Moody's Analytics

Better Faster Decisions

Webinar: Managing IFRS9 Volatility

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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-β.

Proposed Structure for Volatility Dampening

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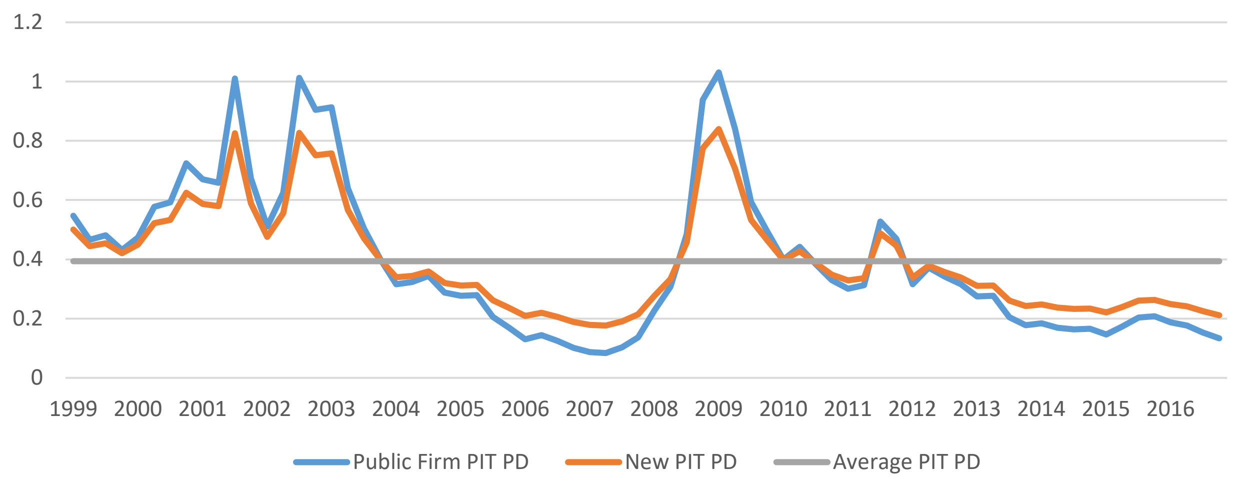

Values for $Avg(PITPD_i^{CONV}) = TTCPD_i^{CONV}$

- $Avg(PITPD_i^{CONV})$ 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%

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- 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:

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

- 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):

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

Estimating β_{SIZE}

$$EDF_{it} - TTCPD^{CONV}_{rating_{it}} = \beta_{SIZE_{it}} * \left(PITPD^{CONV}_{it} - TTCPD^{CONV}_{rating_{it}}\right) + e_{it}$$

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

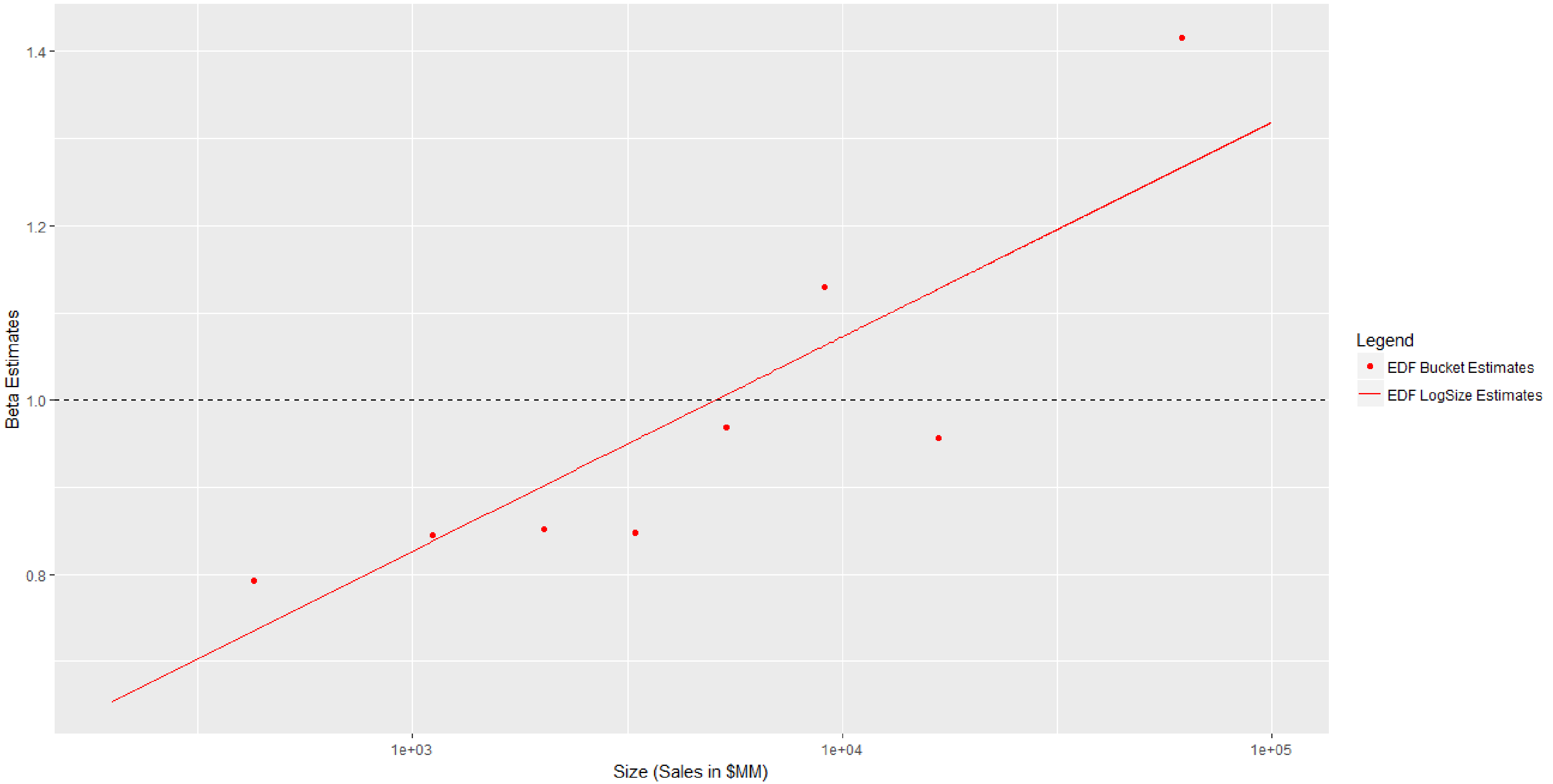
1. Log-Linear in size of the firm (sales for corporates, assets for financials)

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

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

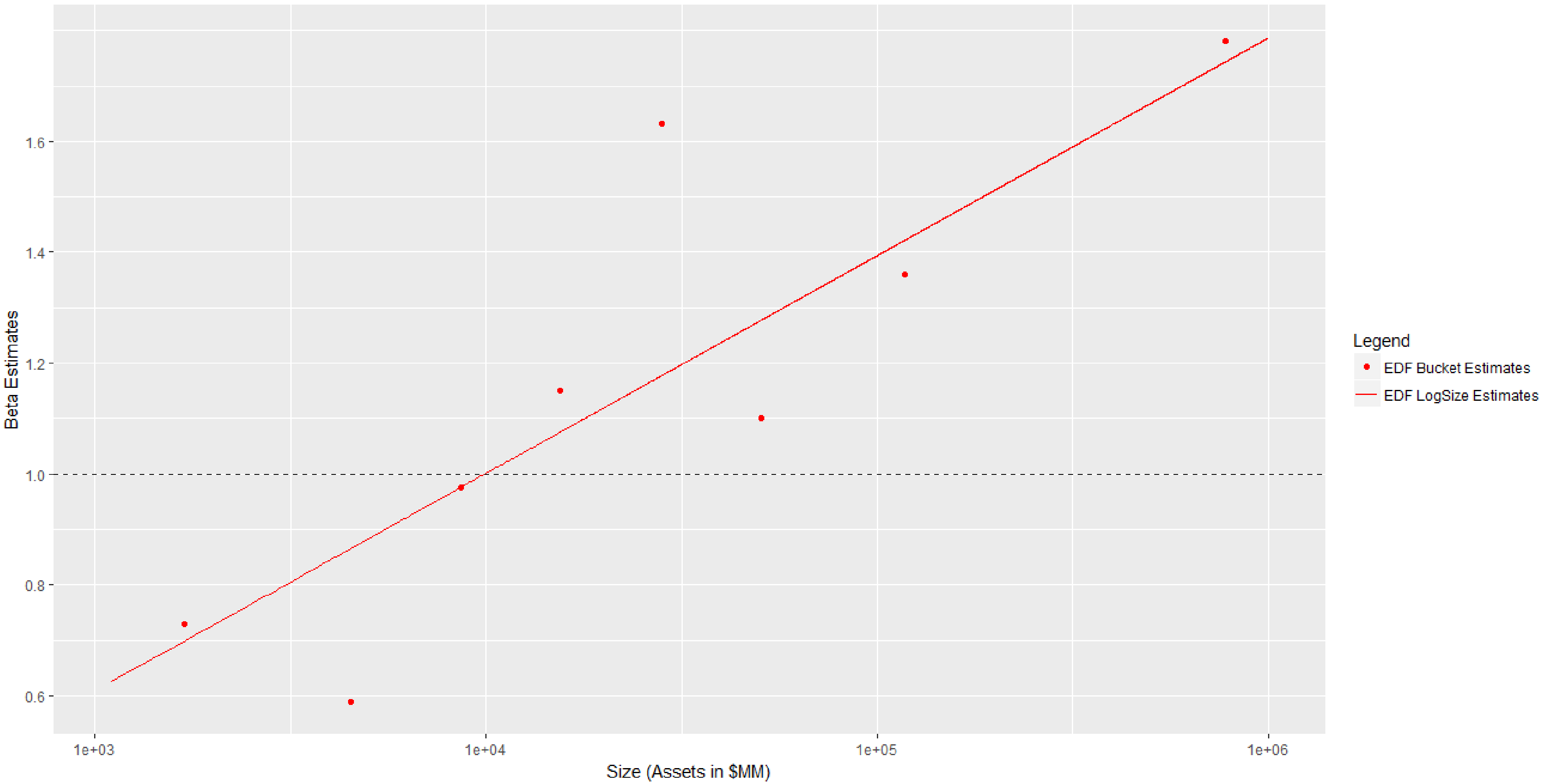
$$\beta_{SIZE_{it}} = \sum_{k=1}^{8} \beta_k * I[SIZE_{it}\ in\ bucket\ k]$$

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 it's 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

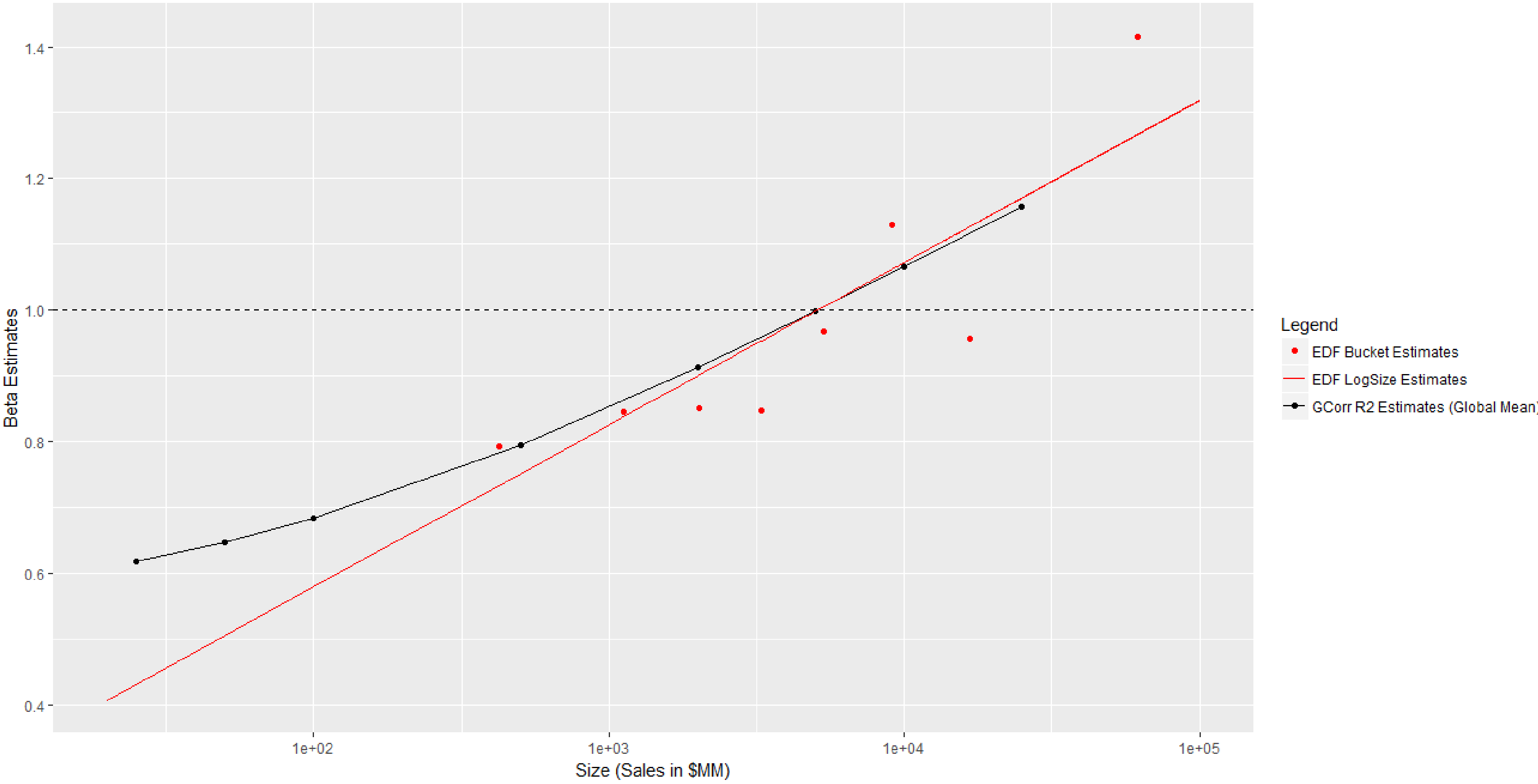
» Therefore, $\beta_{SIZE_{it}}$ can be calculated as:

$$\beta_{SIZE_{it}} = \frac{\sqrt{N_{BIV}\left(N^{-1}(TTCPD), N^{-1}(TTCPD), \gamma * R^2_{SIZE_{it}}\right) - TTCPD^2}}{\sqrt{N_{BIV}\left(N^{-1}(TTCPD), N^{-1}(TTCPD), \gamma * R^2_{SIZE_{Converter}}\right) - TTCPD^2}}$$

» 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



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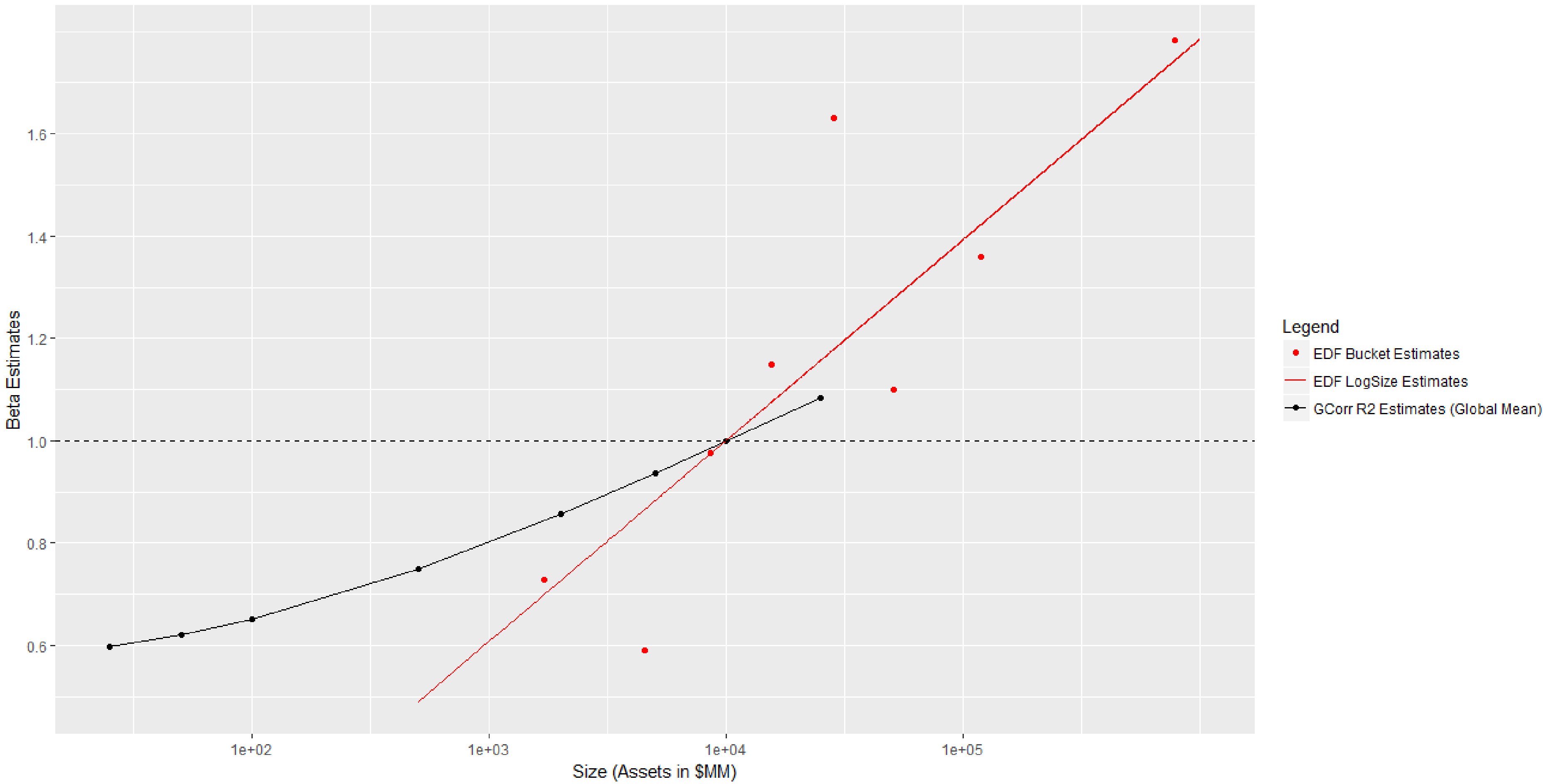

Final β_{SIZE} values

- 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:

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

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Regional β_{SIZE} coming directly from GCORR

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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}:

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

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.

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