

# Bonds

Ugo Pomante


Professor of «Finance & Banking»

Tor Vergata University

# Why are they issued?

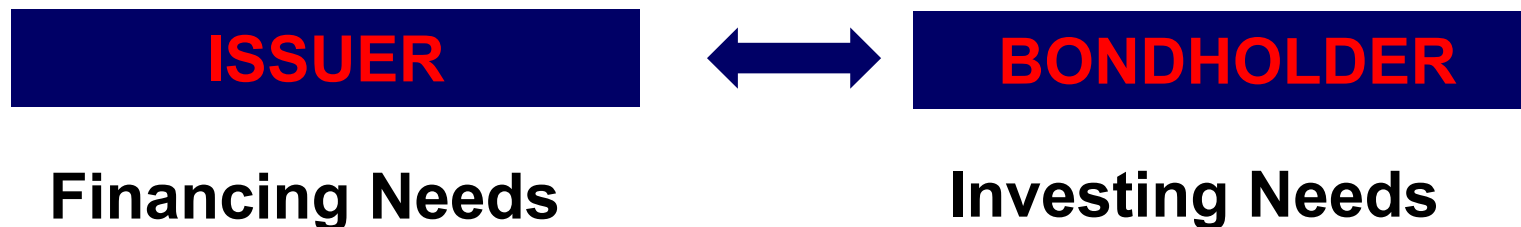
They are issued in order to *borrow money*

Funding Sources/Channels:

- Banks (via *loans*)
- **Market (via bonds)** 

## A. Definition

The bond is a contract between the **issuer** (lender) and the **bondholder** (borrower), where the issuer is obliged to pay an interest and to return the borrowed capital.



## B. Bonds: Classification

Bonds can be classified in many ways. These are the most commons and widely applied:

- **Issuer:** Government-Corporate
- **Maturity:** Short term – Long Term
- **Presence of the Coupon:** Zero coupon bond – Coupon bond
- **Type of interest:** Fixed rate bond – Floating rate bond
- **Quality of the issuer:** Investment grade – Speculative grade
- **Embedded Derivatives:** plain vanilla bond – structured bond

# Bonds: Valuation

*\* The analysis is focused only on fixed rate bonds*

# **An Introduction to the Pricing of Financial Assets**

# Pricing of Financial Assets

- Pricing of Financial asset is based on a **BASIC RULE**:

**Asset Price = Present Value of future cash flows**

$$P = \sum_{t=1}^n \frac{E(CF_t)}{(1+r)^t}$$

**Where:**

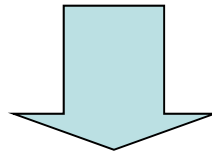
**$P$  = Asset Price**

**$E(CF_t)$  = Cash Flow that the asset is expected to pay at time  $t$**

**$r$  = Fair return required by the investor (the discount rate)**

# Pricing Problems

- **Maturity may be uncertain**
- **Cash flow unknown**
- **Timing of cash flows unknown**



**Anyway, these problems don't affect the valuation of fixed rate bonds held to maturity**



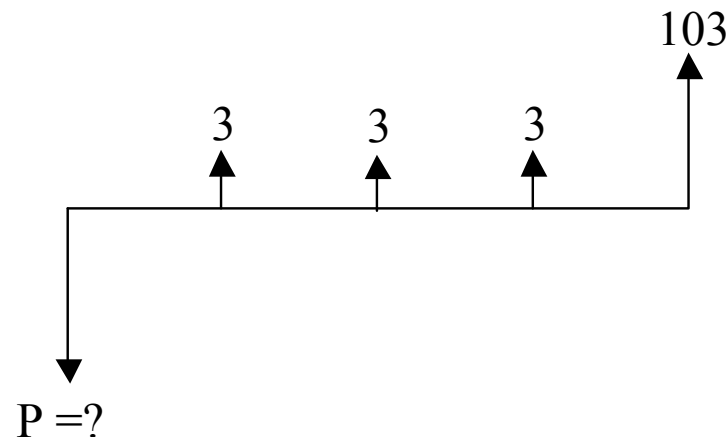
## **C. Bond Pricing on Yield curve**

# Bond Pricing on Yield curve *(follows)*

Suppose we need to price the following Government Bond issued by country which credit quality is average:

T = Maturity = 4 yrs
Coupon frequency = yearly
Coupon Value = 3

So, the financial structure of the bond is the following:

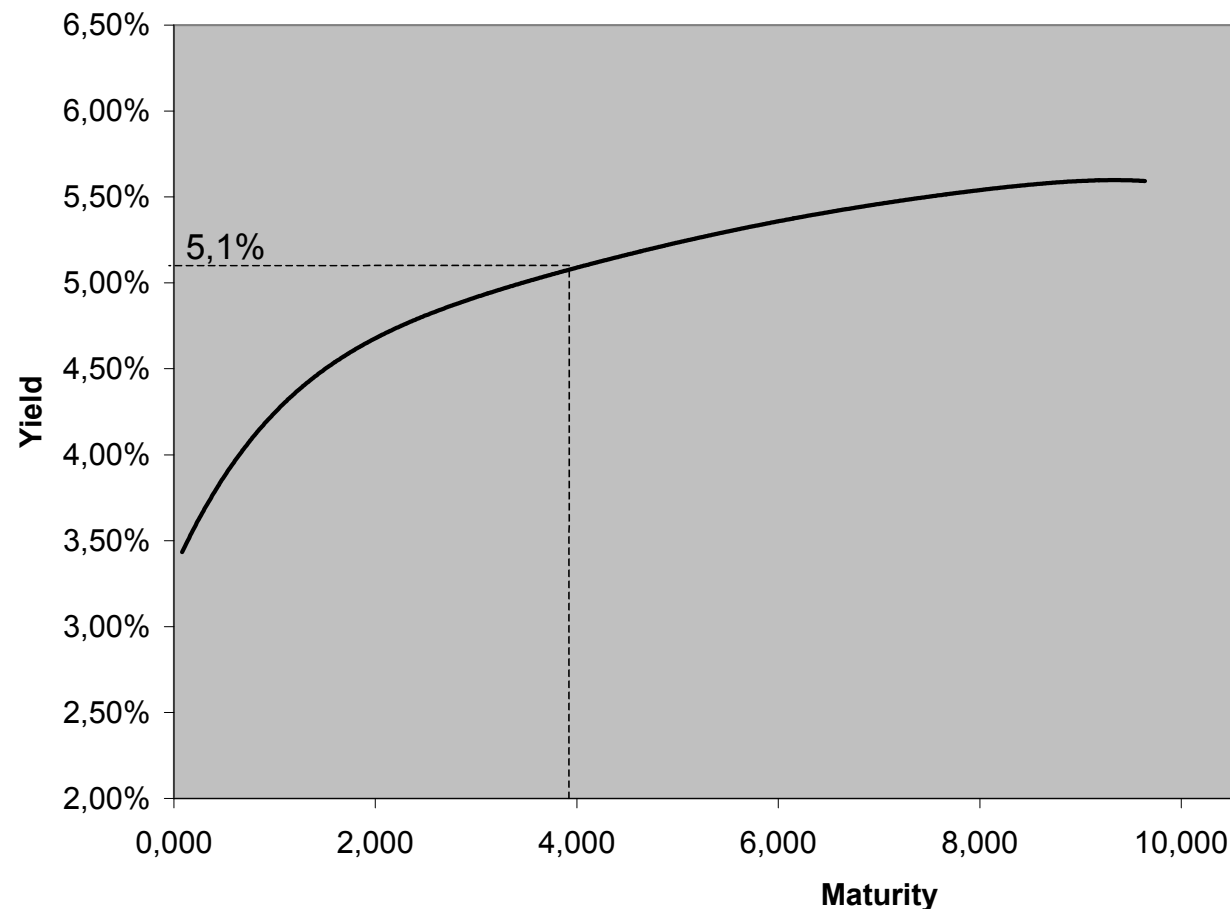


- In order to price the Bond, we need to discount all the future cash flows (in other words, we need to find the present value of the future cash flows). To do that, we need to choose **the discount rate**.

# Bond Pricing on Yield curve

*(follows)*

- At the valuation date, the Bond Market “shows” the following Yield Curve of Bonds issued by this country:



**Yield Curve**  
shows the yields  
that market  
“quotes” for  
different maturities  
of  
bonds.

# Bond Pricing on Yield curve

*(follows)*

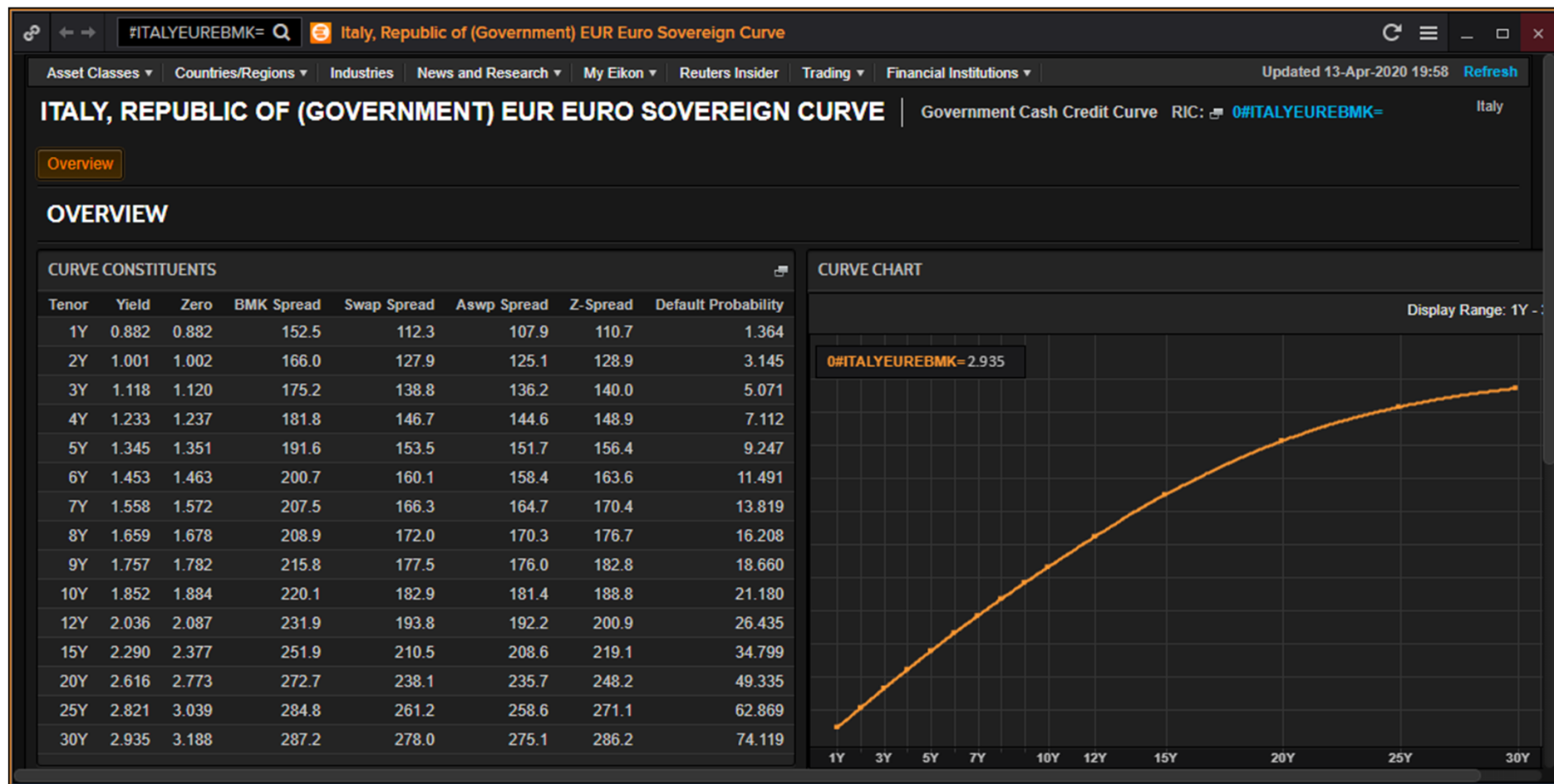
- Previous Chart shows that for the 4 yrs maturity bonds issued by this country market requires a yield-to-maturity of 5.1%.
- So In order to price the Bond, we need to discount all the future cash flows using the discount rate of 5.1%:

$$P_{Fair} = \frac{3}{(1 + 5.1\%)^1} + \frac{3}{(1 + 5.1\%)^2} + \frac{3}{(1 + 5.1\%)^3} + \frac{103}{(1 + 5.1\%)^4} =$$
$$= 2.85 + 2.72 + 2.58 + 84.42 = 92.57$$

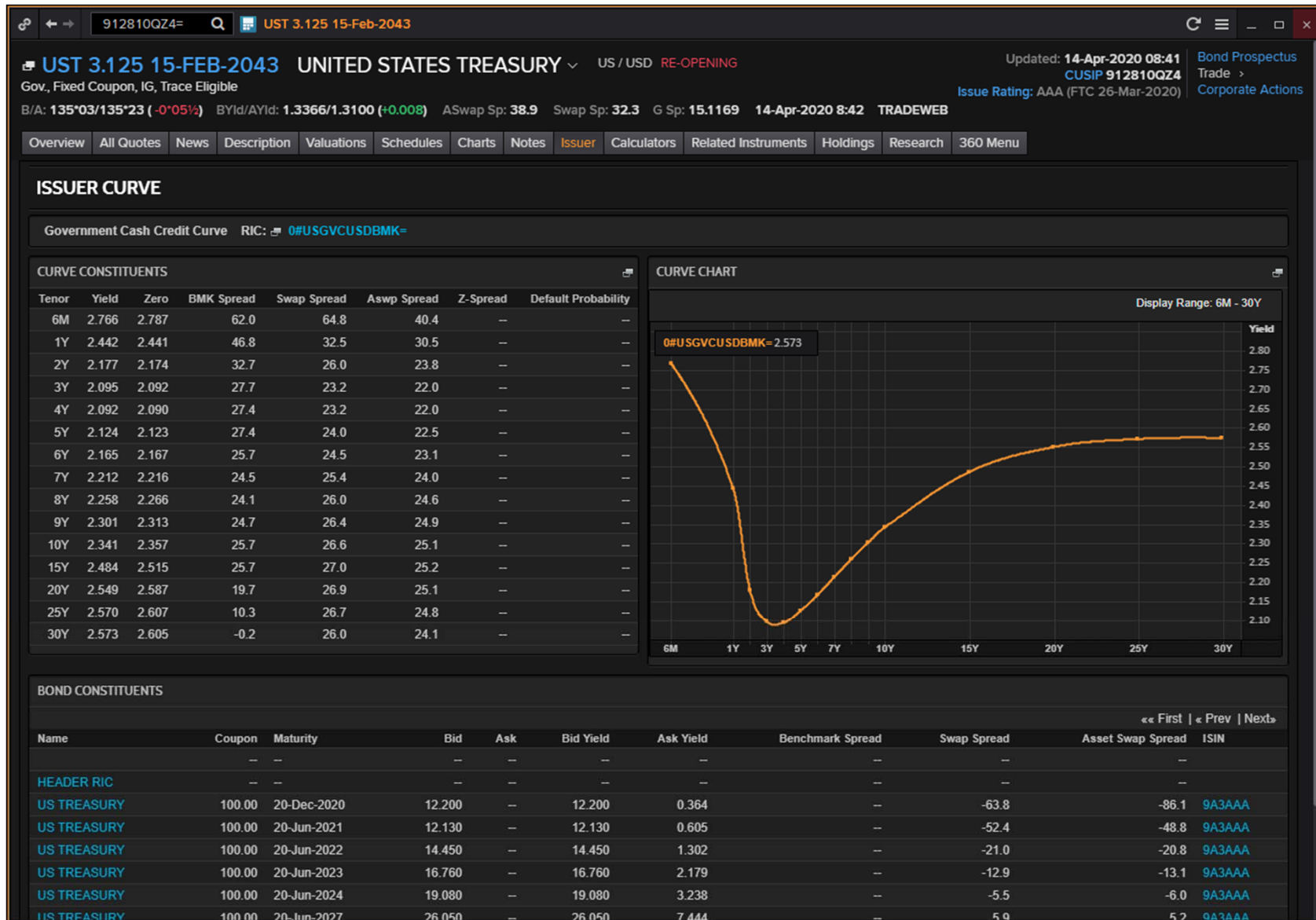
- If the price were differed from 92.57, the bond wouldn't have the yield-to-maturity (5.1%) that market requires on a 4yrs government bond.

# Bond Pricing on Yield curve: conclusion

- In order to price a Bond on the Yield curve, you have to discount its cash flows using the yield-to-maturity that the bond market “quotes” for bonds having same issuer and same maturity.



# US Treasury Yield Curve



## D. Risk

The purpose of this section is to analyse the risk measures useful to quantify the overall risk of bonds.



## **D. Risk**

**Investors in bonds face three types of risk:**

- Interest Rate Risk**
- Credit Risk**
- Liquidity Risk**

***(\*if the bonds are issued in foreign currency, Exchange Rate Risk)***

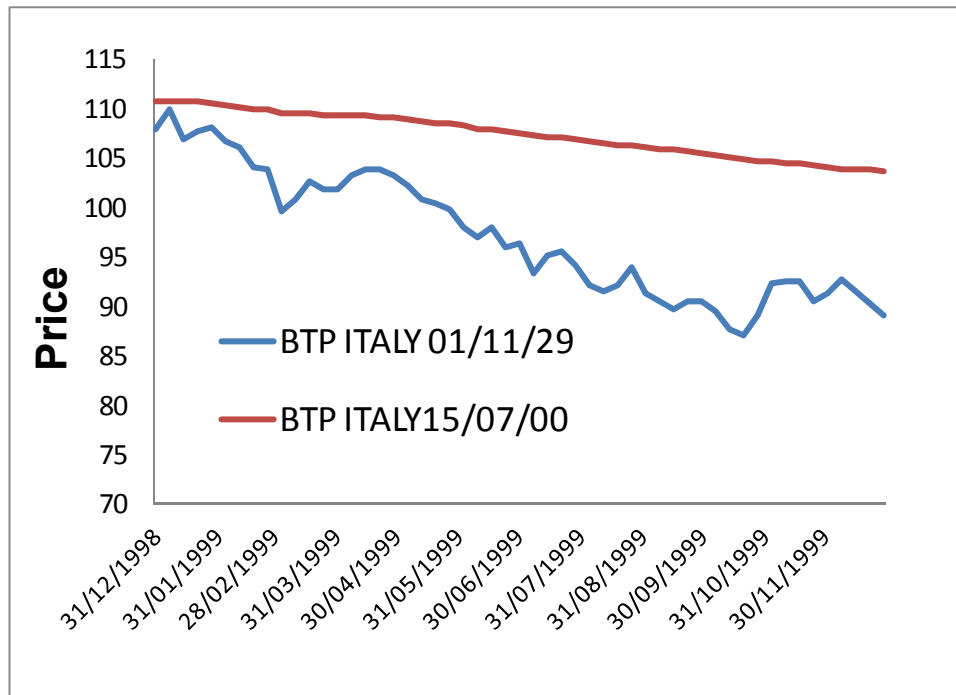
 Interest Rate Risk

Info:

a. We are at the date: December 31, 1998

b. Let's analyze the following Bonds:

- **BTP ITALY 5,25 01/11/29**
- **BTP ITALY 10,5 15/07/00**



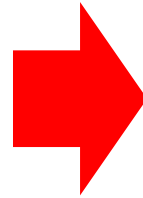
BTP ITALY 01/11/29	BTP ITALY 15/07/00
-17,4%	-6,4%

# Interest Rate Risk

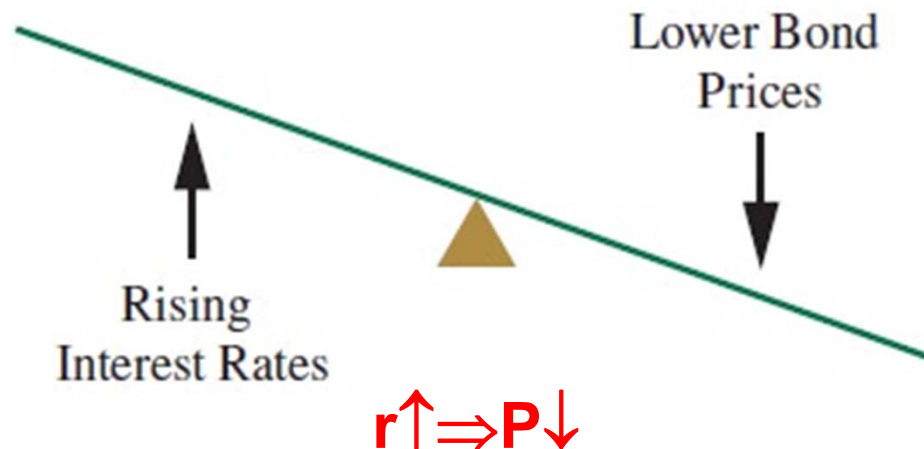
Among the risk measures mentioned, this is undoubtedly the one which, before the 2008 crisis, assumed greater importance.

Definition: "*Interest rate risk is the risk of a reduction in the price of a bond, due to an unexpected rise of market interest rates*".

**Increase of market  
interest rate**

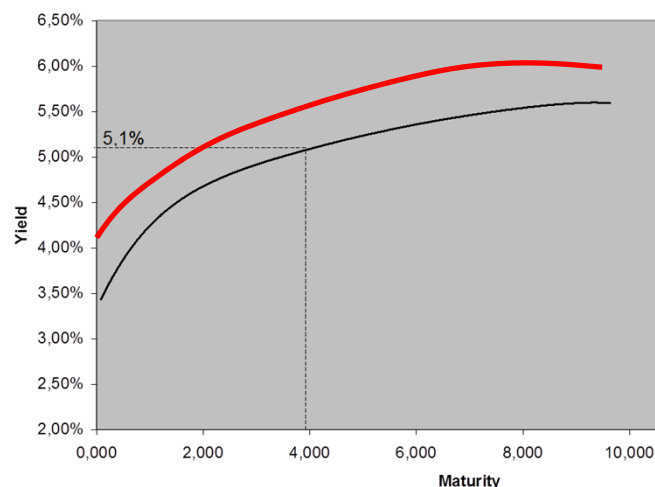
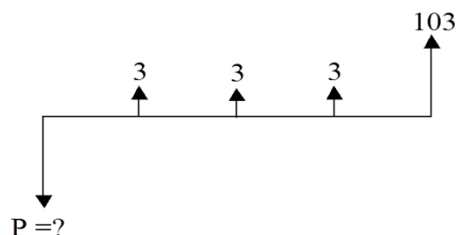


**Price reduction**



# Example

T = Maturity = 4 yrs  
Coupon frequency = yearly  
Coupon Value = 3



$$P_{Fair} = \frac{3}{(1+5.1\%)^1} + \frac{3}{(1+5.1\%)^2} + \frac{3}{(1+5.1\%)^3} + \frac{103}{(1+5.1\%)^4} =$$

$$= 2.85 + 2.72 + 2.58 + 84.42 = 92.57$$



Due to an unexpected **increase** in inflation rates, interest rates increase by 1% ( $\Delta r = +1\%$ )

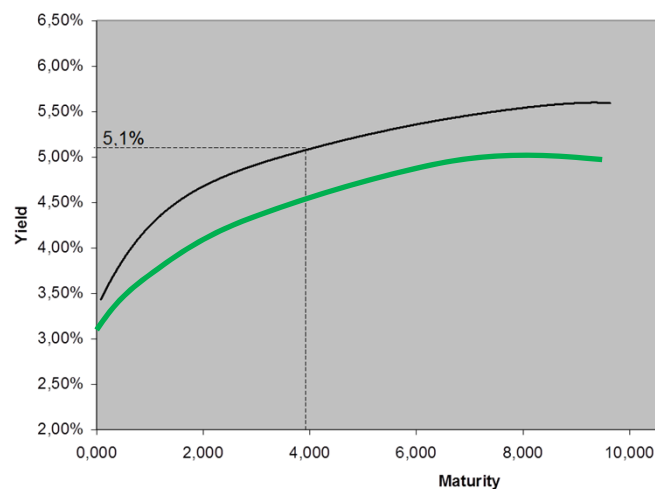
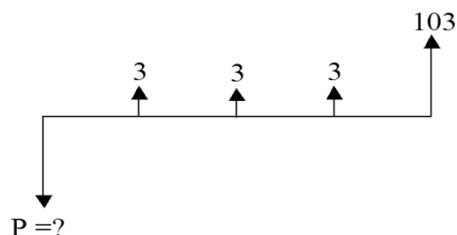
$$P_{Fair} = \frac{3}{(1+6.1\%)^1} + \frac{3}{(1+6.1\%)^2} + \frac{3}{(1+6.1\%)^3} + \frac{103}{(1+6.1\%)^4} =$$

$$= 2.83 + 2.66 + 2.51 + 81.28 \approx 89.28$$

$$\Delta\%P = \frac{(89.28 - 92.57)}{92.57} = -3.55\%$$

# Example

T = Maturity = 4 yrs  
 Coupon frequency = yearly  
 Coupon Value = 3



$$P_{Fair} = \frac{3}{(1 + 5.1\%)^1} + \frac{3}{(1 + 5.1\%)^2} + \frac{3}{(1 + 5.1\%)^3} + \frac{103}{(1 + 5.1\%)^4} =$$

$$= 2.85 + 2.72 + 2.58 + 84.42 = 92.57$$



Due to an unexpected **reduction** in inflation rates, interest rates decrease by 1% ( $\Delta r = -1\%$ )

$$P_{Fair} = \frac{3}{(1 + 4.1\%)^1} + \frac{3}{(1 + 4.1\%)^2} + \frac{3}{(1 + 4.1\%)^3} + \frac{103}{(1 + 4.1\%)^4} =$$

$$= 2.88 + 2.77 + 2.66 + 87.71 \approx 96.02$$

$$\Delta\%P = \frac{(96.02 - 92.57)}{92.57} = +3.73\%$$

# How to easily calculate the interest rate risk

3 well known bond pricing relationships:

1. Bond prices and yields are so inversely related:  $r \uparrow \Rightarrow P \downarrow$      $r \downarrow \Rightarrow P \uparrow$
2. Long-maturity bond prices tend to be *more sensitive* to interest rate changes than short- maturity bond prices (given  $\Delta r$ ,  $\Delta P$  is higher for long maturity bonds).
3. Interest rate risk is inversely related to the bond's coupon rate (given two bond with the same maturity,  $\Delta P$  is higher for bonds having little coupons).

# Modified Duration

Modified Duration: a measure of the sensitivity of a bond price to interest rate changes.

The Modified Duration (MD) is directly proportional to the maturity and inversely proportional to the coupon.

*[\* The analytics of this risk indicator will be analyzed in Financial Mathematics courses]*



Let's consider a government bond issued by Italy  
(BTP)

**ITGV 3.000 01-AUG-2029**

**Price: 112.5**

**Annual Coupon 3**

**Maturity: August 1, 2029**

**Yield to Maturity = 1.52%**

IT536516=ITGV 3.000 01-Aug-2029

ITGV 3.000 01-AUG-2029ITALY, REPUBLIC OF (GOVERNMENT)IT / EURRE-OPENING

Updated: 13-Apr-2020 19:55  
ISIN IT0005365165  
Issue Rating: BBB (high) (DOM 15-Nov-2019)

Bond Prospectus  
Trade  
Corporate Actions

B/A: 112.200/112.800 (-0.197)BYld/AYld: 1.590/1.524 (+0.022)ASwap Sp: 168.91Swap Sp: 161.10G Sp: 196.27413-Apr-2020 8:06TR COMPOSITE

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BOND INFORMATION

Summary View

PRINCIPAL / COUPON INFORMATION

Maturity Date01-Aug-2029 @ 100%

Principal / Coupon CurrencyEUR / EUR

Coupon TypeFixed:Plain Vanilla Fixed Coupon

Coupon FrequencySemiannually

Current Coupon / Next Pay D...3.00000 / 01-Aug-2020

Dated / First / Final Coupon01-Feb-2019 / 01-Aug-2019 / ...

Amount Outstanding20,262,500,000 EUR

Par Value / Min. Denominatio...1,000.00 / 1,000.00 / 1,000.00...

Floating Rate NoteNo

Show More

ISSUANCE DETAILS

Issue Date / Price / Yield01-Mar-2019 / 101.85% / 2.81

Issue Spread--

Announcement Date22-Feb-2019

Country of IssueItaly

Market of IssueDomestic

Underwriters--

Show More

MORE BOND INFORMATION

Rank (Seniority)NewSovereign

Series #10Y

Listed On

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MARKET CONVENTIONS

Day Count BasisActual/Actual ICMA, Act/Act IC...

SettlementTrade + 2 Business Days

Show More

BOND TYPE

Instrument TypeBond

MTNNo

Show More

COVENANTS

Prospectus AvailableYes (27-Feb-2019)

Latest Prospectus31-Jul-2019

Collective Action ClauseYes

Show More

TRADING RESTRICTIONS

NameCountryStatus

ISSUER

NameITALY, REPUBLIC OF (GOVERNMENT)

DomicileItaly (IT)

Country of IncorporationItaly (IT)

IndustryFinance - Finance

Show More

IDENTIFIERS

TypeValue

Show More

➤ **What is the loss if rates go up 100 basis points (+ 1.0%)?**

IT536516=ITGV 3.000 01-Aug-2029

ITGV 3.000 01-AUG-2029 ITALY, REPUBLIC OF (GOVERNMENT)IT / EUR RE-OPENING

Updated: 13-Apr-2020 19:57  
ISIN IT0005365165  
Issue Rating: BBB (high) (DOM 15-Nov-2019)

Bond Prospectus  
Trade >  
Corporate Actions

Gov., Fixed Coupon, IG, RegS

B/A: 112.200/112.800 (-0.197) BYld/AYld: 1.590/1.524 (+0.022) ASwap Sp: 168.91 Swap Sp: 161.10 G Sp: 196.274 13-Apr-2020 8:06 TR COMPOSITE

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VALUATIONS

PRICE INFORMATION		HISTORICAL VALUATION	
Bid / Ask Price	*112.8260400 / 113.0098700	Change Information	Previous DayEnd of Month
Bid / Ask Spread	18.4	Price	112.9291300113.4168000
Priced Using	190.0 bp yield spread off 9.29 YR / -0.38% (interpolated European Monetary Union/EUR Native Treasury Curve) (MAT Aug-2029)	Price Change	-0.1030900-0.5907600
Pricing Source	Thomson Reuters End of Day Pricing (EJV)	OAS	191.0197.8
Valuation Date	10-Apr-2020	OAS Change	0.14-6.62
Valuation Settle Date	15-Apr-2020	YTW	1.50474501.4573000
Accrued Interest (Days)	0.610 (74 Days)	YTW Change	0.01114000.0585850
* Bid Price affects P/Y Values and Options Adjusted Values calculations		Return Information	Previous DayEnd of Month
PRICE YIELD VALUES		Price Return	-0.091-0.518
Maturity	Worst	Coupon Return	0.0000.094
Yield	1.5212090	Reinvestment Return	0.0000.000
DV01/PVBP	0.0925	Principal Return	0.0000.000
Interpolated Spread	189.5	Total Return	-0.091-0.424
OTR Spread	191.2 (EPT9Y)		
Modified Duration	8.154		
Mac. Duration	8.216		
Convexity	0.7601		
Disc Margin	-		
Average Life	9.30		
		OPTION ADJUSTED VALUES	
		Yield	1.5212090
		Spread	191.1
		Effective Duration	8.095
		Effective Convexity	0.7595
		Price (+25bp )	110.5416610
		Price (-25bp )	115.1642650
		Option Cost	0.0000
		Option Value	0.0000
		DV01	0.0918
		Zero Volatility	191.1
		Spread Duration	8.095
		Spread Convexity	0.7595

- What is the loss if rates go up 100 basis points (+1.0%)?

$$\begin{aligned}\frac{\Delta P}{P} &= -DM \cdot \Delta i = \\ &= -8.154 \cdot (+1.0\%) = \\ &= -8.154\%\end{aligned}$$

if interest rates rise by 100 basis points, the market value falls by 8.154%.

- What is the profit if rates go down 50 basis points (- 0.5%)?

$$\begin{aligned}\frac{\Delta P}{P} &= -DM \cdot \Delta i = \\ &= -8.154 \cdot (-0.5\%) = \\ &= +4.077\%\end{aligned}$$

if interest rates fall by 50 basis points, the market value goes up by 4.077%.

Let's have a look to a different bond

**ITGV 4.750 01-AUG-2023**

**Price: 112.6**

**Annual Coupon 4.75**

**Maturity: August 1, 2023**

**Yield to Maturity = 0.78%**

IT435684=ITGV 4.750 01-Aug-2023

ITGV 4.750 01-AUG-2023ITALY, REPUBLIC OF (GOVERNMENT)IT / EURRE-OPENING

Updated: 14-Apr-2020 08:33ISIN IT0004356843

Bond ProspectusTradeCorporate Actions

B/A: 112.558/112.616 (-0.1910)BYld/AYld: 0.8756/0.8588 (+0.052)ASwap Sp: 119.94Swap Sp: 112.84G Sp: 146.550014-Apr-2020 8:35TR COMPOSITE

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BOND INFORMATION

Summary View

PRINCIPAL / COUPON INFORMATION

ISSUANCE DETAILS

ISSUER

Maturity Date01-Aug-2023 @ 100%

Principal / Coupon CurrencyEUR / EUR

Coupon TypeFixed:Plain Vanilla Fixed Coupon

Coupon FrequencySemiannually

Current Coupon / Next Pay D...4.75000 / 01-Aug-2020

Dated / First / Final Coupon01-Feb-2008 / 01-Aug-2008 / ...

Amount Outstanding24,799,152,000 EUR

Par Value / Min. Denominatio...1,000.00 / 1,000.00 / 1,000.00...

Floating Rate NoteNo

► Show More

Issue Date / Price / Yield16-Apr-2008 / 99.135% / 4.888

Issue Spread-

Announcement Date07-Apr-2008

Country of IssueItaly

Market of IssueDomestic

► Underwriters

► Show More

NAMEITALY, REPUBLIC OF (GOVERNMENT)

DomicileItaly (IT)

Country of IncorporationItaly (IT)

IndustryFinance - Finance

► Show More

IDENTIFIERS

TypeValue

ISINIT0004356843

Italian Securities435684

Common Code035868062

► Show More

MARKET CONVENTIONS

Day Count BasisActual/Actual ICMA, Act/Act IC...

SettlementTrade + 2 Business Days

► Show More

BOND TYPE

Instrument TypeBond

MTNNo

► Show More

COVENANTS

Prospectus AvailableYes (27-Mar-2012)

Latest Prospectus20-Jan-2020

Change of ControlNo

TRADING RESTRICTIONS

NameCountryStatus

US Rule 144AUnited StatesActive

MORE BOND INFORMATION

Rank (Seniority)NewSovereign

Series #15Y

► Listed On

► Show More

TAX DETAILS

EU Savings Tax DirectiveYes

01-Mar-2002 or later tapYes

Issued on or before 01-Mar-2...No (16-Apr-2008)

► Show More

REGULATIONS

MiFIR Identifier / MiFID Bond ...Bond / Sovereign bond

MiFID Liquidity Indicator (COF...No

MiFID liquidity indicator (ESMA)No

► Show More

Rating Agency &...Rating...Outlook...Affirm...

Fitch Long-term I...BBB...--07-Feb...

Dominion Bond ...BBB...Stb (15-...--

Moody's Long-te...Baa3...--

S&P Long-term Is...NR (...--

\*\* Unsolicited ratings



IT435684=ITGV 4.750 01-Aug-2023

Updated: 14-Apr-2020 08:35  
ISIN IT0004356843  
Issue Rating: BBB (FTC 07-Feb-2020)

Bond Prospectus  
Trade >  
Corporate Actions

ITGV 4.750 01-AUG-2023

ITALY, REPUBLIC OF (GOVERNMENT)

IT / EUR RE-OPENING

Gov., Fixed Coupon, IG, 144a

B/A: 112.557/112.615 (-0.1920) BYId/AYId: 0.8759/0.8591 (+0.052) ASwap Sp: 119.97 Swap Sp: 113.66 G Sp: 145.9788 14-Apr-2020 8:35 TR COMPOSITE

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VALUATIONS

PRICE INFORMATION

Bid / Ask Price

\*112.9031600 / 112.9727900

Bid / Ask Spread

7.0

Priced Using

138.9 bp yield spread off 3.29 YR / -0.61% (interpolated European Monetary Union/EUR Native Treasury Curve) (MAT Aug-2023)

Pricing Source

Thomson Reuters End of Day Pricing (EJV)

Valuation Date

13-Apr-2020

Valuation Settle Date

15-Apr-2020

Accrued Interest (Days)

0.966 (74 Days)

\* Bid Price affects P/Y Values and Options Adjusted Values calculations

HISTORICAL VALUATION

Change Information

Previous Day

End of Month

Price

112.8982600

113.5715900

Price Change

0.0049000

-0.6684300

OAS

138.6

133.0

OAS Change

0.04

5.59

YTW

0.7796380

0.6283390

YTW Change

-0.0014040

0.1498950

Return Information

Previous Day

End of Month

Price Return

0.004

-0.584

Coupon Return

0.000

0.148

Reinvestment Return

0.000

0.000

Principal Return

0.000

0.000

Total Return

0.004

-0.436

PRICE YIELD VALUES

Maturity

Worst

OPTION ADJUSTED VALUES

Yield

0.7791740

Yield

0.7791740

DV01/PVBP

0.0349

Spread

138.6

Interpolated Spread

138.8

Effective Duration

3.056

OTR Spread

140.8 (EPT3Y)

Effective Convexity

0.1134

Modified Duration

3.066

Price (+25bp)

112.0346210

Mac. Duration

3.078

Price (-25bp)

113.7797700

Convexity

0.1134

Option Cost

0.0000

Disc Margin

-

Option Value

0.0000

Average Life

3.30

DV01

0.0348

Zero Volatility

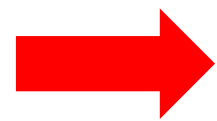
138.6

Spread Duration

3.056

Spread Convexity

0.1134



Credit Risk

			OMGV 6.750 17-Jan-2048 MTN				
			OMAN, SULTANATE OF (GOVERNMENT) OM / USD				
Gov., Fixed Coupon, HY, RegS, Eurobonds			Updated: 14-Apr-2020 20:07 ISIN XS1750114396 Issue Rating: BB (FTC 12-Mar-2020)				
Close Bid: 68.127 Close Ask: 68.794 Close Bid Yield: 10.225127 Close Ask Yield: 10.125127 13-Apr-2020 TR Pricing Service							
Overview All Quotes News Description Valuations Schedules Charts Notes Issuer Calculators Related Instruments Holdings Research 360 Menu			Summary View				
BOND INFORMATION							
PRINCIPAL / COUPON INFORMATION		ISSUANCE DETAILS		ISSUER			
Maturity Date	17-Jan-2048 @ 100%	Issue Date / Price / Yield	17-Jan-2018 / 98.796% / 6.845	Name	OMAN, SULTANATE OF (GOVERNMENT)		
Principal / Coupon Currency	USD / USD	Issue Spread	395	Domicile	Oman (OM)		
Coupon Type	Fixed: Plain Vanilla Fixed Coupon	Announcement Date	10-Jan-2018	Country of Incorporation	Oman (OM)		
Coupon Frequency	Semiannually	Country of Issue	Eurobond	Industry	Finance - Finance		
Current Coupon / Next Pay D...	6.75000 / 17-Jul-2020	Market of Issue	Eurobond	► Show More			
Dated / First / Final Coupon	17-Jan-2018 / 17-Jul-2018 / 1...	► Underwriters		IDENTIFIERS			
Amount Outstanding	2,750,000,000 USD	► Show More		Type	Value		
Par Value / Min. Denominatio...	1,000.00 / 200,000.00 / 1,000....	MORE BOND INFORMATION		ISIN	XS1750114396		
Floating Rate Note	No	Rank (Seniority)	New Sovereign	▼ SAME OFFERING			
► Show More		Series #	3	Corresponding 144A ISIN	US682051AJ69		
MARKET CONVENTIONS		► Listed On		Common Code	175011439		
Day Count Basis	30/360 US, 30U/360, 30US/3...	► Show More		► Show More			
Settlement	Trade + 2 Business Days	TAX DETAILS		BOND RATINGS			
► Show More		EU Savings Tax Directive	Yes	Rating Agency & Type	Rating Watch Code O... ..		
BOND TYPE		01-Mar-2002 or later tap	No	Fitch Long-term Issue ...	BB (12... -- -- E...		
Instrument Type	Note	Issued on or before 01-Mar-2...	No (17-Jan-2018)	Moody's Long-term Is...	Ba2 (0... DNG (30-Mar... -- E...		
MTN	Yes	► Show More					
► Show More		REGULATIONS					
COVENANTS		MIFIR Identifier / MiFID Bond ...	Bond / Sovereign bond				
Prospectus Available	Yes (18-Jan-2018)	MiFID Seniority	Senior Debt				
Latest Prospectus	18-Jan-2018	MiFID Liquidity Indicator (COF...	No				
Events of Default	Yes	► Show More					
TRADING RESTRICTIONS							
Name	Country	Status					
FFA PRIIP Non-Ret	European Economi	Active					

OM175011439= Q

OMGV 6.750 17-Jan-2048 MTN

OMGV 6.750 17-JAN-2048 MTN

OMAN, SULTANATE OF (GOVERNMENT)

OM / USD

Gov., Fixed Coupon, HY, RegS, Eurobonds

Updated: 14-Apr-2020 20:09

Bond Prospectus

ISIN XS1750114396

Trade >

Issue Rating: BB (FTC 12-Mar-2020)

B/A: 71.502/72.227 (+3.500)

BYld/AYld: 9.736/9.636 (-0.508)

ASwap Sp: 678.88

Swap Sp: 872.44

G Sp: 841.343

14-Apr-2020 17:54

TR PRICING

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VALUATIONS

PRICE INFORMATION

Bid / Ask Price

\*68.1270000 / 68.7940000

Bid / Ask Spread

66.7

Priced Using

yield priced at 10.225% (MAT Jan-2048)

Pricing Source

Thomson Reuters End of Day Pricing (EJV)

Valuation Date

13-Apr-2020

Valuation Settle Date

15-Apr-2020

Accrued Interest (Days)

1.650 (88 Days)

HISTORICAL VALUATION

Change Information

Previous Day

End of Month

Price

68.0020000

65.4990000

Price Change

0.1250000

2.6280000

OAS

929.3

971.4

OAS Change

-3.30

-45.36

YTW

10.2440510

10.6350990

YTW Change

-0.0189240

-0.4099720

\* Bid Price affects P/Y Values and Options Adjusted Values calculations

Return Information

Previous Day

End of Month

Price Return

0.179

3.928

Coupon Return

0.000

0.364

Reinvestment Return

0.000

0.000

Principal Return

0.000

0.000

Total Return

0.179

4.292

PRICE YIELD VALUES

Maturity Worst

OPTION ADJUSTED VALUES

Yield

10.2251270

Yield

10.2251270

DV01/PVBP

0.0662

Spread

926.0

Interpolated Spread

892.8

Effective Duration

9.482

OTR Spread

886.2 (TSY30Y)

Effective Convexity

1.5275

Modified Duration

9.482

Price ( +25bp )

66.5482640

Mac. Duration

9.967

Price ( -25bp )

69.7723520

Convexity

1.6064

Option Cost

0.0000

Disc Margin

-

Option Value

0.0000

Average Life

27.76

DV01

0.0662

Zero Volatility

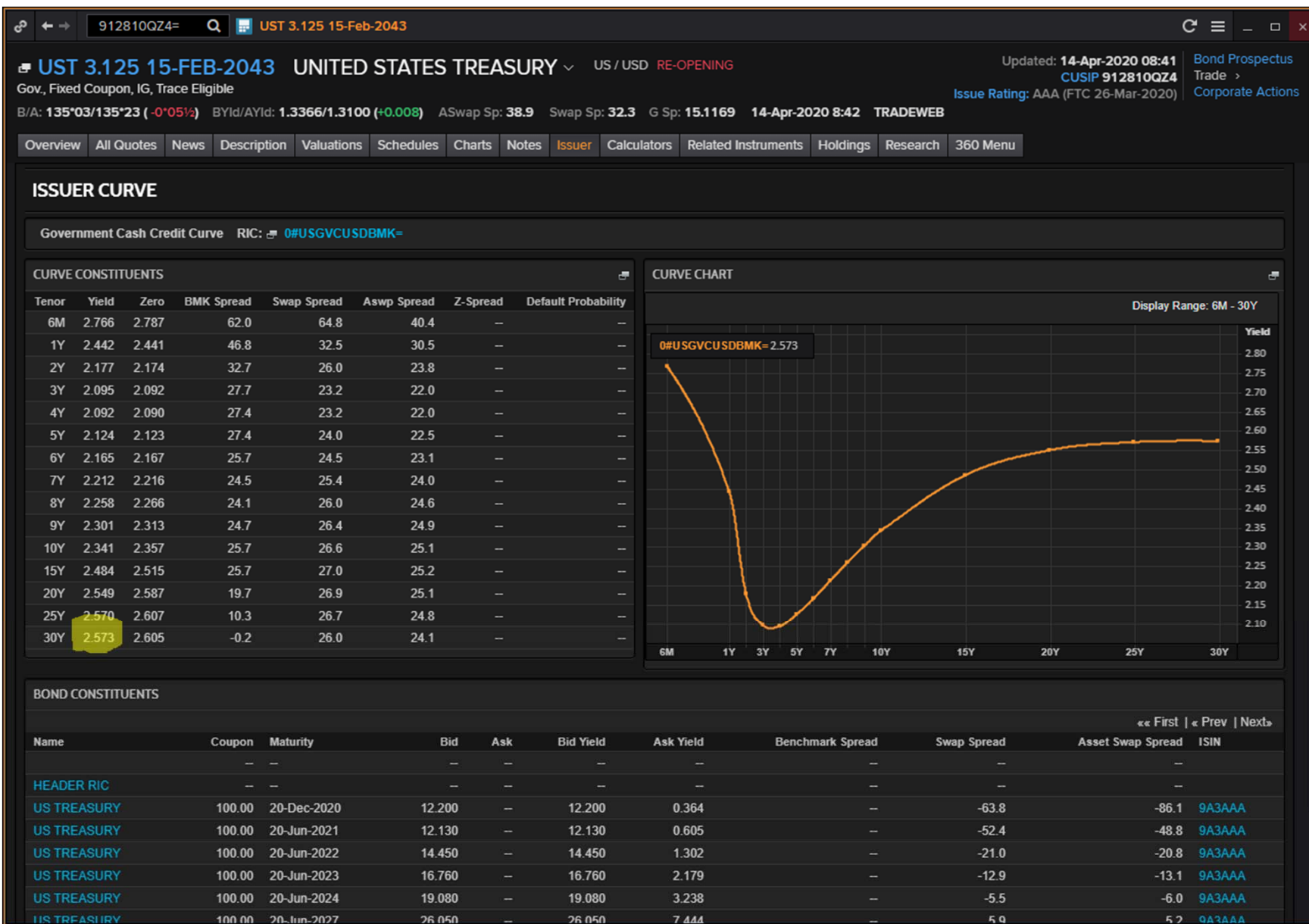
926.0

Spread Duration

9.482

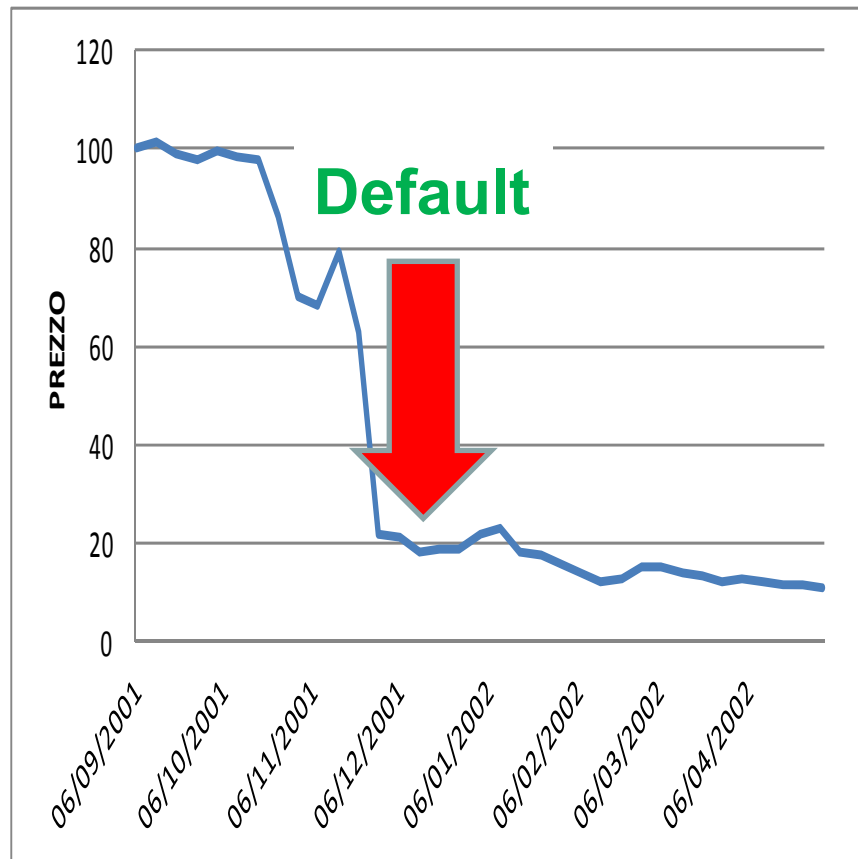
Spread Convexity

1.5275



Info:

a. **ENRON CORP. 6,75 01/08/09**



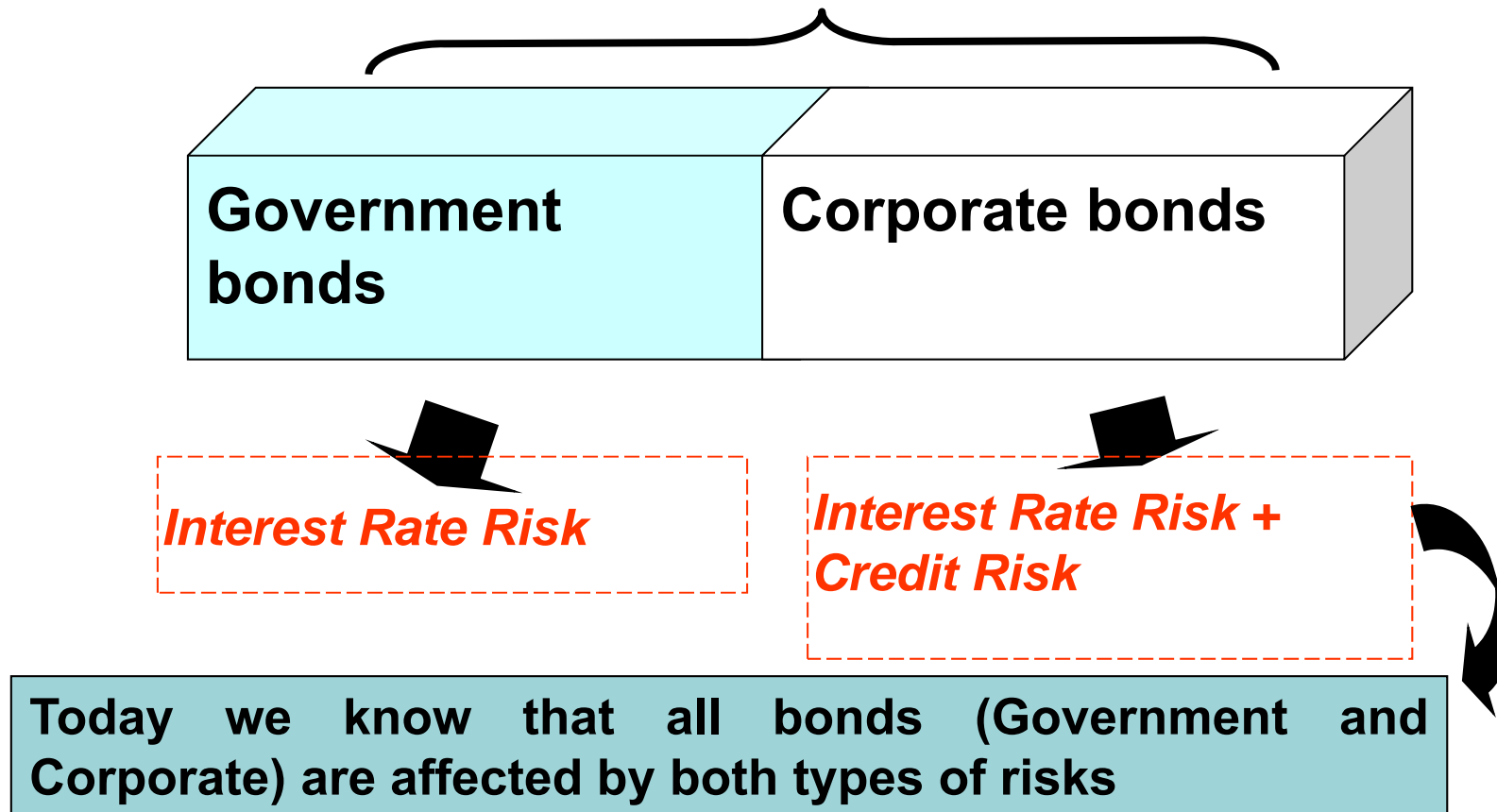
Enron Corporation, an  
US energy company  
based in Houston, Texas

# Definition

Among the risk measures previously mentioned, this is undoubtedly the one which, after the 2008 crisis, is perceived as the most relevant.

Definition: "*Credit risk is the risk of negative price **fall/decrease** due to a **negative credit event***".

## A classification (today) out of date





## Rating by Agencies

- In order to “capture” the credit risk of a bond, we need a measure of the creditworthiness of the issuer.
- Rating Agencies express judgements with the purpose to measure (*in a synthetic way*) the credit quality of the issuers.
- The better the rating the lower the probability that the issuer may have problems on repaying the debt and paying interest (for ex, paying *coupons*).
- For the rating attribution, rating agencies use a symbolic and a synthetic language.
- The best-known rating companies are Moody's, Standard & Poor's and Fitch.

# Rating by Agencies

MOODY'S	S&P	Short description
<i>Investment Grade Bonds</i>		
Aaa	AAA	<i>Superior quality / maximum safety</i>
Aa1 Aa2 Aa3	AA+ AA AA-	<i>High Quality</i>
A1 A2 A3	A+ A A-	<i>Strong payment capacity</i>
Baa1 Baa2 Baa3	BBB+ BBB BBB-	<i>Adequate payment capacity</i>
<i>Speculative Grade Bonds /</i>	<i>High Yield Bonds /</i>	<i>Junk Bonds</i>
Ba1 Ba2 Ba3	BB+ BB BB- <i>NOTCHES</i>	<i>Low quality, speculative bonds</i>
B1 B2 B3	B+ B B-	<i>Highly speculative securities</i>
Caa Ca C	CCC CC C	<i>Extremely speculative bonds, Maximum risk of insolvency</i>
D	D	<i>Default</i>

# Bond ratings

- Bond issuer pays rating agency
- Bond ratings may change over time
- A Rating improve is named *upgrading*
- Rating decrease is named *downgrading*)

## Enron: rating

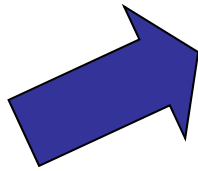
ENRON	
Data	S&P
19/04/01	BBB+
27/06/01	BBB+
15/08/01	BBB+
16/10/01	BBB+
23/10/01	BBB+
24/10/01	BBB+
26/10/01	BBB+
29/10/01	BBB+
31/10/01	BBB+
01/11/01	BBB (neg.)
06/11/01	BBB (neg.)
07/11/01	BBB (neg.)
09/11/01	BBB- (neg.)
21/11/01	BBB- (neg.)
26/11/01	BBB- (neg.)
28/11/01	BBB- (neg.)
28/11/01	B-
29/11/01	B-
30/11/01	CC (neg.)
03/12/01	D

# A peculiar type of speculative grade bond

➤ **Fallen angels**

## From credit risk to default risk

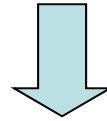
**The most  
known and  
most serious  
type of credit  
risk:**



***Default Risk***

## Default Risk

**It represents the risk that the bond issuer will declare bankruptcy before the title expires**



**Thanks to the rating agencies it is possible to estimate the default probability.**

# The default rate matrix

**Global corporate average cumulative default rates by rating modifier (1981 - 2017)**

Credit rating	Time horizon									
	1	2	3	4	5	6	7	8	9	10
AAA	0.00	0.03	0.13	0.24	0.35	0.46	0.51	0.60	0.65	0.71
AA+	0.00	0.05	0.05	0.10	0.16	0.21	0.27	0.33	0.39	0.45
AA	0.02	0.03	0.08	0.22	0.36	0.48	0.61	0.72	0.81	0.91
AA-	0.03	0.09	0.18	0.25	0.33	0.45	0.52	0.57	0.63	0.69
A+	0.05	0.09	0.20	0.34	0.45	0.55	0.66	0.79	0.93	1.08
A	0.06	0.15	0.24	0.36	0.49	0.68	0.86	1.03	1.23	1.47
A-	0.07	0.17	0.28	0.40	0.57	0.74	0.98	1.16	1.30	1.42
BBB+	0.11	0.31	0.53	0.77	1.03	1.32	1.54	1.78	2.04	2.30
BBB	0.17	0.43	0.68	1.05	1.42	1.80	2.15	2.49	2.85	3.23
BBB-	0.25	0.77	1.39	2.11	2.84	3.50	4.09	4.65	5.11	5.53
BB+	0.34	1.11	2.02	2.94	3.86	4.74	5.50	6.05	6.70	7.33
BB	0.56	1.71	3.38	4.94	6.52	7.77	8.89	9.85	10.75	11.53
BB-	1.00	3.13	5.37	7.66	9.66	11.62	13.24	14.80	16.04	17.12
B+	2.08	5.71	9.23	12.21	14.53	16.33	17.98	19.43	20.77	21.97
B	3.60	8.29	12.29	15.46	17.89	20.15	21.66	22.76	23.77	24.81
B-	7.15	14.28	19.62	23.37	26.18	28.31	29.99	31.13	31.84	32.40
CCC/C	26.82	36.03	41.03	43.97	46.22	47.13	48.33	49.23	50.08	50.71
Investment grade	0.10	0.26	0.45	0.68	0.92	1.17	1.40	1.61	1.82	2.03
Speculative grade	3.75	7.31	10.39	12.90	14.95	16.64	18.05	19.23	20.27	21.21
All rated	1.50	2.95	4.22	5.29	6.18	6.94	7.57	8.12	8.60	9.05

*Source: Standard and Poor's Global Research*



# Default probability is not stable over time!

Varies over the business cycle:

- higher in economic recession
- lower in economic expansion

So, during economic crisis, spread between Treasury bonds and Bond with low rating increases

## default risk & yield





Liquidity Risk

# Liquidity Risk

The previous risk measures are considered much more relevant than liquidity risk that however can not be ignored.

Definition: “Liquidity risk identifies the risk of failing to **sell quickly** a bond or to sell the bond at a **fair price**”.

# Liquidity depends on:

Size of issuer (Positive correlation between size and liquidity)

Efficiency/Liquidity of markets where bonds are traded