



GreenPoint
Financial

FORDHAM UNIVERSITY

FRTB CAPSTONE COURSE 2019

Collateralized pricing. Curve building and pricing for OIS, Libor, Xccy, ...



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ADMIN/FEEDBACK

➤ Are groups correct?

Groups			
Group1	Group2	Group3	Group4
Yu Dai	Jiayue Xing	Kai Lyu	Jinzhou Yao
Tian Yang	Wenqi Hua	Yu Jin	Yating Wang
Yu Lin	Wenhao Zhao	Zheng Tang	Jialun Luo
Ci Song	Hanyun Zhang	Yuxiang Wang	Ziyuan Zhao
	Xiaoxiang Shan		Xiaojun Guo

➤ Next week's lecture will cover

- UXP – Vincent Ferret
- DRC Computation – John Beckwith
- Prof Sharma and Prof Glauner will be in Europe

➤ Please post on Slack if you have issues and are stuck.

➤ Also, let us all know if you post on Stackoverflow.

PROJECT NOTES (CONT)

Market Data Setup and P&L Vector Generation

- TEAM0 is Finastra Curve Id
- Keep Curves simple with MM, Swaps for LIB3M/EUR3M and MM, OIS Swaps for OIS/EONIA
- Price USD LIB3M and take screenshots of all Curves (SWPM)
- Price USD LIB1M and do same
- Based on this information you define the points in the curve up to 10 years
 - USD LIB3M
 - USD LIB1M
 - USD OIS – we have it called FED
 - EUR EONIA
 - EUR XUSD – build with FX Forwards (this might be hard) and Xccy Swap Spreads
 - FX Spot
- Let's look at system with curve id TEAM0

PROJECT NOTES

General



- We'll be upgrading the environment this and next week. There will be some downtime. After upgrade we will have more modern UXP with node-red.
- Node-red allows building low code REST orchestration. Next week's lecture will cover some of it.
- Let's look at some software tools that you should explore and use. You have discretion of what to use. [Tech Tools](#)

PROJECT NOTES (CONT)

Docker and Flask server

- Troubleshoot for a while but when stuck use Stackoverflow to post questions
- Test run by connecting to your flask server that runs in docker container
- <https://stackoverflow.com/questions/56727763/cannot-connect-from-chrome-to-flask-server-that-runs-in-docker-container-on-wind> (Fixed in 45 min)

Cannot connect from Chrome to Flask server that runs in docker container on Windows 10 [duplicate]



- <https://stackoverflow.com/questions/56759409/error-building-docker-from-onedrive-on-windows-10-unable-to-prepare-context>

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BENEFITS OF FUSIONCAPITAL SUMMIT'S OIS MODULE



Developed on the basis of proven market experience – award-winning interest rate derivatives solution, 20 years of experience.

ISDA CSA compliant – enables cash-collateral trades to be discounted using the OIS rate for the trade currency and allows the discount index to be specified for each trade.

Real time processing – OIS curves are generated automatically following any movement in market data

Arbitrage-free valuation – includes integrated and arbitrage-free set-up with OIS discounting and all basis swaps.

Multi-curve management – Users have total flexibility in choosing a curve dependency level for hedging under the Misys Summit FT OIS framework

Forward rates do not change

Discounting depends on collateral posted

No collateral implies Libor or Funding rate discounting

If the trade is collateralized

- Risk free curve if flow ccy same as collateral ccy
- More complex curve with xccy basis if ccys differ
- Multi collateral ccys have CTD option

USD/LIBOR VS FIXED 5Y

Swap Trade: STANDARD *

ID: _____ Version: _____ State: 5/1/2013 COLL

Pay Disc OIS Receive Disc OIS TEL3750 TradeCleared: NONE

Trade

Start 5/3/2013 End 5/3/2018

Ccy USD Ntl 100,000,000.00 Ccy USD Ntl 100,000,000.00

Index FIXED Index LIBOR

Term _____ Rate 0.943 Term 3M Rate _____

Basis 30/360 Spread _____ Basis A360 Spread _____

Counterparty _____ Broker _____ Do!

Product / Formula

[Product description]

Company / Desk / Book / Folder

MASTER OPERATIONS OPS

Portfolio

Clearing house / Clearing member / Executing Broker

More...

Schedule

Pay	Freq	Day	Roll date	Cal	Pay	Freq	Day	Roll date	Cal
S	3	MF	NY		Q	3	MF	NYL	

Reset

Valuation

Pay -4,569,057.98 USD Net 0.02 USD Receive 4,569,058.00 USD

IR - USD LIBOR 5/1/2013 COLL: STAN(?)

[Last update timestamp]

Shift: Parallel/Segment/Basis Point

Parameters: Par Interp/Continuous

Money Market

Date	Rate	Spread
2D	0.1	

Forward

Start	End	Rate
5/15/20	6/19/20	0.27476
6/19/20	3M	0.29
7/17/20	8/21/20	0.305
3M	7/17/20	0.29
8/21/20	9/18/20	0.31971
9/18/20	12/18/2	0.34

Futures

Date	Price	ConvAdj
JUN13	9969-50	
SEP13	9966-00	0.1
DEC13	9963-00	0.3
MAR14	9960-50	0.4
JUN14	9957-50	0.5
SEP14	9953-50	0.63
DEC14	9947-50	0.63
MAR15	9940-50	0.75
JUN15	9931-50	0.88
SEP15	9922-00	1

Extended All In Cost

Date	Rate	Spread
2Y	0.232	16.25
3Y	0.341	17.25
4Y	0.55	15.25
5Y	0.758	18.5
6Y	0.993	19.94
7Y	1.24	19.88
8Y	1.443	21.13

IR - USD OIS 5/1/2013 COLL

[Last update timestamp]

Shift: Parallel/Segment/Basis Point

Parameters: Par Interp/Continuous

Average AIC with: FEDUS pillars

Date	Rate	Spread
1D	0.07	
1W	0.1	
2W	0.1	
3W	0.1	
1M	0.109	
3M	0.12	
6M	0.138	
9M	0.1655	
12M	0.1965	
2Y	0.4545	

Swap Spread

Date	Spread
10Y	10
12Y	10
15Y	10
20Y	15
25Y	15
30Y	15

0.758%+18.5bp=0.943%

USD OIS VS FIXED 5Y



Swap Trade: STANDARD *

ID: Version: State: 5/1/2013 COLL

Pay: Disc OIS Receive: AVG Disc OIS OIS TradeCleared: NONE

Trade Start: 5/3/2013 End: 5/3/2018

Pay

Receive

Ccy: USD Ntl: 100,000,000.00

Ccy: USD Ntl: 100,000,000.00

Index: FIXED Ntl exp: 1.751

Index: OIS Ntl exp: 1D

Term: Rate: Spread: Basis: A360

Term: Rate: Spread: Basis: A360

Counterparty: Broker: Do!

Product / Formula

Company / Desk / Book / Folder: MASTER OPERATIONS OPS

Portfolio

Clearing house / Clearing member / Executing Broker

More...

Schedule

Pay: A 3 MF NY

Pay: A 3 MF NY

Reset: 3

Reset: 3

Valuation: Pay: -8,568,843.30 USD Net: -0.01 USD Receive: 8,568,843.29 USD

IR - USD LIBOR 5/1/2013 COLL: STAN

[Last update timestamp]

Shift: Parallel/Segment/Basis Point

Parameters: Par Interp/Continuous

Money Market

Date	Rate	Spread
2D	0.1	

Forward

Start	End	Rate
5/15/20	6/19/20	0.27476
6/19/20	3M	0.29
7/17/20	8/21/20	0.305
3M	7/17/20	0.29
8/21/20	9/18/20	0.31971
9/18/20	12/18/2	0.34

Futures

Date	Price	ConvAdj
JUN13	9969-50	
SEP13	9966-00	0.1
DEC13	9963-00	0.3
MAR14	9960-50	0.4
JUN14	9957-50	0.5
SEP14	9953-50	0.63
DEC14	9947-50	0.63
MAR15	9940-50	0.75
JUN15	9931-50	0.88
SEP15	9922-00	1

Extended All In Cost

Date	Rate	Spread
2Y	0.232	16.25
3Y	0.341	17.25

IR - USD OIS 5/1/2013 COLL: STAN

[Last update timestamp]

Shift: Parallel/Segment/Basis Point

Parameters: Par Interp/Continuous

Average AIC with: FEDUS pillars

Date	Rate	Spread
6M	0.138	
9M	0.1655	
12M	0.1965	
2Y	0.4545	
3Y	0.886	
4Y	1.327	
5Y	1.751	
8Y	1.85	

Swap Spread

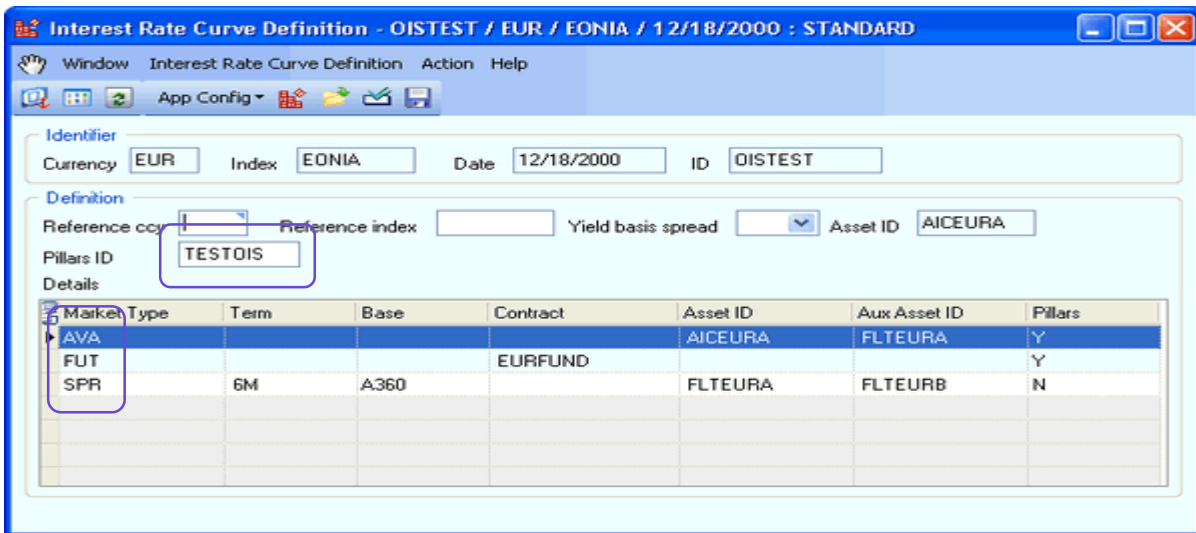
Date	Spread
10Y	10
12Y	10
15Y	10
20Y	15
25Y	15
30Y	15

OIS CURVE DEFINITION SETUP

Segments shown

- Average All-in-cost
- Fed Fund futures
- Swap Spreads

Fed meeting dates via Date Rule



Interest Rate Curve Definition - OISTEST / EUR / EONIA / 12/18/2000 : STANDARD

Window Interest Rate Curve Definition Action Help

App Config

Identifier

Currency Index Date ID

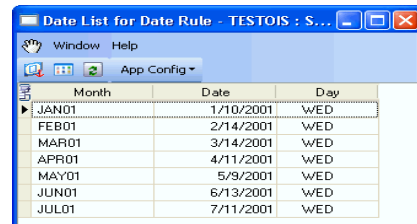
Definition

Reference ccy Reference index Yield basis spread Asset ID

Pillars ID

Details

Market	Type	Term	Base	Contract	Asset ID	Aux Asset ID	Pillars
AVA					AICEURA	FLTEURA	Y
FUT				EURFUND			Y
SPR		6M	A360		FLTEURA	FLTEURB	N



Month	Date	Day
JAN01	1/10/2001	WED
FEB01	2/14/2001	WED
MAR01	3/14/2001	WED
APR01	4/11/2001	WED
MAY01	5/9/2001	WED
JUN01	6/13/2001	WED
JUL01	7/11/2001	WED



BASIS SWAP OIS VS LIBOR 15Y



Swap Trade : STANDARD

ID: Version: State: 5/1/2013 COLL

Pay: Disc OIS TEL3750 Receive: AVG Disc OIS OIS TradeCleared: NONE

Trade

Start 5/3/2013 End 5/3/2028

Pay

Ccy USD Ntl 100,000,000.00

Index LIBOR Ntl exp

Term 3M Rate

Basis A360 Spread

Counterparty

Receive

Ccy USD Ntl 100,000,000.00

Index OIS Ntl exp

Term 1D Rate

Basis A360 Spread 10

Broker

Do!

Product / Formula

Company / Desk / Book / Folder

MASTER OPERATIONS OPS

Portfolio

Clearing house / Clearing member / Executing Broker

More...

Schedule

Pay

Reset

Valuation

Pay -33,008,882.27 USD Net 0.40 USD Receive 33,008,882.67 USD

IR - USD LIBOR 5/1/2013 COLL : STANDARD

[Last update timestamp]

Shift: Parallel/Segment/Basis Point

Parameters: Par Interp/Continuous

Money Market

Date	Rate	Spread
2D	0.1	

Forward

Start	End	Rate
5/15/20	6/19/20	0.27476
6/19/20	3M	0.29
7/17/20	8/21/20	0.305
3M	7/17/20	0.29
8/21/20	9/18/20	0.31971
9/18/20	12/18/20	0.34

Futures

Date	Price	ConvAdj
JUN13	9969-50	
SEP13	9966-00	0.1
DEC13	9963-00	0.3
MAR14	9960-50	0.4
JUN14	9957-50	0.5
SEP14	9953-50	0.63
DEC14	9947-50	0.63
MAR15	9940-50	0.75
JUN15	9931-50	0.88
SEP15	9922-00	1

Extended All In Cost

Date	Rate	Spread
2Y	0.232	16.25
3Y	0.341	17.25

IR - USD OIS 5/1/2013 COLL : STANDARD

[Last update timestamp]

Shift: Parallel/Segment/Basis Point

Parameters: Par Interp/Continuous

Average AIC with: FEDUS pillars

Date	Rate	Spread
6M	0.138	
9M	0.1655	
12M	0.1965	
2Y	0.4545	
3Y	0.886	
4Y	1.327	
5Y	1.751	
8Y	1.85	

Swap Spread

Date	Spread
10Y	10
12Y	10
15Y	10
20Y	15
25Y	15
30Y	15

EUR FLOW WITH USD COLLATERAL

Swap Trade: STANDARD *

ID: _____ Version: _____ State: 5/1/2013 COLL

Pay: Disc XUSD EXCH BB Receive: Disc OIS EXCH TEL3750 TradeCleared: NONE

Trade

Start: 5/3/2013 End: 5/3/2018 FX rate: 1.35925

Pay Ccy: EUR Ntl: 110,354,975.17 Index: EUR3M Term: 3M Basis: A360 Spread: 13

Receive Ccy: USD Ntl: 150,000,000.00 Index: LIBOR Term: 3M Basis: A360 Spread: _____

Counterparty: _____ Broker: _____ Do!

Product / Formula

[Product description] [Product description]

Company / Desk / Book / Folder

MASTER OPERATIONS OPS

Portfolio

Clearing house / Clearing member / Executing Broker

More...

Schedule

	Freq	Day	Roll date	Cal
Pay	Q	3	MF	LON
Reset	Q	3	MF	LON

Valuation

	Pay	Net	Receive
EUR	4,412,267.31	0.00	-5,998,141.53
USD			

IR - EUR XUSD 5/1/2013 COLL Li

9/9/2013 2:59:57 PM COLL

Shift: Parallel/Segment/Basis Point/1.C

Parameters: Raw/Continuous

FX Spot

Date	Rate
2D	1.35925

Money Market

Date	Rate	Spread
2D	0.08	

FX Forward

Date	Spread
1W	-0.33
2W	-0.75
3W	-2.00
4W	-2.30
3M	-6.30

Swap Spread

Date	Spread
2Y	10
3Y	11
4Y	12
5Y	13
7Y	14
10Y	15
15Y	16
20Y	17
30Y	18
50Y	19

DISCOUNT CONFIGURATION SETUP



Discount Configuration Definition - DISC_CFG :...

Window Discount Configuration Definition Action Help

App Config

Config ID: DISC_CFG

Use trade discount index (if set) ☐

Flow Ccy	Collateral Ccy	Cross Ccy	Discount Index
EUR	EUR		EONIA
EUR			EURIB
EUR	USD		XUSD
GBP	EUR	USD	
GBP			LIBOR
GBP	GBP		SONIA
GBP	USD		XUSD
USD	USD		FFUND
USD			LIBOR

Easy to maintain

USD flows with no collateral -> USD LIBOR

USD flows with USD collateral -> USD FFUND

EUR flows with no collateral -> EUR EURIB

EUR flows with EUR collateral -> EUR EONIA

EUR flows with USD collateral -> EUR XUSD

CUSTOMER LINK TO COLLATERAL CURRENCY



Collateral Support Definition - WRNT_EQ1 / ISDA / CSA / SUMMIT / NY / CUST1 / EQW : STANDARD

Version: 6 State: LIVE Load Reference

Identifier

Agreement format: ISDA CSD type: CSA CSD sub type: EQW
 Comm lend deal #: CSD name: WRNT_EQ1 Counterparty: CUST1
 Company: SUMMIT Desk: NY Legal Entity:
 Common Reference:

Local calendar: NYL Effective date: Initial Margin amount:
 Base currency: USD Close date: Initial Margin transfer date:
 Schedule: Freq: Day: Roll: Date Rule: Reciprocity: BILATERAL
☐ Gross Repo
☐ Bond price valuation
☐ Exclude expired and spot bond trades

Basic Trades **Collateral Definition**

Cash SSI Ops product type: Securities SSI Ops product type: Navigation Ops product type:
 Global: Initial/Independent Margin:

Cash:

Currenc	Eligibility	Interest	Asset	Spread	Σ	Ops Prod Type	Convert to Base Ccy	Include Int
EUR	BOTH	N					N	N

Customer links CSA

CSA defines Ccy

Multiple Panes : Trade Back : STANDARD *

Swap Trade X Trade Back X

Audit Linkage Reference Reuters Operations Attachments **Netting** Documents Exceptions Expected Fl

Collateral

Collateral: Y Ccy: EUR Confirmed: N CSD: ISDA//CSA//EQW//WRNT_EQ1

BLACK SCHOLES AND OIS



Swaption Trade : STANDARD

ID: Version: State: 12/18/2000 AA

Trade Indicators

Pay Disc EONIA
Receive Disc EONIA

Option

BUY Style EURO Type YIELD Model BSFT

Product [Product description]

1st exp City NY Time 1 11:00 AM Time 2 11:00 AM

Expiry 12/20/2010 Settle CASH Cal EUR Rule F

Swap Full>

Cpty CUST1 Broker Do!

Swap

Start 12/22/2010 End 12/22/2025 Ccy EUR Ntl 10,000,000.00

Pay Receive

Index FIXED Rate 5.67983 Index EURIB Rate

Term Spread Term 6M Spread

Premium

Complex... Ccy USD Type ORIG Percent Date 12/20/2000

Company / Desk / Book / Folder

SUMMIT NY

Portfolio

Clearing house / Clearing member / Executing Broker

More...

Vol 99.0 Yield 5.67983 Risk free 4.45502

Value 3,211,161.07 Delta ccy 6,029.29 Gamma % 42.13

BPV 3,211.16 Delta ratio -94.13 Vega % 13,469.50

Fee NPV 0.00 Rho -3,216.44 Theta 209.47

Swap Trade : STANDARD

ID: Version: State: 12/18/2000 AA

Window Swap Trade Action Help

App Config Auto-Price

Trade Indicators

Trade Diary NO

Pay Disc EUR EONIA
Receive Disc EUR EONIA

Trade

Start 12/22/2010 End 12/22/2025

Pay Receive

Ccy EUR Ntl 10,000,000.00 Ccy EUR Ntl 10,000,000.00

Index FIXED Ntl exp Index EURIB Ntl exp

Term Rate 5.67983 Term 6M Rate

Basis A360 Spread Basis A360 Spread

Counterparty CUST1 Broker Do!

Product / Formula

[Product description]

Company / Desk / Book / Folder

SUMMIT NY

Portfolio

Clearing house / Clearing member / Executing Broker

More...

Schedule

Pay A 22 MF EUR Pay S 22 MF EUR

Reset S 22 MF EUR Reset S 22 MF EUR

Valuation

Pay -3,902,414.79 EUR Net 0.02 EUR Receive 3,902,414.81 EUR

Swaption ATM rate equals
Collateralized swap rate

BSFT model stays valid

Volatility can be
collateralized or not

THWT = Trinomial Hull and White Tree pricing

$$dr_d(t) = [\theta_d(t) - a \cdot r_d(t)]dt + \sigma(t) \cdot dW_t$$

**Key Idea: Model on discount rate,
projection = discount + deterministic spread**

$$P_{\text{discount}}(r(t), t, T) = \bar{A}(t, T) e^{-B(t, T) r_d(t)}$$

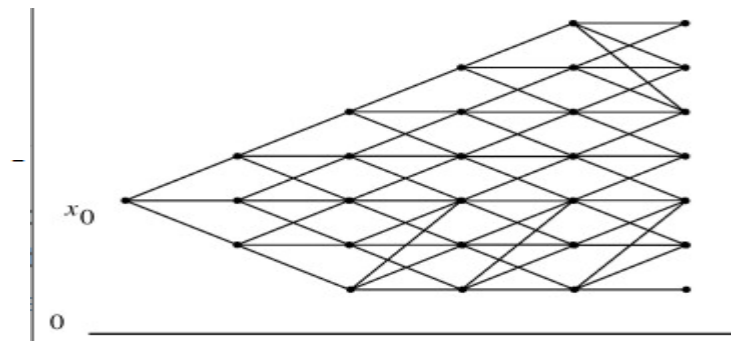
With:

$$B(t, T) = \frac{1 - e^{-a(T-t)}}{a}$$

$$A(t, T) = \exp \left\{ \int_t^T \frac{\sigma^2(s) B^2(s, T)}{2} - \theta(s) B(s, T) ds \right\}$$

The zero coupon bond price for projection curve is equal to:

$$P_{\text{project}}(r(t), t, T) = P_{\text{discount}}(r(t), t, T) \cdot S_{\text{spread}}(t, T)$$



Calibration with project index vol

Calibration

Pre-calibration method

ITERCON

Pre-calibration in hedge

☐

THWT OIS Calibration

☒



RECAP

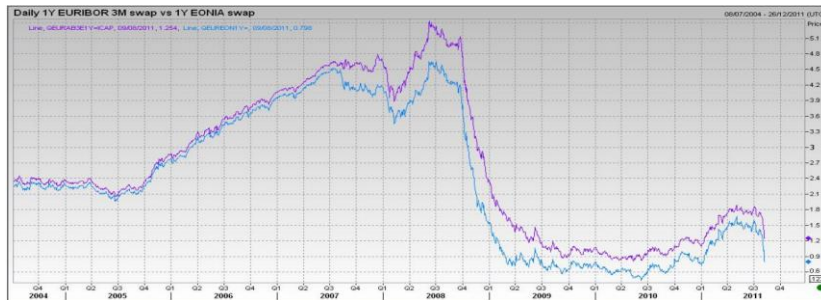
Discount curve
configuration on
pricing model level

LIBOR curve
generation with
collateralized swaps

Leg of OIS spread
curve definable

OIS – LIBOR curve
generation in pair

Convexity
adjustment auto-re-
computation in
Futures segment



1 day forward rates
are step functions
between meeting
dates

FX forward points
based on points or
outright rates

Curve generation
with collateralized
FRA

Cross currency
basis curves are in
the cross ccy OIS
framework

Domestic basis
curves are OIS
enabled