	2	3	4		
Zero-coupon yield	2%	3%	4%	5%		
Discount factor	0.98	0.94	0.89	0.82		
Bond D (6% coupon)						
Payment	€ 60	€ 1,060				
PV(CF_n)	**€ 58.82**	**€ 999.15**			**€ 1,057.98**	**2.97%**
Bond E (6% coupon)						
Payment	€ 60	€ 60	€ 1060			
PV(CF_n)	**€ 58.82**	**€ 56.56**	**€ 942.34**		**€ 1,057.72**	**3.92%**
Bond F (6% coupon)						
Payment	€ 60	€ 60	€ 60	€ 1060		
PV(CF_n)	**€ 58.82**	**€ 56.56**	**€ 53.34**	**€ 872.06**	**€ 1,040.78**	**4.85%**

Bonds have the same coupon rate, but differ in terms of maturity

Term structure

- Since bonds with higher duration carry more interest rate risk, the yield curve is typically upward sloping
- This leads to a positive *term spread*, which is the spread of yields for bonds with longer maturity over bonds with shorter maturity
- This has several explanations:
  - The belief that short-term rates will be higher in the future
  - Higher exposure of longer-term bonds to changes in interest rates
  - Risk of higher inflation in the future

Inflation

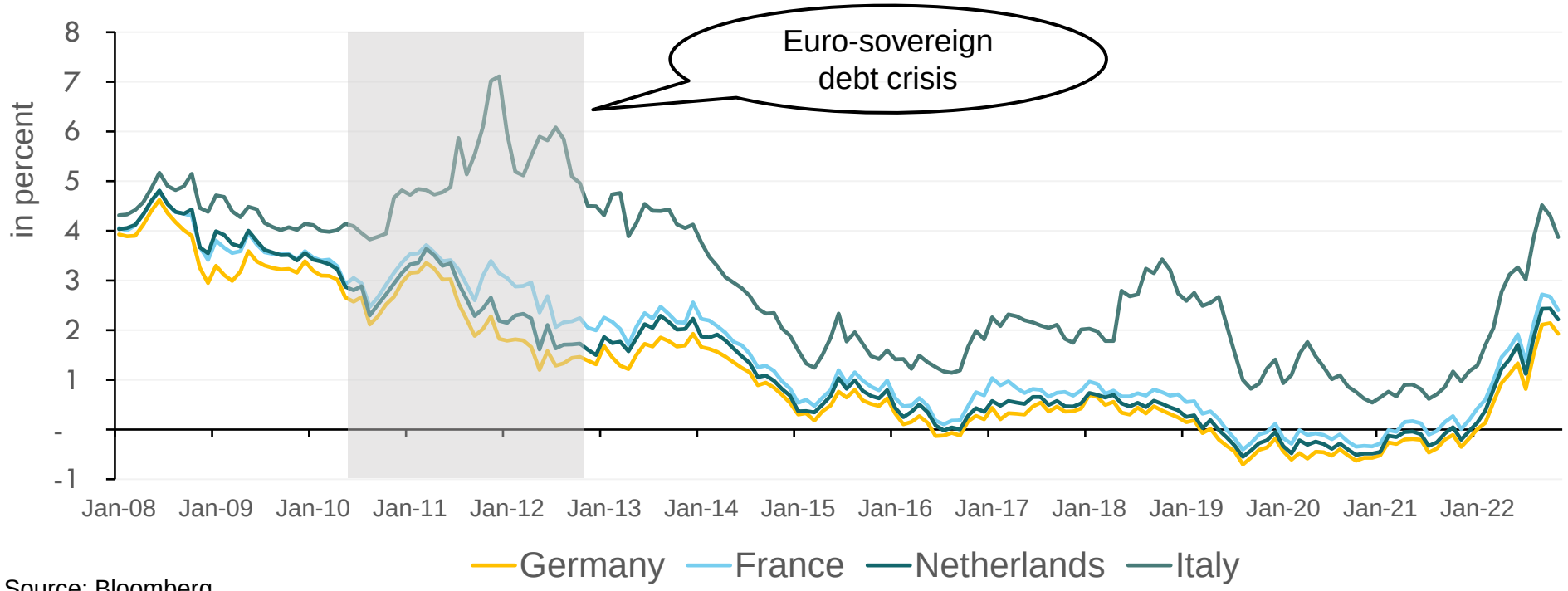
- Inflation, $i_{i,t} = \frac{(CPI_{i,t} - CPI_{i,t-1})}{CPI_{i,t-1}}$, is the realised consumer price index (CPI) inflation rate given country i in year t
- The real rate of return r_r is calculated as $r_r = \frac{1+r}{1+i} - 1$
- We can use the approximation for real interest rates in the form of nominal return minus inflation $r_r \approx r - i$ in low inflation countries
- For high inflation countries, use the full formula, since larger numbers result in larger deviations

Drivers of yields on government bonds

- Cantor and Packer (1996) find that sovereign borrowing costs can be explained by:
  - Per capita income
  - GDP growth
  - Inflation
  - External debt
  - Level of economic development
  - Default history
- Government bonds are typically bought by institutional investors seeking a relatively safe investment
- *Financial contagion* is the spread of market disturbances from one market or country to other markets or countries
  - Example: European Sovereign Debt Crisis, originating from Greece in 2009

Government bond yields as risk-free rates

- The German bond yield is most creditworthy and can be used as the Euro's risk-free rate

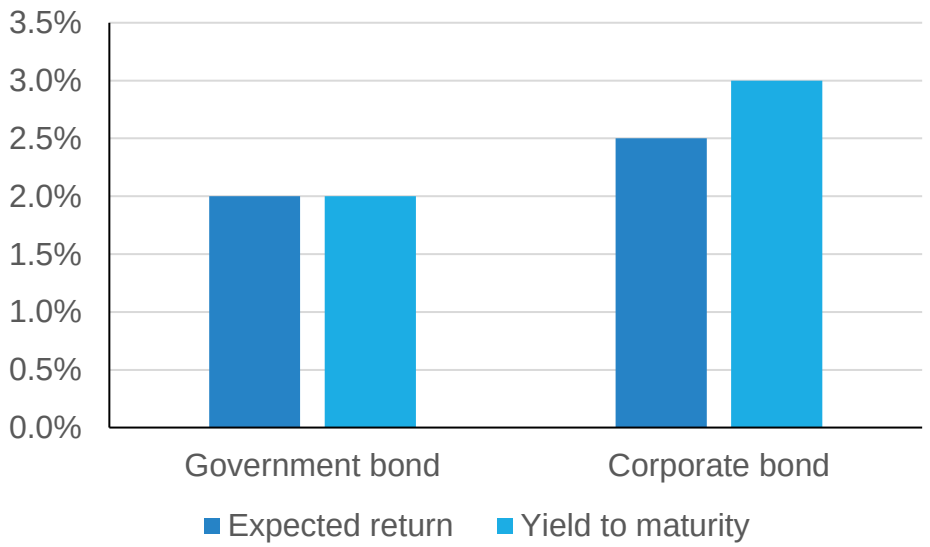


Source: Bloomberg

- U.S. government bonds (also called Treasuries) serve as the risk-free rate for the US dollar

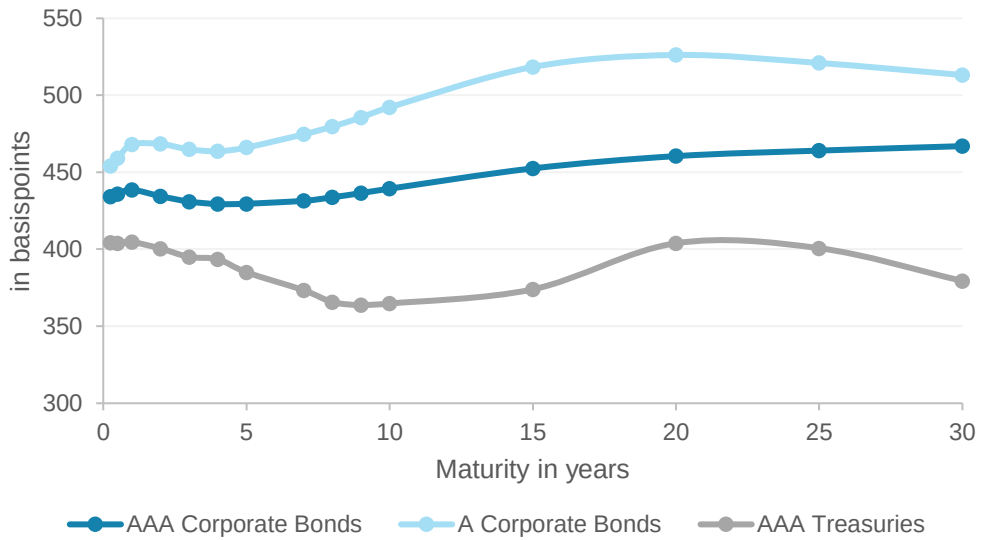
Drivers of yields on corporate bonds

- Compared to government bonds, corporate bonds tend to carry more serious default and liquidity risks
  - Due to lower trading frequencies, higher transaction costs and smaller sizes
- Due to the *risk of default,* the bond's expected return (equal to the firm's cost of capital) is less than the yield to maturity *YTM*



Drivers of yields on corporate bonds

- The *yield spread* is the difference between yields of corporate bonds and yields of government bonds
- The higher the default risk, the larger the spread



Maturity	1 year	5 year	10 year	20 year
AAA corporate bonds	4.39%	4.30%	4.39%	4.61%
A corporate bonds	4.68%	4.66%	4.92%	5.26%
AAA Treasuries	4.07%	3.85%	3.65%	4.04%
AAA corporate yield spread	**0.31%**	**0.45%**	**0.75%**	**0.57%**
A corporate yield spread	**0.61%**	**0.81%**	**1.28%**	**1.22%**

Source: Bloomberg, as per November 2022

Credit risk

- *Credit risk* refers to the risk of default of the entity issuing a bond
- The expected return on a bond is different from the promised return, as some issuers default on their bond
- The expected return on debt r_D is

$$E[y] = (1 - PD) \cdot y + PD \cdot (y - LGD) = y - PD \cdot LGD = r_D$$

PD = the probability of default

LGD = loss given default (the fraction of the principal and interest lost in case of default)

Credit risk - example

- The expected return on debt r_D is

$$E[y] = (1 - PD) \cdot y + PD \cdot (y - LGD) = y - PD \cdot LGD = r_D$$

- Example: assume a promised yield *y* of 6%, a probability of default *PD* of 4% and a loss given default *LGD* of 60%
- What is the expected return on debt r_D?
- Answer: $r_D = y - PD \cdot LGD$ = 6% – 4% ∗ 0.60 = 3.6%

Credit risk

- The expected credit losses ECL are calculated by:

$$ECL = EAD \cdot PD \cdot LGD$$

EAD = exposure at default

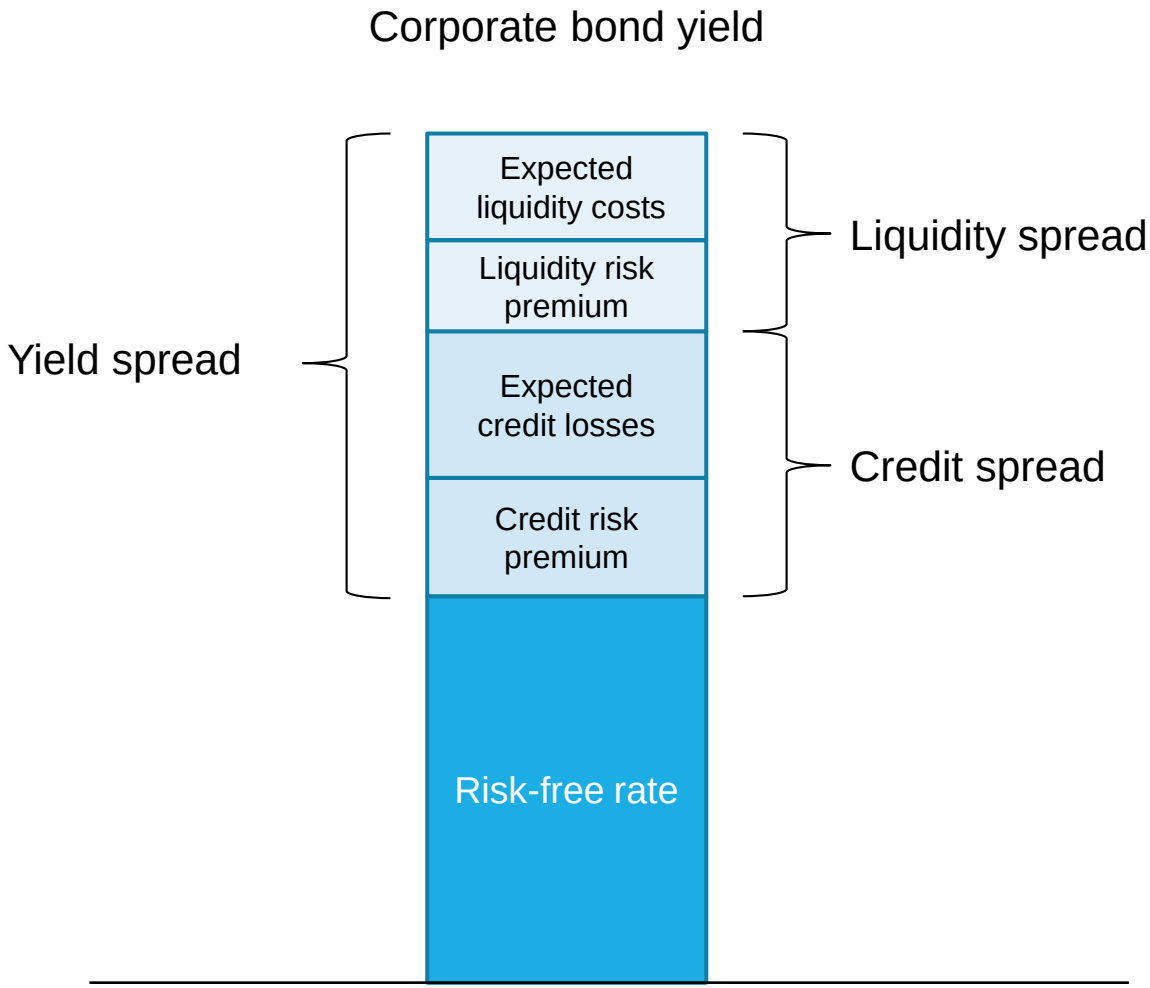
- The credit risk premium CRP is the investor's reward for risk taking, and is the difference between the expected return on a bond $E[y]$ and the risk-free rate r_f:

$$CRP = E[y] - r_f$$

Yield, credit and liquidity spreads

Yield spread is difference between promised yield and risk-free (government) yield

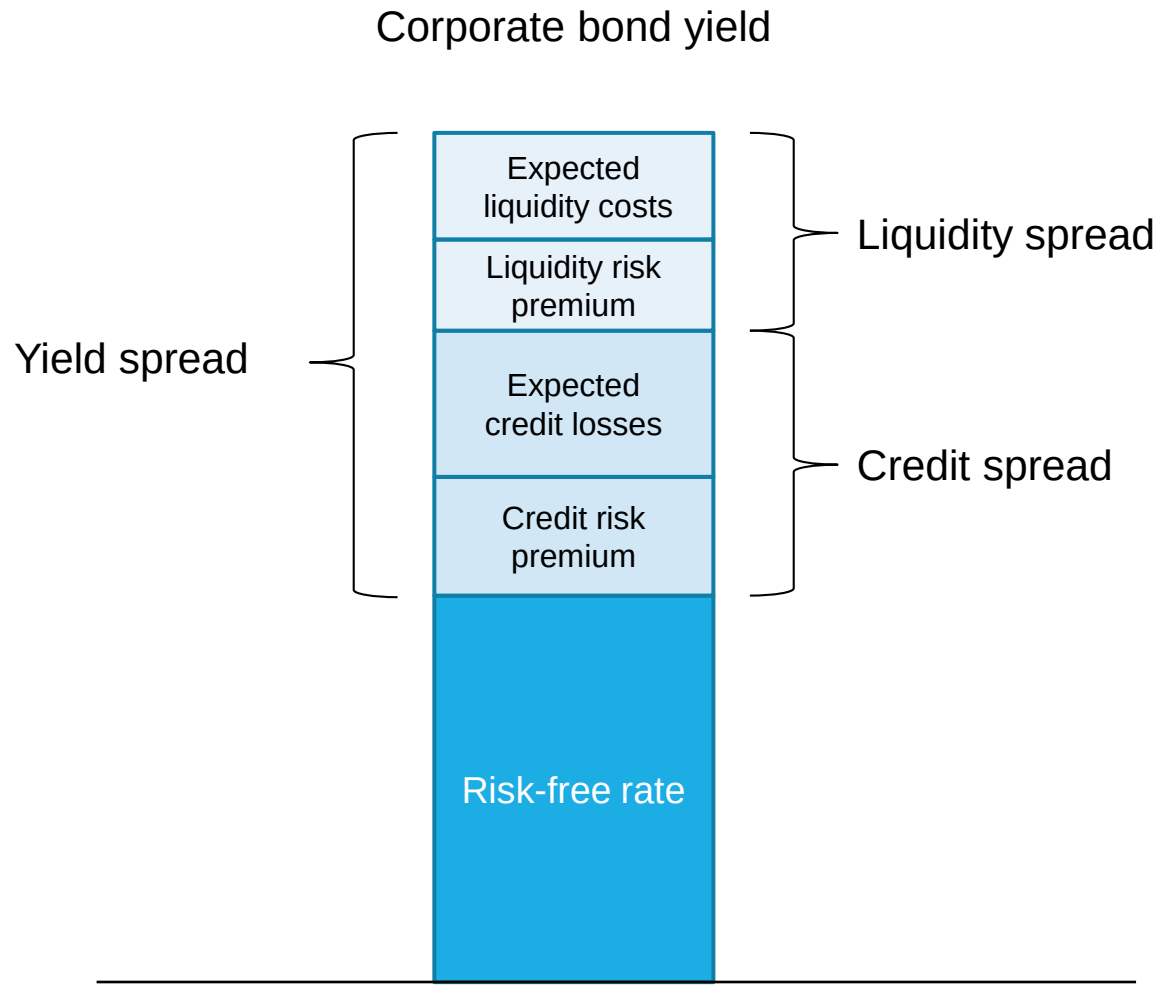
- The *liquidity spread* covers:
  - The expected liquidity costs
  - The liquidity risk premium
- The *credit spread* covers:
  - The expected credit losses ECL
  - The credit risk premium CRP



Be very precise on credit definitions

To recap on credit (ignoring liquidity spread)

- The *credit spread* covers:
  - Expected credit losses reflects promised yield minus expected yield: $ECL = y - E[y]$
  - Credit risk premium is reward for risk-taking: $CRP = E[y] - r_f$
- Check: credit spread is $ECL + CRP$ -> $y - E[y] + E[y] - r_f$ -> $y - r_f$ promised yield – risk free rate



Example

Example

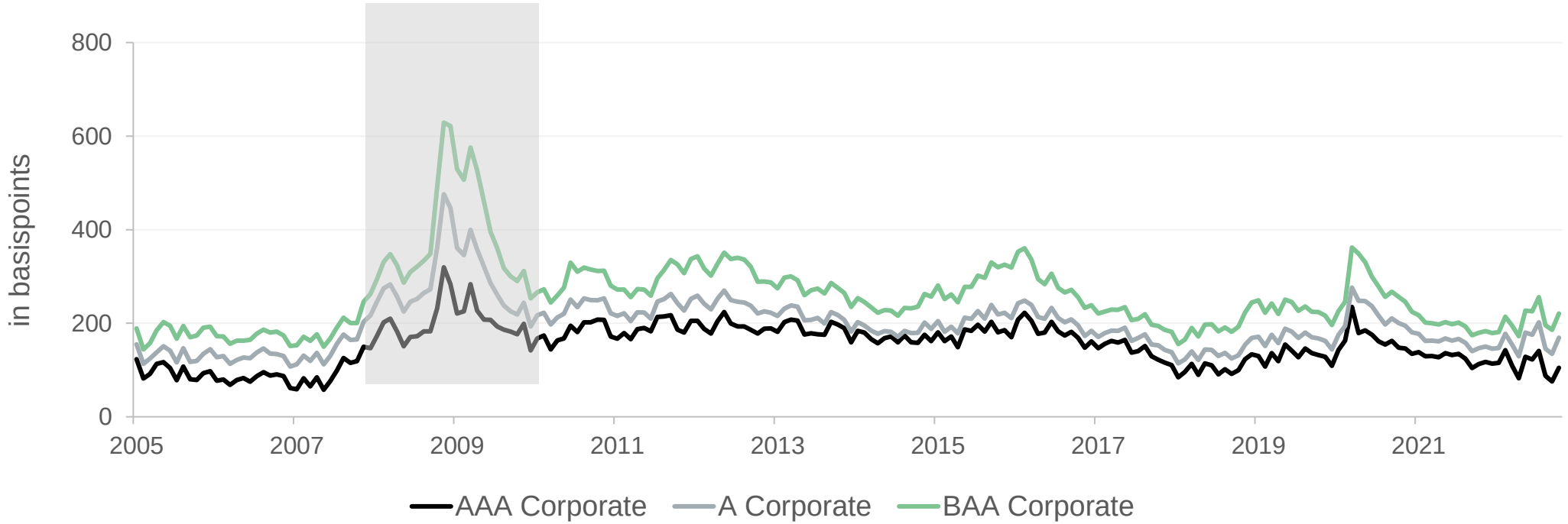
- One-year corporate bond with yield 7.5%, risk of default 4%, loss given default 60%
- Calculate expected credit losses and credit risk premium, given government bond yields 3%

Solution:

1. Expected yield: $E[y] = r_D = 7.5\% - 4\% * 0.60 = 5.1\%$
2. Expected credit losses: $ECL = y - E[y] = 7.5\% - 5.1\% = 2.4\%$
3. Credit risk premium : $CRP = E[y] - r_f = 5.1\% - 3\% = 2.1\%$
4. Check: credit spread is difference between corporate yield (7.5%) and government yield (3%) -> $ECL + CRP$ -> $2.4\% + 2.1\% = 4.5\%$

Corporate bonds during times of crises

- During crises, credit spreads can jump due to higher (perceived) risk of default and/or investor's 'flight to safety'
- During the 2009 global financial crisis, spreads increased considerably:



Source: Bloomberg

Credit ratings

Rating agency	Moody's	Standard & Poor's and Fitch	Long-term average default rate
Type of bonds	**Investment grade bonds**		
	Aaa	AAA	0.00%
	Aa	AA	0.02%
	A	A	0.05%
	Baa	BBB	0.16%
Type of bonds	**Junk or high yield bonds**		
	Ba	BB	0.61%
	B	B	3.33%
	Caa	CCC	27.08%
	Ca	CC	
	C	C	

Agency costs

- Owning the equity of a company is like having the right to buy the company (an option) paying the face value of debt to the bondholders
- The more debt there is, the riskier that right becomes (Merton, 1974)
- A benefit for bondholders is that they get paid back first in case of default
- Equity holders benefit from volatility (risk), while bondholders suffer from volatility or uncertainty
- Myers' (1977) 'debt overhang' problem: if management is aligned with equity holders, it will only attract new capital for projects with high enough returns to leave a residual return for shareholders as well

Liquidity risk

- Bonds also face liquidity risk, which is the risk that bonds cannot be sold swiftly
- *Liquidity* is the ease with which an investor can sell or buy a bond
- The *liquidity spread* is the spread between the yield of a bond with high liquidity and a similar bond with less liquidity
- The higher liquidity risk of corporate bonds stems from lower trading frequencies and higher transaction costs

Integrating sustainability into bond valuation

- Sustainability issues include value relevant issues (inefficiencies) that are not yet properly priced
- Compared to equity, the focus in fixed income valuation is much more on risk than on opportunities
- Environmental and social exposures can have effects on performance by generating risks that may materialise in future scenarios
  - Volkswagen credit default swap (CDS) spread went from 75.5 basis points (bp) to 299.5 after Dieselgate scandal in 2015
  - Russian CDS spread went from 200-300bp to 600bp after seizing Crimea from Ukraine in 2014, while Ukrainian CDS spread rose to over 5,000bp

From sustainability to credit risk

- Climate change
- Biodiversity
- Energy management
- Pollution
- Human rights
- Health & safety
- Gender gap
- Etc.

- Cash reserves
- Profitability
- Productivity
- Competitive advantage
- Cost of capital
- Leverage
- Intangibles
- Etc.

- Credit ratings
- CDS spreads
- Bond yields and prices
- Volatility
- Default probability
- Breach of covenants
- Etc.

Integrating sustainability into bond valuation

- Credit risk assessment models estimate the probability of default PD and the loss given default LGD on the basis of historical data at industry and company level
- Integrating sustainability is challenging due to its forward-looking nature
- Factors to include in credit risk analysis:
  - The **prospect of internalisation** of social and environmental factors – companies that internalise factors can reduce credit risk
  - The **company's capability to adapt** to a sustainable world – adaptable companies have a reduced probability of default and loss given default

Altman Z-score

- The Altman Z-score is a simple method to incorporate sustainability into credit risk assessment (Altman, 2018)
- Based on four factors:

1. Working capital: $x_1 = \frac{\text{current assets} - \text{current liabilities}}{\text{total assets}}$
2. Retained earnings: $x_2 = \frac{\text{retained earnings}}{\text{total assets}}$
3. EBIT: $x_3 = \frac{\text{earnings before interest and taxes}}{\text{total assets}}$
4. Equity: $x_4 = \frac{\text{book value of equity}}{\text{total liabilities}}$

Estimate the impact of sustainability on these four factors

Altman Z-score

- Z-score formula:

$$Z = 3.25 + 6.56 \cdot x_1 + 3.26 \cdot x_2 + 6.72 \cdot x_3 + 1.05 \cdot x_4$$

- The zones of discrimination:
  - **Safe zone:** $Z > 5.85$ **–** company does not go bankrupt
  - **Grey zone:** $4.35 < Z < 5.85$ **–** company is at risk of bankruptcy
  - **Distress zone:** $Z < 4.35$ **–** company are (or will be) bankrupt

Evonik’s Z-score

Problem

In 2020, Evonik, a German specialty chemicals company with a large focus on sustainability, had the following current and projected future profile:

Factor	2020	2021	2022
Working capital	0.10	0.11	0.11
Retained earnings	0.33	0.40	0.43
EBIT	0.04	0.07	0.07
Equity	0.39	0.39	0.39

What is the impact of Evonik’s sustainability strategy on its default risk?

Evonik's Z-score

Solution

$$Z - score = 3.25 + 6.56 \cdot x_1 + 3.26 \cdot x_2 + 6.72 \cdot x_3 + 1.05 \cdot x_4$$

Factor	Weight	2020	2021	2022
Constant	1.00	3.25	3.25	3.25
Working capital	6.56	0.10	0.11	0.11
Retained earnings	3.26	0.33	0.40	0.43
EBIT	6.72	0.04	0.07	0.07
Equity	1.05	0.39	0.39	0.39
Z-score		**5.66**	**6.16**	**6.25**

Safe zone: $Z > 5.85$

Grey zone: $4.35 < Z < 5.85$

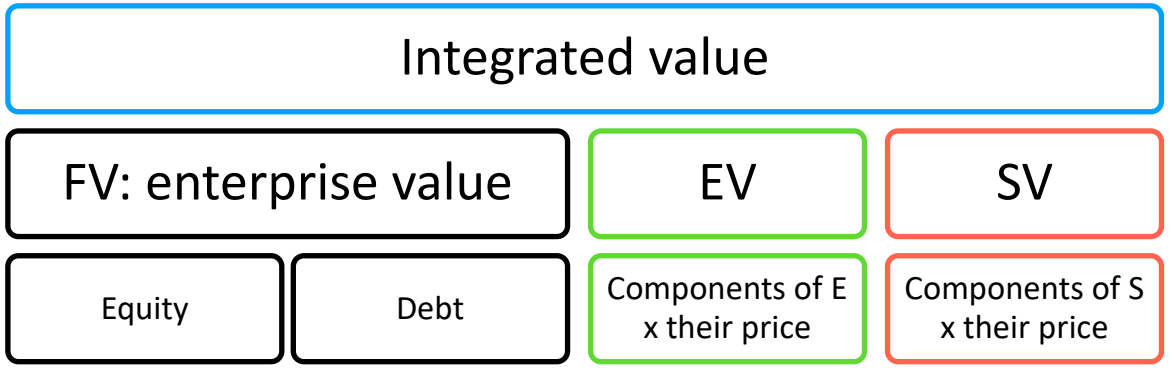
Distress zone: $Z < 4.35$

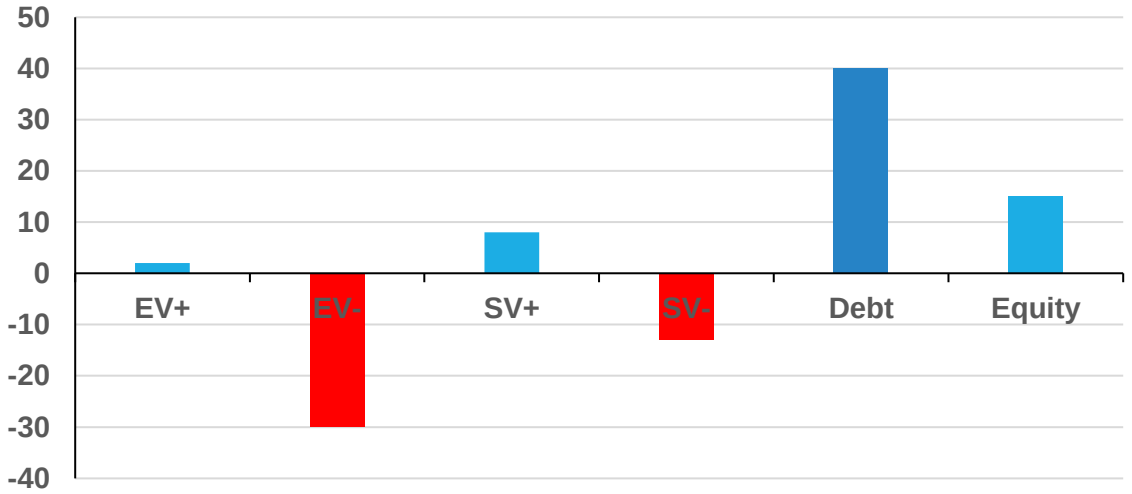
Evonik's Z-score of 5.66 in 2020 indicates the company is in the grey zone

The improvement in 2021 and 2022 means Evonik moves to the safe zone

Integrated value calculation

- Graph shows IV and its components: FV, EV, SV
- High debt and negative values of S and E raise risk of both debt and equity
- S and E factors can be internalised and spill over into financial value





Case-studies integrated value calculation

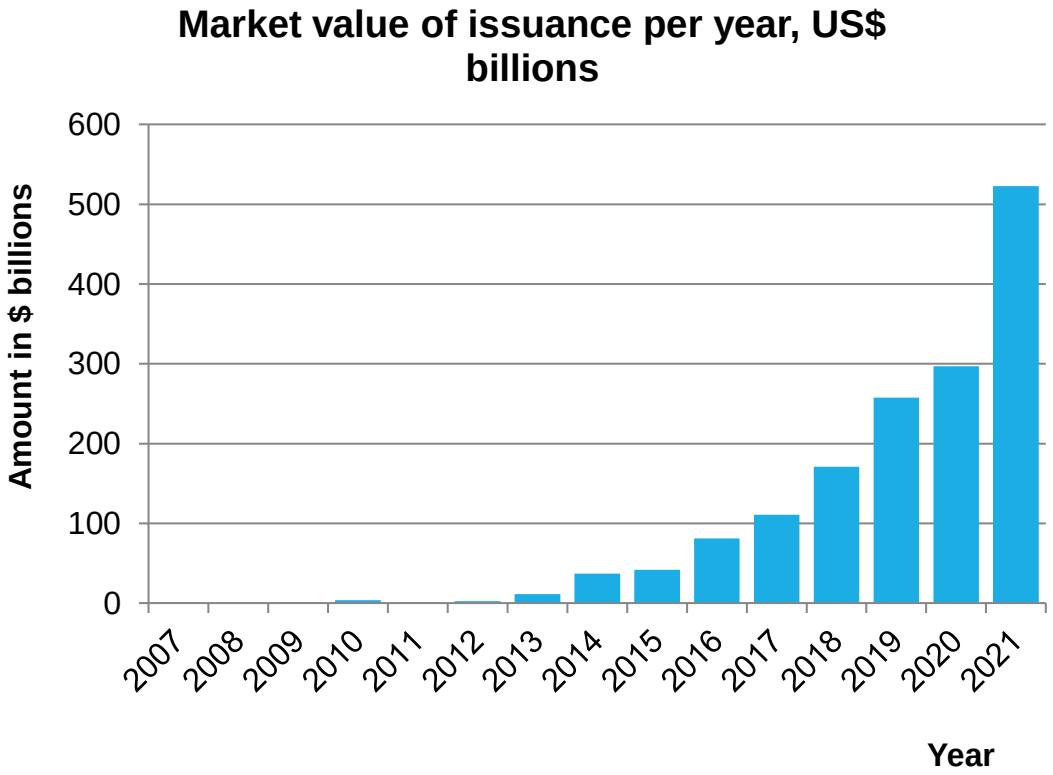
Case-studies integrated value

- Ch6-7 – project valuation
- Ch11 – company valuation Inditex
  - Make DCF for enterprise value FV
  - Make DCF for SV + EV
  - Integrate numbers
- Ch18 – attempted take-over of Unilever by Kraft Heinz

Inditex IV calculation	Value (Euro billions)
FV (enterprise value)	79
Positive SV	283
Negative SV	-137
Negative EV	-183
IV (integrated value)	42

Green bonds

- The purpose of green bonds is to finance environmentally friendly (green) projects
- The green bond market has grown exponentially, reaching a global annual issuance of $520 billion in 2021
- Issuers include:
  - Supranationals (i.e., World Bank, IMF, EIB)
  - Agencies
  - Governments
  - Municipalities
  - Corporates
  - Financial institutions



Green bonds

- Criteria for green bonds, as set out by ICMA (2021):

1. **Use of proceeds:** proceeds are exclusively for green projects, which should be appropriately described in the legal documentation accompanying the security
2. **Process of project evaluation and selection:** the issuer should clearly communicate to investors:
   - What the environmental objectives are
   - The process by which the issuer determines how the project fits within eligible green project categories
   - The related eligibility criteria
3. **Management of proceeds:** the net proceeds of the green bond should be credited to a sub-account, and subsequently tracked and verified
4. **Reporting:** mandatory reporting on the use of the proceeds

EU Taxonomy for sustainable activities

- The EU Green Bond Standard specifies that green products should contribute to at least one of six environmental objectives:
  1. Climate change mitigation
  2. Climate change adaptation
  3. Sustainable use and protection of water and marine resources
  4. Transition to a circular economy
  5. Pollution prevention and control
  6. Protection and restoration of biodiversity and ecosystems
- A green project should not undermine any of the objectives
- The EU Green Bond Standard also requires verification of the allocation of the proceeds to green projects by an external party

Green bonds

- Sustainable investors are prepared to pay a *green bond premium*, resulting in a lower yield – known as the ‘clientele effect’
- Green bond premium is the difference in yield between green bonds and perfectly matched reference bonds
- Green bond premium typically ranges from 0 to 20bp and averages around 5bp
- Benefits for issuers is partly offset by higher issuing and reporting costs, also estimated around 5bp per year
  - Green bonds is more about signaling greenness, than saving on borrowing costs

Social bonds

- Social bonds need to provide clear social benefits
- They are a *payment by results contract* where an organization (with a social purpose) agrees to deliver outcome on a social project
- If the objectives are not reached, investors do not receive a return nor repayment of the principal
- Social project categories include, but are not limited to:
  - Affordable basic infrastructure
  - Access to essential services
  - Affordable housing
  - Employment generation
  - Food security
  - Socioeconomic advancement
  - Empowerment

Sustainability-linked bonds

- Sustainability-linked bonds can be used for the issuer's general purposes
- They incorporate forward-looking sustainability key performance indicators (KPIs) and sustainable performance targets -> expected to be way forward
- Improvement in KPIs leads to lower interest rate payments (i.e. a lower yield)

Label	Format
Green bonds	Use of proceeds
Social bonds	Use of proceeds
Sustainability bonds	Use of proceeds
Sustainability-linked bonds	Entity KPI-linked

A combination of green and social projects

Conclusions

- The pricing of bonds is relevant for corporate finance for two reasons:
  - The yield on government bonds serves as the risk-free rate
  - Companies issue bonds to finance their operations
- Bond markets are bigger than stock markets, with institutional investors typically holding more bonds than equity
- Companies that can better adapt their business model face a lower credit risk
- There is innovation in the form of green bonds and social bonds to cater for sustainable investment projects of governments and companies