Notes from CQF Project Consultation 2

(15:00 GMT Portfolio Allocation, Forward LIBOR, 17:00 GMT LMM extras)

Question 1 Portfolio Topic (time horizon)

from JP to Richard Diamond (privately):

for portfolio construction, how deal with timezones when using daily data? (what is the meaning of portfolio with Japanese assets?)

from JP to Richard Diamond (privately):

US and Japan for example..

from JP to Richard Diamond (privately):

Serial correlation... why not use montly data..?

Answer 1 Portfolio Topic

from Richard Diamond to Everyone:

for portfolio contruction, how deal with timezones when using daily data? (what is the meaning of portfolio with Japanese assets?)

from JP to Everyone:

if trade portfolio on daily basis cannot trade one portfolio... geography does matter. how measure daily return of portfolio for uk investor? (different closing times for asset classe

from Richard Diamond to Everyone:

Partial correlations or Granger Causality or ECM (pairwise cointegration)

from Richard Diamond to Everyone:

Japan on US t-1

Question 2 Portfolio Topic (GARCH)

from simon n to Everyone:

For GARCH smoothing of variances:

from simon n to Everyone:

for garch smoothed variances, do I need to 1) estimate the parameters using MLT for each asset then get variance from GARCH for t+1? and it says in your notes that be careful when using weekly / monthly returns with GARCH - is there anything to look out for here?

from Richard Diamond to Everyone:

Robust Covariance Matrix

from Richard Diamond to Everyone:

- Separate GARCH estimation for each asset (separate MLE)

from Richard Diamond to Everyone:

- Vary type of GARCH depending on the asset

from Richard Diamond to Everyone:

GARCH(1,1)

from Richard Diamond to Everyone:

GARCH for implied vol. (correlation between asset and vol.)

from Richard Diamond to Everyone:

EGARCH for interest rates (under log)

from JP to Everyone:

can we index data or needs to traded instruments? (eg s&p total return index vs ES futures). Why 2 to 3 years of data, can we use longer? (to capture different macro regime to assess stability covar matrix?

from Richard Diamond to Everyone:

daily returns --> GARCH sigma2 horizon is 1Day

from Richard Diamond to Everyone:

weekly returns --> projection (sigma2 and allocations) for 1Week

from Richard Diamond to Everyone:

Multivariate models (PCA GARCH, DCC)

from Richard Diamond to Everyone:

instead

from Richard Diamond to Everyone:

better to do rank correlation estimation

Question 3 Portfolio Topic (benchmark /market allocations, data)

from simon n to Everyone:

For getting the assets initially from a benchmark, many papers give assets from the benchmark as asset types for example US Equities 5%, Intl Equities 4%, US Bonds etc.... I'm assuming we don't have to do that as I'm not sure how to get returns say for US Equities, do we just use actual instruments like apple for example if it is in the index?

from Richard Diamond to Everyone:

Reflecting the factor in the portfolio choice:

from Richard Diamond to Everyone:

market indices vs. top market cap names

from Richard Diamond to Everyone:

developing country + commodity asset

from Richard Diamond to Everyone:

basket of commodities (there is an index)

from Richard Diamond to Everyone:

Index is a benchmark, gives market allocations wtilda -- for equilibrium weights for BL

from Richard Diamond to Everyone:

Data sources

from Richard Diamond to Everyone:

Yahoo Finance - xls

from Richard Diamond to Everyone:

Quandl

from Richard Diamond to Everyone:

connect to Quandl data source using specialised libraries (in Python, R, must have C library for connection and Matlab)

from simon n to Everyone:

It says in the notes when estimating prior that a naive mean variance optimisation is not ideal, as part of black litterman you have to optimise, do you just mean by this that mean variance optimisation on it's own is not good enough?

from Richard Diamond to Everyone:

"multi-dimensional results"

from Richard Diamond to Everyone:

- different _kinds of optimisation_ (min Var, max SR)

from Richard Diamond to Everyone:

- different levels of risk aversion (three)

from Richard Diamond to Everyone:

table on 3 rows x 2 columns

from Richard Diamond to Everyone:

compare on the side: vs index (benchmark) allocations

from simon n to Everyone:

Thanks for all this One more! Sorry CVA people :), also might be a stupid question but just wanted to know how you get the volatility surface plots towards the end of your notes, how do you change the volatility to make the different portfolios?

Question & Answer 1 CVA Calculation (Forward LIBOR for IRS)

from Richard Diamond to Everyone:

How do we get multiple forward curves

from Richard Diamond to Everyone:

we simulate!

from Richard Diamond to Everyone:

either HJM (past rates data)

from Richard Diamond to Everyone:

or LMM ("forward looking" implied vols of caps)

from Richard Diamond to Everyone:

or r(t) model

from Richard Diamond to Everyone:

(calibrated to Z(0, 6M), Z(0 12M))

from Richard Diamond to Everyone:

Vasicek, HW

from Tanya to Everyone:

i can't see the slides on the screen - can anyone see them?

from Richard Diamond to Everyone:

forward curve built through the r(t) simulation

from Gustavo to Everyone:

In the HJM example the first volatility is parametrized by a constant, but if you re-do the working for today it looks like the best fit is 3degree polynomial. Is there a reason to use a constant?

from Martin to Everyone:

to calibrate model - acn we use (from Bank of England)

from Martin to Everyone:

GLC - Government liability curve ... for interest rate swap

from Martin to Everyone:

OIS from BOE for OIS discounting

from Venetia to Richard Diamond (privately):

its not me:)

from Richard Diamond to Everyone:

Please put yourselves in Mute

from Richard Diamond to Everyone:

6M LIBOR use the column

from Richard Diamond to Everyone:

C

from Martin to Everyone:

can't we just set dt = 0.5 instead of 0.01 as we just need LIBOR 6M, in 0.5 steps... or does it need it to be continious (0.01)

from Richard Diamond to Everyone:

1000 simulations

from Richard Diamond to Everyone:

sample of 1000

throw out the rates below K

600 rates > K left

-- median to calculate EE (from CVA lecture)

why the median and not the mean?

-- 97.5, 99th percentile to calculate PFE

what strike in an ir swap?

meadian is more reliable

average is skewed by few large observations

for each point of the IRS

0, 6M, 12M, 18M and on

L(t, 0,0,5)

L(t, 0.5, 1) -- Forward LIBOR in C62

a sample of 1000 --> cut rates

<K

L(t, 1, 1.5) -- Forward LIBOR in C112

L(t, 1.5, 2) -- Forward LIBOR in C162

EACH of those will have a sample (therefore median, percentiles)

under Monte-Carlo

can you explain the notation you use in e.g. L(t, 1, 1.5)... why is t not fixed?

"Optimising HJM Monte-Carlo"

Q: can't we just set dt = 0.5 instead of 0.01 as we just need LIBOR 6M, in 0.5 steps... or does it need it to be continious (0.01)

A: cannot do because we evolve curve in continious time to satisfy the nature of modelling by SDE

ok... I understand! thx

just easier to program in python

calibrate curve on all tenors available

PCA on (0 to 25Y)

but simuate only for (0, 5Y)

our preference is that you do take the recent data

BOE data : GLC - Government liability curve, and OIS curve for discounting rates simulation

data input to HJM (covariance matrix for PCA)

from Gustavo to Everyone:

de Gustavo para Todos:

In the HJM example the first volatility is parametrized by a constant, but if you re-do the working for today it looks like the best fit is 3degree polynomial. Is there a reason to use a constant?

from Richard Diamond to Everyone:

2-3 years

from Martin to Everyone:

ok... thanks

from Richard Diamond to Everyone:

BLC -- built from LIBOR linked instruments to model HJM and obtain Forward LIBORs

from Richard Diamond to Everyone:

single curve discounting -- take DF from the same HJM calibration

from Richard Diamond to Everyone:

dual curve discounting --

from Richard Diamond to Everyone:

 OIS curve data -- calbrate separate HJM

from Richard Diamond to Everyone:

evolve OIS forward curve separately! on different spreadsheet

from Richard Diamond to Everyone:

But LIBOR and OIS move mostly in parallel

from Richard Diamond to Everyone:

OIS curve today + add spread = DF

from Richard Diamond to Everyone:

dual curve discounting -- simple version:

from Sergey Movshev to Richard Diamond (privately):

is it possible to simulate LIBOR-OIS spread (which will have small volatility), rather than simulate OIS curve?

from Richard Diamond to Everyone:

use constant DFs implied by today's forward OIS curve

from Andre Guehlke to Everyone:

and then take the spread from the libor simulation Column B??

from Richard Diamond to Everyone:

LIBOR-OIS spread -- if using this assume constant

from Richard Diamond to Everyone:

OIS rates are overnight -- "to make it compatible with 6M LIBOR)

from Richard Diamond to Everyone:

DF from value which is OIS rate + spread

from Richard Diamond to Everyone:

DF from OIS rate

from Richard Diamond to Everyone:

DF (6M, 12M, 18M) for each point of the swap

from Tanya to Everyone:

how do we calculate the spread?

from Richard Diamond to Everyone:

for the purposes of the project you do not need to adjust the DF by OIS-LIBOR spread

from Tanya to Everyone:

ok, thx

from Richard Diamond to Everyone:

in practice, the adjustment is done but typically only by adding a constant (spread) to the OIS spot rate

Answers CVA Calculation Evaluation & Report -- Answered verbally

from Tanya to Everyone:

from Gustavo to Everyone:

About CVA component, do we have to include it in the report? or just implement it?

from Martin to Everyone:

how many marks (%) is the CVA component of the final project?

from Richard Diamond to Everyone:

80/20 to 40/60 [allocation of effort]

from Gustavo to Everyone:

About CVA component, do we have to include it in the report? or just implement it?

from Gustavo to Everyone:

ok

from Richard Diamond to Everyone:

CVA component -- yes, please reflect in the report

from Richard Diamond to Everyone:

3-4 pages

Answers on updating HJM for CVA calculation

from Richard Diamond to Everyone:

input data, OIS discounting (if used), HJM simulation, CVA calculation itself -- to be covered in the lectures to come

from Stig to Richard Diamond (privately):

so we could also use existing eigenvectors/parameters (from HJM spreadsheet), but use current rates - or is it expected that we calibrate new vectors based on recnet data

from Richard Diamond to Everyone:

we take recent data

from Richard Diamond to Everyone:

use existing spreadsheets (including the PCA)

from Gustavo to Everyone:

using recent data, 1st vol's shape is different. we are using a constant to parametrize it

from Gustavo to Everyone:

should we keep this way? is there a reason for that?

from Richard Diamond to Everyone:

One option is to use HJM PCA spreadsheet to get principlal components = volatility functions

from Richard Diamond to Everyone:

and then just re-code HJM SDE Monte-Carlo in Python, VBA etc

from Richard Diamond to Everyone:

if you do PCA on recent data -- you will discover that there more randomness and less systematic movement in the yield curve

can the principal components left as discrete functions?

from simon n to Everyone:
might be a stupid question but just wanted to know how you get the volatility surface plots towards the end of your notes, how do you change the volatility to make the different portfolios?

from simon n to Everyone:
for portfolio construction

from Richard Diamond to Everyone:
can the principal components left as discrete functions?

from Richard Diamond to Everyone:
we need to fit them

from Richard Diamond to Everyone:
because we need an analytical function to do the integration over

from Stig to Richard Diamond (privately):
should we assume a certain fixed rate ? like current 5 YR rate ?

from Sergey Movshev to Richard Diamond (privately):
a discrete function can be numerically integrated over

from Richard Diamond to Everyone:
now, our integration is numerical method -- done for flexibility

...

from Richard Diamond to Everyone:
You can assume any rate for the fixed leg of the IRS

from Richard Diamond to Everyone:
usually, it is set to equal to the LIBOR (t, 0, 0.5) today so that you have no cashflow

from Richard Diamond to Everyone:
in the first period

from Richard Diamond to Everyone:

AND

what if you have a forward-starting IRS

Forward LIBOR (estimation) for the time of the start as fixed leg's rate

or maybe pick the par-swap rate so MV of swap will be 0 to begin with?

Answers on Covariance Matrix (Portfolio Topic vs. Credit Topic)

I have a question regarding covariance matrix between terms in credit curve.

Should we check on robustness(stability) and make some adjustments in process of matrix estimation for make it more stable?

ok, thx

fiexed rate on the swap we are pricing

for the Credit Topic -- rank correlation estimation for correlation matrix

for the Portfolio Topic -- rank correlations matrix plus GARCH-smoothed variances for each asset individually

END OF WORKSHOP

17:00 GMT -- LMM Q&A for advanced interest rate discussion (could be quite fragmented!)

(1) The base set up is calibration from caps

once LMM SDE is calibrated, we can re-price caps and also price swaptions and Bermudans

(2) It is also possible to calibrate LMM wrt swaptions especially if one is using the model to manage the book of swaptions

but the Rebonato method is very engaged technically (inverse integral equation etc.)

The problem of calibrating to multiple strikes -- OLS or Partial Least Squares fit of volatilities to those strikes

volatilities for ATM strike remain dominant

(3) with OIS discounting

- statitic (constant) OIS-LIBOR spread (effecitively shifting OIS curve up to match its level with LIBOR curve)

- stochastic OIS-LIBOR spread (mean-reverting with high frequency) but literature not agree on which SDE to use, e.g., OU process, stochastic vol process

- Forward OIS curve is avaliable to 5Y point but there are no caps traded on it (we can calibrate HJM on historic volatility but not LMM yet)

(4) implied volatilities for caps (interest rates context)

- no benefit fitting under log

- simplistic piecewise fitting would lose the gradient

- use multiple splines or monotone convex fitting (Hagan & West)

this is for sigma(0, T_i)

then after sigma(T_i, T_i+1) stripped

we fit them to abcd function

coefficient phi_i , different for each tenor, plays multiple roles

-- improving local fits

-- can be found as some optimised coefficient if you have different sources of stripped implied volatility (from caps, from swaptions)

(5) calibration to swaption volatilities requires their transformation to caplet-equivalent volatilities using the Cascade Calibraiton Algorithm (simple quadratic fit and exact analytical solution)

[(6)} Hull and White -- bond pricing depends on volatility inputs, requires parametric fits over the volatiity term structure in practice

then the choice of fitting functions/recipes are

from Richard Diamond to Everyone:

-- abcd function (again)

from Richard Diamond to Everyone:

-- multiple cubic splines

from Richard Diamond to Everyone:

-- monotone convex fitting

from Richard Diamond to Everyone:

(over the volatility term structure)

from Richard Diamond to Everyone:

back to Hagan & West for fitting recipes, careful as they discuss fitting of the instantaneous forward curve

from Richard Diamond to Everyone:

here we are talking about fitting over implied vol. term structure