

Webinar: Managing IFRS9 Volatility

ImpairmentCalc Rating to PIT PD Converter

- » The *Rating to PIT PD Converter* takes as input an agency rating or TTC PD and outputs a up-to-date and forward-looking PITPD for each instrument, based on:
 - Rating Grade
 - Country
 - Industry
- » For more details about the methodology of the *Rating to PITPD Converter*, please refer to:
 - *Chen, Nan, Douglas Dwyer, and Sue Zhang, “Converting Agency Ratings to Point-In-Time PD Term Structure.” Moody’s Analytics White Paper, March 2017.*

Quarter to Quarter PITPD Volatility within the Converter

- » The PITPD output of the converter (for a specific rating, country, and industry) will change from quarter to quarter
 - This reflects changes in the credit environment facing the borrower
 - Will rise and fall cyclically across the credit cycle

- » **Question from Users:** Is the quarter-to-quarter PITPD volatility of the converter correctly reflecting the PITPD volatility of the instruments in my portfolio?

Enhancing Granularity in PD Converter Volatility

- » The PD Converter output is calibrated using the Moody's global public firm universe
 - It therefore reflects the quarter-to-quarter PITPD volatility of an “average” firm in Moody's global public firm universe, holding TTCPD constant
- » If the firms in a user's portfolio are meaningfully different from an “average” public firm, the PITPD volatility of these firms may be different.

Enhancing Granularity in PD Converter Volatility

- » Based on previous Moody's research, one important characteristic that may affect PITPD volatility is the **size of the firm**.
- » Smaller firms typically are less affected by shocks in overall market conditions. This causes small firm PITPDs to be less volatile/cyclical.

Proposed Structure for Volatility Dampening

- » We propose a simple structure for dampening PITPD Volatility: the user specifies a dampening parameter β .
- » Based on β , PITPD will be calculated as a weighted average of the Public Firm PIT PD and the relevant TTC PD:

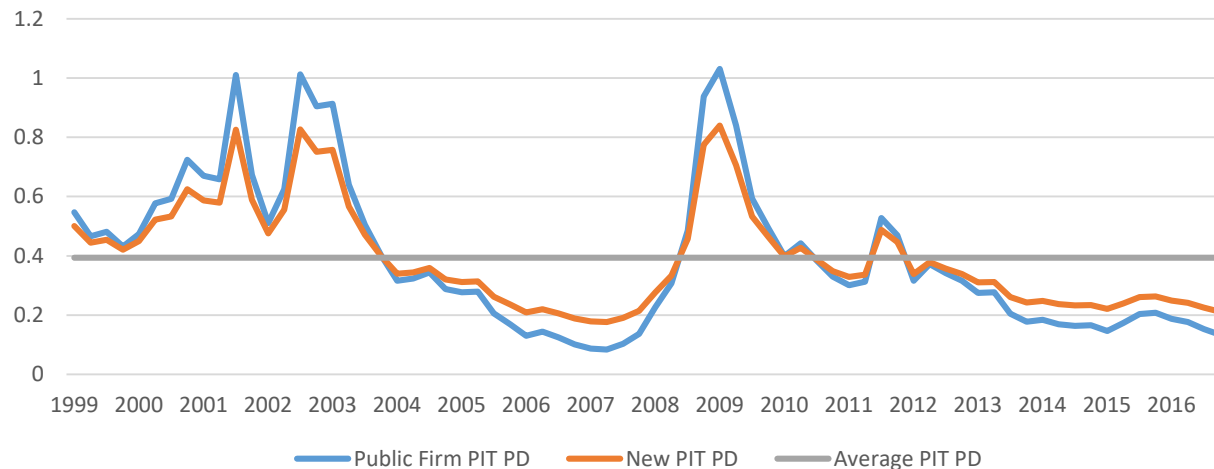
$$PITPD_i^{USER} = \beta * PITPD_i^{CONV} + (1 - \beta) * Avg(PITPD_i^{CONV})$$

This will result in a SME PIT PD time series with a similar shape to the Public Firm PIT PD time series, but proportionally less volatility (for $\beta < 1$).

The mean of the time series would be unchanged, but the standard deviation of the time series would be reduced by $1-\beta$.

Proposed Structure for Volatility Dampening

$$PITPD_i^{USER} = \beta * PITPD_i^{CONV} + (1 - \beta) * Avg(PITPD_i^{CONV})$$



Values for $Avg(PITPD_i^{CONV}) = TTCPD_i^{CONV}$

- » $Avg(PITPD_i^{CONV})$ has been calculated by Moody's over the period 1999-2017. This table has been provided in the document "Mapping Internal and External Ratings to PIT PDs" and updated in "Adjusted Financial Mapping for Rating to PIT PD Converter" (shown here).
- » Moody's will monitor this table and update as enough extra data becomes available to materially change this table.

TABLE 1
Mapping Table between Rating and Modeled TTC PD

Rating	NON-FINANCIALS			ORIGINAL FINANCIAL MAPPING			ADJUSTED FINANCIALS MAPPING (BAILOUT-FREE)		
	Global*	NA/Europe	Rest of World*	Global*	NA/Europe	Rest of World*	Global*	NA/Europe	Rest of World*
Aaa	0.02%	0.02%	0.03%	0.33%	0.30%	0.43%	0.08%	0.07%	0.10%
Aa1	0.03%	0.03%	0.04%	0.37%	0.33%	0.48%	0.11%	0.09%	0.13%
Aa2	0.05%	0.04%	0.06%	0.42%	0.37%	0.54%	0.14%	0.12%	0.17%
Aa3	0.07%	0.06%	0.09%	0.47%	0.42%	0.61%	0.19%	0.16%	0.22%
A1	0.10%	0.09%	0.13%	0.53%	0.47%	0.68%	0.25%	0.21%	0.29%
A2	0.14%	0.13%	0.18%	0.60%	0.53%	0.77%	0.33%	0.27%	0.38%
A3	0.21%	0.18%	0.26%	0.67%	0.60%	0.86%	0.43%	0.36%	0.50%
Baa1	0.30%	0.27%	0.38%	0.76%	0.67%	0.98%	0.57%	0.48%	0.66%
Baa2	0.43%	0.38%	0.54%	0.86%	0.76%	1.10%	0.76%	0.64%	0.87%
Baa3	0.62%	0.55%	0.78%	0.97%	0.85%	1.24%	1.01%	0.85%	1.16%
Ba1	0.89%	0.80%	1.12%	1.09%	0.96%	1.41%	1.35%	1.14%	1.55%
Ba2	1.29%	1.15%	1.61%	1.24%	1.09%	1.59%	1.81%	1.54%	2.07%
Ba3	1.86%	1.66%	2.33%	1.40%	1.23%	1.81%	2.43%	2.08%	2.79%
B1	2.69%	2.41%	3.36%	1.59%	1.40%	2.05%	3.29%	2.82%	3.76%
B2	3.90%	3.49%	4.86%	1.80%	1.59%	2.32%	4.47%	3.84%	5.09%
B3	5.65%	5.06%	7.03%	2.05%	1.80%	2.64%	6.10%	5.27%	6.91%
Caa1	8.20%	7.36%	10.18%	2.32%	2.04%	3.00%	8.36%	7.26%	9.43%
Caa2	11.92%	10.71%	14.77%	2.64%	2.32%	3.42%	11.50%	10.06%	12.92%
Caa3	17.34%	15.60%	21.44%	3.01%	2.65%	3.90%	15.91%	14.02%	17.77%
Ca	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
C	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

What Value Should be used for β ?

- » We will derive suggested values for β via the following method:

What Value Should be used for β ?

» We will derive suggested values for β via the following method:

Step 1: Directly comparing the volatility of EDFs for different sized public firms to the PIT Converter volatility, estimate global values of β that depend on the firm's size.

What Value Should be used for β ?

» We will derive suggested values for β via the following method:

Step 1: Directly comparing the volatility of EDFs for different sized public firms to the PIT Converter volatility, estimate global values of β that depend on the firm's size.

Step 2: To make these β_{SIZE} more granular by region, leverage GCORR Modelled Public R^2 to adjust the global β_{SIZE} estimates regionally.

Step 1: EDF-implied Volatility

- » Note the volatility dampening equation:

$$PITPD_i^{USER} = \beta * PITPD_i^{CONV} + (1 - \beta) * TTCPD_i^{CONV}$$

Can be rewritten as:

$$PITPD_i^{USER} - TTCPD_i^{CONV} = \beta * (PITPD_i^{CONV} - TTCPD_i^{CONV})$$

- » Notice that this equation takes the univariate regression form of $Y = \beta * X$.

Step 1: EDF-implied Volatility

- » To inform us how β should vary with the size of the underlying firms, we will leverage rated CreditEdge firms from 1999-Present, given their measures of:

PITPD: the firm's *EDF*

TTCPD: the $TTCPD_i^{CONV}$ corresponding to the firm's rating

- » We will estimate the following univariate specification, where $\beta_{SIZE_{it}}$ varies by the size of the firm (sales for corporates, assets for financials):

$$EDF_{it} - TTCPD_{rating_{it}}^{CONV} = \beta_{SIZE_{it}} * (PITPD_{it}^{CONV} - TTCPD_{rating_{it}}^{CONV}) + e_{it}$$

Estimating β_{SIZE}

$$EDF_{it} - TTCPD_{rating_{it}}^{CONV} = \beta_{SIZE_{it}} * (PITPD_{it}^{CONV} - TTCPD_{rating_{it}}^{CONV}) + e_{it}$$

» In practice, we must specify a functional form for how the coefficient $\beta_{SIZE_{it}}$ varies with size. We report the following two specifications:

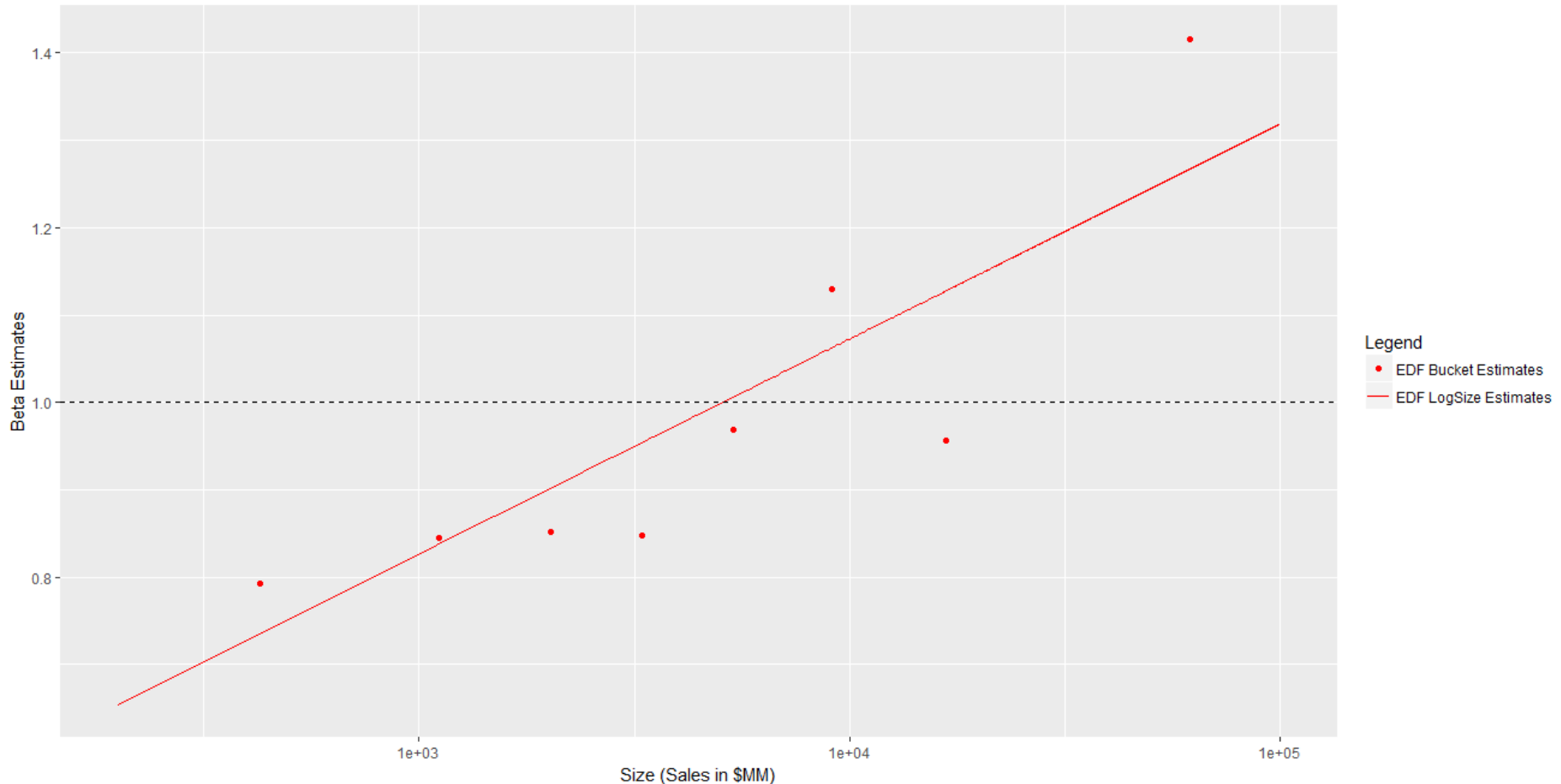
1. Log-Linear in size of the firm (sales for corporates, assets for financials)

$$\beta_{SIZE_{it}} = \beta_0 + \beta_1 * \log(SIZE_{it})$$

2. Varying for 8 equal buckets of increasing firm size :

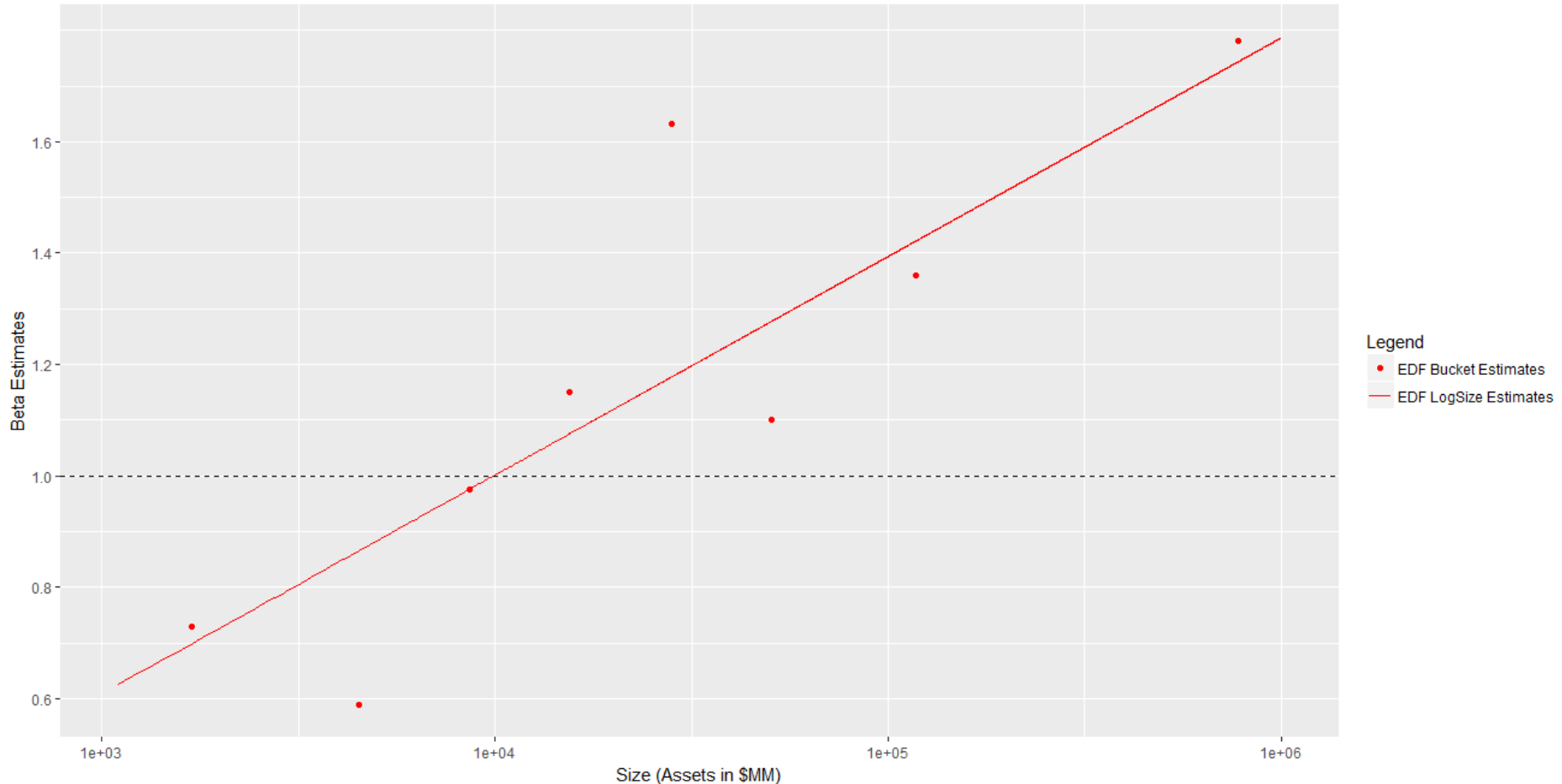
$$\beta_{SIZE_{it}} = \sum_{k=1}^8 \beta_k * I[SIZE_{it} \text{ in bucket } k]$$

Corporate β_{SIZE} Estimates



» Note that the log-linear estimates indicate that PIT Converter output has volatility equivalent to a corporate firm with \$5.2 Billion in sales.

Financial β_{SIZE} Estimates



» Note that the log-linear estimates indicate that the PIT Converter output has volatility equivalent to a financial firm with \$10.3 Billion in assets.

Step 2: Granulizing β_{SIZE} by Region

- » Because the EDF-driven method is inherently noisy and relies on the relatively small universe of rated firms, there is not enough data to estimate the previous parameters region by region.
- » To make the method more granular, we now leverage the GCORR modelled R^2 , which allows firm asset return correlation (and thus PITPD to TTCPD volatility) to vary by:
 - › Region
 - › Industry
 - › Size of Firm

Step 2: Granulizing β_{SIZE} by Region

- » β defines the relative volatility between the PITPD converter output and a firm's true PITPD. We have already estimated the firm size implied by the converter output, so:

$$\beta_{SIZE_{it}} = \frac{SD_{SIZE_{it}}}{SD_{SIZE_{Converter}}}$$

- » Vasicek (1991) gives the standard deviation of a firm's PITPD as a function of its R^2 and the TTCPD:

$$SD = \sqrt{N_{BIV}(N^{-1}(TTCPD), N^{-1}(TTCPD), R^2) - TTCPD^2}$$

where N_{BIV} is the bivariate normal cdf, and N^{-1} is the inverse normal cdf

Step 2: Granulizing β_{SIZE} by Region

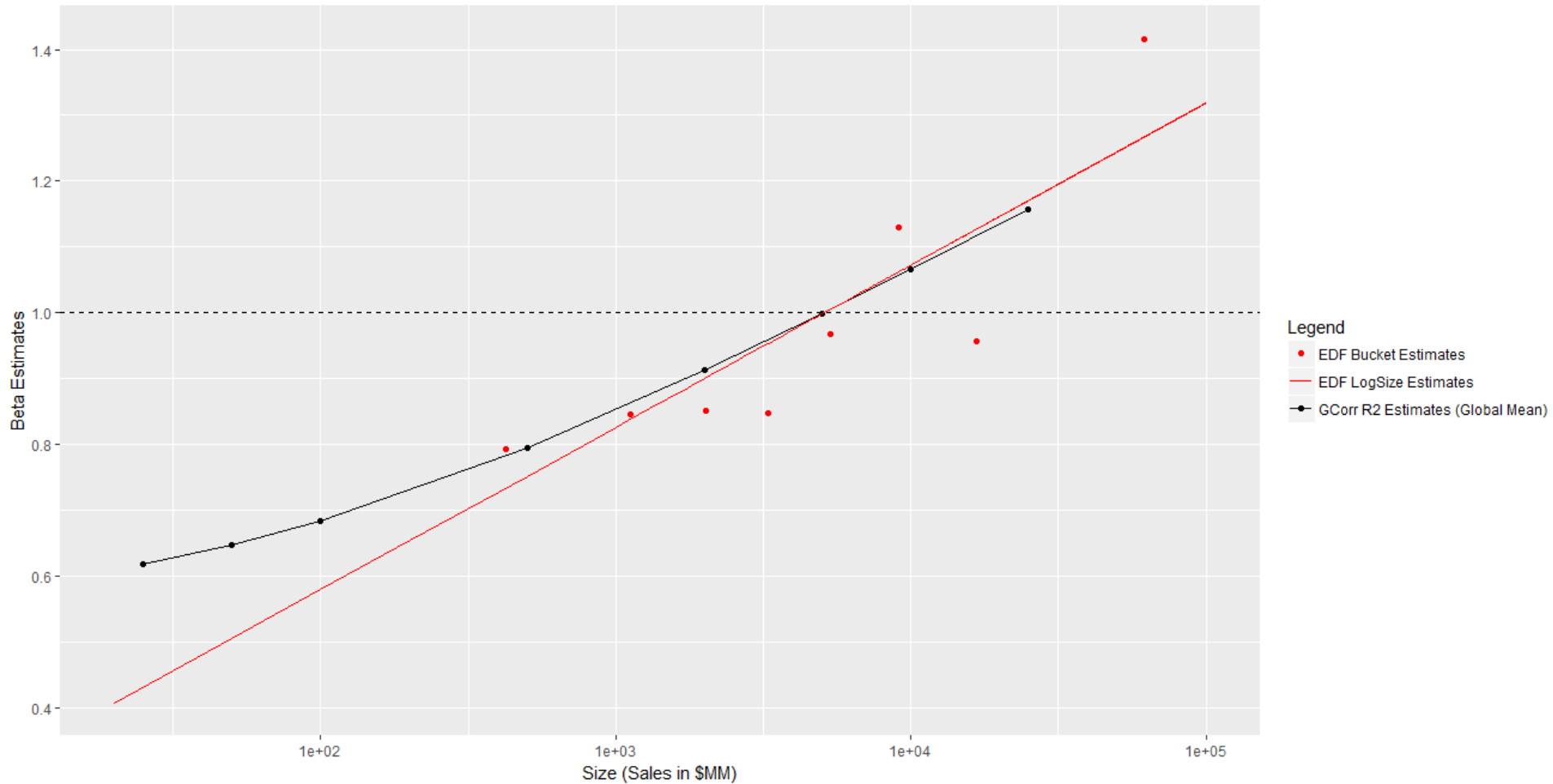
» Therefore, $\beta_{SIZE_{it}}$ can be calculated as:

$$\beta_{SIZE_{it}} = \frac{\sqrt{N_{BIV}(N^{-1}(TTC PD), N^{-1}(TTC PD), \gamma * R_{SIZE_{it}}^2) - TTC PD^2}}{\sqrt{N_{BIV}(N^{-1}(TTC PD), N^{-1}(TTC PD), \gamma * R_{SIZE_{Converter}}^2) - TTC PD^2}}$$

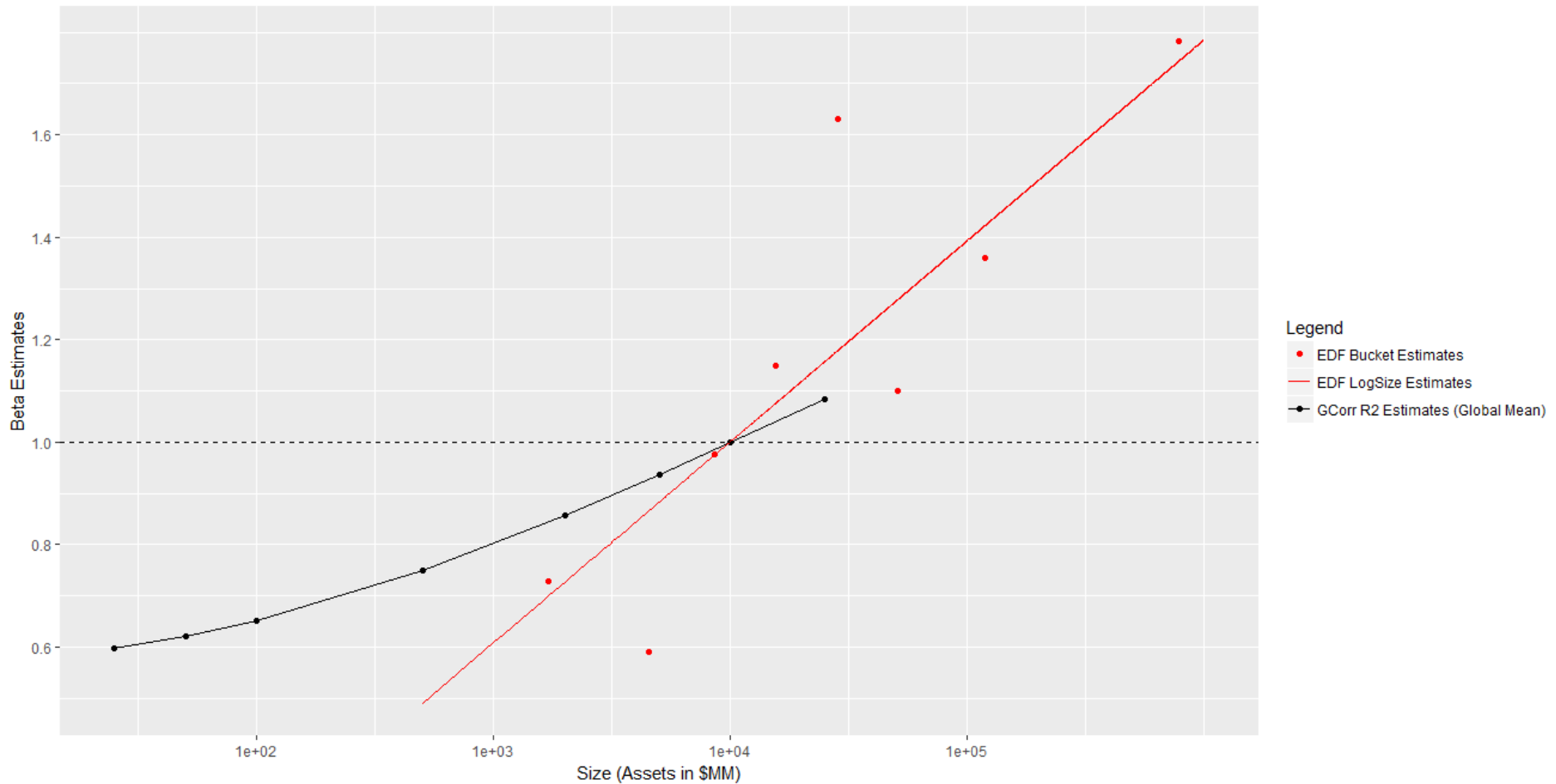
» We can use this equation and GCORR to calculate $\beta_{SIZE_{it}}$ for any region and industry, given:

- Corporate $SIZE_{Converter}$ = \$5.2B in Sales
- Financial $SIZE_{Converter}$ = \$10.3B in Assets
- γ is a fitting parameter to ensure the denominator equals the observed SD of the converter

Corporate β_{SIZE} Estimates



Financial β_{SIZE} Estimates



Final β_{SIZE} values

- » Given the relative stability of β_{SIZE} across industries and GCORR regions, we report β_{SIZE} values only across PIT Converter country groups and broad industry (corporates and financials).
- » Because of the data constraints, we choose to be conservative in the amount we depressing volatility. Therefore we report the following final values for β_{SIZE} , which reflect the maximum of the estimates in the two methods:

$$\beta_{SIZE}^{FINAL} = \max\left(\beta_{SIZE,Region}^{GCORR}, \frac{\beta_{SIZE,Region}^{GCORR}}{\beta_{SIZE,Global}^{GCORR}} \beta_{SIZE,Global}^{EDF}\right)$$

Final β_{SIZE} values

- » Given the relative stability of β_{SIZE} across industries and GCORR regions, we report β_{SIZE} values only across PIT Converter country groups and broad industry (corporates and financials).
- » Because of the data constraints, we choose to be conservative in the amount we depressing volatility. Therefore we report the following final values for β_{SIZE} , which reflect the maximum of the estimates in the two methods:

$$\beta_{SIZE}^{FINAL} = \max\left(\beta_{SIZE,Region}^{GCORR}, \frac{\beta_{SIZE,Region}^{GCORR}}{\beta_{SIZE,Global}^{GCORR}} \beta_{SIZE,Global}^{EDF}\right)$$

Regional β_{SIZE} coming directly from GCORR

Final β_{SIZE} values

- » Given the relative stability of β_{SIZE} across industries and GCORR regions, we report β_{SIZE} values only across PIT Converter country groups and broad industry (corporates and financials).
- » Because of the data constraints, we choose to be conservative in the amount we depressing volatility. Therefore we report the following final values for β_{SIZE} , which reflect the maximum of the estimates in the two methods:

$$\beta_{SIZE}^{FINAL} = \max\left(\beta_{SIZE,Region}^{GCORR}, \frac{\beta_{SIZE,Region}^{GCORR}}{\beta_{SIZE,Global}^{GCORR}} \beta_{SIZE,Global}^{EDF}\right)$$

Regional β_{SIZE} coming directly from GCORR

EDF-Implied β_{SIZE} , adjusted by ratio of regional GCORR β_{SIZE} to global GCORR β_{SIZE}

Final Corporate β_{SIZE} Values

Country Group	SIZE (Sales in Millions USD)								
	25	50	100	500	2000	5000	10000	25000	50000
Africa	0.62	0.65	0.68	0.79	0.91	1.00	1.07	1.17	1.24
Australia & NZ	0.69	0.69	0.70	0.78	0.90	1.00	1.08	1.19	1.27
Benelux	0.59	0.62	0.66	0.79	0.91	1.00	1.08	1.18	1.25
Canada	0.60	0.62	0.66	0.78	0.91	1.00	1.08	1.18	1.25
Central Europe	0.64	0.65	0.67	0.78	0.91	1.00	1.08	1.19	1.26
China	0.63	0.67	0.72	0.83	0.93	1.00	1.05	1.11	1.18
East Asia	0.61	0.64	0.68	0.80	0.92	1.00	1.07	1.16	1.24
Eastern Europe	0.67	0.68	0.69	0.78	0.91	1.00	1.08	1.19	1.27
France	0.64	0.64	0.67	0.78	0.91	1.00	1.08	1.19	1.26
Hong Kong	0.58	0.63	0.68	0.80	0.92	1.00	1.07	1.16	1.23
Japan	0.58	0.63	0.68	0.80	0.92	1.00	1.07	1.16	1.23
Latin America	0.65	0.67	0.71	0.81	0.92	1.00	1.07	1.18	1.25
Middle East	0.58	0.62	0.67	0.79	0.91	1.00	1.07	1.17	1.24
Nordic	0.60	0.63	0.67	0.79	0.91	1.00	1.07	1.17	1.25
South Asia	0.61	0.65	0.70	0.82	0.93	1.00	1.06	1.13	1.20
Southern Europe	0.58	0.62	0.67	0.79	0.91	1.00	1.07	1.17	1.24
United Kingdom	0.70	0.70	0.70	0.78	0.90	1.00	1.08	1.19	1.27
US & Caribbean	0.58	0.62	0.66	0.79	0.91	1.00	1.07	1.17	1.25

Final Financial β_{SIZE} Values

Country Group	Size (Assets Millions USD)									
	25	50	100	500	2000	5000	10000	25000	100000	500000
Africa	0.59	0.62	0.65	0.75	0.86	0.94	1.00	1.16	1.39	1.67
Australia & NZ	0.66	0.67	0.68	0.74	0.84	0.93	1.00	1.17	1.41	1.69
Benelux	0.58	0.60	0.63	0.74	0.85	0.93	1.00	1.16	1.40	1.67
Canada	0.59	0.60	0.63	0.73	0.85	0.93	1.00	1.16	1.40	1.68
Central Europe	0.62	0.63	0.65	0.73	0.85	0.93	1.00	1.17	1.41	1.68
China	0.61	0.65	0.69	0.80	0.90	0.96	1.00	1.12	1.34	1.61
East Asia	0.59	0.61	0.65	0.76	0.86	0.94	1.00	1.15	1.39	1.66
Eastern Europe	0.65	0.66	0.67	0.74	0.84	0.93	1.00	1.17	1.41	1.69
France	0.62	0.63	0.65	0.73	0.85	0.93	1.00	1.17	1.41	1.68
Hong Kong	0.55	0.60	0.64	0.76	0.87	0.94	1.00	1.15	1.38	1.66
Japan	0.55	0.60	0.64	0.76	0.87	0.94	1.00	1.15	1.38	1.66
Latin America	0.63	0.65	0.67	0.77	0.86	0.94	1.00	1.16	1.40	1.67
Middle East	0.56	0.58	0.63	0.74	0.86	0.94	1.00	1.16	1.39	1.67
Nordic	0.58	0.60	0.64	0.74	0.85	0.93	1.00	1.16	1.40	1.67
South Asia	0.58	0.62	0.67	0.78	0.88	0.95	1.00	1.13	1.37	1.63
Southern Europe	0.56	0.59	0.63	0.74	0.86	0.94	1.00	1.16	1.39	1.67
United Kingdom	0.67	0.67	0.68	0.74	0.84	0.93	1.00	1.17	1.41	1.69
US & Caribbean	0.56	0.59	0.63	0.74	0.86	0.94	1.00	1.16	1.39	1.67

Implementation

» We suggesting calculating a single β_{SIZE} value for the entire portfolio, via the following method:

1. Estimate:

$SIZE_{Mean}^{Corp}, SIZE_{Mean}^{Fin}$: The exposure-weighted geometric mean of sales and assets for corporates and financials, respectively.

$Percent^{Corp}, Percent^{Fin}$: The percent of exposures in corporates and financials.

2. Calculate portfolio β_{SIZE} :

$$\beta_{SIZE}^{Portfolio} = Percent^{Corp} * \beta_{SIZE}^{Corp}(SIZE_{Mean}^{Corp}) + Percent^{Fin} * \beta_{SIZE}^{Fin}(SIZE_{Mean}^{Fin})$$

Conclusion

- » The method described enhances the granularity of the PIT Converter volatility by allowing the user to vary output volatility by the average size of the firms in their portfolio
- » The suggested β values are directly drawn from observed volatility in public firm PITPDs, as well as leveraging the extensive research behind Moody's GCORR R^2 estimates.

MOODY'S
ANALYTICS

*Better
Faster
Decisions*

James Edwards
Moody's Analytics London
james.edwards@moodys.com

moodysanalytics.com

© 2019 Moody's Corporation, Moody's Investors Service, Inc., Moody's Analytics, Inc. and/or their licensors and affiliates (collectively, "MOODY'S"). All rights reserved.

CREDIT RATINGS ISSUED BY MOODY'S INVESTORS SERVICE, INC. AND ITS RATINGS AFFILIATES ("MIS") ARE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES, AND MOODY'S PUBLICATIONS MAY INCLUDE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES. MOODY'S DEFINES CREDIT RISK AS THE RISK THAT AN ENTITY MAY NOT MEET ITS CONTRACTUAL FINANCIAL OBLIGATIONS AS THEY COME DUE AND ANY ESTIMATED FINANCIAL LOSS IN THE EVENT OF DEFAULT OR IMPAIRMENT. SEE MOODY'S RATING SYMBOLS AND DEFINITIONS PUBLICATION FOR INFORMATION ON THE TYPES OF CONTRACTUAL FINANCIAL OBLIGATIONS ADDRESSED BY MOODY'S RATINGS. CREDIT RATINGS DO NOT ADDRESS ANY OTHER RISK, INCLUDING BUT NOT LIMITED TO: LIQUIDITY RISK, MARKET VALUE RISK, OR PRICE VOLATILITY. CREDIT RATINGS AND MOODY'S OPINIONS INCLUDED IN MOODY'S PUBLICATIONS ARE NOT STATEMENTS OF CURRENT OR HISTORICAL FACT. MOODY'S PUBLICATIONS MAY ALSO INCLUDE QUANTITATIVE MODEL-BASED ESTIMATES OF CREDIT RISK AND RELATED OPINIONS OR COMMENTARY PUBLISHED BY MOODY'S ANALYTICS, INC. CREDIT RATINGS AND MOODY'S PUBLICATIONS DO NOT CONSTITUTE OR PROVIDE INVESTMENT OR FINANCIAL ADVICE, AND CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT AND DO NOT PROVIDE RECOMMENDATIONS TO PURCHASE, SELL, OR HOLD PARTICULAR SECURITIES. NEITHER CREDIT RATINGS NOR MOODY'S PUBLICATIONS COMMENT ON THE SUITABILITY OF AN INVESTMENT FOR ANY PARTICULAR INVESTOR. MOODY'S ISSUES ITS CREDIT RATINGS AND PUBLISHES MOODY'S PUBLICATIONS WITH THE EXPECTATION AND UNDERSTANDING THAT EACH INVESTOR WILL, WITH DUE CARE, MAKE ITS OWN STUDY AND EVALUATION OF EACH SECURITY THAT IS UNDER CONSIDERATION FOR PURCHASE, HOLDING, OR SALE.

MOODY'S CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT INTENDED FOR USE BY RETAIL INVESTORS AND IT WOULD BE RECKLESS AND INAPPROPRIATE FOR RETAIL INVESTORS TO USE MOODY'S CREDIT RATINGS OR MOODY'S PUBLICATIONS WHEN MAKING AN INVESTMENT DECISION. IF IN DOUBT YOU SHOULD CONTACT YOUR FINANCIAL OR OTHER PROFESSIONAL ADVISER.

ALL INFORMATION CONTAINED HEREIN IS PROTECTED BY LAW, INCLUDING BUT NOT LIMITED TO, COPYRIGHT LAW, AND NONE OF SUCH INFORMATION MAY BE COPIED OR OTHERWISE REPRODUCED, REPACKAGED, FURTHER TRANSMITTED, TRANSFERRED, DISSEMINATED, REDISTRIBUTED OR RESOLD, OR STORED FOR SUBSEQUENT USE FOR ANY SUCH PURPOSE, IN WHOLE OR IN PART, IN ANY FORM OR MANNER OR BY ANY MEANS WHATSOEVER, BY ANY PERSON WITHOUT MOODY'S PRIOR WRITTEN CONSENT.

CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT INTENDED FOR USE BY ANY PERSON AS A BENCHMARK AS THAT TERM IS DEFINED FOR REGULATORY PURPOSES AND MUST NOT BE USED IN ANY WAY THAT COULD RESULT IN THEM BEING CONSIDERED A BENCHMARK.

All information contained herein is obtained by MOODY'S from sources believed by it to be accurate and reliable. Because of the possibility of human or mechanical error as well as other factors, however, all information contained herein is provided "AS IS" without warranty of any kind. MOODY'S adopts all necessary measures so that the information it uses in assigning a credit rating is of sufficient quality and from sources MOODY'S considers to be reliable including, when appropriate, independent third-party sources. However, MOODY'S is not an auditor and cannot in every instance independently verify or validate information received in the rating process or in preparing the Moody's publications.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability to any person or entity for any indirect, special, consequential, or incidental losses or damages whatsoever arising from or in connection with the information contained herein or the use of or inability to use any such information, even if MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers is advised in advance of the possibility of such losses or damages, including but not limited to: (a) any loss of present or prospective profits or (b) any loss or damage arising where the relevant financial instrument is not the subject of a particular credit rating assigned by MOODY'S.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability for any direct or compensatory losses or damages caused to any person or entity, including but not limited to by any negligence (but excluding fraud, willful misconduct or any other type of liability that, for the avoidance of doubt, by law cannot be excluded) on the part of, or any contingency within or beyond the control of, MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers, arising from or in connection with the information contained herein or the use of or inability to use any such information.

NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE ACCURACY, TIMELINESS, COMPLETENESS, MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF ANY CREDIT RATING OR OTHER OPINION OR INFORMATION IS GIVEN OR MADE BY MOODY'S IN ANY FORM OR MANNER WHATSOEVER.

Moody's Investors Service, Inc., a wholly-owned credit rating agency subsidiary of Moody's Corporation ("MCO"), hereby discloses that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by Moody's Investors Service, Inc. have, prior to assignment of any rating, agreed to pay to Moody's Investors Service, Inc. for ratings opinions and services rendered by it fees ranging from \$1,000 to approximately \$2,700,000. MCO and MIS also maintain policies and procedures to address the independence of MIS's ratings and rating processes. Information regarding certain affiliations that may exist between directors of MCO and rated entities, and between entities who hold ratings from MIS and have also publicly reported to the SEC an ownership interest in MCO of more than 5%, is posted annually at www.moody.com under the heading "Investor Relations — Corporate Governance — Director and Shareholder Affiliation Policy."

Additional terms for Australia only: Any publication into Australia of this document is pursuant to the Australian Financial Services License of MOODY'S affiliate, Moody's Investors Service Pty Limited ABN 61 003 399 657AFSL 336969 and/or Moody's Analytics Australia Pty Ltd ABN 94 105 136 972 AFSL 383569 (as applicable). This document is intended to be provided only to "wholesale clients" within the meaning of section 761G of the Corporations Act 2001. By continuing to access this document from within Australia, you represent to MOODY'S that you are, or are accessing the document as a representative of, a "wholesale client" and that neither you nor the entity you represent will directly or indirectly disseminate this document or its contents to "retail clients" within the meaning of section 761G of the Corporations Act 2001. MOODY'S credit rating is an opinion as to the creditworthiness of a debt obligation of the issuer, not on the equity securities of the issuer or any form of security that is available to retail investors.

Additional terms for Japan only: Moody's Japan K.K. ("MJKK") is a wholly-owned credit rating agency subsidiary of Moody's Group Japan G.K., which is wholly-owned by Moody's Overseas Holdings Inc., a wholly-owned subsidiary of MCO. Moody's SF Japan K.K. ("MSFJ") is a wholly-owned credit rating agency subsidiary of MJKK. MSFJ is not a Nationally Recognized Statistical Rating Organization ("NRSRO"). Therefore, credit ratings assigned by MSFJ are Non-NRSRO Credit Ratings. Non-NRSRO Credit Ratings are assigned by an entity that is not a NRSRO and, consequently, the rated obligation will not qualify for certain types of treatment under U.S. laws. MJKK and MSFJ are credit rating agencies registered with the Japan Financial Services Agency and their registration numbers are FSA Commissioner (Ratings) No. 2 and 3 respectively.

MJKK or MSFJ (as applicable) hereby disclose that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by MJKK or MSFJ (as applicable) have, prior to assignment of any rating, agreed to pay to MJKK or MSFJ (as applicable) for ratings opinions and services rendered by it fees ranging from JPY125,000 to approximately JPY250,000,000.

MJKK and MSFJ also maintain policies and procedures to address Japanese regulatory requirements.