

LQA-LIQUIDITY ASSESSMENT

LIQUIDITY RISK AND MARKET IMPACT. ESTIMATING LIQUIDITY USING PRICE
UNCERTAINTY AND MACHINE LEARNING.

(HIGHLY CONFIDENTIAL, FOR DISCUSSION PURPOSE ONLY)

JAN 2015

Bloomberg

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MARKET NEEDS

Regulatory requirements

Risk management functions
and systemic risk

Trading/investment support

THE PROBLEM

There is no industry-standard
definition of liquidity

Liquidity is difficult to
estimate due to lack of data
and transparency

Bid-ask spread is an
inadequate approach relied
on by the market and
academia

THE SOLUTION

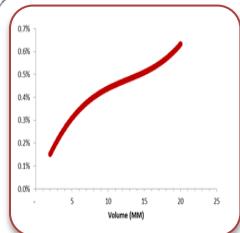
We developed a proxy that
addresses market demands
leveraging Bloomberg data,
analytics and pricing

**Our methodology is based on
machine learning.** We
approach the problem from a
systemic risk perspective
“melting” together relevant
factors that can influence
liquidity

Uncertainty in the data is
factored into the calibration

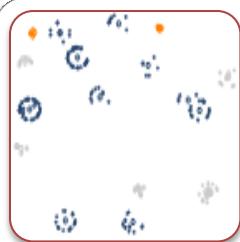
- **The Liquidity Assessment Tool (LQA) helps measure market depth and liquidity of securities for the purposes of regulatory reporting, risk and pre/post trade analysis.**
- It provides information, based on a machine learning approach, such as the probability of selling a specific volume at a specific price, the expected cost of liquidation and expected maximum volume and expected days to liquidate a specific volume (given a maximum market impact).
- The tool also provides the level of uncertainty for each of these returns.

The overall model is based on THREE components:



Market Impact model

- Market Impact model derived from literature
- We estimate price shift from a fair value (equilibrium) given a specific volume
- In the proposed framework the calibration can be extended to **every asset class**



Machine Learning Engine

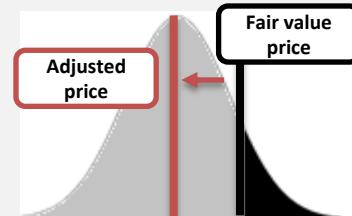
- Problem : A lack of trade data gives < 100% coverage
- Solution : Cluster Analysis is used to identify comparable assets
- **We also leverage NON-traditional information**



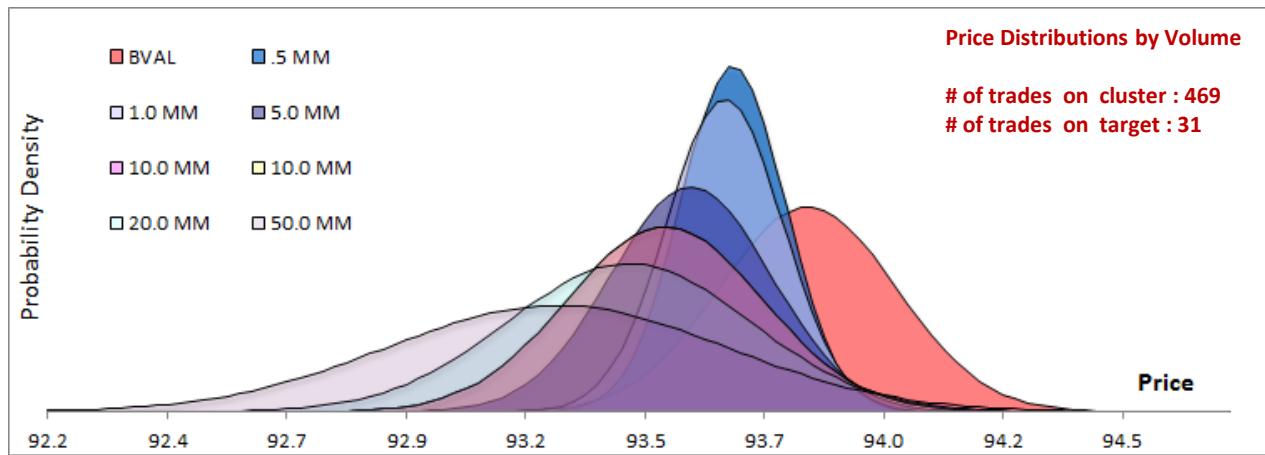
Market Normalization Factor

- We want the model to react to market conditions
- We measure the quality of information in the market (Entropy)
- **New concept of market indices**

- Definition : “PROBABILITY OF LIQUIDATING A GIVEN VOLUME AT A FAIR VALUE PRICE OR WORSE”
- Illiquidity (low probability of SELL) can be driven by
 - illiquidity of the bond (high cost of liquidation)
 - high uncertainty in the estimation due to poor market observation or low cluster quality

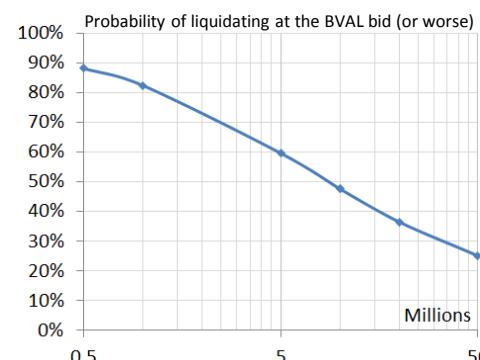


Security features	
Date	2014-12-22
Snapshot Time (2=NY4, 4=LO4)	2
Duration	7.05
Coupon	1.88
Age	2.41
AMT Outstanding	1,000,000,000
Price	93.52
Contrib Std	0.189652
% of Market Data	100.00%
BA Spread	0.29
Sum Trade Vol. of past 2 months	21,859,000
Country of Risk	US
Currency	USD

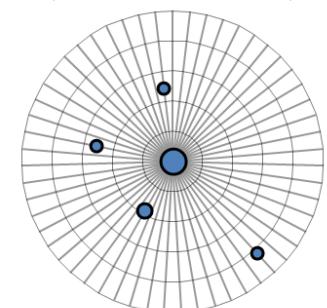


All values in local currency

Volume	New Price	Impact	Uncertnty	Prob of selling at bid or higher	TTL for MI < 0.31
500,000	93.65	-0.16	0.11	88.20%	0.06
1,000,000	93.63	-0.18	0.12	82.48%	0.11
5,000,000	93.56	-0.25	0.17	59.68%	0.57
10,000,000	93.50	-0.31	0.21	47.61%	1.15
20,000,000	93.42	-0.39	0.26	36.50%	2.30
50,000,000	93.27	-0.54	0.37	25.12%	5.74



Distances in Cluster (# of member s5)
(BLUE are from the same issuer)



Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEJ2992190	IBM CORP	Technology	21.83%	2.78	0.29	1,000,000,000	7.05	1.88	AA-	US	0.47	9
COEJ7725454	IBM CORP	Technology	20.23%	3.05	0.28	1,500,000,000	7.45	3.38	AA-	US	0.52	9
COEI8592749	IBM CORP	Technology	19.80%	2.49	0.59	500,000,000	6.24	2.90	AA-	US	0.39	9
COEK0635616	IBM CORP	Technology	19.69%	3.09	0.13	2,000,000,000	7.78	3.63	AA-	US	0.64	9
COEJ6626075	IBM CORP	Technology	18.46%	2.31	0.33	1,250,000,000	5.16	1.63	AA-	US	0.27	9

- Price impact for selling 1% of AMT is -0.307 (USD) with uncertainty (st.dev.) of 0.210. The probability of execution at the bid is 47.61%.
- The max volume can be executed, with market impact not bigger than 0.31%, is 8.70 MM (USD).
- Given max volume and accepted market impact, the time to liquidation is 1.15 days (under linearity assumption in this release).

INPUTS

GENERAL INPUTS

- V = Trade Volume
- P = Reference (fair value) Price
- S = Bid/Ask Spread
- σ = Price Volatility over period ΔT (i.e. 2 months for Corp)
- $F2$ = Turn over in period ΔT (i.e. 2 months for Corp)
- $F3$ = Average daily volume
- N = Average daily number of trades
- R = Participation Rate

ASSET CLASS SPECIFIC INPUTS

- Fixed Income : Duration (D), Coupon (C), AMT (M), etc.
- Equity : Fundamentals
- Other asset class

NOVEL INPUTS

- News Sentiment Index
- Accessibility Index (function of holder type)
- Other specific features for different asset classes

OUTPUTS

LIQUIDITY ASSESSMENT (LQA)

- Φ = Probability of Selling volume (V) at Price (P) or worse
- I_V = Market Impact selling custom volume (V)
- V_{MAX} = Given max Market Impact (I_{max}), max Volume can be sold
- T = Given max Market Impact (I_{max}), days to liquidate custom volume (V)
- L = Synthetic Liquidity Score (*)
- Γ = Cluster Quality Index (*)
- Θ = Cluster Migration Rate (*)

PRUDENT VALUATION (PRUVAL)

- P_{MPU} = Market Prudent Price
- ΔCC_{AVA} = Close Out cost AVA
- ΔMPU_{AVA} = Market Price Uncertainty AVA
- ΔCP_{AVA} = Concentrated position AVA
- ΔC_{AVA} = Combined AVA

MARGIN PERIOD OF RISK (MPR)

- Under Test (Q2 2015, details in the appendix)

HQLA : Active and sizable market

- Under Test

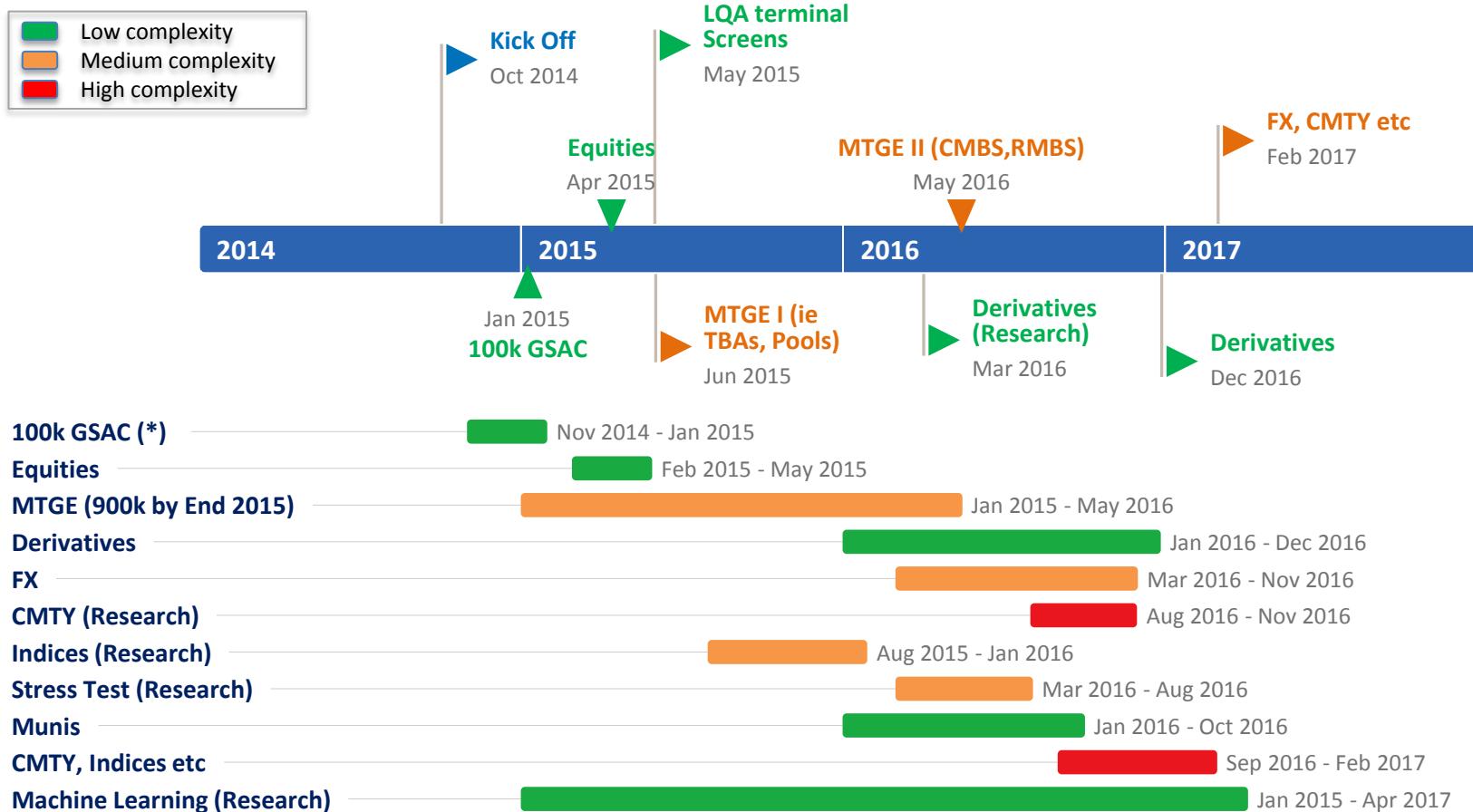
Volker : RENTD

- Under Test

- (*) input overridable with client assumption
- (**) available in Q2 2015

PRODUCT DEVELOPMENT TIMELINE

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2015

- Official roll out with Data License and terminal page (100k GSAC : Gov, Sov, Agency, Corp) full input override capabilities by clients
- During the year we will deliver up to 900k structured finance bonds
- We will deliver equities
- Phase 1 of portfolio liquidity analysis

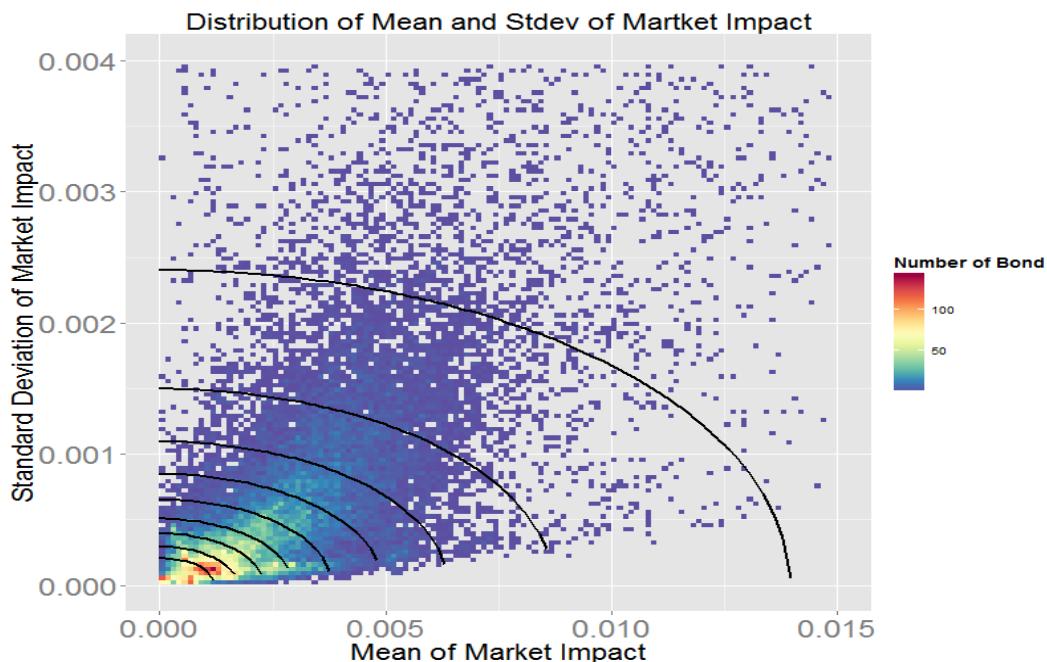
USE CASE 1 : SCORING

SYNTHETIC LIQUIDITY SCORE

LIQUIDITY SCORE OVERVIEW

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- We developed a score able to synthetize the security level liquidity estimated from LQA
- We simulate a standard volume SELL per security and account for :
 - Average market impact (\hat{I}_i)
 - Historical standard deviation of market impact (σ_{I_i})
- We calculate the liquidity for every security
 - $l_i = f(\hat{I}_i, \sigma_{I_i})$
- To define the final score :
 - We bucket l_i in quantiles and generate an score L where $L = (1, \dots, 100)$
 - $L = 100$ (**highly liquid**) is attributed to securities having l_i from 99th quantile to 100th etc



- In the plot on the left we show how our securities (Corp and Gov in this case) distribute
- The black lines represent the score boundaries defined according to percentiles (0-10, 11-20 etc)
- Illiquidity is high where we have high average and high volatility of market impact
- The colors represent the number of bonds in the region

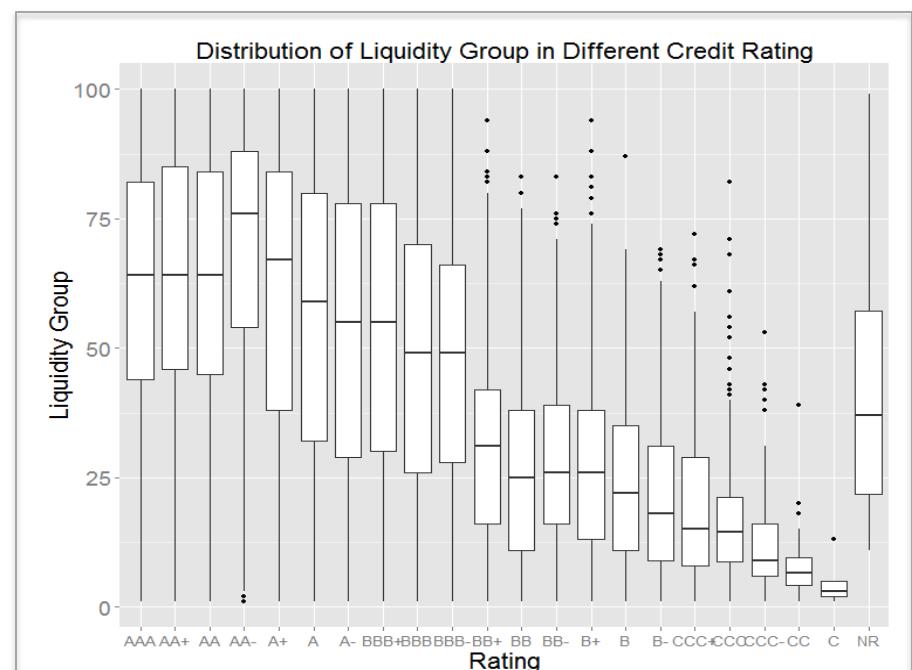
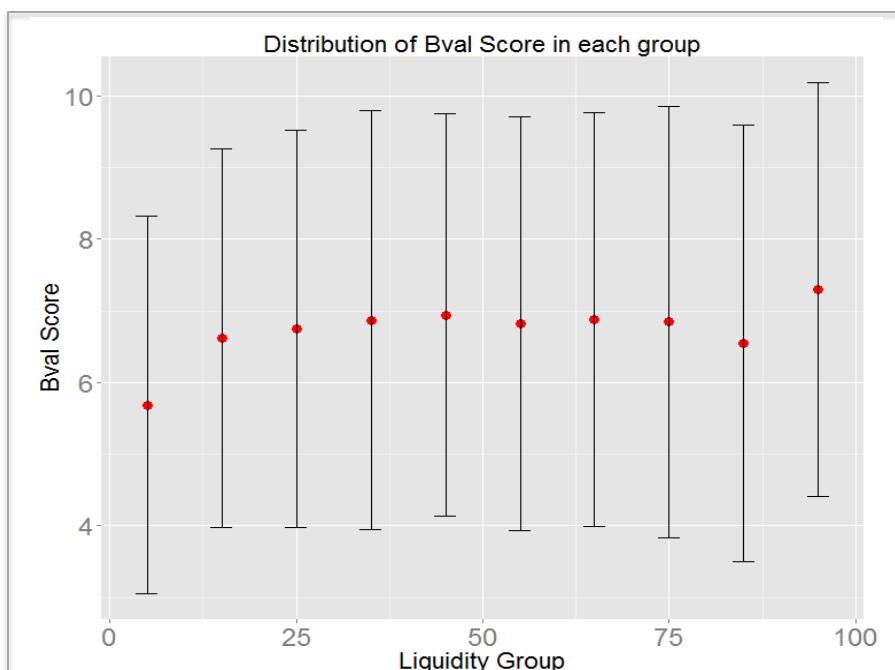
HIGHER LIQUIDITY SCORE MEANS HIGHER LIQUIDITY

SCORE DYNAMIC (1/2)

Bloomberg

Liquidity Score compared with BVAL score and Rating (test on 87k bonds)

- BVAL Score represent quantity and quality of the direct observation used for the fair value ask and bid. It is an important component of liquidity estimation but doesn't guarantee that a bond with a lot of observation has necessarily a low liquidation cost
- Rating is used as proof of concept because the expectation is that higher rated bonds, given similar other characteristic, will have lower cost of liquidation



- Distribution of Bval Score in different liquidity group show that Bval Score (measure quality of input data) is not sufficient as indicator of liquidity

- As expected, in average, higher rated bonds have lower liquidity

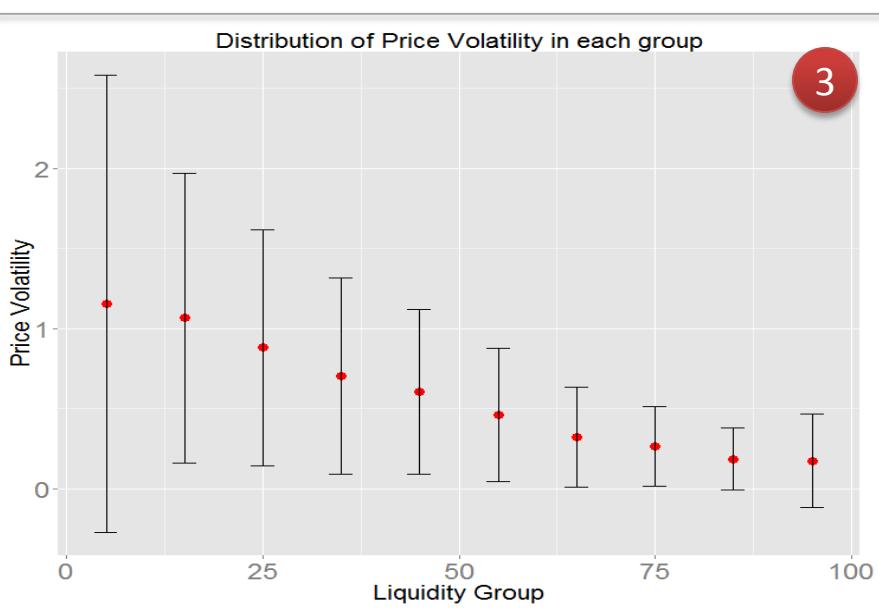
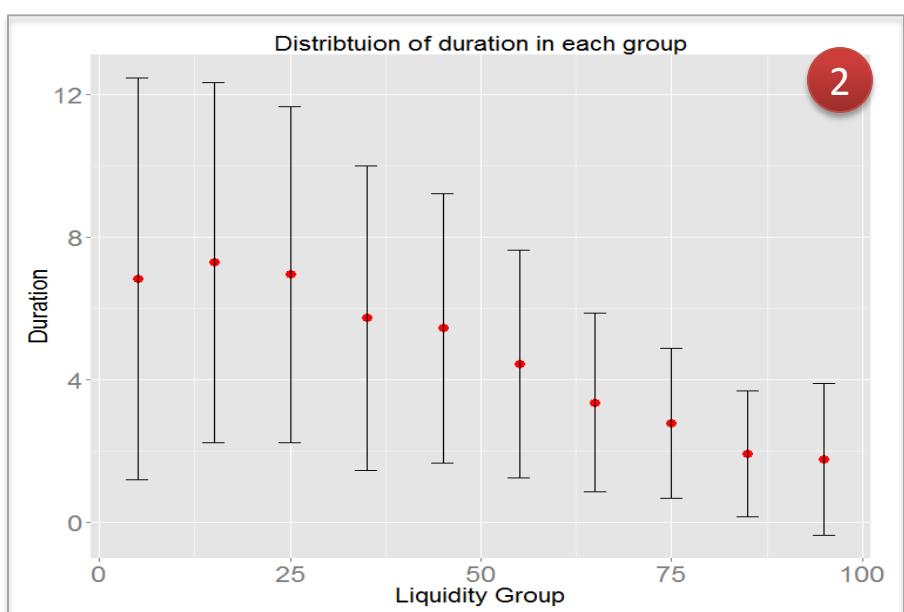
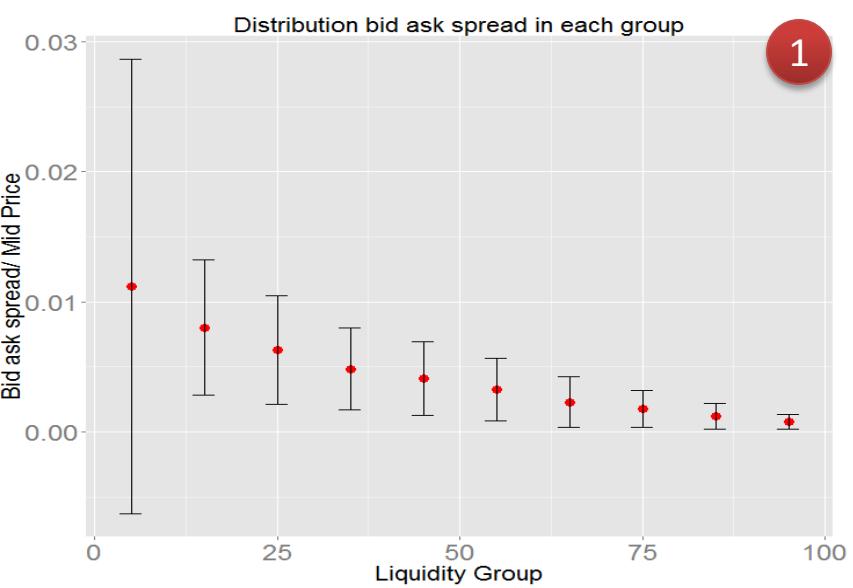
SCORE DYNAMIC (2/2)

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- Plot (1) : Score vs average bid/ask spread in bonds with the same score
- Plot (2) : score vs average duration
- Plot (3) : score vs average price volatility

We observe :

- The pattern (red dots) is coherent. Higher duration bonds are more illiquid etc.
- But the error bands are strongly overlapped. This means that the single feature (bid/ask spread, duration, price volatility etc.) is not enough to capture cost of liquidation



1

2

3

EXAMPLE : LOW LIQUIDITY SCORE

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- Our model only use up to 12/2/2014 data, at that time this bond already classify as illiquid bond.
- BVAL Score was 8 but now its only 3.
- This show that our model are more sensitive to market change
- This means that just looking the number of direct observation is not enough to assess liquidity

Analyze Corp. Bond Menu: RSHB 10.9 10/13/22 Corp - DES - Message ?

ES
ROSSELKHOZBANK RSHB Var 22-15 / () MICB
RSHB 10.9 10/13/22 Corp

99 Notes 99 Buy 99 Sell 99 Settings

20 Bond Description

Pages		Issuer Information		Identifiers	
1) Bond Info	Name	ROSSELKHOZBANK	ID Number	EJ4171629	
2) Add'l Info	Industry	Banks	ISIN	RU000A0JT874	
3) Covenants	Mkt Iss	domestic	BBGID	BBG003L6TV06	
4) Guarantor	Country	RU	Bond Ratings	Moody's Ba1 *- Fitch BBB- Composite BB+	
5) Bond Ratings	Rank	Sr Unsecured	Currency	RUB	
6) Identifiers	Schedule	Series	Type	Variable	
7) Exchanges	Coupons	Maturity	Iss Price	100.00000	
8) Inv. Parties	Quick Links	PUT 10/22/15@100.00			
9) Fees, Restrict	1) ALLQ Pricing	Calc Type	(1155)RUSSIA: 91/182-PAY	Amt Issued/Outstanding	
10) Schedules	2) QRD Quote Recap	Announcement Date	10/25/2012	RUB 5,000,000.00 (M) /	
11) Coupons	3) T0H Trade Hist	Interest Accrual Date	10/25/2012	RUB 5,000,000.00 (M)	
12) ALLQ Pricing	4) CACS Corp Action	1st Settle Date	10/25/2012	Min Piece/Increment	
13) QRD Quote Recap	5) Prospektus	1st Coupon Date	04/25/2013	1,000.00 / 1,000.00	
14) T0H Trade Hist	6) Sec News			Par Amount 1,000.00	
15) CACS Corp Action	7) Holders			Book Runner SBERBK,VTBCAP	
16) Prospektus	8) VPRD Underly Info			Exchange MICEX A1	
17) Sec News	9) Send Bond				

CHBS Menu: RSHB 10.9 10/13/22 Corp - BVAL - Message ?

HELP for explanation. Enter snapshot criteria and hit <Go>

RSHB 10.9 10/13/22 Corp # Request Demo Bloomberg Valuation

Evaluated Pricing Direct Observations Capital Structure Sector Relative Value

Snapshot ASK 12/02/14 LO 3PM Methodology Price YTW YTM Weight Score

Final BVAL Price	Final BVAL	100.625	10.380	- 0.0%	8/10
Final BVAL Score (out of 10)	Final BVAL	100.629	10.370	- 0.0%	8/10
Yield to Worst (%)	Direct Obs	100.629	10.370	- 0.0%	8/10
Spread to Worst (bps)	Cap Structure	101.590	9.170	- 0.0%	2/5
Worst Date	Sector Rel Value	101.586	9.180	- 0.0%	2/3
OAS (bps)	Previous BVAL	100.500	10.530	- 0.0%	7/10
Effective Duration (yrs)					

BVAL History Price

100.00
100.50
100.55
100.50
100.45
100.40
100.35
100.30
100.25
100.20

Sep Oct Nov

Issue Information (DES)

Issuer: ROSSELKHOZBANK
Sector: Commer Banks ...
Ratings: NR/Ba1
Rank: Sr Unsecured
Amt Outstanding: RUB 5MM
Next Call Date:
Next Call Price:
Issue Date: 10/25/12
Issue Price: 100.0000
Issue Spread (bps):
Identifier: EJ4171629

CHBS Menu: RSHB 10.9 10/13/22 Corp - BVAL - Message ?

HELP for explanation. Enter snapshot criteria and hit <Go>

RSHB 10.9 10/13/22 Corp # Request Demo Bloomberg Valuation

Evaluated Pricing Direct Observations Capital Structure Sector Relative Value

Snapshot ASK 01/12/15 LO 3PM Methodology Price YTW YTM Weight Score

Final BVAL Price	Final BVAL	103.750	5.940	- 10.0%	3/10
Final BVAL Score (out of 10)	Final BVAL	103.750	5.940	- 10.0%	3/10
Yield to Worst (%)	Direct Obs	106.390	2.530	- 5.5%	3/5
Spread to Worst (bps)	Cap Structure	106.389	2.530	- 0.0%	3/5
Worst Date	Sector Rel Value	106.250	9.360	- 94.5%	3/10
OAS (bps)	Previous BVAL	101.250	9.360	- 94.5%	3/10
Effective Duration (yrs)					

BVAL History Price

103.75
103.50
103.00
102.50
102.00
101.50
101.00
100.50

Oct Nov Dec 2014 2015

Issue Information (DES)

Issuer: ROSSELKHOZBANK
Sector: Commer Banks ...
Ratings: NR/Ba1
Rank: Sr Unsecured
Amt Outstanding: RUB 5MM
Next Call Date:
Next Call Price:
Issue Date: 10/25/12
Issue Price: 100.0000
Issue Spread (bps):
Identifier: EJ4171629

EXAMPLE : LOW LIQUIDITY SCORE

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- This bond has high Bid ask spread (>1.5 Euro), which means that it should have high market impact
- low credit rating also increase liquidity risk
- High coupon rate 8.5%, high Price Volatility (1 Euro) increase market impact
- But this bond have Bval Score 8, indicating a big number of pricing source (ie contributions). **This doesn't guarantee low liquidity risk**

Analyze Corp Bond Menu YIOULA 8 1/2 05/15/19 Corp DES Message

ES
GLASSTANK BV YIOULA8 1/2 05/19 82.7570/85.3590 (13.936/13.029) BGN 011:59
YIOULA 8 1/2 05/15/19 Corp

2) Bond Description 3) Order Description
Pages 1) Bond Info 2) Addtl Info 3) Covenants 4) Guarantors 5) Bond Ratings 6) Identifiers 7) Exchanges 8) Inv Parties 9) Fees, Restrict 10) Schedules 11) Coupons
Quick Links 32) ALLQ Pricing 33) QRD Quote Recap 34) TDH Trade Hist 35) CACS Corp Action 36) CF Prospectus 37) CN Sec News 38) HDS Holders 39) VPRD Underly Info

Issuer Information
Name GLASSTANK BV
Industry Containers & Packaging

Identifiers
ID Number EK2677541
ISIN XS1069662812
BBGID BBG006GS69M7

Bond Ratings
Moody's Caa1
S&P CCC
Composite CCC

Security Information
Mkt Iss EURO MTN
Country NL Currency EUR
Rank Secured Series REGS
Coupon 8.5 Type Fixed
Cpn Freq S/A
Day Cnt ISMA-30/360 Iss Price 91.04840
Maturity 05/15/2019
MAKE WHOLE @50 until 05/15/19/ CALL 05/15/16...
Iss Sprd 1038.50bp vs OBL 0 1/2 04/12/19

Calc Type (1)STREET CONVENTION
Announcement Date 05/14/2014
Interest Accrual Date 05/21/2014
1st Settle Date 05/21/2014
1st Coupon Date 11/15/2014

Issuance & Trading
Aggregated Amount Issued/Out
EUR 185,000.00 (M)/
EUR 185,000.00 (M)
Min Piece/Increment
100,000.00 / 1,000.00
Par Amount 1,000.00
Book Runner CITI
Exchange DUBLIN

CMBS Menu YIOULA 8 1/2 05/15/19 Corp BVAL Message

HELP for explanation.
Enter snapshot criteria and hit <Go>

Snapshot ASK 12/02/14 **NY 4PM**

	Methodology	Price	YTW	YTM	Weight	Score
Final BVAL Price	93.189	10.451	10.451	0.00%	7/10	
Final BVAL Score (out of 10)	7					
Yield to Worst (%)	10.451					
Spread to Worst (bps)	1036					
Worst Date	05/15/19					
OAS (bps)	1011					
Effective Duration (yrs)	3.6					

BVAL History

Issue Information (DES)

Issuer	GLASSTANK BV
Sector	Containers-Metal...
Ratings	CCC/Caa1
Rank	Secured
Amt Outstanding	EUR 185MM
Next Call Date	05/15/16
Next Call Price	104.250
Issue Date	05/21/14
Issue Price	91.048
Issue Spread (bps)	1039
Identifier	EK2677541

CMBS Menu YIOULA 8 1/2 05/15/19 Corp BVAL Message

HELP for explanation.

Snapshot BID 12/02/14 **NY 4PM**

	Methodology	Price	YTW	YTM	Weight	Score
Final BVAL Price	91.459	10.975	10.975	100.0%	8/10	
Final BVAL Score (out of 10)	8					
Yield to Worst (%)	10.975					
Spread to Worst (bps)	1089					
Worst Date	05/15/19					
OAS (bps)	1064					
Effective Duration (yrs)	3.5					

BVAL History

Issue Information (DES)

Issuer	GLASSTANK BV
Sector	Containers-Metal...
Ratings	CCC/Caa1
Rank	Secured
Amt Outstanding	EUR 185MM
Next Call Date	05/15/16
Next Call Price	104.250
Issue Date	05/21/14
Issue Price	91.048
Issue Spread (bps)	1039
Identifier	EK2677541

EXAMPLE : HIGH LIQUIDITY SCORE

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- Small Bid Ask Spread (3 cents) will have small market impact
- Very high Amount of outstanding
- High Credit Rating, Sovereign bond of developed country also reduce liquidity risk
- Duration was 2 years, which is low and create less market impact
- Previous 2 month Price volatility was 0.17, which also indicate this bond was unlikely to be illiquid

Pages	Issuer Information	Identifiers
1) Bond Info	Name BELGIUM KINGDOM	ID Number EI8918720
2) Addtl Info	Industry Sovereigns	ISIN BE3871241688
3) Covenants	Security Information	BBGID BBG00290XLD0
4) Guarantor s	Mkt Iss Euro-zone	Bond Ratings
5) Bond Ratings	Country BE	Moody's NA
6) Identifiers	Rank Unsecured	DBRS AAH
7) Exchanges	Currency EUR	Composite NR
8) Inv Parties	Coupon 4	
9) Fees, Restrict.	Cpn Freq Annual	
10) Schedules	Day Cnt ACT/ACT	
11) Coupons	Iss Price 100.00000	
Quick Links	Maturity 12/04/2016	
12) ALLO Pricing	BULLET	
13) QRD Quote Recap	Iss Sprd	
14) TDH Trade Hist	Calc Type (1)STREET CONVENTION	
15) CACS Corp Action	Announcement Date 11/28/2011	
16) CF Prospectus	Interest Accrual Date 12/04/2011	
17) CN Sec News	1st Settle Date 12/05/2011	
18) HDS Holders	1st Coupon Date 12/04/2012	
19) VPRD Underly Info		
20) Send Bond		



EXAMPLE : HIGH LIQUIDITY SCORE

Bloomberg

- Small Bid Ask Spread (10 cents) will have small market impact
- Closed to maturity ,duration is low, so it can be sell without much discount
- Market can easily digest the trade since this bond has high Amount of outstanding
- High Credit Rating, Sovereign bond of developed country also reduce liquidity risk
- Previous 2 month Price volatility was 0.005, which also indicate this bond was unlikely to be illiquid

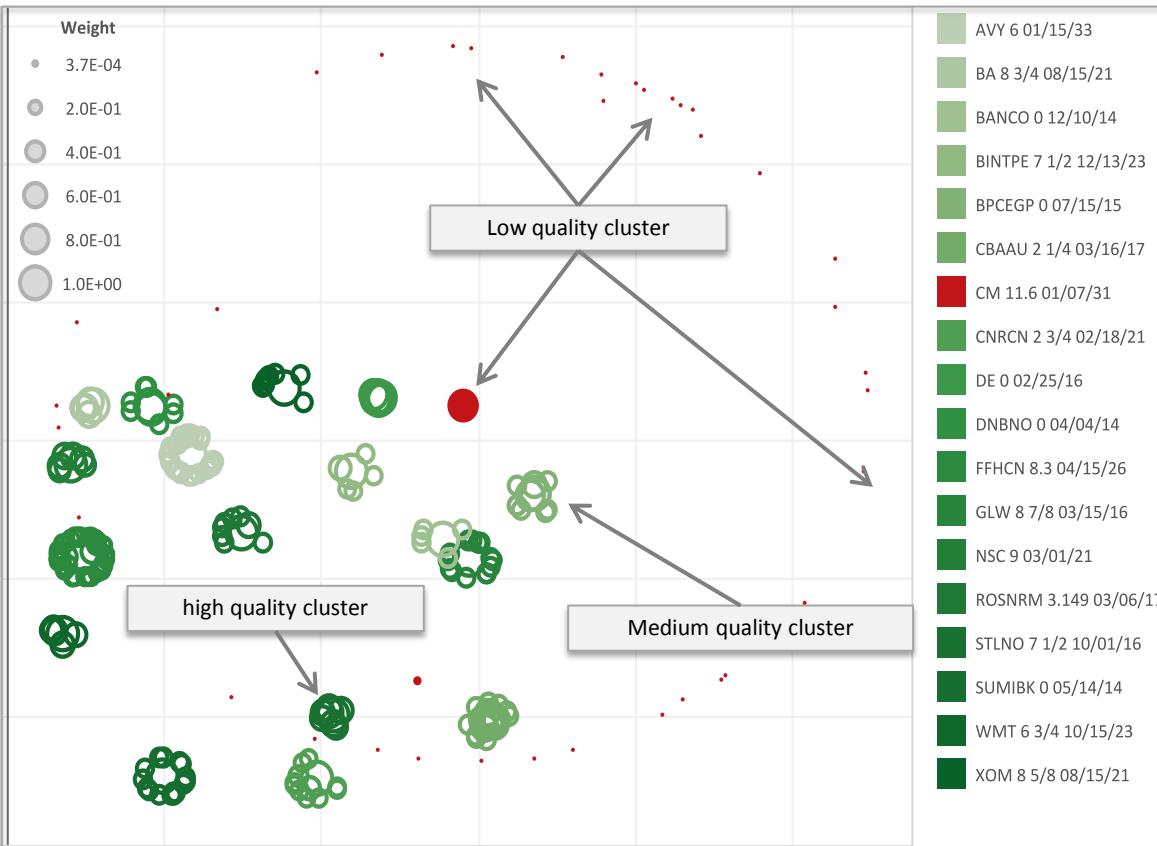
Pages		Issuer Information		Identifiers	
1) Bond Info		Name	KINGDOM OF SWEDEN	ID Number	EJ5759273
2) Addtl Info		Industry	Sovereigns	ISIN	XSO899755226
3) Covenants		Mkt Iss	Euro MTN	BBGID	BBG0046HCMZ7
4) Guarantors		Country	SE	Bond Ratings	
5) Bond Ratings		Rank	Unsecured	Moody's	Aaa
6) Identifiers		Coupon	0.1608	S&P	NR
7) Exchanges		Formula	MONTHLY US LIBOR FLAT	Fitch	AAA
8) Inv Parties		Day Cnt	ACT/360	DBRS	AAA
9) Fees, Restrict		Maturity	03/14/2015	Issuance & Trading	
10) Schedules		BULLET		Amt Issued/Outstanding	
11) Coupons		Iss Sprd		USD	1,000,000.00 (M)
Quick Links		Calc Type	(21)FLOAT RATE NOTE	USD	1,000,000.00 (M)
33) ALLQ Pricing		Announcement Date	02/28/2013	Min Piece/Increment	1,000.00 / 1,000.00
33) QRD Quote Recap		Interest Accrual Date	03/14/2013	Par Amount	1,000.00
34) TDH Trade Hist		1st Settle Date	03/14/2013	Book Runner	GS
35) CACS Corp Action		1st Coupon Date	04/15/2013	Exchange	LONDON
36) CF Prospectus					
37) CN Sec News					
38) HDS Holders					
39) VPRD Underly Info					
60) Send Bond					



THE MODEL : LIQUIDITY ASSESSMENT

SIMILARITY FACTORS AND CLUSTER CONCEPTS

Bloomberg



- Traditional Approach
 - Static : heuristic use of features like Rating etc.
 - Limited in terms of features involved
 - Not reactive enough to changes in market conditions
- Our Approach
 - Dynamic, non-heuristic clustering methodology
 - “Weighted Euclidean Distance” based on many features
 - Reactive to market conditions

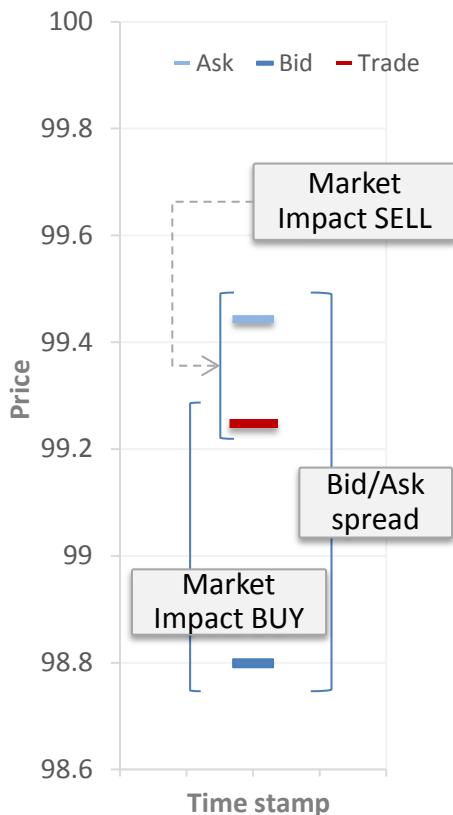
Example of distance function

Duration	17.10%	Country of Risk	4.80%	Direct Observation Dispersion	1.80%
Rating	9.80%	Coupon Type	4.20%	Age	1.50%
Bid/Ask Spread	8.50%	Is Callable	3.80%	Collateral Type	1.20%
Cds rate	8.50%	Holder Type	3.70%	Central Banks Eligible	1.20%
Maturity	7.30%	# of days to next call	3.20%	Issuer	1.20%
Currency Correlation	5.70%	Industry Correlation	2.40%	# of Directs Observation	0.40%
Amount Outstanding	4.90%	Coupon	2.00%		
News Sentiment Index	4.90%	Option Delta	1.90%		

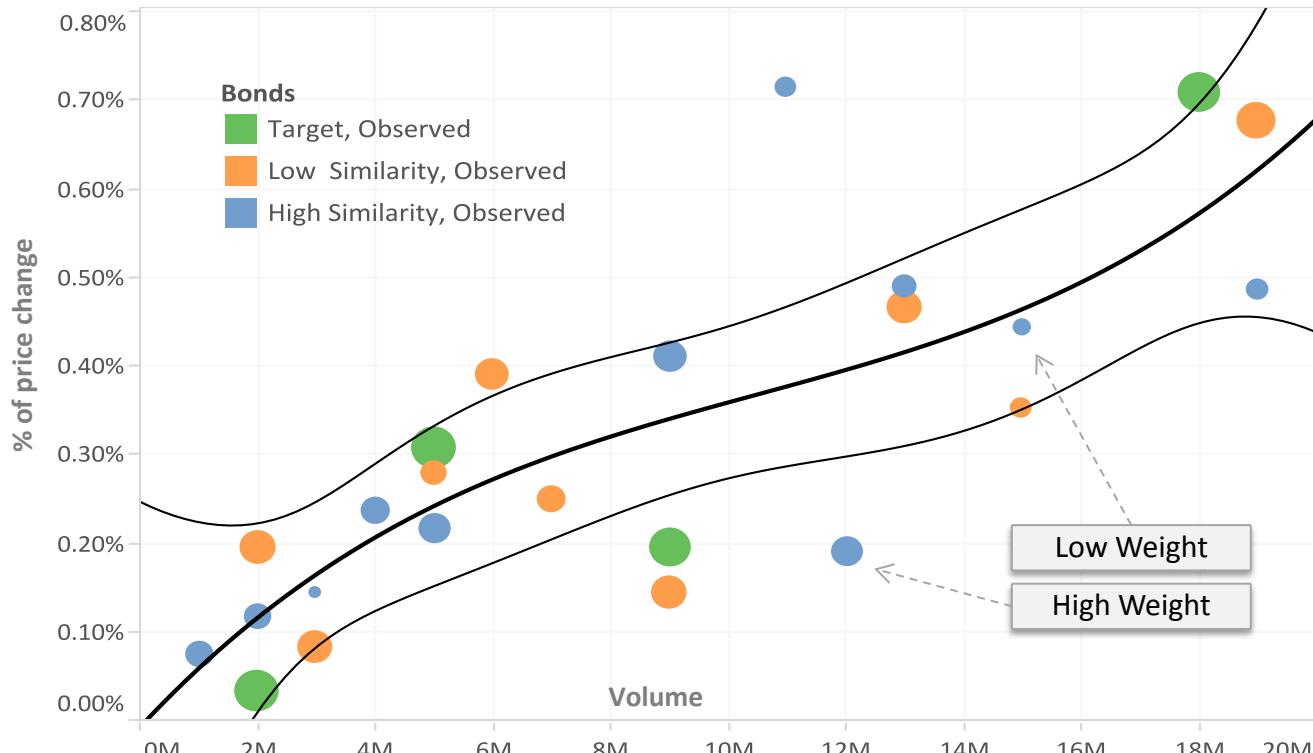
MARKET IMPACT DYNAMICS

Bloomberg

Bid/Ask spread and trades



Observed market impact fitting (as % price change)



Similarity/Weight driven by :

- Quantity and quality of direct market observation
- Difference in :
 - Duration, Coupon, Amount Outstanding, Rating, CDS, Sector Correlation, Country of Risk, Currency, Collateral Type etc. (20+ factors)
 - Additional features : Holder Type (HDS), News Sentiment Index, Central bank REPO eligibility**

GLOBAL AND LOCAL (CLUSTER) MODEL

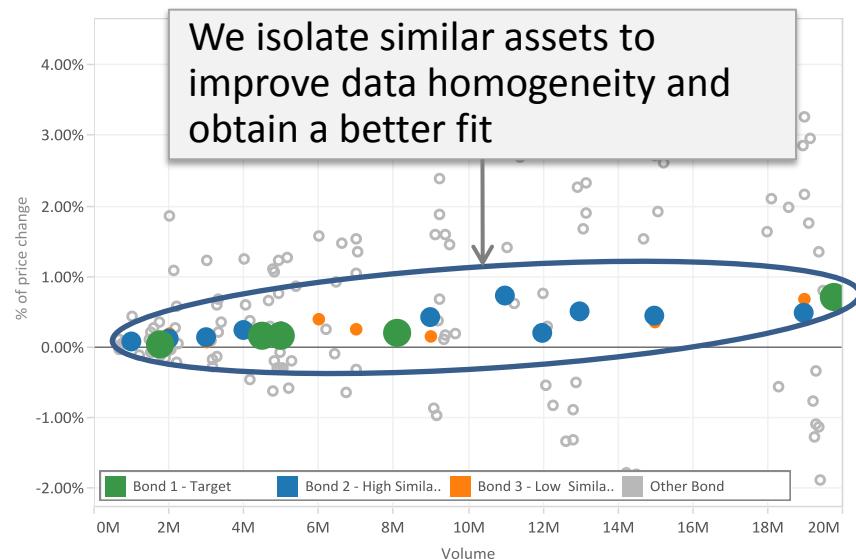
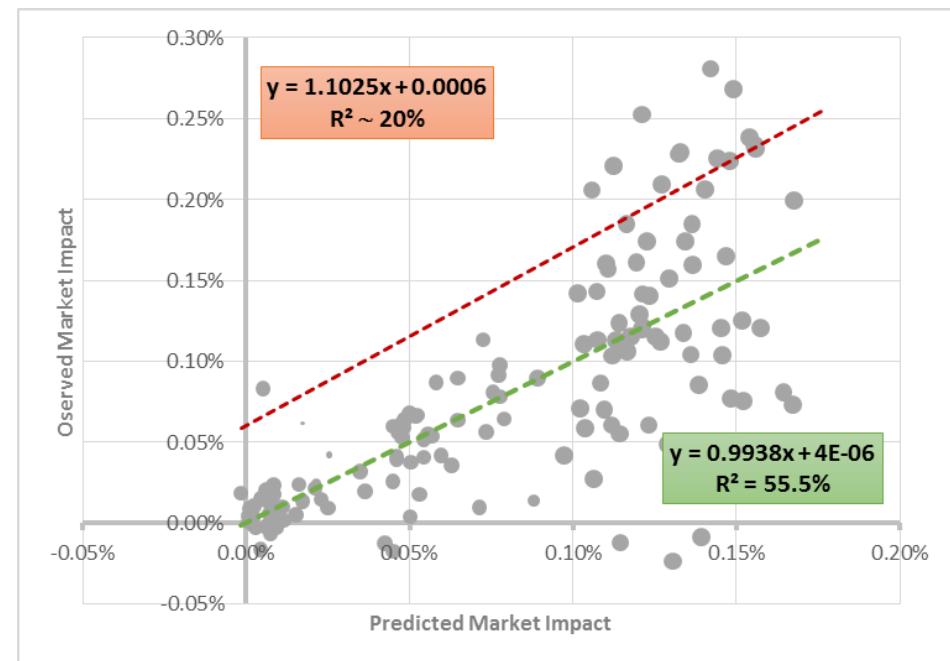
Bloomberg

The market impact $I(v)$, percentage of price change given a volume v , is represented in function of

- a volume component term $F_1 = S \cdot \left[\frac{v}{\ln(M)} \right]^\delta$ (S ask-bid, M amount outstanding)
- turnover $F_2 = \frac{\sum V}{M}$ (V : last 2 months total volume)
- function $H(D, C, \sigma_p, K, E, \dots)$ related to the standard factor influencing liquidity (i.e. duration D, coupon C, price volatility σ_p , holder type K, central banks eligibility E etc).

EQUATION / ROLE OF CLUSTER

REBOBK Float 06/03/14 Corp (COEJ7017142) - Residual Plot



GLOBAL Model

- There is no bias in the estimation, but the prediction power of the model can be improved using local calibration with our cluster engine. **R2 = 20 %**

LOCAL (CLUSTER) MODEL

- Cluster weighted **R2 = 53.65 %**

Cluster based fitting is better than global

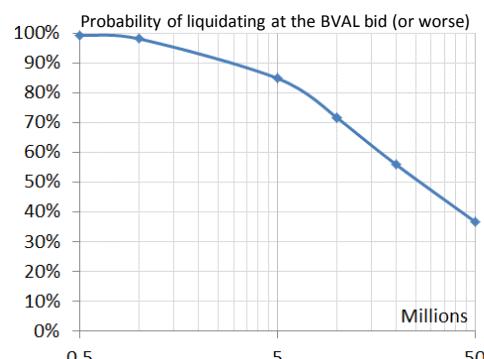
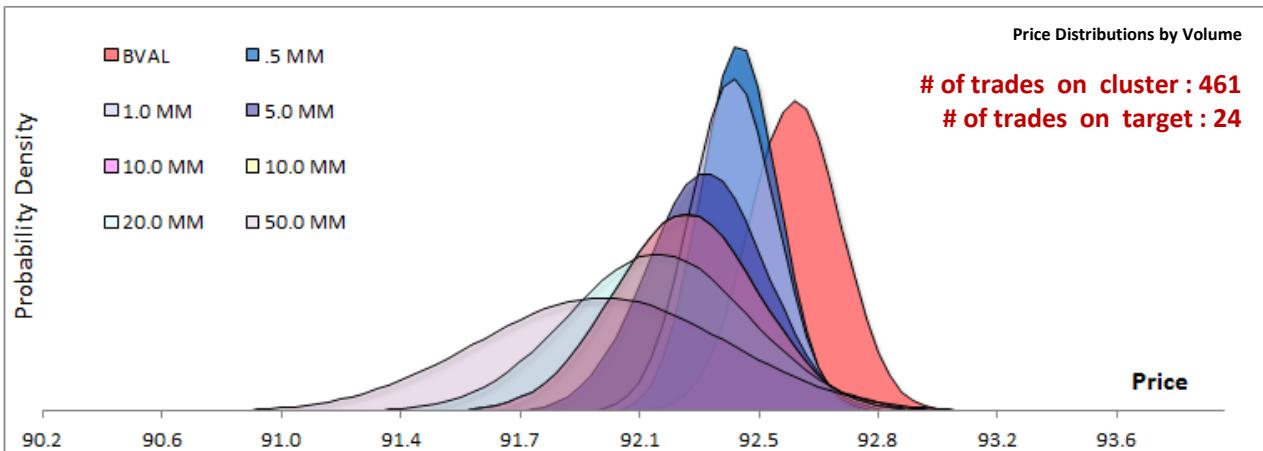
Security features	
Date	2014-08-01
Snapshot Time (2=NY4, 4=LO4)	2
Duration	7.49
Coupon	1.88
Age	2.01
AMT Outstanding	1,000,000,000
Price	92.12
Contrib Std	0.142732
% of Market Data	100.00%
BA Spread	0.47
Sum Trade Vol. of past 2 months	35,057,000
Country of Risk	US
Currency	USD

All value in local currency

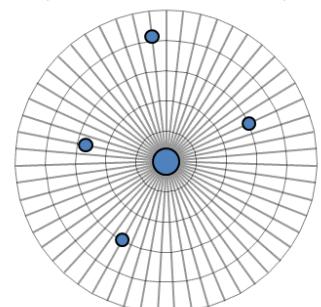
Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.3636
500,000	92.41	-0.18	0.12	99.25%	0.04
1,000,000	92.39	-0.20	0.13	98.02%	0.08
5,000,000	92.31	-0.28	0.19	84.80%	0.41
10,000,000	92.25	-0.34	0.23	71.63%	0.82
10,000,000	92.25	-0.34	0.23	71.63%	0.82
20,000,000	92.16	-0.43	0.28	55.78%	1.64
50,000,000	91.98	-0.61	0.39	36.66%	4.11

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEJ2992190	IBM CORP	Technology	22.49%	2.92	0.47	1,000,000,000	7.49	1.88	AA-	US	0.39	10
COEK0635616	IBM CORP	Technology	19.82%	3.36	0.16	2,000,000,000	8.07	3.63	AA-	US	0.45	9
COEJ7725454	IBM CORP	Technology	19.59%	3.20	0.43	1,500,000,000	7.89	3.38	AA-	US	0.42	8
COEI8592749	IBM CORP	Technology	19.55%	2.61	0.36	500,000,000	6.58	2.90	AA-	US	0.35	9
COEJ6626075	IBM CORP	Technology	18.54%	2.30	0.25	1,250,000,000	5.54	1.63	AA-	US	0.30	9



Distances in Cluster (# of member 5)
(BLUE are from the same issuer)



- Price impact for selling 1% of AMT is -0.342 (USD) with uncertainty (st.dev.) of 0.227. The probability of execution at the bid is 71.63%.
- The max volume can be executed, with market impact not bigger than 0.39%, is 12.17 MM (USD).
- Given max volume and accepted market impact, the time to liquidation is 0.82 days (under linearity assumption in this release).

THE MODEL : MARKET CONDITIONS

MARKET NORMALIZATION FACTOR

MARKET NORMALIZATION FACTOR

- We use the following factor to have an external adjustment for the shifting and uncertainty of the market impact.
- We want to link this factor to the quality “deterioration” of the financial information use in the model

THE LINK AND MECHANICS

- Cluster tendency reflects market entropy. Our liquidity model reacts to the entropy via price uncertainty.
- We measure market condition in function of the chaos/order (entropy) in financial information
- CLUSTER TENDENCY (H) primarily tells us how efficiently we can identify good clusters

THE MEASURE

We use the Hopkins statistic (H) to measure cluster tendency



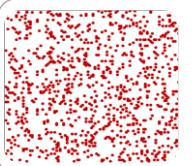
$H \approx 1$ indicates high clustering in the data

The market is showing a clear pattern



$H \approx 0.5$ indicates medium clustering in data

There is a weaker pattern in the market data



$H \approx 0$ indicates low clustering in the data

Comparable analysis will have higher uncertainty

CLUSTER TENDENCY (H) VS STANDARD INDICES

Bloomberg

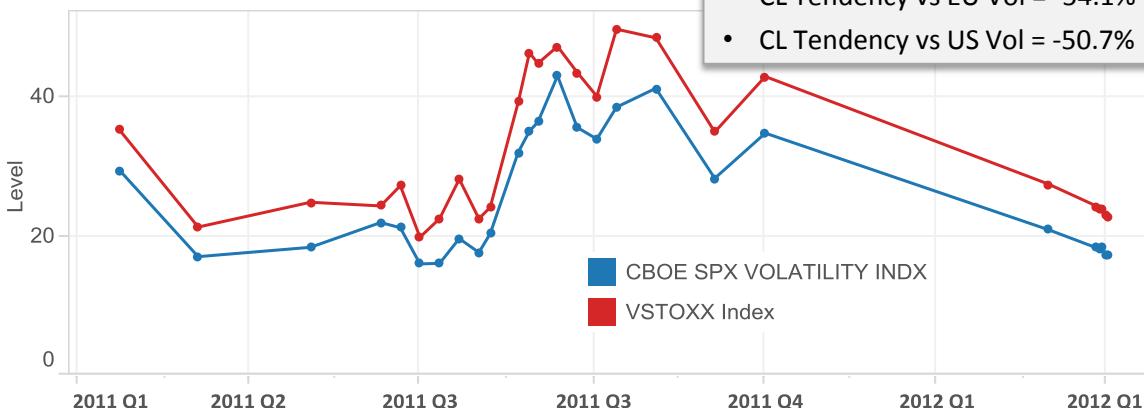
Cluster Tendency



LEGEND

- EUR portfolio : 2.5k IG Corp
- USD portfolio : 3k IG Corp
- **Cluster Tendency ≈ 0 :**
 - Real securities are scattered around in space. "Chaotic market condition"
 - Low Cluster tendency
- **Cluster Tendency ≈ 1 :**
 - Real securities are clustered around each other. "Orderly state of market"
 - High Cluster tendency

Volatility Indices



INNOVATIVE INDEX FAMILY

For a given observable forecast (i.e. accuracy of the price level, price uncertainty), this quantity measures the **"Deterioration of the information available in the market"** and increases/lowers the uncertainty in related estimations.

- Measures the chaos in financial information
- In other words the **ENTROPY** of the market

- Portfolios of 3000 USD IG Corp and 2500 EUR IG Corp
- Systematic spread between the EUR portfolio and the USD. This is due to :
 - Different liquidity in the two markets
 - More transparency (less uncertainty) in the US market
- In Scenario (1) the clusters are better defined and supported with more high quality data than in scenario (2)

INNOVATION

New standard for the industry to assess, track and manage Information Entropy across a variety of market segments

BACK-TEST

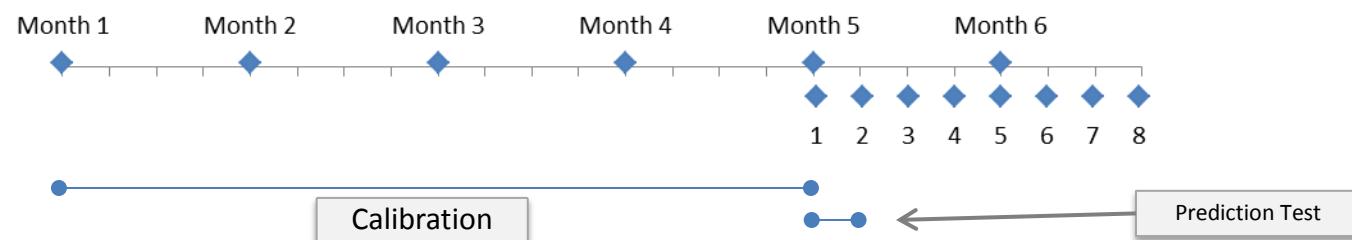
BACK-TEST : OVERVIEW

Bloomberg

In order to back test the results of our model, we employed a **rolling window out-of-sample test**. This test has the following advantages:

1. Using future real trading data to test forecasted results from our model truly measures the predictive power of our estimations of market impact
2. Using a rolling window for training the model avoids undesirable impact from the old observations and introduces new trading information each time the model is trained.
3. This approach not only tests the accuracy, but also the stability of our predictions.

We calibrated the model on four Months, test the prediction power on the following week trades and then rolling the training and test period of one week.



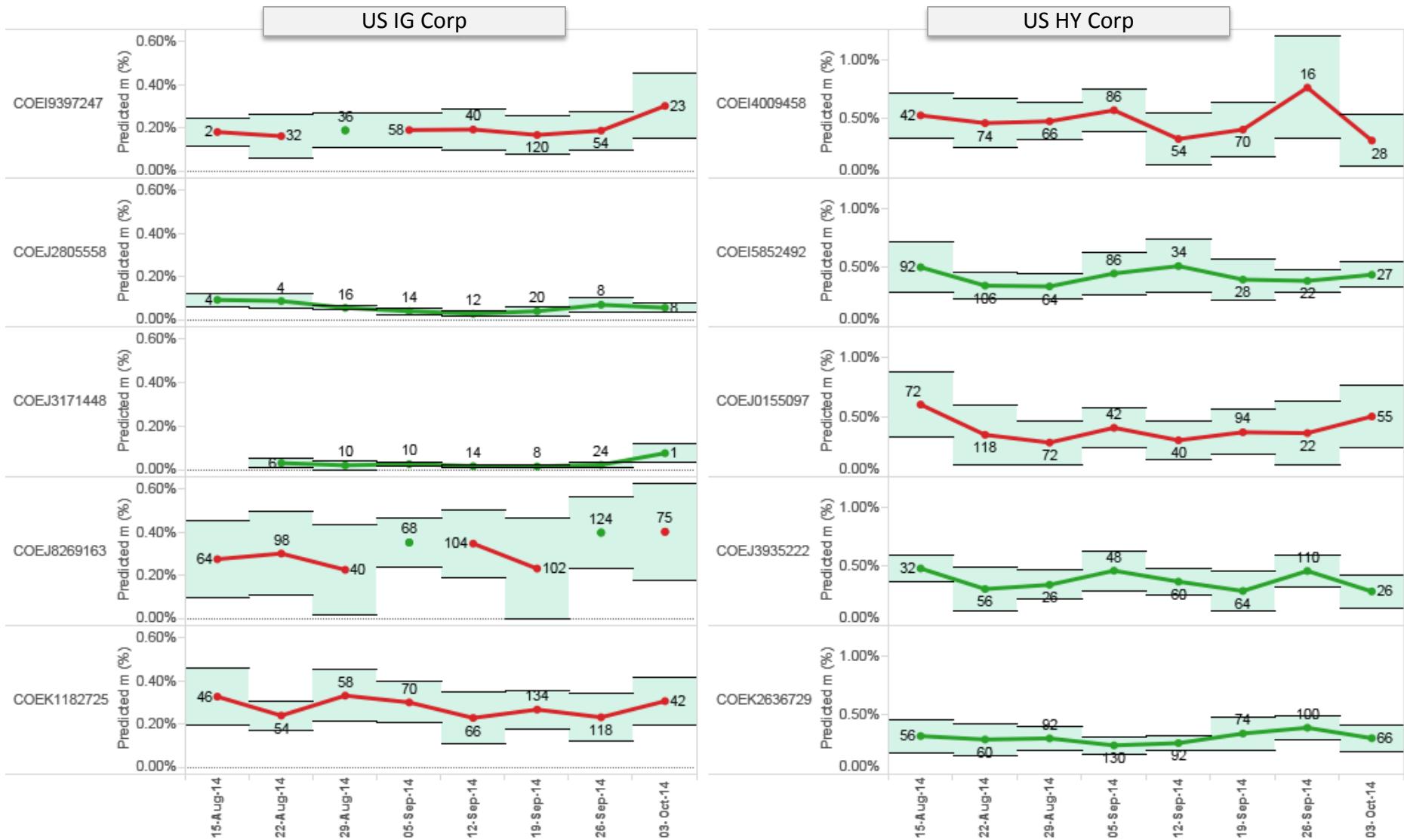
Average Residuals Fit R2	15-Aug-14	22-Aug-14	29-Aug-14	05-Sep-14	12-Sep-14	19-Sep-14	26-Sep-14	03-Oct-14
01-IG NORTH AMERICA (18)	26.89%	31.84%	29.70%	23.82%	30.43%	26.95%	23.81%	27.72%
02-HY NORTH AMERICA (21)	18.82%	17.60%	17.64%	13.28%	15.42%	16.64%	19.13%	19.11%
03-IG EUR (42)	38.13%	31.17%	36.27%	32.96%	35.39%	50.53%	42.60%	37.82%
04-HY EUR (49)	34.57%	30.54%	23.22%	36.15%	42.32%	38.60%	40.34%	43.02%

Average RSMSE	15-Aug-14	22-Aug-14	29-Aug-14	05-Sep-14	12-Sep-14	19-Sep-14	26-Sep-14	03-Oct-14
01-IG NORTH AMERICA (18)	0.142%	0.120%	0.127%	0.130%	0.131%	0.137%	0.164%	0.150%
02-HY NORTH AMERICA (21)	0.264%	0.243%	0.242%	0.285%	0.273%	0.316%	0.365%	0.309%
03-IG EUR (42)	0.144%	0.118%	0.130%	0.165%	0.082%	0.111%	0.137%	0.117%
04-HY EUR (49)	0.173%	0.167%	0.208%	0.179%	0.167%	0.228%	0.278%	0.225%

- R2 is considerable high and stable across different weeks
- RMSE is considerable small and stable across different weeks

BACK TEST – CUSIP EXAMPLE

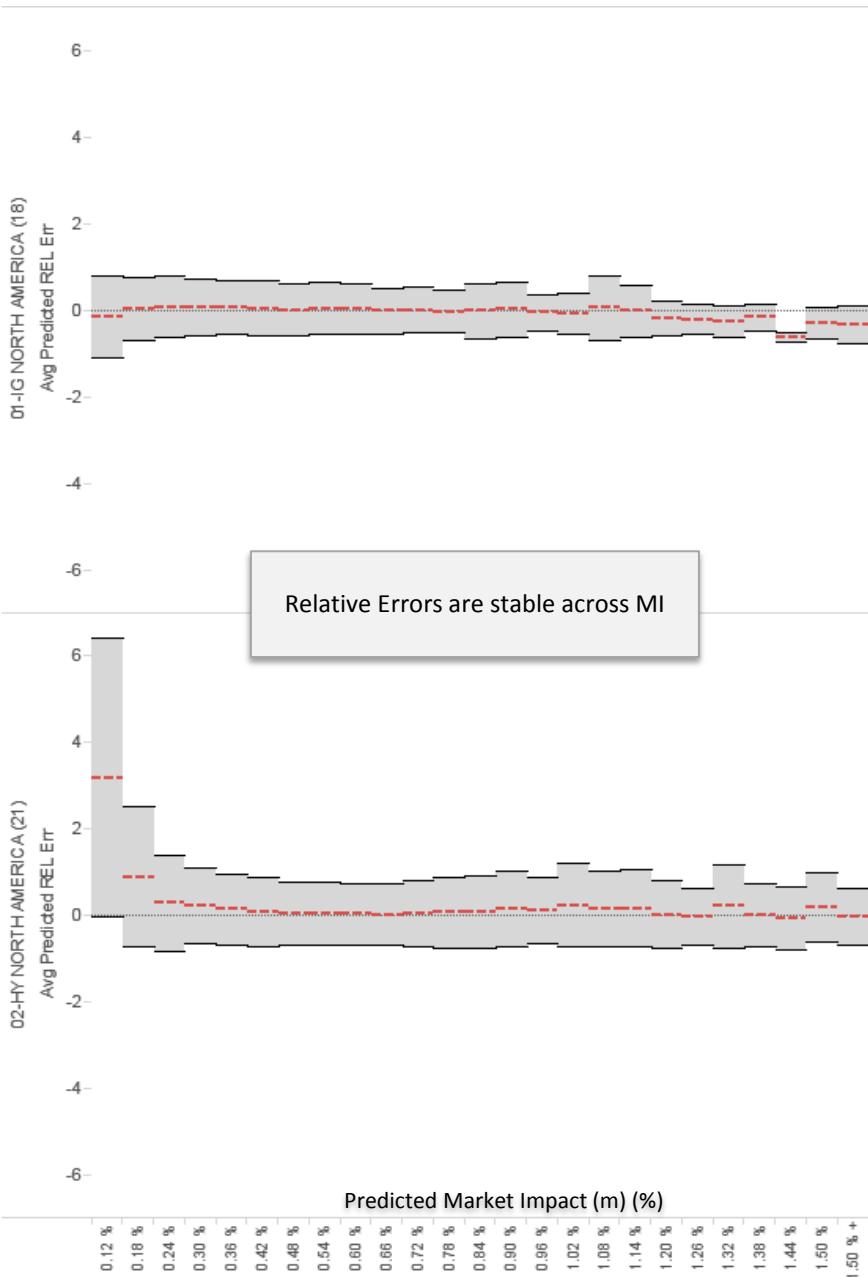
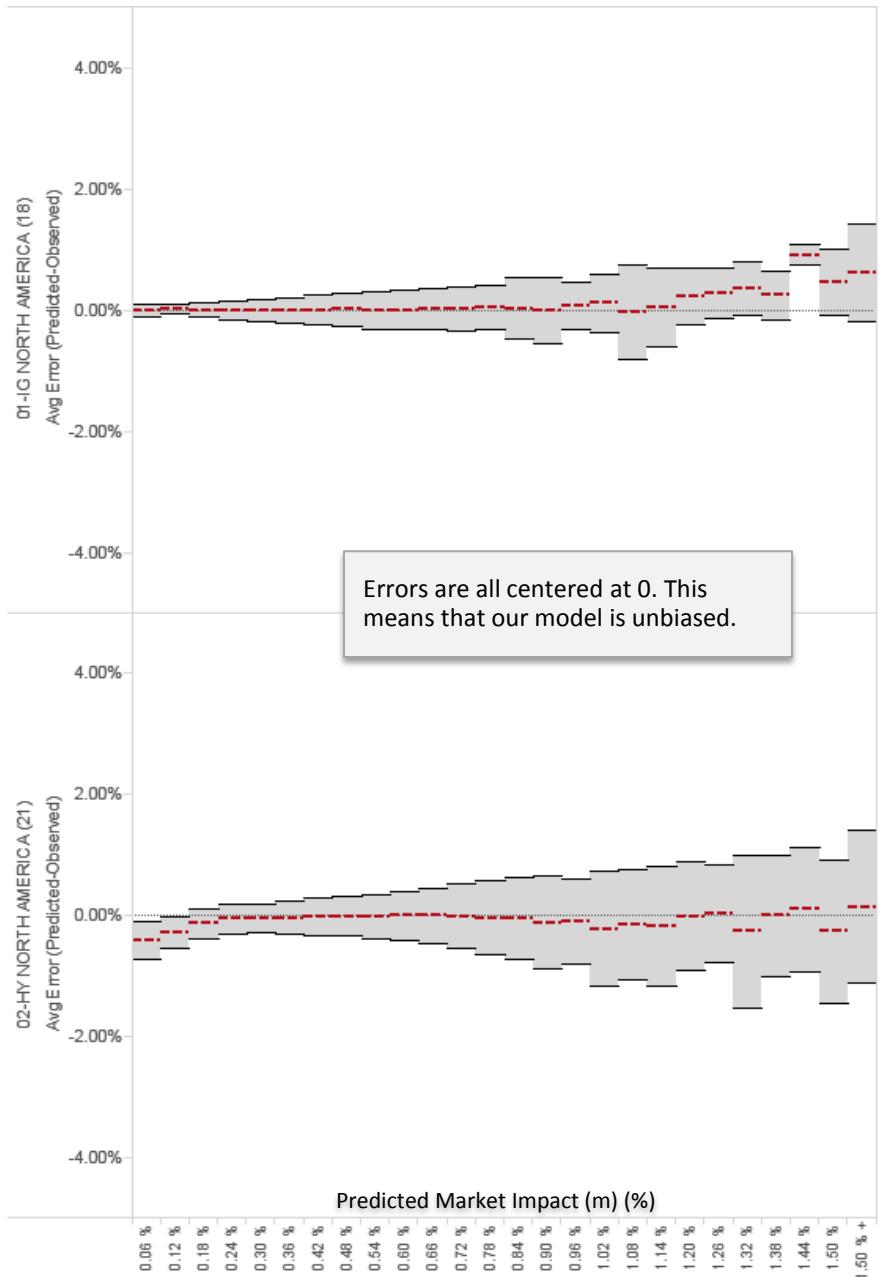
Bloomberg



- Green means using cluster regression and red bucket regression.
- Number indicates the number of trades in the testing.
- Error is systematically lower than the predicted market impact
- Cluster regression improves the predictive power of the model.

BACK-TEST : AVG ERR, AVG ABS ERROR

Bloomberg

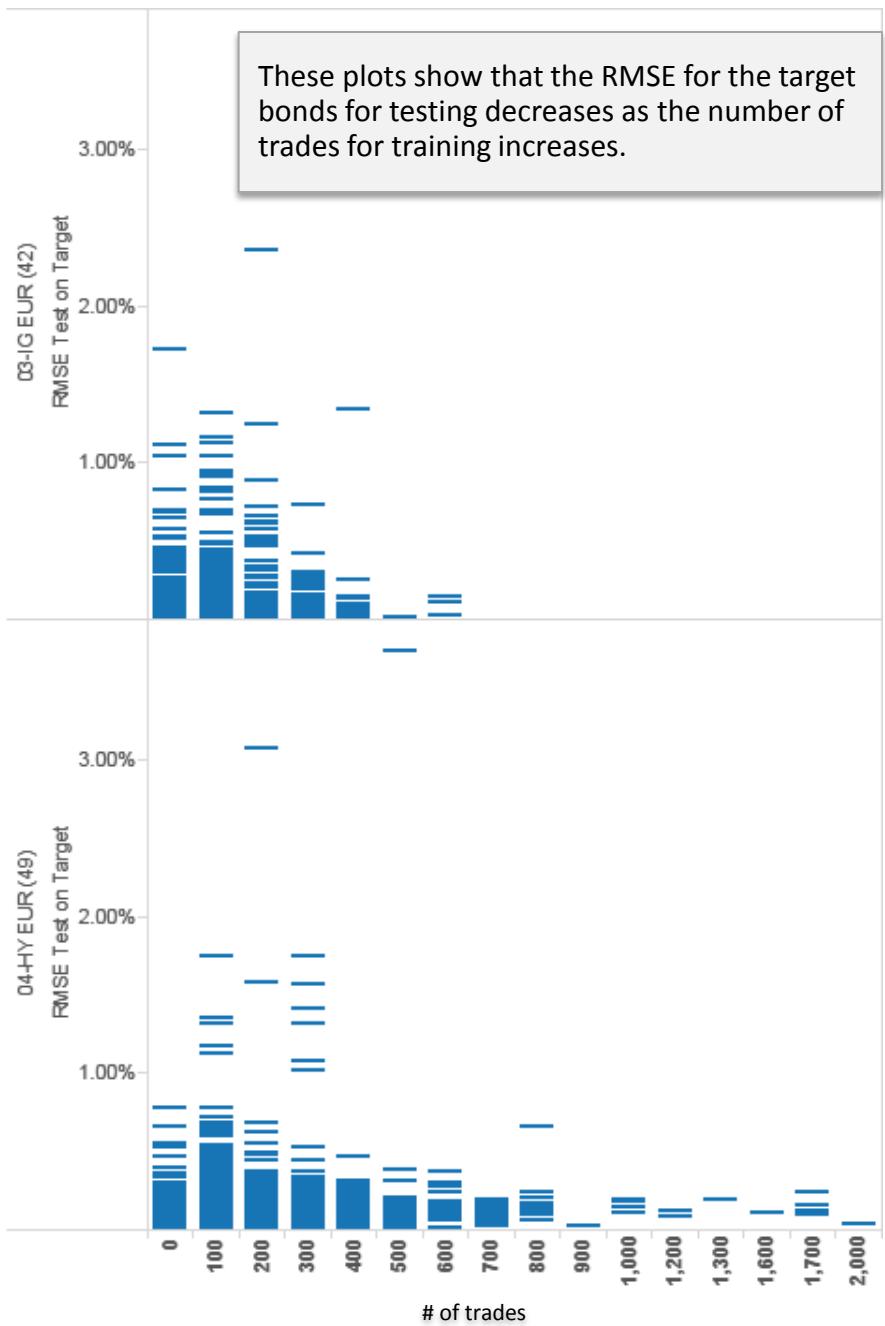
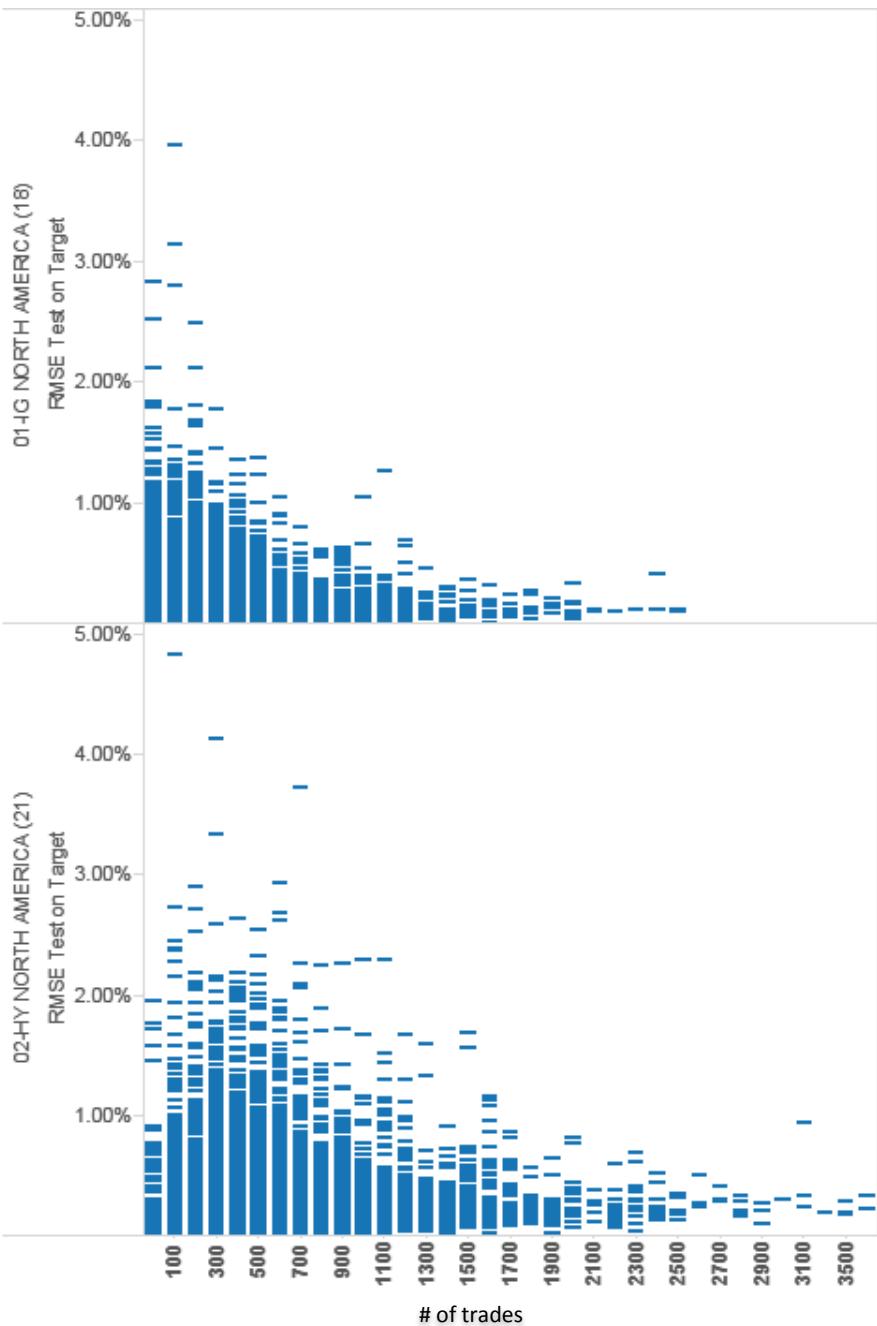


US IG Corp

US HY Corp

BACK-TEST : RMSE vs # of trades

Bloomberg



APPENDIX

EXAMPLES

Bloomberg

REPORT EXPLANATION

Bloomberg

Security features	
Date	5/9/2014
Snapshot Time	2
Duration	7.67
Coupon	1.88
Age	1.78
AMT Outstanding	1,000,000,000
Price	91.34
Contrib Std	0.14
% of Market Data	100.00%
BA Spread	0.37
Sum Trade Vol. of past 2 months	37,122,000
Country of Risk	US
Currency	USD

All value in local currency

Volume	New Price	Impact	Uncertainty	Prob(>BVAL)	N of days to Liqdtn for an impact of 0.3172
500,000	91.55	-0.17	0.12	95.68%	0.04
1,000,000	91.53	-0.18	0.13	92.89%	0.07
5,000,000	91.47	-0.24	0.17	77.10%	0.37
10,000,000	91.42	-0.29	0.20	65.40%	0.74
10,000,000	91.42	-0.29	0.20	65.40%	0.74
20,000,000	91.36	-0.36	0.25	52.29%	1.48
50,000,000	91.22	-0.49	0.34	36.39%	3.71

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEJ292190	BM CORP	Technology	100.00%	3.02	0.37	1,000,000,000	7.67	1.88	AA-	US	0.60	9
COEJ7725454	NULL	NULL	92.23%	3.27	0.25	1,500,000,000	8.02	3.38	AA-	US	0.65	10
COEI8592749	BM CORP	Technology	91.00%	2.70	0.27	500,000,000	6.83	2.90	AA-	US	0.52	9
COEK0635616	NULL	NULL	89.16%	3.38	0.28	2,000,000,000	8.34	3.63	AA-	US	0.60	10
COEJ626075	NULL	NULL	82.59%	2.40	0.19	1,250,000,000	5.73	1.63	AA-	US	0.40	9

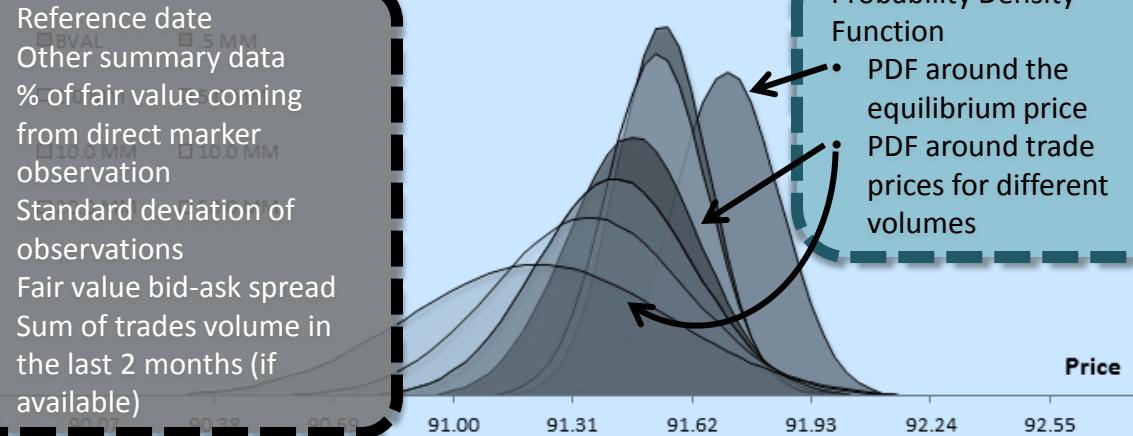
New Price : Predicted price.

Impact : Difference between new and ask price.

Uncertainty : Standard Deviation of the distribution of the Impact.

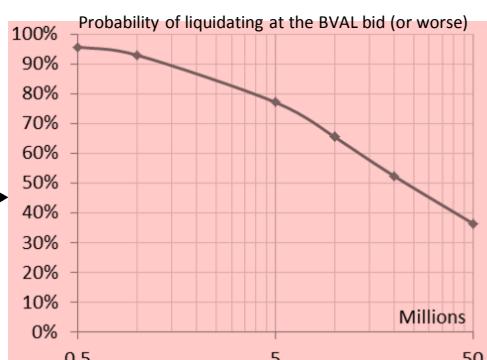
Probability of selling at fair value bid or higher for different volumes

N of days to liquidation: This is the number of days that it would take to sell a specific volume at simulated maximum accepted market impact (\$ 0.31 in this case). In this version with linearity assumption

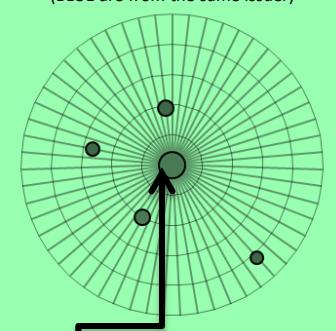


Probability Density Function

- PDF around the equilibrium price
- PDF around trade prices for different volumes



Distances in Cluster (# of member 5)
(BLUE are from the same issuer)



Cluster composition order in by similarity with the target asset.

- The table show some of the main features used to cluster asset
- The chart show the cluster density

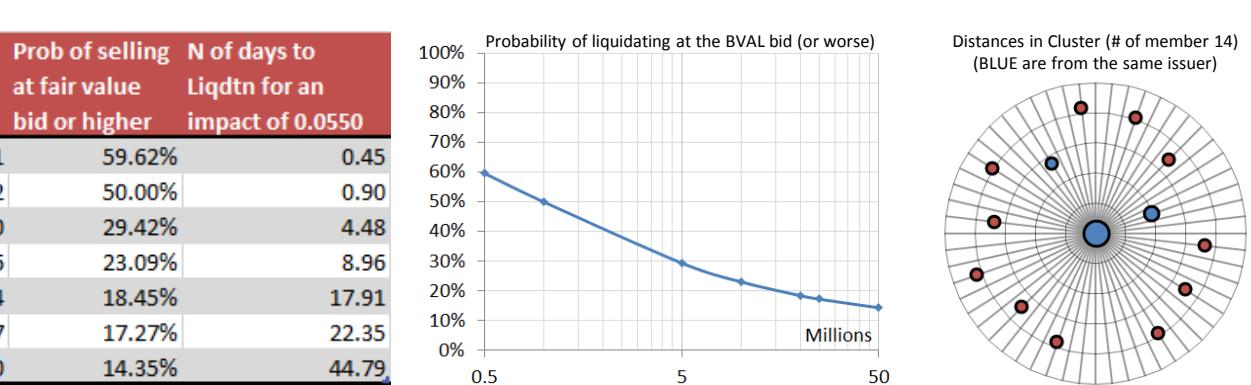
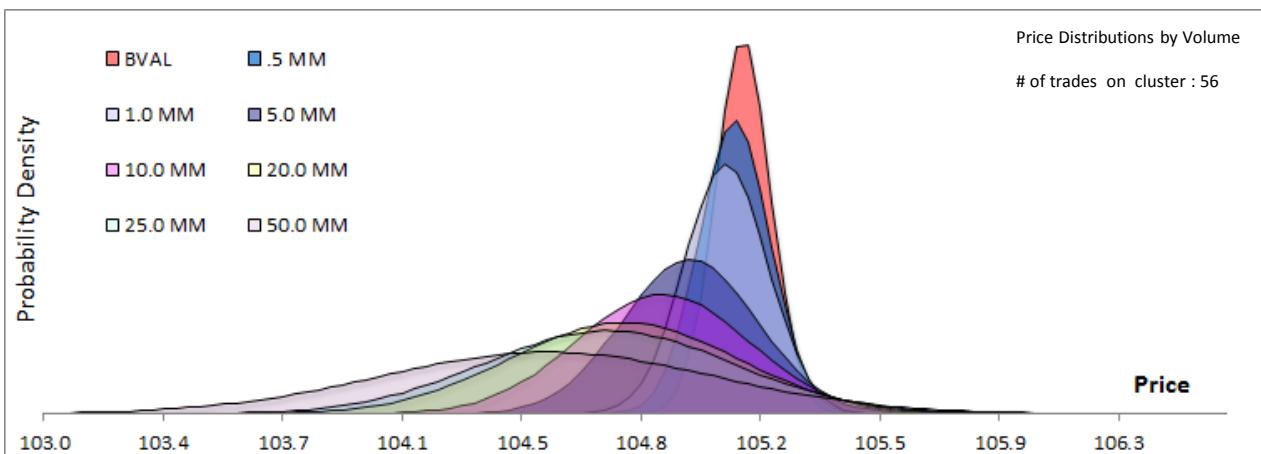
Security features	
Date	2014-10-14
Snapshot Time (2=NY4, 4=LO4)	2
Duration	3.88
Coupon	1.63
Age	1.04
AMT Outstanding	2,495,200,000
Price	105.08
Contrib Std	0.082544
% of Market Data	100.00%
BA Spread	0.05
Sum Trade Vol. of past 2 months	0
Country of Risk	FR
Currency	EUR

All value in local currency

Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.0550
500,000	105.10	-0.02	0.11	59.62%	0.45
1,000,000	105.08	-0.05	0.12	50.00%	0.90
5,000,000	104.97	-0.16	0.20	29.42%	4.48
10,000,000	104.89	-0.24	0.26	23.09%	8.96
20,000,000	104.77	-0.36	0.34	18.45%	17.91
24,952,000	104.73	-0.40	0.37	17.27%	22.35
50,000,000	104.54	-0.59	0.50	14.35%	44.79

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEJ8959219	DEXIA CREDIT LOCAL	Financial	8.75%	0.34	0.05	2,495,200,000	3.88	1.63	AA-	FR	0.17	10
COEK1178764	DEXIA CREDIT LOCAL	Financial	7.75%	0.45	0.07	2,183,300,000	4.80	1.38	AA-	FR	0.25	10
COEK3639961	DEXIA CREDIT LOCAL	Financial	7.39%	0.22	0.04	2,495,200,000	2.72	0.38	AA-	FR	0.13	10
COEJ9113865	RAIFFEISEN BANK INTL	Financial	7.10%	1.25	0.12	623,800,000	3.87	1.88	A-	AT	0.46	10
COEJ9351101	STANDARD CHARTERED PLC	Financial	7.06%	0.66	0.08	1,559,500,000	3.94	1.63	A	GB	0.25	10



- Price impact for selling 1% of AMT is -0.403 (EUR) with uncertainty (st.dev.) of 0.374. The probability of execution at the bid is 17.27%.
- The max volume can be executed, with market impact not bigger than 0.05%, is 1.12 MM (EUR).
- Given max volume and accepted market impact, the time to liquidation is 22.35 days (under linearity assumption in this release).

DEXIA CREDIT LOCAL -- DEXGRP 1 5/8 10/29/18

Bloomberg

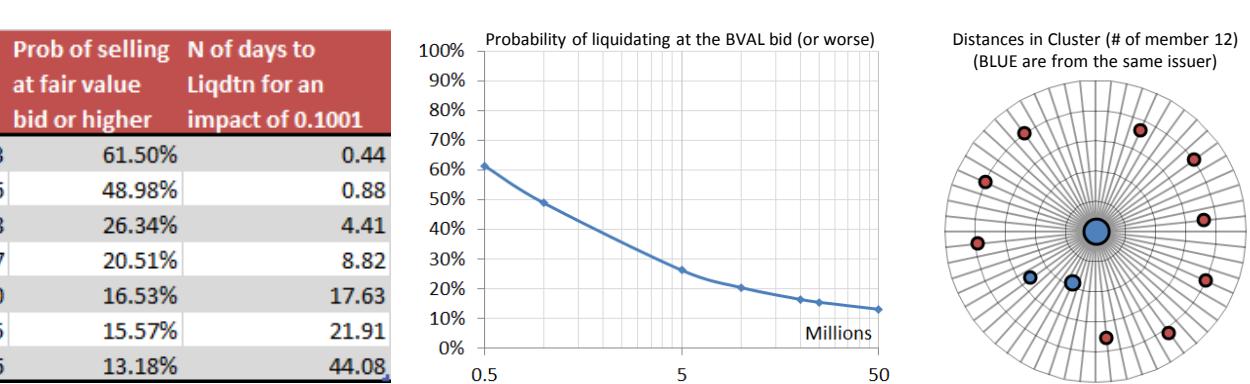
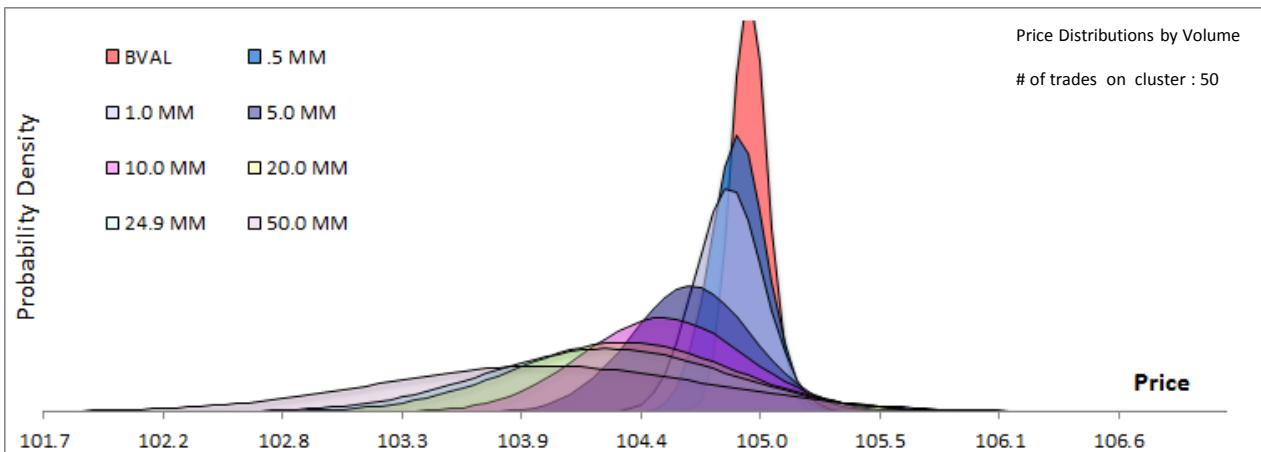
Security features	
Date	2014-10-27
Snapshot Time (2=NY4, 4=LO4)	2
Duration	3.91
Coupon	1.63
Age	1.04
AMT Outstanding	2,485,400,000
Price	104.83
Contrib Std	0.081598
% of Market Data	100.00%
BA Spread	0.09
Sum Trade Vol. of past 2 months	0
Country of Risk	FR
Currency	EUR

All value in local currency

Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.1001
500,000	104.87	-0.05	0.13	61.50%	0.44
1,000,000	104.83	-0.09	0.16	48.98%	0.88
5,000,000	104.65	-0.26	0.28	26.34%	4.41
10,000,000	104.52	-0.39	0.37	20.51%	8.82
20,000,000	104.34	-0.58	0.50	16.53%	17.63
24,854,000	104.27	-0.65	0.55	15.57%	21.91
50,000,000	103.98	-0.94	0.76	13.18%	44.08

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEJ8959219	DEXIA CREDIT LOCAL	Financial	10.12%	0.38	0.09	2,485,400,000	3.91	1.63	AA-	FR	0.10	10
COEK1178764	DEXIA CREDIT LOCAL	Financial	9.06%	0.50	0.12	2,174,725,000	4.76	1.38	AA-	FR	0.15	10
COEK3639961	DEXIA CREDIT LOCAL	Financial	8.64%	0.25	0.05	2,485,400,000	2.68	0.38	AA-	FR	0.07	10
COEJ5147826	DEUTSCHE HYPOTHEKENBANK	Financial	8.18%	0.18	0.06	932,025,000	3.19	0.88	AA	DE	0.09	10
COEJ9113865	RAIFFEISEN BANK INTL	Financial	8.15%	1.15	0.09	621,350,000	3.83	1.88	A-	AT	0.42	10



- Price impact for selling 1% of AMT is -0.648 (EUR) with uncertainty (st.dev.) of 0.555. The probability of execution at the bid is 15.57%.
- The max volume can be executed, with market impact not bigger than 0.10%, is 1.13 MM (EUR).
- Given max volume and accepted market impact, the time to liquidation is 21.91 days (under linearity assumption in this release).

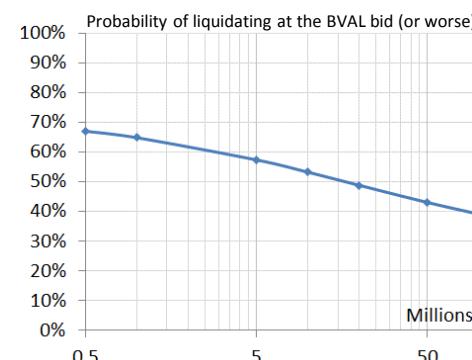
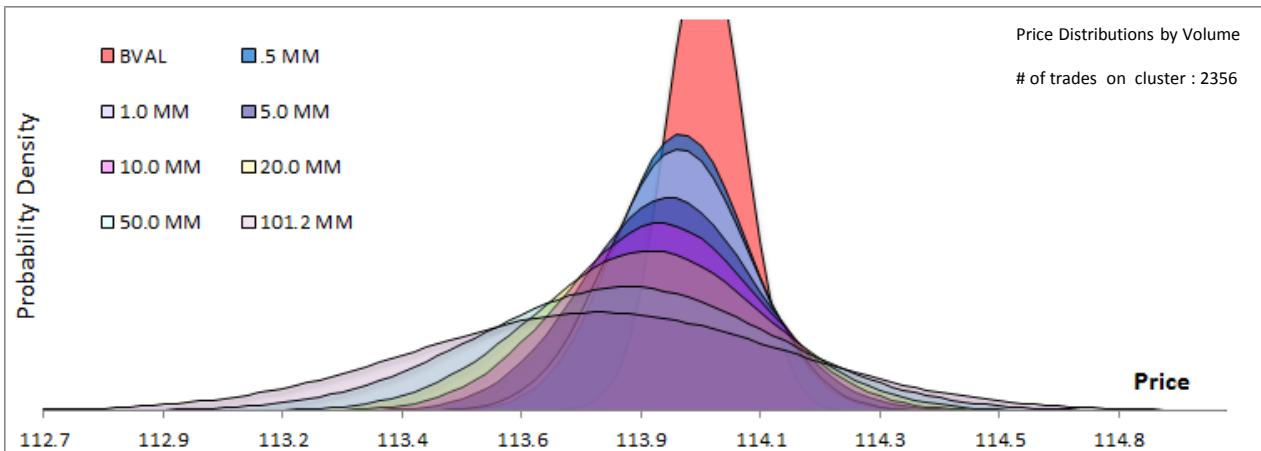
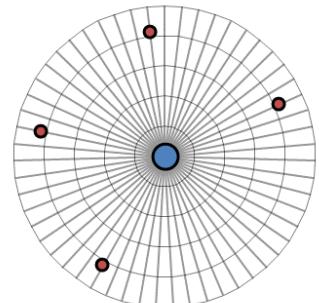
Security features	
Date	2014-11-03
Snapshot Time (2=NY4, 4=LO4)	2
Duration	8.16
Coupon	3.40
Age	0.82
AMT Outstanding	10,116,669,935
Price	113.88
Contrib Std	0.074908
% of Market Data	100.00%
BA Spread	0.10
Sum Trade Vol. of past 2 months	4,756,150
Country of Risk	IE
Currency	EUR

All value in local currency

Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.1010
500,000	113.93	-0.05	0.13	67.07%	0.03
1,000,000	113.93	-0.05	0.13	64.87%	0.06
5,000,000	113.91	-0.07	0.16	57.40%	0.30
10,000,000	113.89	-0.09	0.19	53.26%	0.60
20,000,000	113.87	-0.11	0.22	48.84%	1.20
50,000,000	113.83	-0.15	0.28	43.07%	2.99
101,166,699	113.78	-0.20	0.36	39.07%	6.06

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEK0113978	IRISH TSY 3.4		35.81%	1.77	0.10	10,116,669,935	8.16	3.40	BBB+	IE	0.73	10
COEK0407495	BONOS Y OBLIG DEL ESTADO		16.06%	2.02	0.06	26,340,354,872	8.15	3.80	BBB	ES	0.72	10
COEK3289700	BONOS Y OBLIG DEL ESTADO		16.05%	2.14	0.02	23,931,909,953	8.96	2.75	BBB	ES	0.73	10
COEJ6780583	BONOS Y OBLIG DEL ESTADO		16.05%	1.92	0.05	22,957,233,621	7.77	4.40	BBB	ES	0.68	10
COEH5475882	BONOS Y OBLIG DEL ESTADO		16.03%	1.96	0.05	18,712,783,970	7.66	4.80	BBB	ES	0.73	10

Distances in Cluster (# of member 5)
(BLUE are from the same issuer)

- Price impact for selling 1% of AMT is -0.200 (EUR) with uncertainty (st.dev.) of 0.356. The probability of execution at the bid is 39.07%.
- The max volume can be executed, with market impact not bigger than 0.09%, is 16.71 MM (EUR).
- Given max volume and accepted market impact, the time to liquidation is 6.06 days (under linearity assumption in this release).

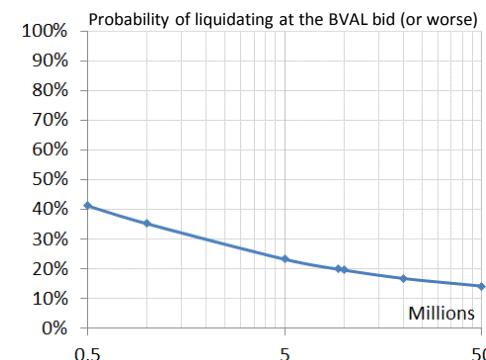
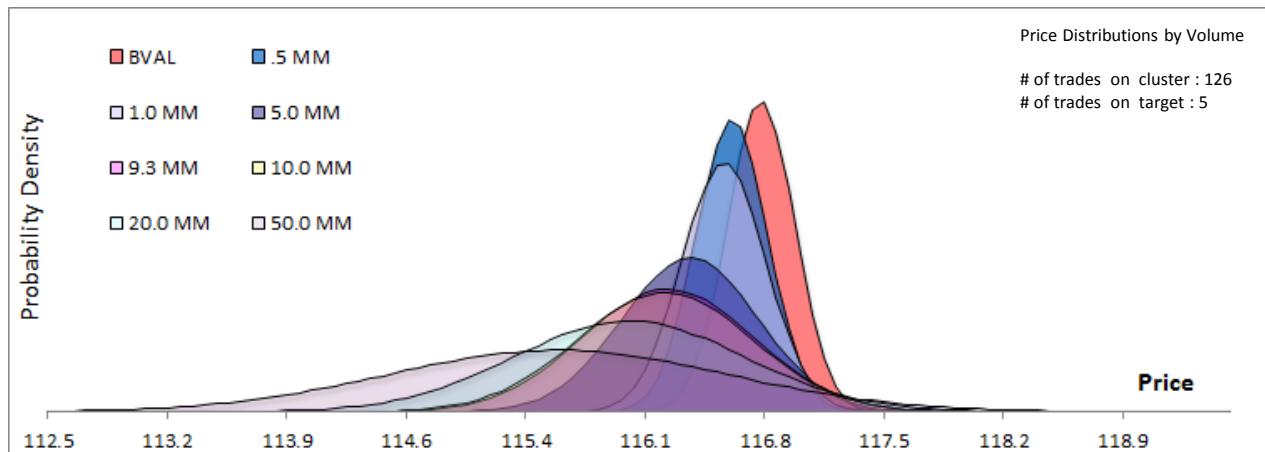
Security features	
Date	2014-11-03
Snapshot Time (2=NY4, 4=LO4)	2
Duration	5.30
Coupon	4.75
Age	1.11
AMT Outstanding	932,475,000
Price	116.63
Contrib Std	0.2
% of Market Data	100.00%
BA Spread	0.13
Sum Trade Vol. of past 2 months	508,180
Country of Risk	FR
Currency	EUR

All value in local currency

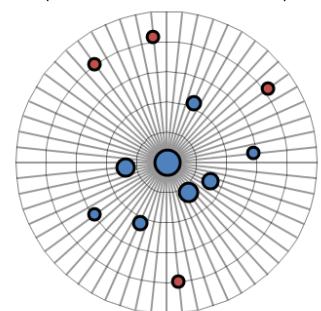
Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.2412
500,000	116.58	-0.17	0.21	41.30%	0.39
1,000,000	116.53	-0.22	0.25	35.27%	0.78
5,000,000	116.33	-0.42	0.40	23.29%	3.88
9,324,750	116.20	-0.55	0.51	19.94%	7.24
10,000,000	116.18	-0.57	0.52	19.61%	7.76
20,000,000	115.97	-0.78	0.68	16.83%	15.52
50,000,000	115.55	-1.20	1.01	14.26%	38.80

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEJ8476958	LAFARGE SA	Industrial	9.15%	1.74	0.13	932,475,000	5.30	4.75	BB+	FR	0.31	10
COEI0747556	LAFARGE SA	Industrial	8.74%	2.30	0.50	932,475,000	4.30	6.75	BB+	FR	0.25	10
COEI4758328	LAFARGE SA	Industrial	8.69%	2.18	0.25	1,243,300,000	3.51	6.63	BB+	FR	0.45	10
COEI2154256	LAFARGE SA	Industrial	8.62%	1.92	0.25	621,650,000	3.10	6.25	BB+	FR	0.34	10
COED8549765	LAFARGE SA	Industrial	8.44%	1.66	0.38	621,650,000	4.77	4.75	BB+	FR	0.22	10



Distances in Cluster (# of member 12)
(BLUE are from the same issuer)



- Price impact for selling 1% of AMT is -0.552 (EUR) with uncertainty (st.dev.) of 0.507. The probability of execution at the bid is 19.94%.
- The max volume can be executed, with market impact not bigger than 0.21%, is 1.29 MM (EUR).
- Given max volume and accepted market impact, the time to liquidation is 7.24 days (under linearity assumption in this release).

JPMORGAN CHASE & CO -- JPM 0 03/31/18

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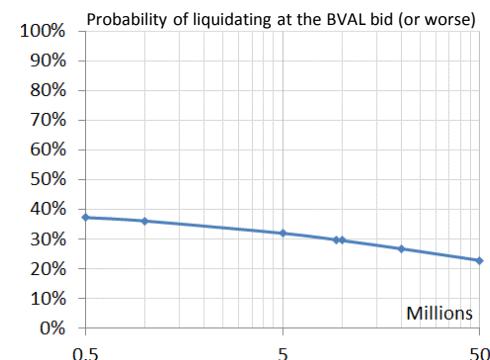
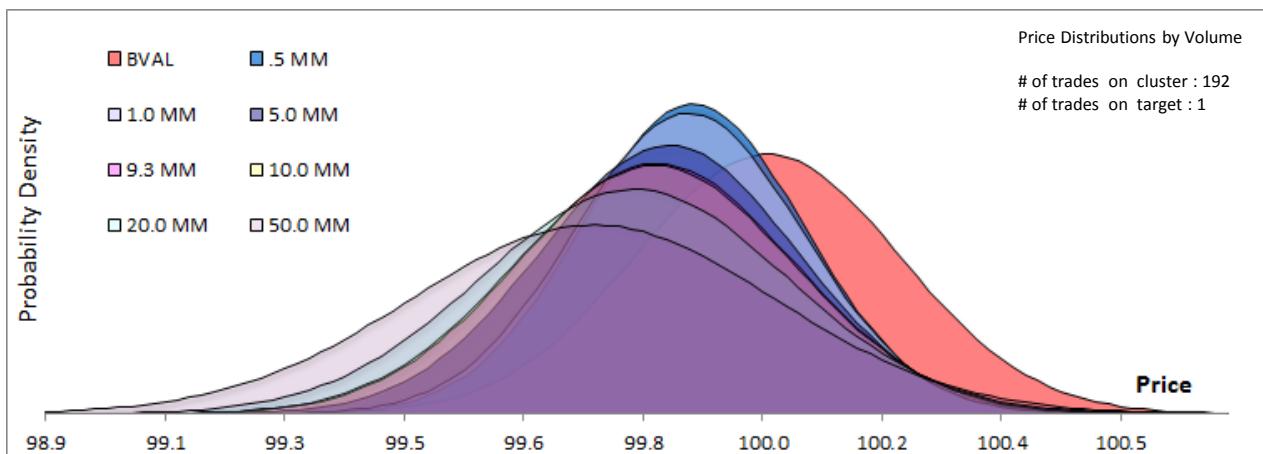
Security features	
Date	2014-11-03
Snapshot Time (2=NY4, 4=LO4)	2
Duration	2.03
Coupon	1.23
Age	8.66
AMT Outstanding	932,475,000
Price	99.95
Contrib Std	0.2
% of Market Data	100.00%
BA Spread	0.06
Sum Trade Vol. of past 2 months	128,250
Country of Risk	US
Currency	EUR

All value in local currency

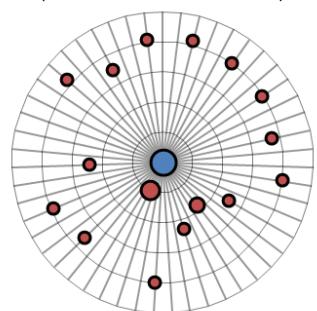
Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.1288
500,000	99.89	-0.11	0.17	37.33%	0.25
1,000,000	99.89	-0.12	0.17	36.17%	0.51
5,000,000	99.86	-0.15	0.19	32.04%	2.53
9,324,750	99.84	-0.17	0.21	29.86%	4.72
10,000,000	99.84	-0.17	0.21	29.59%	5.07
20,000,000	99.80	-0.20	0.23	26.81%	10.13
50,000,000	99.74	-0.26	0.27	22.87%	25.33

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEF3085166	JPMORGAN CHASE & CO	Financial	10.55%	1.13	0.06	932,475,000	2.03	1.23	BBB+	US	0.06	8
COED3623144	ING BANK NV	Financial	9.10%	0.79	0.24	670,438,335	3.03	1.52	BBB	NL	0.03	9
COED8393727	DANSKE BANK A/S	Financial	8.09%	0.68	0.36	870,310,000	0.36	4.10	BBB-	DK	0.14	9
COEF9412232	LANDBK HESSEN-THUERINGEN	Financial	7.48%	0.99	0.78	310,825,000	2.05	0.98	BBB+	DE	0.22	9
COEF2373597	ING BANK NV	Financial	7.40%	0.38	0.17	500,827,349	1.32	0.76	BBB	NL	0.05	9



Distances in Cluster (# of member 17)
(BLUE are from the same issuer)



- Price impact for selling 1% of AMT is -0.168 (EUR) with uncertainty (st.dev.) of 0.207. The probability of execution at the bid is 29.86%.
- The max volume can be executed, with market impact not bigger than 0.13%, is 1.97 MM (EUR).
- Given max volume and accepted market impact, the time to liquidation is 4.72 days (under linearity assumption in this release).

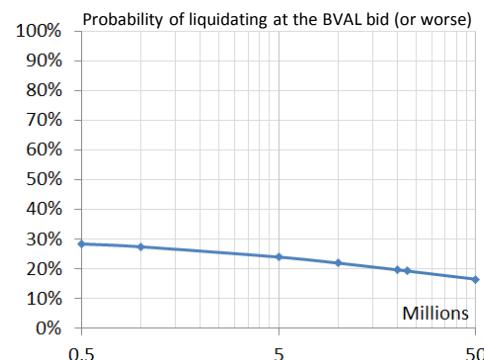
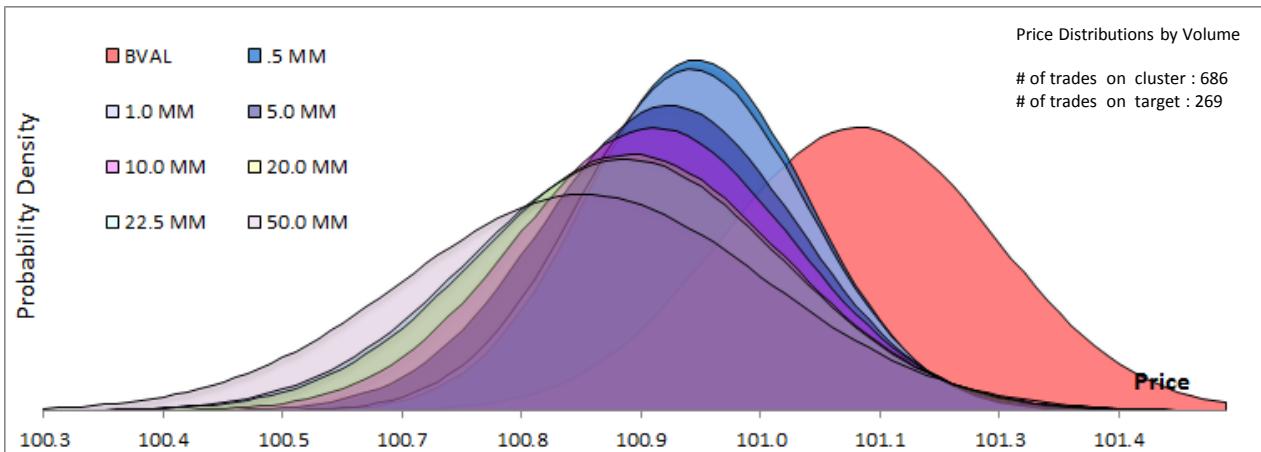
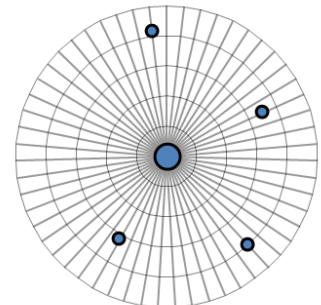
Security features	
Date	2014-11-03
Snapshot Time (2=NY4, 4=LO4)	2
Duration	7.98
Coupon	3.75
Age	0.48
AMT Outstanding	2,250,000,000
Price	101.02
Contrib Std	0.137091
% of Market Data	100.00%
BA Spread	0.10
Sum Trade Vol. of past 2 months	350,053,000
Country of Risk	GB
Currency	USD

All value in local currency

Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.1977
500,000	100.96	-0.16	0.11	28.46%	0.06
1,000,000	100.95	-0.17	0.11	27.48%	0.13
5,000,000	100.93	-0.19	0.13	24.03%	0.64
10,000,000	100.91	-0.20	0.14	22.00%	1.28
20,000,000	100.89	-0.23	0.15	19.73%	2.56
22,500,000	100.89	-0.23	0.15	19.33%	2.88
50,000,000	100.85	-0.27	0.18	16.57%	6.39

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEK2703933	BARCLAYS BANK PLC	Financial	25.43%	3.61	0.10	2,250,000,000	7.98	3.75	A	GB	0.90	10
COEJ4436212	BARCLAYS BANK PLC	Financial	19.50%	5.96	0.49	3,000,000,000	5.97	7.63	BBB-	GB	1.65	10
COEI4291288	BARCLAYS BANK PLC	Financial	18.96%	3.48	0.35	1,093,685,000	5.19	5.14	BBB-	GB	0.50	9
COEI0994638	BARCLAYS BANK PLC	Financial	18.18%	2.52	0.11	1,774,360,000	4.58	5.13	A	GB	0.58	8
COEK0730342	BARCLAYS BANK PLC	Financial	17.92%	2.33	0.07	2,000,000,000	4.07	2.50	A	GB	0.38	10

Distances in Cluster (# of member 5)
(BLUE are from the same issuer)

- Price impact for selling 1% of AMT is -0.232 (USD) with uncertainty (st.dev.) of 0.155. The probability of execution at the bid is 19.33%.
- The max volume can be executed, with market impact not bigger than 0.20%, is 7.82 MM (USD).
- Given max volume and accepted market impact, the time to liquidation is 2.88 days (under linearity assumption in this release).

GENERAL MOTORS CO -- GM 6 1/4 10/02/43

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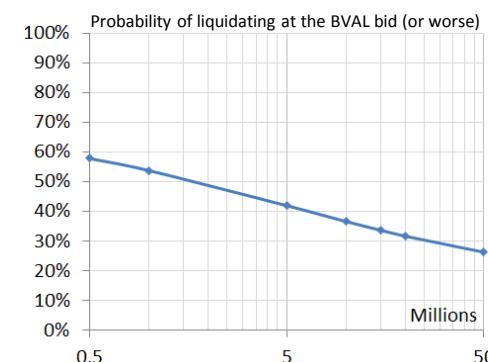
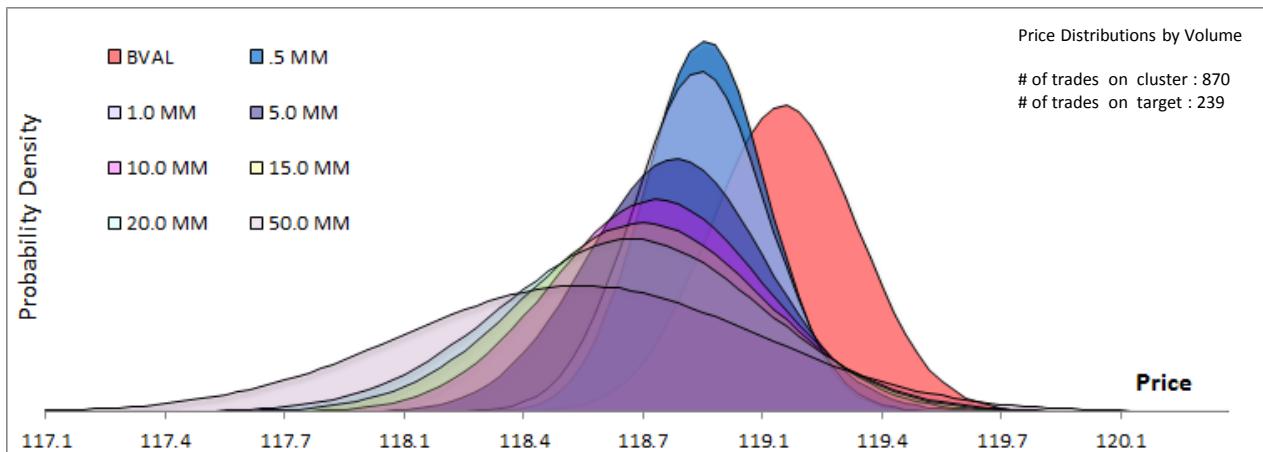
Security features	
Date	2014-11-03
Snapshot Time (2=NY4, 4=LO4)	2
Duration	14.63
Coupon	6.25
Age	0.30
AMT Outstanding	1,499,952,000
Price	118.88
Contrib Std	0.203378
% of Market Data	100.00%
BA Spread	0.25
Sum Trade Vol. of past 2 months	185,176,000
Country of Risk	US
Currency	USD

All value in local currency

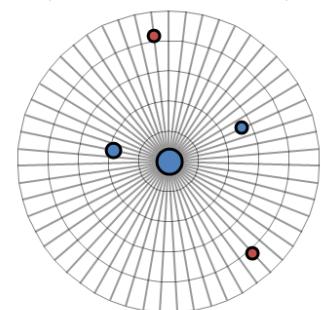
Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 0.3031
500,000	118.91	-0.22	0.17	57.89%	0.09
1,000,000	118.89	-0.23	0.18	53.82%	0.19
5,000,000	118.83	-0.30	0.25	42.02%	0.94
10,000,000	118.78	-0.35	0.29	36.67%	1.89
14,999,520	118.74	-0.39	0.33	33.72%	2.83
20,000,000	118.70	-0.42	0.36	31.75%	3.78
50,000,000	118.56	-0.56	0.49	26.33%	9.44

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEK3478170	GENERAL MOTORS CO	Consumer C	29.08%	4.99	0.25	1,499,952,000	14.63	6.25	BB+	US	2.07	10
COEK3478113	GENERAL MOTORS CO	Consumer C	21.65%	3.89	0.38	1,498,590,000	7.35	4.88	BB+	US	1.13	10
COEK3477990	GENERAL MOTORS CO	Consumer C	19.04%	2.59	0.25	1,492,843,000	3.66	3.50	BB+	US	0.77	10
COEJ0530059	CENTURYLINK INC	Communication Services	15.13%	7.54	0.68	650,000,000	11.33	7.65	BB	US	1.12	9
COEK5145744	ALLY FINANCIAL INC	Financial	15.10%	4.57	0.38	700,000,000	7.86	5.13	BB-	US	1.92	10



Distances in Cluster (# of member 5)
(BLUE are from the same issuer)



- Price impact for selling 1% of AMT is -0.388 (USD) with uncertainty (st.dev.) of 0.330. The probability of execution at the bid is 33.72%.
- The max volume can be executed, with market impact not bigger than 0.25%, is 5.30 MM (USD).
- Given max volume and accepted market impact, the time to liquidation is 2.83 days (under linearity assumption in this release).

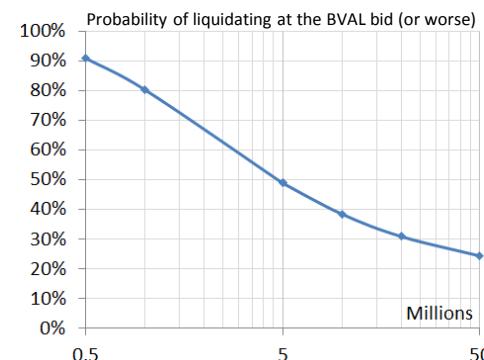
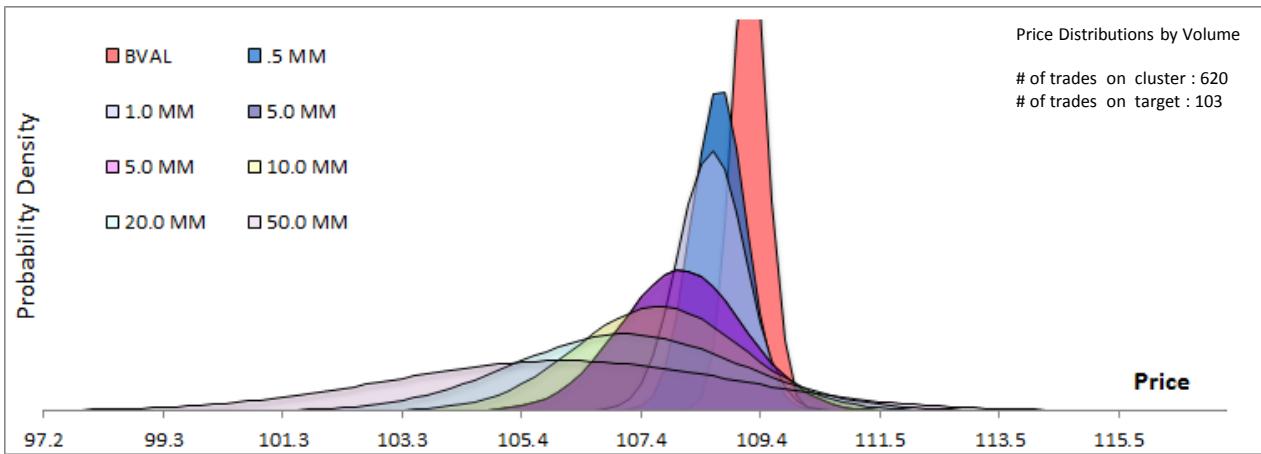
Security features	
Date	2014-11-03
Snapshot Time (2=NY4, 4=LO4)	2
Duration	12.29
Coupon	6.63
Age	5.51
AMT Outstanding	500,000,000
Price	108.13
Contrib Std	0.302379
% of Market Data	100.00%
BA Spread	1.13
Sum Trade Vol. of past 2 months	35,485,000
Country of Risk	FI
Currency	USD

All value in local currency

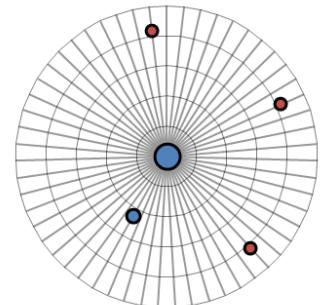
Volume	New Price	Impact	Uncertainty	Prob of selling at fair value bid or higher	N of days to Liqdtn for an impact of 1.1250
500,000	108.73	-0.52	0.45	90.99%	0.11
1,000,000	108.61	-0.64	0.57	80.38%	0.21
5,000,000	108.10	-1.15	1.05	48.91%	1.06
5,000,000	108.10	-1.15	1.05	48.91%	1.06
10,000,000	107.71	-1.54	1.41	38.48%	2.13
20,000,000	107.16	-2.09	1.93	30.92%	4.26
50,000,000	106.08	-3.17	2.95	24.40%	10.65

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEH8136887	NOKIA OYJ	Communicat	31.50%	5.91	1.13	500,000,000	12.29	6.63	BB	FI	0.86	9
COEH8129155	NOKIA OYJ	Communicat	21.60%	3.36	0.50	1,000,000,000	3.97	5.38	BB	FI	0.62	10
COEH9743038	CENTURYLINK INC	Communicat	15.69%	7.46	0.74	800,000,000	11.09	7.60	BB	US	1.09	9
COEF1097403	TELECOM ITALIA CAPITAL	Communicat	15.62%	5.95	0.50	1,000,000,000	11.65	6.00	BB+	IT	0.80	8
COEF3638154	STORA ENSO OYJ	Basic Materi	15.60%	6.79	1.38	300,000,000	11.06	7.25	BB	FI	0.20	7



Distances in Cluster (# of member 5)
(BLUE are from the same issuer)



- Price impact for selling 1% of AMT is -1.154 (USD) with uncertainty (st.dev.) of 1.052. The probability of execution at the bid is 48.91%.
- The max volume can be executed, with market impact not bigger than 1.03%, is 4.70 MM (USD).
- Given max volume and accepted market impact, the time to liquidation is 1.06 days (under linearity assumption in this release).

CZECH REPUBLIC -- CZECH 2 7/8 11/23/16

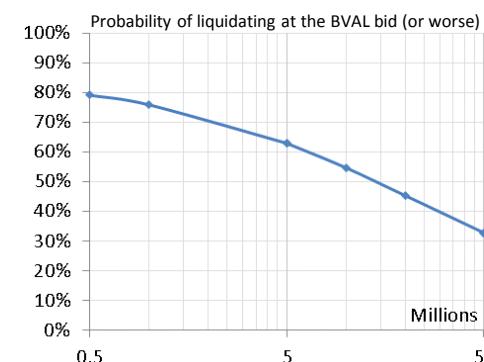
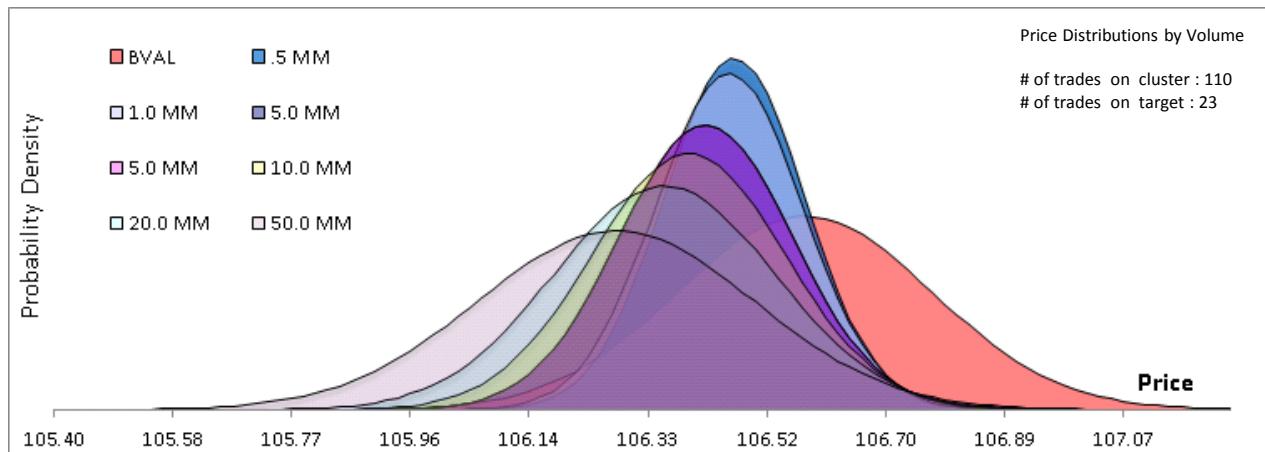
Security features	
Date	2014-05-16
Snapshot Time (2=NY4, 4=LO4)	2
Duration	2.43
Coupon	2.88
Age	4.48
AMT Outstanding	500,000,000
Price	106.38
Contrib Std	0.2
% of Market Data	100.00%
BA Spread	0.20
Sum Trade Vol. of past 2 months	43,715,000
Country of Risk	CZ
Currency	CHF

All value in local currency

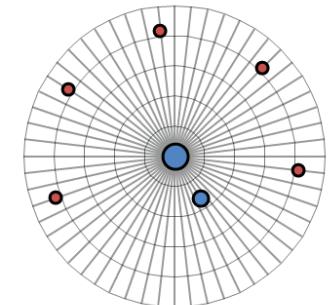
Volume	New Price	Impact	Uncertainty	Prob of selling at fair value at bid or higher	N of days to Liqdtn for an impact of 0.1898
500,000	106.46	-0.11	0.11	79.21%	0.04
1,000,000	106.46	-0.12	0.12	75.95%	0.08
5,000,000	106.42	-0.15	0.14	63.01%	0.42
5,000,000	106.42	-0.15	0.14	63.01%	0.42
10,000,000	106.39	-0.18	0.15	54.75%	0.85
20,000,000	106.35	-0.22	0.17	45.37%	1.70
50,000,000	106.28	-0.30	0.22	32.87%	4.25

Comparable: Top 5 Cluster Members

Security	Issuer	Sector	Weight	Yield	BA Spread	AMT Outstanding	Duration	CPN	Rating	Country	2m P std	Score
COEI0208575	CZECH REPUBLIC		25.18%	0.24	0.20	500,000,000	2.43	2.88	A+	CZ	0.13	9
COEH3980131	CZECH REPUBLIC		18.21%	0.67	0.27	2,000,000,000	3.65	5.00	A+	CZ	0.10	10
COEI5670449	REPUBLIC OF POLAND		11.35%	0.35	0.18	350,000,000	1.74	2.75	A-	PL	0.08	9
COEH2848768	REPUBLIC OF POLAND		11.34%	0.48	0.24	250,000,000	2.81	3.63	A-	PL	0.07	9
COED9037836	REPUBLIC OF POLAND		11.32%	0.25	0.13	1,500,000,000	0.97	2.63	A-	PL	0.08	9



Distances in Cluster (# of member 7)
(BLUE are from the same issuer)



- Price impact for selling 1% of AMT is -0.155 (CHF) with uncertainty (st.dev.) of 0.136. The probability of execution at the bid is 63.01%.
- The max volume can be executed, with market impact not bigger than 0.18%, is 11.77 MM (CHF).
- Given max volume and accepted market impact, the time to liquidation is 0.42 days (under linearity assumption in this release).

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