Markit iBoxx Implied Credit Quality Methodology

January 2016

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Changes to the Markit iBoxx Implied Credit Quality Methodology

20 January 2016	Update of the implied credit quality methodology • Inclusion of the implied credit quality criteria for the USD denominated bonds in Markit iBoxx ADBI and AHBI indices • Inclusion of Markit iBoxx ALBI China – offshore bonds into the existing implied credit quality criteria for the Offshore RMB denominated bonds
31 July 2014	Update of the implied credit quality methodology • Changes of the boundary calculation (error minimizing function, z-scores) • Changes to the implied credit quality up- and downgrade process • Inclusion of the implied credit quality criteria for the Markit iBoxx Offshore RMB denominated bonds
25 June 2013	Publication of Markit iBoxx Implied Credit Quality Methodology

1   Overview

The Markit iBoxx Implied Credit Quality methodology assigns implied iBoxx Ratings to bonds in an index family that are not rated by any of the three rating agencies:
- Fitch Ratings
- Moody's Investor Service
- Standard & Poor's Rating Services

The methodology uses spreads to the government benchmark curve, as calculated according to iBoxx Spread Analytics methodology, to derive the implied iBoxx Ratings.

The Markit iBoxx Implied Credit Quality methodology uses benchmark spread information of rated senior bonds from an index universe to estimate spread boundaries between adjacent rating grades. These spread boundaries are then used to assign implied iBoxx ratings to unrated bonds from within the same index universe.
The methodology is currently used in the Markit iBoxx SGD, Markit iBoxx Offshore RMB, Markit iBoxx ALBI China – offshore, and Markit iBoxx ADBI and AHBI index families, but may be extended to cover other index families that include unrated bonds in the future. The granularity of the assigned implied iBoxx Ratings differ from index family to index family, depending on the number and distribution of rated bonds in the index, the assigned range of implied iBoxx Ratings for each index family can be found in Appendix 4.2.

The procedure uses two major steps. First, ratings boundaries are calculated, using the benchmark spreads of all rated senior bonds in the index universe. Thereafter, all unrated bonds are assigned implied iBoxx Ratings by comparing their benchmark spreads against the estimated boundaries. Unrated bonds/issuers are monitored for downgrades and upgrades are according to the rules in section 3.

2   Determination of rating boundaries

In the document, the pairs CCC/B, B/BB, BB/BBB, BBB/A, A/AA are denoted as boundary pairs. The separate ratings of CCC, B, BB, BBB, A and AA are the implied credit quality segments. The methodology does not assign an implied AAA iBoxx rating.

2.1 Methodology for calculating rating boundaries on a daily basis

All boundaries are calculated based on the information from all rated senior bonds on a daily basis, except that bonds with a remaining time to maturity of below 6 months are not used in the calculation. The exception is put in place because the spread-credit risk relationship weakens as the bond gets closer to maturity.

The calculation is based on individual senior bonds or at the aggregate issuer level depending on the number of observations available to calculate the boundaries. The breakdown of which currencies use the bond or issuer data can be found in the appendix.

At the close of each calculation day of the index, the spread boundaries between all maintained implied credit quality segments are calculated according to the following steps:

1. If there are 5 or more rated senior bonds, having at least 6 months to maturity, in both adjacent credit quality segments of a boundary, then the boundary is calculated as follows (with an example of the A-BBB boundary):

    - First the average distance to the boundary is calculated as:

$$F(B) = \frac{\sum_{i=1}^{m} Max\left[Z_{i,A} - \left(\frac{B - \mu_A}{\sigma_A}\right), 0\right]}{m} + \frac{\sum_{j=1}^{n} Max\left[\left(\frac{B - \mu_{BBB}}{\sigma_{BBB}}\right) - Z_{j,BBB}, 0\right]}{n}$$

where

$$Z_{i,A} = \frac{S_{i,A} - \mu_A}{\sigma_A}$$

$$Z_{j,BBB} = \frac{S_{j,BBB} - \mu_{BBB}}{\sigma_{BBB}}$$

$$\mu_A = \frac{1}{m} \cdot \sum_{i=1}^{m} S_{i,A}$$

$$\sigma_A = \sqrt{\frac{1}{m-1} \cdot \sum_{i=1}^{m} (S_{i,A} - \mu_A)^2}$$

$$\mu_{BBB} = \frac{1}{n} \cdot \sum_{j=1}^{n} S_{j,BBB}$$

$$\sigma_{BBB} = \sqrt{\frac{1}{n-1} \cdot \sum_{j=1}^{n} (S_{j,BBB} - \mu_{BBB})^2}$$

Where
- B .... Estimated boundary spread level between A and BBB
- $S_{i,A}$ .... Spread of senior bond (i) with an A rating
- $S_{j,BBB}$ .... Spread of senior bond (j) with a BBB rating
- μ_A ....Mean of spreads of senior bonds with an A rating
- σ_A .... Standard Deviation of spreads of senior bonds with an A rating
- μ_{BBB} .... Mean of spreads of senior bonds with a BBB rating
- σ_{BBB} .... Standard Deviation of spreads of senior bonds with a BBB rating
- $Z_{i,A}$ ....Z-score of the spread of senior bond (i) with an A rating
- $Z_{j,BBB}$ ....Z-score of the spread of senior bond (j) with an BBB rating
- m .... Number of senior bonds with rating A
- n .... Number of senior bonds with rating BBB

- The boundary spread "B" is chosen so that it minimizes the average distance function $F(B)$. Boundary "B" will be known as the Credit Quality Boundary.

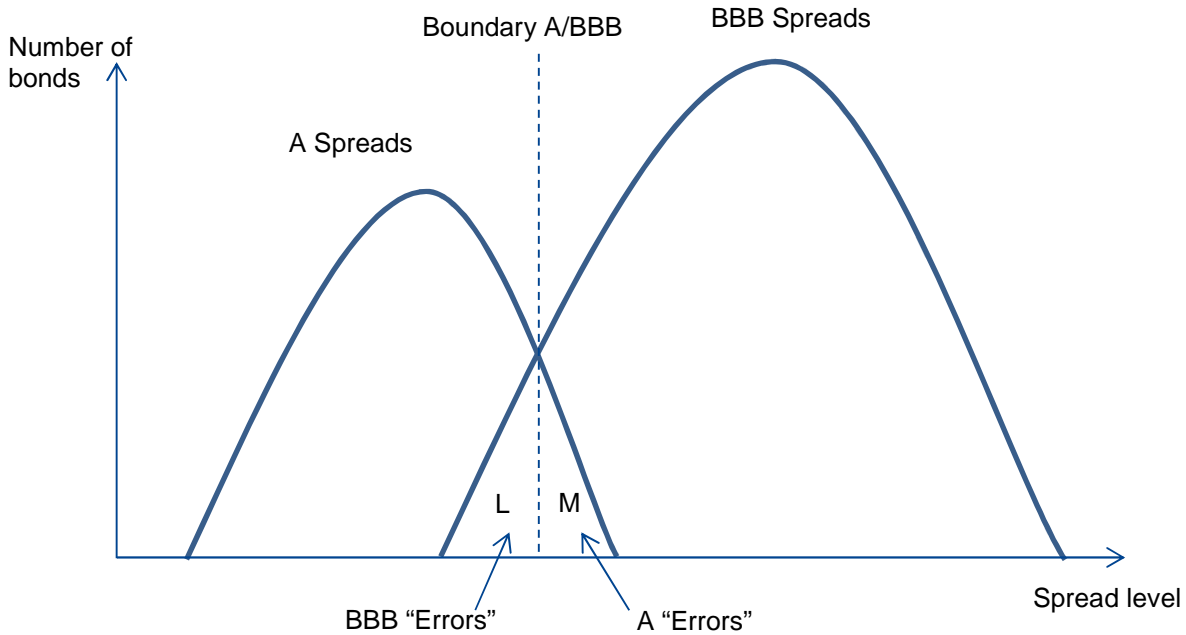Figure 1: Illustration of the error minimizing function

Figure 1 illustrates the goal of the function. As there is some overlap between the distribution of A rated and BBB rated bonds' spreads, the function should find the Boundary A/BBB which minimizes the area covered by the BBB and A errors, i.e. the area under L+M.

2. If there are less than 5 rated senior bonds in one of the adjacent rating segments of a boundary, then the boundary is calculated based on the spread information of the rating segment with the larger number of rated bonds, having at least 6 months to maturity. In case that the number of rated bonds of the two adjacent rating segments is equal, the boundary is calculated based on the spreads of the higher rating segment. For example, If there are more A rated bonds than BBB rated bonds, the A-BBB boundary under this scenario will be calculated as:

$$Boundary \ = \ \mu_A + Z * \sigma_A$$

Where
Mean is the arithmetic mean of the spreads of the A rated bonds.

$$\mu_A = \frac{1}{m} \cdot \sum_{i=1}^{m} S_{i,A}$$

SD is the standard deviation of the spreads of the A rated bonds.

$$\sigma_A = \sqrt{\frac{1}{m-1} \cdot \sum_{i=1}^{m} (S_{i,A} - \mu_A)^2}$$

Z is the number of standard deviations away from the mean. The number differs from rating pair to rating pair and has been determined by analyzing the spread behavior within the Markit iBoxx EUR and Markit iBoxx USD indices. The parameters are available in Appendix 4.1.

2.2 Implied credit quality up- and downgrade thresholds based on the estimated rating boundaries

The estimated rating boundaries are used in the calculation of the up- and downgrade thresholds for bonds with an implied credit quality. The upgrade and downgrade thresholds are used to capture gradual trends in the implied credit quality. The immediate upgrade and immediate downgrade thresholds are used to capture credit events that lead to a sudden shift in the implied credit quality. A description of the downgrade/upgrade process can be found in section 3. The upgrade and downgrade thresholds will consider the distance between adjacent rating boundaries and will be computed as follows (example of A-BBB Boundary):

1. Upgrade Threshold A-BBB (BBB->A)

$$\text{Up Threshold} = \frac{A}{BBB} \, Boundary - 0.15 * \left(\frac{A}{BBB} Boundary - \frac{AA}{A} Boundary \right)$$

2. Downgrade Threshold A-BBB (A->BBB)

$$\text{Down Threshold} = \frac{A}{BBB} \, Boundary + 0.15 * \left(\frac{BBB}{BB} Boundary - \frac{A}{BBB} Boundary \right)$$

The same logic applies to all other thresholds except for the upgrade threshold of the highest rating boundary and the downgrade threshold of the lowest rating boundary (in this example AA-A and BB-B, respectively), where the following formula holds:

1. Upgrade Threshold AA-A (A->AA)

$$\text{Up Threshold} = 0.9 * \frac{AA}{A} \, Boundary$$

2. Downgrade Threshold BB-B (BB->B)

$$\text{Down Threshold} = 1.1 * \frac{BB}{B} \, Boundary$$

The immediate upgrade and downgrade thresholds are calculated as follows:

3. Immediate Upgrade Threshold A-BBB (BBB->A)

$$Immediate \, Up \, Threshold = 0.6 * \frac{A}{BBB} Boundary$$

4. Immediate Downgrade Threshold A-BBB (A->BBB)

$$Immediate \, Down \, Threshold = 1.4 * \frac{A}{BBB} Boundary$$

3 Implied credit quality assignment

The implied credit quality methodology distinguishes between unrated senior and subordinated debt. All senior bonds from an issuer (in the same currency) are assigned the same implied credit quality regardless of the individual bond spreads. The assigned credit quality is based on the duration-weighted average spread of all senior bonds, having at least 6 months to maturity, from the issuer that qualify for the index:

$$S^{NEW} = \frac{\sum_{i=1}^{n} MV_i \times D_i \times S_i}{\sum_{i=1}^{n} MV_i \times D_i}$$

Where
  MV$_i$ .... Is the market value of senior bond i from the issuer
  D$_i$ .... Is the duration of senior bond i from the issuer
  Si .... Is the spread of senior Bond i from the issuer
  n .... Is the number of senior bonds of the issuer, with more than 6 months to maturity

Each subordinated bond is treated separately and retains its own spread:

$$S^{NEW} = S_i$$

New unrated bonds are assigned an implied credit quality when they first enter the index - the process is described in chapters 3.1. The implied credit quality is monitored daily, and bonds will change their implied credit quality according to the procedure described in chapter 3.3 and 3.4. Any change in the implied credit quality becomes effective in the index at the next index rebalancing.

3.1 Determination of the initial implied credit quality for new bonds/issuers

All senior bonds from one issuer will have the same implied credit quality at any point of time. Therefore, if a new senior bond from an issuer, which already has one or more bonds in the index, is added to the index, its initial credit quality will be the current implied credit quality of the senior bonds from the same issuer that are already in the index.

At index start date, for newly issued subordinated debt or senior bonds whose issuer does not have existing senior debt in the index, the initial implied credit quality needs to be determined based on the available spread information.

The initial implied credit quality is determined based on the spreads of the 20 trading days prior to the index re-balancing cut-off date (currently the third last trading day of the month). In case that a bond is issued/priced within the last 20 trading days of the month, the following applies:
- For bonds issued before or on the third last trading day of the month – all trading days between the issuance and the rebalancing cut-off date are taken into account
- For bonds issued on the last two trading days of the month, the calculation is based on the issue price of the bond should it qualify for the index

For each day in the observation period, the bond/issuer is assigned to a provisional implied credit quality depending on its daily spread, e.g. if the AA/A boundary is 200 and the A/BBB boundary is 250 and the spread of the bond/issuer is 220, then it would fall into the 'A' category on this day,

The assignment of the bond/issuer to each implied credit quality is counted and the bond/issuer is assigned the implied credit quality which it was most frequently assigned to during the observation period, e.g. if a bond/issuer was assigned to A on 6 days and BBB on 4 days, then the assigned implied credit quality would be A.

In the event that the bond/issuer was assigned to two or more categories with equal frequency, then the initial implied credit quality is determined as follows:

1. For each bond, the aggregate spread difference to each boundary is calculated:

$$X_{i,i+1} = \sum_{t=1}^{T} (S_t^{NEW} - B_{t,i,i+1})$$

Where

$X_{i,i+1}$............ Is the aggregate difference to the boundary between the i/i+1 ratings (such as AA/A, A/BBB, etc.

$B_{t,i,i+1}$........... Is the Boundary between the I and i+1 rating and day t

2. The $X_{i,i+1}$ are ordered according to their absolute value. The $X_{i,i+1}$ with the smallest absolute value is used to assign the implied credit quality. The implied credit quality is equal to:
   - The higher rating category i, if the value of $X_{i,i+1}$ is negative, else
   - The lower rating category i+1

3. In the event that the absolute values are the same for two Xi,i+1, the lower boundary is used to determine the implied credit quality.

To illustrate the process look at the following hypothetical example:

Day	Bond spread	AA/A Boundary	A/BBB Boundary	BBB/BB Boundary
1	215	210	250	400
2	245	220	240	410
3	255	210	250	410
4	205	200	260	380

The bond could be assigned to either the A or BBB implied credit quality with two days each in the observation period.
The aggregate distance to the AA/A Boundary is
$X_{AA,A}$ = (215-210)+(245-220)+(255-210)+(205-200) = 80
Similarly, the aggregate distance $X_{A,BBB}$ = -80 and $X_{BBB,BB}$ = -680

Since $X_{AA,A}$ and $X_{A,BBB}$ have the same absolute value, the lower boundary A/BBB is chosen to assign the implied credit quality. Since the value is negative, the bond is assigned the higher implied credit quality of A.

3.2 Determination of the initial implied credit quality for bonds that become unrated

For rated bonds that become unrated, the initial implied credit quality is determined by

- Assigning the last published rating as the initial implied credit quality, and
- Testing whether the up-/downgrade or immediate up-/downgrade conditions are fulfilled as described below.

3.3 Determination of the implied credit quality for bonds with less than 6 months to maturity

Bonds with less than 6 months to maturity are not included in the implied credit quality calculation because of the weak link between credit risk and spread due to the short remaining life of the bond. The implied credit quality for these bonds is determined as follows:

- For senior bonds:
  - The implied credit quality of longer dated bonds from the same issuer, if senior bonds from this issuer with a time to maturity longer than 6 months are included in the index
  - If not, the current implied credit quality remains unchanged until maturity of the bond
- For subordinated debt:
  - If no senior bond with time to maturity longer than 6 months is available from the same issuer: the current implied credit quality remains unchanged
  - If senior bonds are available – the implied credit quality is the minimum of the current implied credit quality of the subordinated bond and the implied credit quality of the senior bonds for the same issuer

3.4 Regular up-/downgrade of the implied credit quality

Once an implied credit quality has been assigned, the bond will change its implied credit quality if the following conditions are fulfilled:

1. A bond/issuer is downgraded to the lower implied credit quality if
The spread of the bond/issuer is higher than the Downgrade Threshold for 40 days out of the last 60 days AND
The spread of the bond/issuer has been higher than the Downgrade Threshold for 18 days out of the last 20 days.

2. A bond/issuer is upgraded to the higher rating segment if
The spread of the bond/issuer is lower than the Upgrade Threshold for 40 days out of the last 60 days AND
The spread of the bond/issuer has been below the Upgrade Threshold for 18 days out of the last 20 days.

3.5 Immediate up-/downgrade of the implied credit quality

In the case of large[1] sudden spread changes, a shortened period is tested.

1. A bond/issuer is downgraded to the lower implied credit quality segment if
The spread of the bond/issuer is higher than the Immediate Downgrade Threshold for the last 10 trading days

2. A bond/issuer is upgraded to the lower implied credit quality segment if
The spread of the bond/issuer is lower than the Immediate Upgrade Threshold for each of the last 10 trading days

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[1] Large spread change is defined in Section 2.2.3 – Immediate upgrade and downgrade thresholds

4 Appendices

4.1 Parameters for the fall back rating boundary calculation

Boundary	Rating Category	Z
AA-A	AA	0.5
	A	-0.5
A-BBB	A	0.5
	BBB	-0.5
BBB-BB	BBB	1
	BB	-0.5
BB-B	BB	1
	B	-0.5
B-CCC	B	1
	CCC	-0.5

4.2 Implied Markit iBoxx Ratings per index family

Implied Markit iBoxx Rating	Markit iBoxx SGD	Markit iBoxx Offshore RMB and Markit iBoxx ALBI China - Offshore	Markit iBoxx ADBI and AHBI
AAA			
AA	X	X	X
A	X	X	X
BBB	X	X	X
BB	X	X	X
B		X	X
CCC			X

4.3 Parameter for the calculation of the rating boundaries

Currency	Boundary basis
Offshore RMB	Individual bonds
SGD	Individual bonds
USD	Issuer aggregate

5 Further information

- For contractual or content issues please refer to

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