

# Math 5422 - Quantitative Hedge Fund Strategies

## Project 6: Convertible Bond Pricing Using QuantLib

Due Date: March 1, 2023

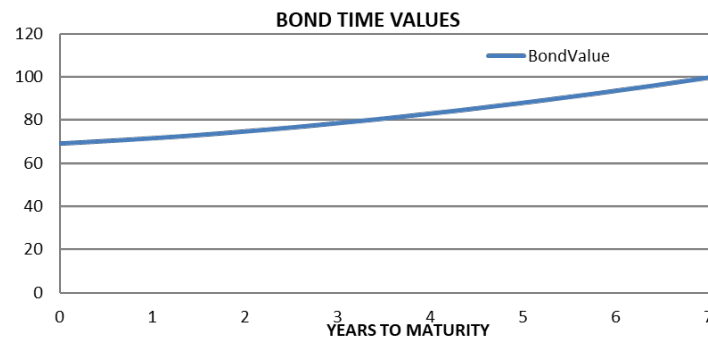


# Project Description

## 1. Using QuantLib to price a convertible bond

- Ideally, we should use the actual swap curve as the yield curve. If that is too difficult, you can use a constant yield curve
- Dividend is 0
- Soft calls will be ignored
- Outputs should include prices, accrued, and the Greeks.

## 2. Calculate the bond floor curve (on the time grids) using a risky yield curve = swap curve + 400bp, this is simply a cashflow discount from maturity back to valuation date.



<http://gouthamanbalaraman.com/blog/value-convertible-bond-quantlib-python.html>



# Bond Description

< >   OPK 3 02/01/2033 144A Corp   DES   Related Functions Menu		Message	
OPK 3 02/01/33 \$174.882 - .248 73.882 / 75.882 6.629 / 6.302		At 15:00 -- X -- Source BVAL	
OPK 3 02/01/33 Corp		Actions	Settings
Page 1/13		Security Description: Convertible	
94 No Notes		95 Buy	96 Sell
25 Convertible Bond		26 Underlying Description	
Pages		Issuer Information	
11 Bond Info		Name OPKO HEALTH INC	
12 Addtl Info		Industry Healthcare (BCLASS)	
13 Reg/Tax		Convertible Information	
14 Covenants		Mkt of Issue PRIV PLAC... Convertible	
15 Guarantors		Ctry/Reg US Currency USD	
16 Bond Ratings		Rank Sr Unsecured Series 144A	
17 Identifiers		Conv Ratio 141.4827 Conv Price 7.0680	
18 Exchanges		Stock Tkr OPK US Stock Price 1.090000	
19 Inv Parties		Parity 15.4216 Premium 392.0496	
20 Fees, Restrict		Coupon 3.000000 Init Prem 20.000	
21 Schedules		Type Fixed Freq S/A	
22 Coupons		PUT/SOFTCALL CALL 03/24/23@100.00	
Quick Links		Calc Type (49) CONVERTIBLE	
32 ALLQ Pricing		Pricing Date 01/25/2013	
33 QRD Qt Recap		1st Coupon Date 08/01/2013	
34 TDH Trade Hist		Convertible Until 01/28/2033	
35 CACS Corp Action		Maturity 02/01/2033	
36 CF Filings		{NSN 001W0MEQTXD<Go>} CONVERTIBLE INTO 141.4827 SHARES + ADDTL SHARES AS	
37 CN Sec News		CLOSE PX EXCEEDS 130% OF CONVERSION PRICE FOR 20/30 TRADE DAYS. CONV UNTI...	
38 HDS Holders			
39 OVCV Valuation			
60 Send Bond			
		Identifiers	
		FIGI BBG0042LZ6H2	
		CUSIP 68375NAA1	
		ISIN US68375NAA19	
		Bond Ratings	
		Issuance & Trading	
		Aggregated Amount Issued/Out	
		USD 175,000.00 (M) /	
		USD 50.00 (M)	
		Min Piece/Increment	
		1,000.00 / 1,000.00	
		Par Amount 1,000.00	
		Book Runner JEFF, LTHAL	
		Reporting TRACE	



# Calls / Puts / Soft Calls

Schedules		
51) Call	53) Put	54) Softcall 61) Cash Tender
Call with minimum 30 days notice		
Callable on and anytime after date(s) shown		
Date	Price	
02/01/2019	100.000	

51) Call	53) Put	54) Softcall 61) Cash Tender
Discrete Put minimum 1 days notice		
Date	Price	
02/01/2019	100.000	
02/01/2023	100.000	
02/01/2028	100.000	

Schedules

51) Call

53) Put

54) Softcall

61) Cash Tender

Soft calls are options for the issuer to repurchase or force a conversion which are activated only if the underlying stock price equals or exceeds a trigger determined at the time of issue.

Current Prov Price (Stock Currency)

None

Current Prov Price (Bond Currency)

None

Current Call Price

None

Trigger Type

Percent

Accrual Rate

None

Quote Type

Close

Day Type

20 out of 30 Business Days

Date Range	Call Price (%)	Call Prc (USD)	Trigger (%)	Notes
02/01/2017 - 02/01/2019	100	1000	130	



# Bond Description

OPK 3 02/01/33 144A Corp | OVCV | Related Functions Menu

OPK 3 02/01/33

\$174.882

-.248

73.882 / 75.882

6.629 / 6.302

At 15:00

-- X --

Source BVAL

OPK 3 02/01/33

9) Actions

9) Settings

Convertible Valuation

Bond EJ5299098

Stock OPK US Equity

Make Whole

1) Pricing Analysis

12) Cash Tender

13) Historical Analysis

14) Scenario Analysis

15) Nuke/Hedge

2) Analysis

22) IR Curve

23) Credit Curve

24) Dividends

25) Volatility

Market Price

Spread (Credit)

Volatility

Stock Price

Borrow Cost

75.882

400.000

113.36

1.090

0.0 %

BVAL (15:00)

Flat 1Y Implied

Trade Date

Settle Date

Model

E2C

Greeks based on

Call Adj

02/21/2023

02/23/2023

Jump Diffusion

0.0

Pkt Price & Vol

None

(%)

Fair Value

Cheapness (%)

Implied Spread

Implied Vol

Delta (%)

Delta (pts)

Effective Trig

Unit Prc

Hedge Ratio

80.982

6.297

563.876

N.A.

29.381

0.045

0%/0.000

809.818

4.157

Bond Floor

Option Value

Parity

Premium (pts)

Premium (%)

Gamma

Vega

Theta

Exp Life (Fugl

79.636

1.346

15.422

60.460

392.050

0.081

0.037

0.018

3.545

IR Sens

Spread Sens

Phi

Psi

Chi

Upsilon

Convexity

Effective Dur

-2.595

-2.903

N.A.

-0.087

N.A.

0.400

0.295

3.420

Yield to Mty

Yield to Call

Yield to Put

Yield to Worst

Current Yield

Breakeven (Y)

CF Payback (Y)

Accrued Int

6.302

372.154

9.183

6.302

3.954

20.153

20.153

0.183

Description

Bond CUR

Stock CUR

Stock Ticker

Cusip

Collateral

Par Amount

ISIN

Common

Wertpapier

Moody's Rating

S&P Rating

Fitch Rating

Div Protection

Div Thresh

Series

USD

USD

OPK US

68375NAA1

SR UNSECURED

1000.00

US68375NAA19

088631340

A1UEN5

N.A.

N.A.

N.A.

Yes

None

144A

Conv Prc

Conv Ratio

Proj Conv Ratio

Init Prc (%)

3% FIXED

Cpn Freq

First Coupon

Next Coupon

CoCo Trig (%)

Inc Share

Curr Conv Ratio

Market

Div Carry Fwd

Call Prot (yrs)

Ex Code

7.0680

141.4827

141.4827

20.00

Semi-Annual

08/01/13

08/01/23

130.00

N.A.

141.4827

PRIV PLACEMENT

None

None

Issue Amt

Amt Out

Issue Date

Maturity

Conv From

Conv Until

Day Count

Lead Mgr

Market Cap

Ind Group

Ind Sector

300/1800 Vol

Div Prot Limit

175.00MM

50.00M

01/30/13

02/01/33

04/01/13

01/28/33

30/360

JEFFLTHAL

842MM

Healthcar...

Consumer...

342.05/13...

No

Next Call Date

Next Put Date

Next Call Price

Next Put Price

Prov Trig

Prov Start

BEST Est LT Gwth

BEST EPS 1Y/2Y

BEST P/E 1Y/2Y

BEST PEG 1Y/2Y

Prc vs 52W Hi

Prc vs 52W Low

Yearly Div

03/24/23

02/01/28

100.00

100.00

130%/9.188

02/01/17

None

- .444/- 2...

None/NL

None/NL

-71.164

5.815

.00



# Q&A

## 1. Greeks:

- Delta: Change of value for 1% stock move. Use central difference on +/-1% stock price move. **Note that the denominator should be parity, i.e. 15.422. (Delta should be < 1)**
- Gamma: Change of Delta for 1% stock move, calculate along with Delta.
- Vega: Change of bond value for 1% volatility change
- Rho: change of bond value for +100bp yield curve changes (calculated as  $100 * (\text{change of bond value for 1bp of yield curve changes})$ )





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