

# Financial Instruments

## Lecture 2. Bonds and Money-Market Instruments

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### General information

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### Overview

# Disclaimer

- **About this course:**

If you see any errors in these notes, or if there is anything unclear, please feel free to send me an email to: Fanny.Vidal@credit-agricole-sa.fr

## Disclaimer

Those notes represent the views and opinions of the author, and do not represent those of Crédit Agricole.

# Overview

**Objective** The objective of this course is to have a first understanding of the financial markets and the traditional financial instruments within.

**Keywords** Financial Markets, Financial Instruments, Pricing, No Arbitrage Opportunity

**Hours** Lectures with practical exercises: around 20h

**Evaluation** There will be a final two-hour exam without authorized documentation and calculator.

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### Objectives

# Objectives of this course I

## Learning outcomes

At the end of this course, you should:

- have a global understanding of financial markets and financial instruments
- use the non-arbitrage theory to price financial instruments
- price vanilla options with or without a binomial tree and sensitivity calculation
- have an introduction to the Black-Scholes modelling
- use call-put parity, distinction between time value and intrinsic value and the application to American options
- be able to price bonds: duration, forward rates
- be able to price vanilla swaps
- understand the bootstrapping of the yield curve

## Objectives of this course II

### Disclaimer

This course is not a course of:

- derivatives modelling with stochastic calculus and Monte-Carlo simulation, since you will have an introduction to these courses in the 2nd semester of 2nd year, and a deep dive in 3rd year
- risk management, since you will have a dedicated course in 3rd year

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### Agenda

# Agenda

- ① **Lecture 1:** Introduction to Financial Instruments and Financial Markets
- ② **Lecture 2: Bonds and Money-Market Instruments**
- ③ **Lecture 3:** Futures and Forwards, and Swaps
- ④ **Lecture 4:** Vanilla options and Valuation with (a) Binomial Trees and (b) Black-Scholes Model
- ⑤ **Lecture 5:** Exotic options and trading strategies involving options
- ⑥ **Lecture 6:** Credit Derivatives and Securitization, and a brief overview of Energy Derivatives
- ⑦ **Lecture 7:** Review of this course

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### Bibliography

# References

- ① **Lecture 1:** Introduction to Financial Instruments and Financial Markets [6, 1, 12, 9, 16, 3, 7, 15, 11]
- ② **Lecture 2: Bonds and Money-Market Instruments** [6, 1, 16, 10, 2, 11]
- ③ **Lecture 3:** Futures and Forwards, and Swaps [6, 1, 16, 10, 2]
- ④ **Lecture 4:** Vanilla options and Valuation with (a) Binomial Trees and (b) Black-Scholes Model [6, 1, 16, 8, 13, 14, 4, 5]
- ⑤ **Lecture 5:** Exotic options and trading strategies involving options
- ⑥ **Lecture 6:** Credit Derivatives and Securitization, and a brief overview of Energy Derivatives [6, 1, 16, 14]

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John Wiley and Sons, 2007.

## Contents

# Interest Rates

# Types of Rates

Short-term rates:

- Overnight rate
- Repo rate
- IBOR-type rate, such as LIBOR, EURIBOR

Long-term rates:

- Treasury rate
- government bond yield

# Rates

## Key Interest Rates

Data are annualized on a 360-day basis. Treasury yields are per annum, on actively traded noninflation and inflation-indexed issues that are adjusted to constant maturities. Data are from weekly Federal Reserve release H.15.

	Week Ended — 52-Week —					Week Ended — 52-Week —			
	Aug 19	Aug 12	High	Low		Aug 19	Aug 12	High	Low
<b>Federal funds (effective)</b>									
2-month	2.33	2.33	2.33	0.08	6-month	3.14	3.13	3.14	0.05
1-year					1-year	3.25	3.28	3.28	0.07
2-year					2-year	3.24	3.24	3.27	0.20
3-year					3-year	3.22	3.16	3.44	0.41
5-year					5-year	3.01	2.95	3.45	0.78
7-year					7-year	2.96	2.89	3.44	1.05
10-year					10-year	2.87	2.81	3.36	1.26
20-year					20-year	3.36	3.29	3.64	1.81
<b>Commercial paper</b>									
<b>Nonfinancial</b>									
1-month	2.31	2.33	2.33	0.05	1-month	2.15	2.15	2.15	0.02
2-month	2.39	2.35	2.39	0.05	3-month	2.62	2.55	2.62	0.03
3-month	n.a.	n.a.	n.a.	n.a.	6-month	3.02	3.01	3.02	0.05
<b>Financial</b>									
1-month	2.36	2.36	2.36	0.06	1-year	0.35	0.30	0.52	-1.88
2-month	2.53	2.58	2.58	0.08	7-year	0.36	0.32	0.62	-1.47
3-month	2.75	2.76	2.76	0.09	10-year	0.39	0.35	0.71	-1.14
<b>Discount window primary credit</b>									
	2.50	2.50	2.50	0.25	20-year	0.67	0.62	0.84	-0.72
<b>Treasury yields at constant maturities</b>									
1-month	2.24	2.23	2.24	0.03	Long-term avg	1.01	0.95	1.13	-0.60
3-month	2.71	2.64	2.71	0.03					

Notes on data:

**Federal-funds rate** is an average for the seven days ended Wednesday, weighted according to rates on broker trades; **Commercial paper rates** are discounted offer rates interpolated from sales by discounted averages of dealer bid rates on nationally traded certificates of deposit; **Discount window primary credit rate** is charged for discounts made and advances extended under the Federal Reserve's primary credit discount window program; **rate** is average for seven days ended Wednesday; **Inflation-indexed long-term TIPS** average is indexed and is based on the unweighted average bid yields for all TIPS with remaining terms to maturity of 10 years or more;

Sources: Federal Reserve; for additional information on these rate data and their derivation, please see <https://www.federalreserve.gov/datadownload/Build.aspx?rel=H15>

Figure 1: Interest Rates. Source: Wall Street Journal

# Rates

## Consumer Rates and Returns to Investor

### U.S. consumer rates

A consumer rate against its benchmark over the past year



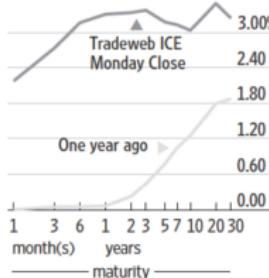
### Selected rates

30-year mortgage, Rate

Bankrate.com avg:	5.81%
Financial Resources Federal Credit Union	3.25%
Bridgewater, NJ	800-933-3280
<b>Savings Bank of Danbury</b>	<b>3.25%</b>
Danbury, CT	844-723-2265
<b>First Montana Bank, Inc.</b>	<b>3.38%</b>
Libby, MT	406-293-0280
<b>United Teletech Financial</b>	<b>3.75%</b>
Tinton Falls, NJ	732-530-8100
<b>First Citizens Bank</b>	<b>4.00%</b>
Raleigh, NC	800-367-0995

## Treasury yield curve

Yield to maturity of current bills, notes and bonds



## Forex Race

Yen, euro vs. dollar; dollar vs. major U.S. trading partners



Interest rate	Yield/Rate (%)	Last (●)	Week ago	52-Week Range (%)	3-yr chg (pct pts)
<b>Federal-funds rate target</b>	2.25-2.50	2.25-2.50	0.00	0.00 - 2.50	0.25
<b>Prime rate*</b>	5.50	5.50	3.25	3.25 - 5.50	0.25
<b>Libor, 3-month</b>	2.98	2.94	0.11	0.11 - 2.98	0.85
<b>Money market, annual yield</b>	0.16	0.14	0.07	0.07 - 0.16	-0.48
<b>Five-year CD, annual yield</b>	1.88	1.83	0.41	0.41 - 1.88	0.10
<b>30-year mortgage, fixed*</b>	5.81	5.55	3.03	3.03 - 6.11	2.06
<b>15-year mortgage, fixed*</b>	4.98	4.97	2.32	2.32 - 5.39	1.74
<b>Jumbo mortgages, \$647,200-plus*</b>	5.86	5.56	3.06	3.06 - 6.11	1.59
<b>Five-year adj mortgage (ARM)*</b>	4.35	4.24	2.82	2.82 - 4.35	0.26
<b>New-car loan, 48-month</b>	5.07	5.07	3.41	3.41 - 5.09	0.41

Bankrate.com rates based on survey of over 4,800 online banks. \*Base rate posted by 70% of the nation's largest banks. ↑ Excludes closing costs.

Sources: FactSet; Dow Jones Market Data; Bankrate.com

## Corporate Borrowing Rates and Yields

Bond total return index	Yield (%)	52-Week	Total Return (%)			
	Close	Last	High	Low	52-wk	3-yr
<b>U.S. Treasury</b> , Bloomberg	2162.910	3.290	3.100	3.550	0.850	-10.463
<b>U.S. Treasury Long</b> , Bloomberg	3480.010	3.430	3.270	3.630	1.720	-22.830
<b>Aggregate</b> , Bloomberg	2018.020	3.790	3.580	4.140	1.400	-10.871
<b>Fixed-Rate MBS</b> , Bloomberg	2018.470	3.700	3.500	4.240	1.670	-8.770
<b>High Yield 100</b> , ICE BofA	3145.894	7.438	6.786	8.427	3.210	-8.388
<b>Muni Master</b> , ICE BofA	559.519	2.866	2.554	3.191	0.754	-7.158
<b>EMBI Global</b> , J.P. Morgan	765.525	7.472	7.110	8.085	4.516	-17.877

Sources: J.P. Morgan; Bloomberg Fixed Income Indices; ICE Data Services

Figure 2: Short-Term Rates. Source: Wall Street Journal

# Money Rates

## Borrowing Benchmarks | [wsj.com/market-data/bonds/benchmarks](http://wsj.com/market-data/bonds/benchmarks)

### Money Rates

August 22, 2022

Key annual interest rates paid to borrow or lend money in U.S. and international markets. Rates below are a guide to general levels but don't always represent actual transactions.

Inflation		
July index level	Chg From (%) June '22	July '21
<b>U.S. consumer price index</b>		
All items	<b>296.276</b>	-0.01
Core	<b>295.646</b>	0.33
5.9		

International rates			
Latest	Week ago	—52-Week—	
		High	Low
<b>Prime rates</b>			
<b>U.S.</b>	<b>5.50</b>	5.50	5.50
Canada	<b>4.70</b>	4.70	4.70
Japan	<b>1.475</b>	1.475	1.475
3.25			
2.45			
2.45			
2.32			
2.32			
2.33			
2.36			
2.37			

Policy Rates				
	Latest	Week ago	—52-WEEK—	
			High	Low
Euro zone	<b>0.50</b>	0.50	0.50	0.00
Switzerland	<b>0.25</b>	0.25	0.25	0.00
Britain	<b>1.75</b>	1.75	1.75	0.10
Australia	<b>1.85</b>	1.85	1.85	0.10

Treasury bill auction				
	Latest	Week ago	—52-WEEK—	
			High	Low
4 weeks			<b>2.150</b>	2.150
13 weeks			<b>2.740</b>	2.610
26 weeks			<b>3.110</b>	3.020
			2.150	0.020
			2.740	0.035
			3.110	0.045

U.S. government rates				
	Latest	Week ago	—52-Week—	
			High	Low
Discount			<b>2.50</b>	2.50
			2.50	0.25

Secondary market				
	Latest	Week ago	—52-Week—	
			High	Low
<b>Fannie Mae</b>				
30-year mortgage yields				
30 days			<b>5.060</b>	4.641
60 days			<b>5.104</b>	4.683
			5.434	2.337
			5.526	2.371

Figure 3: Money Rates. Source: Wall Street Journal

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### Short-Term Rates

# Short-Term Rates

Other short-term rates				
	Latest	Week ago	—52-Week—	
			high	low
<b>Call money</b>		4.25	4.25	4.25 2.00
<b>Commercial paper (AA financial)</b>				
90 days		2.82	2.71	2.88 0.08
<b>Libor</b>				
One month	<b>2.42743</b>	2.37971	2.42743	0.07525
Three month	<b>2.87971</b>	2.94186	2.88400	0.11413
Sixmonth	<b>3.54657</b>	3.53309	3.56888	0.14663
One year	<b>4.03214</b>	3.99457	4.03214	0.21950
<b>Secured Overnight Financing Rate</b>		2.28	2.28	2.30 0.03
	Latest	Value Traded	—52-Week—	
		High	Low	
<b>DTCC GCF Repo Index</b>				
Treasury	<b>2.267</b>	17.650	2.315	0.015
MBS	<b>2.324</b>	35.500	2.342	0.018
<b>Notes on data:</b>				
U.S. prime rate is the base rate on corporate loans posted by at least 70% of the 10 largest U.S. banks, and is effective July 28, 2022. Other prime rates aren't directly comparable; lending practices vary widely by location. Discount rate is effective July 28, 2022. Secured Overnight Financing Rate is as of August 19, 2022. DTCC GCF Repo Index is Depository Trust & Clearing Corp.'s weighted average for overnight trades in applicable CUSIPs. Value traded is in billions of U.S. dollars. Federal-funds rates are Tullett Prebon rates as of 5:30 p.m. ET.				
Sources: Federal Reserve, Bureau of Labor Statistics; DTCC, FactSet; Tullett Prebon Information, Ltd.				

Figure 4: Short-Term Rates. Source: Wall Street Journal

## Overnight Rate

Unsecured borrowing and lending between banks as they adjust the reserve requirements they are required to keep with the central bank. Referred to as the Fed Funds Rate in the US, as EONIA<sup>1</sup> (now €STR) in the Euro zone, SONIA<sup>2</sup> in the UK and SOFR<sup>3</sup> in the US. The effective fed funds rate is the weighted average of the rates on brokered transactions. Central bank may intervene with its own transactions to raise or lower the overnight rate.  
Overnight rates are measure of liquidity in the market

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<sup>1</sup> European Overnight Index Average

<sup>2</sup> Sterling Overnight Index Average

<sup>3</sup> Secured Overnight Financing Rate

# Repo Rate

A **repurchase agreement (repo)** is an agreement to sell some security to another party and buy it back at a fixed date and for a fixed amount.

The **repo rate** is the difference between the price at which the security is bought back is greater than and the selling price.

## From LIBOR...

The London Inter-Bank Offered Rate (LIBOR) is an interest-rate average calculated from estimates submitted by leading banks in London. Each bank estimates what it would be charged were it to borrow from other banks.

Precise definition: "The rate at which an individual Contributor Panel bank could borrow funds, were it to do so by asking for and then accepting inter-bank offers in reasonable market size, just prior to 11.00 London time."

It is the primary benchmark, along with the Euribor, for short-term interest rates around the world

LIBOR has been published in several currencies and maturities (from overnight to one year) and underpins financial contracts all over the world. Because LIBOR is derived from banks' daily quotes of borrowing costs, banks were able to manipulate the rates through lying in the surveys

## ...to new Reference Rates I

<https://www.fca.org.uk/markets/libor-transition>

### LIBOR Phase-Out

Libor was phased out at the end of 2021, and market participants are being encouraged to transition to risk-free interest rates.

In line with announcements from the Financial Conduct Authority (FCA), publication of 24 of the 35 LIBOR settings ceased from 1 January 2022. USD LIBOR settings are continuing under a panel bank methodology until the end of June 2023.

The new reference rates (e.g. for a 3-month period) will be calculated at the end of the period as the compounded overnight rates for that period

5 maturities will remain:

- ① 1 day
- ② 1 month
- ③ 3 months
- ④ 6 months
- ⑤ 12 months

## ...to new Reference Rates II

Jurisdiction	RFR	Administrator	Collateralisations	Description
United States of America	Secured Overnight Financing Rate (SOFR)	Federal Reserve Bank of New York	Secured	Secured rate that covers multiple overnight repo market segments
United Kingdom	Sterling Overnight Index Average (SONIA)	Bank of England	Unsecured	Unsecured rate that covers overnight wholesale deposit transactions
Switzerland	Swiss Average Rate Overnight (SARON)	SIX Exchange	Secured	Secured rate that reflects interest paid on interbank overnight repo rate
Japan	Tokyo Overnight Average Rate (TONAR)	Bank of Japan	Unsecured	Unsecured rate that captures overnight call rate market
Euro area	Euro short-term rate (€STR)	European Central Bank	Unsecured	Unsecured rate that captures overnight wholesale deposit transactions

Table 1: RFRs recommended as alternatives to LIBOR. Source: FCA

# EURIBOR

Note that the Euro LIBOR should not be confused with EURIBOR.

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# Long-Term Rates

# Treasury Rate

Rate on instrument issued by a government in its own currency

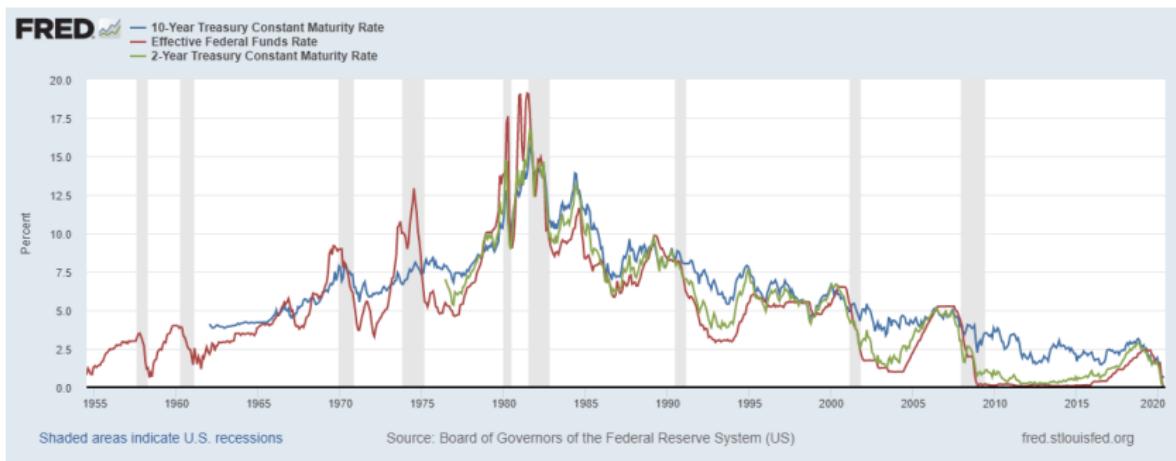


Figure 5: US Treasury Rate and Fed Fund Rate

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# Bonds

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### Overview

# General Characteristics of Bonds

## Definition

- A **bond** is a debt security that represents a financial claim by which the **issuer**, or the borrower, is committed to paying back to the **bondholder**, or the lender, the cash amount borrowed, called the **principal**, plus periodic interests calculated on this amount during a given period of time.
- A **bond** is an **IOU** between the Issuer and the Market.
- It can have either standard or non-standard structure.
- A standard or **bullet bond** is a fixed-coupon bond, without any embedded option, delivering its coupons on periodic dates and the principal on the maturity date.

## Purpose of a Bond

The purpose of a bond issuer (e.g. the Treasury Department, a government entity or a corporation) is:

- to finance its budget or investment projects (e.g. construction of roads, schools, development of new products and new plants) at an interest rate that is expected to be lower than the rate of return on the investment.

# Types of Bonds and Issuers

## Treasury Notes and Bonds

- Treasury Bonds
- Treasury Inflation-Protected Securities (TIPS)
- Treasury STRIPS
- Agency Bonds

## Municipal Bonds

## Corporate Bonds

- Secured Bonds
- Unsecured Bonds
- Junk Bonds

## Financial Guarantee for Bonds: CDS

# Rates

## Bonds | [wsj.com/market-data/bonds/benchmarks](http://wsj.com/market-data/bonds/benchmarks)

### Tracking Bond Benchmarks

Return on investment and spreads over Treasuries and/or yields paid to investors compared with 52-week highs and lows for different types of bonds

Total return close	YTD total return (%)	Index	Yield (%)			Total return close	YTD total return (%)	Index	Yield (%)		
			Latest	Low	High				Latest	Low	High
<b>Broad Market Bloomberg Fixed Income Indices</b>											
2018.02	<b>-10.1</b>	U.S. Aggregate	3.790	1.400	4.140	2018.47	<b>-8.2</b>	Mortgage-Backed	3.700	1.670	4.240
<b>U.S. Corporate Indexes Bloomberg Fixed Income Indices</b>			1988.77	<b>-7.0</b>		Ginnie Mae (GNMA)			3.700	1.700	4.250
2951.23	<b>-13.4</b>	U.S. Corporate	4.670	1.960	4.990	1187.67	<b>-8.4</b>	Fannie Mae (FNMA)	3.700	1.660	4.240
2825.01	<b>-8.1</b>	Intermediate	4.460	1.340	4.820	1820.32	<b>-8.7</b>	Freddie Mac (FHLMC)	3.690	1.660	4.240
4000.75	<b>-21.6</b>	Long term	5.060	2.900	5.310	559.52	<b>-7.1</b>	Muni Master	2.866	0.754	3.191
582.14	<b>-13.8</b>	Double-A-rated	4.050	1.710	4.370	397.25	<b>-6.6</b>	7-12 year	2.704	0.756	3.237
778.41	<b>-13.9</b>	Triple-B-rated	4.990	2.170	5.320	446.48	<b>-9.2</b>	12-22 year	3.353	1.100	3.753
<b>High Yield Bonds ICE BofA</b>			423.63	<b>-12.8</b>		22-plus year			4.011	1.583	4.342
472.96	<b>-9.4</b>	High Yield Constrained	7.976	3.830	8.931	<b>Global Government J.P. Morgan<sup>1</sup></b>					
446.02	<b>-11.5</b>	Triple-C-rated	13.516	6.893	15.197	546.14	<b>-8.9</b>	Global Government	2.350	0.750	2.560
3145.89	<b>-9.4</b>	High Yield100	7.488	3.210	8.427	769.52	<b>-8.3</b>	Canada	3.080	1.280	3.500
409.26	<b>-11.1</b>	Global High Yield Constrained	8.128	4.019	9.062	359.56	<b>-11.4</b>	EMU <sup>2</sup>	2.100	0.191	2.562
311.17	<b>-10.8</b>	Europe High Yield Constrained	6.492	2.304	7.457	673.35	<b>-11.4</b>	France	1.890	0.100	2.330
<b>U.S. Agency Bloomberg Fixed Income Indices</b>			483.13	<b>-10.0</b>		Germany			1.250	0.390	1.740
1721.62	<b>-6.2</b>	U.S. Agency	3.530	0.680	3.670	287.45	<b>-2.4</b>	Japan	0.620	0.280	0.710
1517.60	<b>-5.2</b>	10-20 years	3.500	0.570	3.630	523.62	<b>-12.1</b>	Netherlands	1.580	0.250	2.030
3471.64	<b>-17.2</b>	20-plus years	3.990	1.950	4.190	864.13	<b>-16.7</b>	U.K.	2.710	0.720	2.740
2583.19	<b>-10.4</b>	Yankee	4.370	1.560	4.610	765.53	<b>-16.8</b>	Emerging Markets **	7.472	4.516	8.085

\*Constrained indexes limit individual issuer concentrations to 2%; the High Yield 100 are the 100 largest bonds

<sup>1</sup>In local currency <sup>2</sup>Euro-zone bonds

\*\* EMBI Global Index

Sources: ICE Data Services; Bloomberg Fixed Income Indices; J.P.Morgan

Figure 6: Bond Rates. Source: Wall Street Journal

# International Bond Markets

- In the US, bonds of maturity less than one year are called bills, and are usually zero-coupon. Bonds with maturity 2–10 years are called notes. They are coupon bearing with coupons every six months. Bonds with maturity greater than 10 years are called bonds. Bonds traded in the United States foreign bond market but which are issued by non-US institutions are called Yankee bonds. Since the beginning of 1997 the US government has also issued bonds linked to the rate of inflation.
- In the UK, bonds issued by the UK government are called gilts.
- In Japan, Japanese Government Bonds (JGBs) come as short-term treasury bills, medium-term, long-term (10-year maturity) and super long-term (20-year maturity). The long- and super long-term bonds have coupons every six months. The short-term bonds have no coupons and the medium-term bonds can be either coupon-bearing or zero-coupon bonds. Yen denominated bonds issued by non-Japanese institutions are called Samurai bonds.

# Bond Market

## Data Visualization

# Terminology and Conventions I

## Characteristics of the issuer:

- the issuer's name
  - e.g. Bundesrepublik Deutschland for a German Treasury Bond
- the issuer's type or the issuer's sector
  - e.g. the oil sector for Total Energy
- the issuer's country

## General characteristics of the bond:

- the bond market in which the bond is issued
  - e.g. the US domestic market
- the bond's currency
  - e.g. US Dollars
- the type of guarantee
  - repayment of principal and interest on a bond borrowing can be guaranteed by the issuer, the parent company.

## Terminology and Conventions II

- the identifying code
  - e.g. ISIN (International Securities Identification Number) or CUSIP (Committee on Uniform Securities Identification Procedures)
- the rating
  - given by rating agencies, such as Moody's or Standard & Poor's (S&P)
- the total issued amount
  - in thousands of the issuance currency on Bloomberg (BBG)
- the outstanding amount
  - the amount of the issue still outstanding, in thousands on BBG
- the minimum amount
- the minimum increment that can be purchased
  - the smallest additional amount that can be purchased above the minimum amount
- the settlement date
  - the date on which payment is due in exchange for the bond, generally equals to the trade date + nb working days where nb = 1 for US Treasury bonds or nb = 3 in the Euro zone

# Terminology and Conventions III

## The principal:

- the maturity date  
the date on which the principal amount is due
- the par amount or nominal amount or principal amount  
the face value of the bond
- the redemption value  
in percentage of the nominal amount, it is the price at which the bond is redeemed on the maturity date.
- the method used for the calculation of the bond price/yield  
depending on the bond category, e.g. for US Treasury bonds, price method = street convention, standard convention for the bond market
- the day-count type  
e.g. Actual/360
- the announcement date  
the date on which the bond is announced and offered to the public

## Terminology and Conventions IV

- the issuance price  
the percentage paid at issuance
- the spread at issuance  
equals to the spread in basis points to the benchmark Treasury bond

### Income:

- the coupon type  
e.g. fixed, floating or multi-coupon (a mix of fixed and floating, or different fixed)
- the coupon rate  
expressed in percentage of the nominal amount
- the coupon frequency  
e.g. semi-annual (SA) in the US, UK and Japan, annual in the Euro zone, except for Italy (SA)
- the interest accrual date  
the date when interests begin to accrue
- the first coupon date

# Debt Rating Table

Moody's	S&P	Definition
Aaa	AAA	Gilt-edged, best quality, extremely strong creditworthiness
Aa1	AA+	
Aa2	AA	Very high grade, high quality, very strong creditworthiness
Aa3	AA-	
A1	A+	
A2	A	Upper-medium grade, strong creditworthiness
A3	A-	
Baa1	BBB+	
Baa2	BBB	Lower-medium grade, adequate creditworthiness
Baa3	BBB-	
Ba1	BB+	
Ba2	BB	Lower grade, speculative, vulnerable to nonpayment
Ba3	BB-	
B1	B+	
B2	B	Highly speculative, more vulnerable to nonpayment
B3	B-	
Caa	CCC+	
	CCC	Substantial risk, in poor standing, currently vulnerable to nonpayment
	CCC-	
Ca	CC	May be in default, extremely speculative, currently high vulnerable to nonpayment
C	C	Even more speculative
	D	Default

Table 2: Moody's and S&P's Rating Scales

## Bloomberg example

# Green Bonds

A **Green bond** is a standard bond with a bonus "green" feature, meaning that all the money raised must be used to fund projects that have positive environmental or climate benefits.

Green bonds, for example, can be used to fund improvements in transport infrastructure, agriculture production, and renewable energy generation projects. We are living a transition from a brown to a green economy. <https://www.climatebonds.net/resources/reports/sustainable-debt-summary-q3-2021>

## Contents

### Non-standard Bonds

## Zero-Coupon Bonds

A **zero-coupon bond** or **strip** is a bond that does not make coupon payments. The only cash flow on a zero-coupon bond is the redemption payment on maturity. It is sold at a discount from its face value.

# STRIPS

STRIPS stands for "Separate Trading of Registered Interest and Principal of Securities". The coupons and principal of normal bonds are split up, creating artificial zero-coupon bonds of longer maturity than would otherwise be available.

# Floating-Rate Notes

**Floating-Rate Notes (FRNs)** are bonds with a floating rate coupon payments, meaning that interest payments are linked to an external reference such as the 3-month bank lending rate.

- As interest rates fluctuate, FRN's cash flows are unknown
- FRNs usually pay a fixed margin or spread over a specified reference rate; sometimes the spread is not fixed and such bond is known as **variable-rate note**.

## Inflation-Indexed Bonds I

An **inflation-indexed bond** is a bond indexed to a consumer price index, in another way linked to inflation.

- in the UK: inflation measured by the Retail Price Index (RPI), UK gilt
- in the US and in Europe, Consumer Price Index (CPI)  
US: TIPS, France = OATi

OATi example <https://www.aft.gouv.fr/en/encours-detaille-oati>

The State issued the first OAT indexed to the French consumer price index (OATi) on 15 September 1998. This innovation was followed in October 2001 by the very first issue of an OAT indexed to the euro-area consumer price index (OAT€i).

OATis and OAT€is are designed for all types of investors looking to protect the purchasing power of their investments, improve their asset-liability management or diversify their investment portfolio.

They are intended for resident or non-resident institutional investors, such as insurance companies, pension and social welfare funds, asset managers and banks, as well as retail investors.

Source: AFT

# Perpetual Bonds

A **perpetual or irredeemable bond** is a bond with no maturity. So interest on them are paid indefinitely. They issued from a long time in the past and it is unusual to see them today.

## Example

the 3.5% War loan, a gilt created from existing issues in 1916 to help pay for the 1914-1918 war effort

What is the price of such bond?

$$P = \frac{c}{r}$$

with  $c$  is the coupon rate and  $r$  the fixed-interest rate

## Bonds with Embedded Options

A **callable bond** is a bond that gives the bondholder and/or issuer the option to enforce early redemption of the bond.

A **convertible bond** is a bond that can be converted into equity.

# Securitized Bonds

There is a large market on bonds whose interest and principal liability payments are backed by an underlying cash flow from another asset.

## Mortgage-Backed Securities

A mortgage bank can use cash inflows it receives on its mortgage book as asset backing for an issue of bonds, that are called Mortgage-Backed Securities (MBSs).

Since residential mortgages rarely run to their full term, but are usually paid off early by homeowners, notes backed by mortgages are paid ahead of their legal final maturity ⇒ amortising bonds.

MBs and more largely asset-backed securities (ABSs) are also callable bonds.

## Contents

# Taxonomy of Rates

# Coupon Rate

# Yield to maturity

# Spot Zero-Coupon Rate

or discount rate

# Forwards Rate

FRA

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### Market Quotes

# Spreads

The **spread** is the difference between the rate of return on a bond and that on a **benchmark** used by the market.

In the Euro area, the benchmark can be:

- a short-term rate, e.g. the 3- or 6-month EURIBOR for floating rate debt;
- the interest rate swap rate or government bond yields for long-term debt.

Example: the X bond was issued with a spread of 135 bp (1.35%) to mid-swap rate. That means that X had to pay 1.35% more than banks per year to raise funds.

The spread is a key parameter for pricing bond.

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# Bond Pricing

## Bond Pricing

$$PV(CF_t) = B(0, t) * (1 + R(0, t))^t$$

$$PV(CF_t) = \frac{CF_t}{(1 + R(0, t))^t}$$

where  $R(0, t)$  is the annual spot rate or discount rate at initial date ( $t = 0$ ) for an investment up to date  $t$ .

The **fair price** of a bond is the present value of all its cash flows (coupon interest payments + redemption value).

$$PV(bond) = \sum_{t=1}^T \frac{CF_t}{(1 + R(0, t))^t}$$

## Contents

# Risk Measures

# The Volatility of Debt Securities

Changes in the price of a fixed-rate bond caused by interest rate fluctuations

The value of a fixed-rate debt instrument is not fixed, it varies inversely with market rates.

- If interest rates rise, its value declines;
- If interest rates fall, its value appreciates.

Measures: Duration and Convexity

The **modified duration (MD)** of a bond measures the percentage change in its price for a given change in interest rates.

MD is equal to absolute value of the first derivative of a bond's price with respect to interest rates, divided by the price:

$$MD = \frac{1}{V} * \sum_{t=1}^N \frac{t * CF_t}{(1+r)^{(t+1)}}$$

where  $r$  is the market rate and  $CF_t$  the cash flows generated by the bond

# Duration

**Duration** can measure the speed of payment of a bond, and hence its price risk relative to other bonds of the same maturity.

# Convexity

## Other Types of Risk

- Credit risk
- Liquidity risk
- Reinvestment risk
- Currency risk
- Call risk
- Volatility risk
- Political/legal risk

## Contents

# Money-Market Instruments

# Certificate of Deposit

# Commercial Paper

# Treasury-Bill

# Repurchase Agreement