

Module 7.3: Static Risk Management Corporate Bonds

R Commentary

See module *Ch 7.3 SRM Corporate Bonds*.

We illustrate several different test programs in R. First, we illustrate some traditional static risk measures.

SRM Traditional CB Test.R

This program illustrates three bonds with identical characteristics except for coupon amount and follows nearly identical with 7.2 SRM Traditional UST Test.R and is not reproduced here.

SRM Spreads Over Base Curve Test.R (Selected Excerpts and Output)

Given the level of complexity involved in this R code, we decompose the analysis into different smaller components and build out the separate source code. Thus, the main test program is rather short.

```
#
# Fixed Parameters
#
# LSC horizon
inputHorizon <- 7 # In days
inputFrequency <- 2
inputPar <- 1000000.0
inputChangeInYTM <- 0.01 # Effective duration and convexity
RoughMaturity <- 4.9 # Years
NBCFactors <- 3 # Number of base curve factors including Level, 8 or less
NSCFactors <- 3 # Number of spread curve factors including Level, 8 or less
NBaseCurve <- 30 # Potential observation for every year for 30 years
# Plot range information
FixRange <- FALSE # For plots
FRMax <- 3.1 # Plot bounds if fixed
FRMin <- 2.4
# Input files for U. S. Treasury bond and CMT rates
USTFileName <- 'UST20200619.xlsx'
CBFileName <- 'CB20200619.xlsx'
CMTFileName <- 'CMT20200619.xlsx' # Should have same date as UST
mTitle = "UST: June 19, 2020" # Date in graph title
# Downloaded UST data stored with date appended: use for settlement
SettlementDateMonth = 6 # Based on file name
SettlementDateDay = 19 + 2 # Current practice is + 2 days settlement
SettlementDateYear = 2020
source("UST Book Inputs.R") # Access UST book
source("CB Book Inputs.R") # Access corporate bond book
source("SRM CB Functions.R") # Corporate bond functions (semi-annual only)
source("SRM BC and SC Analysis.R")
```

The UST book and BB book are accessed with the UST Book Inputs.R and CB Book Inputs.R code.

Required functions are provided in SRM CB Functions.R and the LSC-related calculations offered in SRM BC and SC Analysis.R.

We first need to incorporate a credit spread. We consider the BB yields provided by Bloomberg. The selection of corporate bond information is in CB20200619.xlsx. The core optimizer employed here is optimx.

optimx R package provides minimization routine to select LSC coefficients

to minimize squared differences #, all.methods=TRUE (uses all methods)

```
OptOutput <- optimx(par=x, fn=DiffCMTRates, NFac = NFactors, S = Sc,
  NCMTs = NBaseCurve, MSR = MarketCMTRates,
  method=c('nlinb'), control=list(save.failures=FALSE, maxit=2500))
# If 'nlinb' failed, then try a few more optimization routines,
# quit when first one produces answer
Counter = 0
while(is.na(OptOutput$pl)){
  Counter = Counter + 1
  if(Counter == 1)OptOutput <- optimx(par=x, fn=DiffSwRates, NFac = NFactors,
    S = Sc, NCMTs = NBaseCurve, MSR = MarketCMTRates,
    method=c('BFGS'), control=list(save.failures=FALSE, maxit=2500))
  if(Counter == 2)OptOutput <- optimx(par=x, fn=DiffSwRates, NFac = NFactors,
```

```

    S = Sc, NCMTs = NBaseCurve, MSR = MarketCMTRates,
    method=c('Nelder-Mead'), control=list(save.failures=FALSE, maxit=2500))
if(Counter == 3)OptOutput <- optimx(par=x, fn=DiffSwRates, NFac = NFactors,
    S = Sc, NCMTs = NBaseCurve, MSR = MarketCMTRates,
    method=c('L-BFGS-B'), control=list(save.failures=FALSE, maxit=2500))
}
# is.data.frame(OptOutput) # yes, it is
# x <- attr(OptOutput, "details")
OptMethod <- rownames(OptOutput[1]) # Method that provided answer, see Nash
y <- 0
y <- numeric(NFactors)
for(i in 1:NFactors){
  if(i==1)y[1] <- OptOutput$p1[1]
  if(i==2)y[2] <- OptOutput$p2[1]
  if(i==3)y[3] <- OptOutput$p3[1]
  if(i==4)y[4] <- OptOutput$p4[1]
  if(i==5)y[5] <- OptOutput$p5[1]
  if(i==6)y[6] <- OptOutput$p6[1]
  if(i==7)y[7] <- OptOutput$p7[1]
  if(i==8)y[8] <- OptOutput$p8[1]
}
LSCBaseCurveParameters <- y
The optimization process is repeated for spreads.
#
# Spread 1 Analysis (BB curve, Bloomberg)
#
source('SPREADS Functions.R') # Various Bond functions
OptOutput <- optimx(par=x, fn=DiffSwRates, NFac = NFactors, S = Sc,
  NCMTs = NBaseCurve, MSR = MarketAllInRates,
  method=c('nlsminb'), control=list(save.failures=FALSE, maxit=2500))
...
LSCAllInCurveParameters <- yAllIn
LSCSpreadCurveParameters <- LSCAllInCurveParameters - LSCBaseCurveParameters

```

Several graphs are produced within this R code and examples were discussed above.

SRM CB Book HPR Analysis Test.R (Selected Excerpts and Output)

Based on the previous R code, we extend it to cover numerous LSC-related static risk measures here. Given the similarity, we do not reproduce it here. Several graphs are produced with this code and are discussed above.