

The Pakistan Credit Rating Agency



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# Rating Transition and Default Criteria

## Methodology

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### Summary

This criterion explains PACRA's rating transition & default study. This includes standardized measures and tools for appraising the historical performance of ratings on two parameters – stability and accuracy.

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### Data Set

Bold terms used herein are defined in Annexure I “Defined Terms”

PACRA’s rating opinion is an objective view evolving out of a well-defined **methodology** incorporating both qualitative and quantitative **factors**. These include macroeconomic environment, industry dynamics and the relative positioning of an entity/issuer vis-à-vis its peers, alongside the financial and business risk profile of the entity/issuer (hereon referred to as issuer). In the case of debt instruments, the structure and security mechanism are given consideration providing security to the lenders/investors in the event of Default.

A **credit rating** reflects a forward-looking opinion on the creditworthiness of an underlying entity or debt instrument. More specifically, it covers the relative ability to honor financial obligations. The primary factor being captured on the rating scale is the relative likelihood of **default**. Investment grade credit ratings fall under the AAA, AA, A, and BBB rating categories, where AAA is the highest and BBB- is the lowest investment grade rating. Speculative credit ratings include the BB, B, CCC and C rating categories, where CCC-C represents very high credit risk. The default category comprises of only one rating: D .

**Data Set:** PACRA’s **transition & default study** is based on information obtained from PACRA’s database of ratings. The data consists of the following categories of entities/issuers: (i) corporates, and (ii) financial institutions. Within these categories, the study is limited to long-term issuer public ratings. In the context of debt instruments, **preliminary ratings**, if made public, are attributed to the issuer for the purpose of the study. The data set is refined by adjusting for: (i) multiple debt instruments for a single issuer; (ii) debt instrument-only ratings; and (iii) credit substitution.<sup>i</sup>

**Multiple debt instruments for a single issuer:** Rating transitions and defaults are tracked at the issuer level. This is because the likelihood of default is primarily driven by the liability structure and operating performance of an issuer. At the same time, issuers often default on all their debt due to cross-default provisions in debt instrument trust deeds. Therefore, multiple debt instruments belonging to the same issuer are consolidated to a single data point as the issuer-level rating (issuer rating).

**Debt Instrument-only rating:** In cases where an issuer rating does not exist in PACRA’s universe, but a debt instrument rating belonging to that issuer does, an implied issuer rating is used. Thus, PACRA arrives at an issuer rating by adjusting its existing debt instrument rating for the security structure embedded therein and other clauses. It is noteworthy that even if an issuer rating from another credit rating agency (domestic or international) does exist, PACRA will employ its own adjustment to evolve an issuer rating from the debt instrument-only rating.

**Credit Substitution:** In the case of a **credit substitution**, only the rating of the guarantor will form part of the data set. The objective of the aforementioned adjustment is to eliminate the impact of the transition of a series of ratings that are ultimately reliant upon a single issuer (the guarantor).

For the purpose of this study, short-term issuer ratings and structured finance ratings are not taken into account. **Rating modifiers**, insurer financial strength (IFS) ratings, and other qualitative opinions (Broker Fiduciary Rating, Asset Manager Rating, etc.) are also excluded.

Each transition study issued by PACRA is self-contained. PACRA’s continuing data enhancement efforts may result in slightly different statistics than in previously published studies. In addition, comparisons with earlier studies should be viewed within the context of methodologies and definitions employed therein.

### Static Pool

PACRA conducts its transition & default studies on the basis of **static pools**. Static pools can be constructed for any time period. Static pools with time periods smaller than one month are not included as they do not serve any practical purpose. Generally, Static Pools are constructed for a one-to-ten-year period.

**Formation of Static Pools:** Static pools are formed by grouping outstanding issuers by rating notch at the beginning of each period covered by the study. Each static pool is then followed from that point forward. All issuers included in the study are assigned to one or more static pools. Static pools are “static” in the sense that once an issuer becomes part of a static pool, it shall stay in that pool until it has either been withdrawn (due to maturity or otherwise) or it has defaulted.

For instance, ratings active and outstanding at the beginning of CY19 (at 00:00 on Jan 1, 2019), constitute the CY19 original (withdrawal-unadjusted) static pool. Subsequently, the surviving (not withdrawn) issuers of the CY19 static pool are added to the issuers first rated in CY19 to form the CY20 Static Pool.

**Withdrawn Ratings:** Issuers that have had ratings withdrawn in a particular period are excluded from all subsequent static pools including the Static Pool that corresponds to the period in which they are withdrawn. The “original static pools” are thus adjusted for withdrawn ratings at the appropriate time horizon(s). The rationale behind this withdrawal-adjustment practice is to furnish a truly reflective base of “outstanding throughout-the-period ratings” for calculating transition and default Rates. Withdrawal from the ‘D’ category is recorded as a default and not a withdrawn rating. Withdrawn ratings are not monitored for defaults by PACRA. Hence, post-withdrawal defaults on ratings are not assigned back to the static pool(s) in which these ratings were outstanding.<sup>ii</sup>

#### Consider the following scenario:

- An issuer is originally rated BB in mid-CY14 and PACRA downgrades the company to B in CY16. This was followed by a rating withdrawal in April CY18 and a default in CY20 when the issuer was not rated by PACRA. The last major rating action, prior to withdrawal, was a downgrade to B in CY16, and maintenance of that persisted until CY17.
- This hypothetical issuer would be included in the CY15 and CY16 static pools with the BB rating (its assigned rating at the beginning of those years).
- Likewise, it would be included in the CY17 and CY18 static pools with the B rating.
- The rating would not be included in any static pool after the last day of CY18 (December 31, 2018) because PACRA had withdrawn the rating by then. Furthermore, it would also be excluded from the withdrawal-adjusted static pool for CY18.
- The downgrade would not be captured in the annual transition of CY18’s static pool as the pool only captures the first and the last rating state during the period (i.e. the ratings outstanding on January 1, 2018 and December 31, 2018) and ignores all interim rating states manifesting for the rating.
- Each of the three Static Pools in which this company was included (CY15 – CY17) would not record the issuer’s default in CY20.

- Finally, were the issuer to reenlist, then it would constitute a second enlistment. This ensures that the static pools remain intact with the passage of time. Otherwise, especially in instances of successive withdrawals, it would result in an inflated and incorrect marginal default rate.

**Initial Issuers:** Issuers initially rated by PACRA in any given period (**initial ratings**) are included in the subsequent period's static pool.

For instance, continuing the previous example, the issuer originally rated BB in mid-CY14 would not be part of the CY14 Static Pool because it was not rated as of the first day of that year. Instead, its performance would begin to be followed from the CY15 static pool.

## Rating Transition Analysis

A rating transition, as exhibited by **transition rates**, is analyzed for the rating categories at the modifier (+/-) level. Hence a rating transition takes into account all rating movements through notches both inside and across rating categories. Rating transitions represent a distinct historical period and are not meant to portray any predictive information that may represent future rating transition patterns.

**Transition Matrix:** The transition matrix (as depicted below) pinpoints the transition of ratings across the major rating categories (e.g., from A to BBB) at the modifier level, which counts each notch change (e.g., from A to A-). The left-hand vertical axis of the matrix identifies ratings outstanding at the beginning of the period, while the horizontal axis offers information on the transition pattern of those ratings by the period's end. In the transition matrix, the diagonal (beginning with AAA, followed by AA+, and up until D) shows the relative transition of each rating category at the modifier level. The column in the transition matrix marked "withdrawal-adjusted static pool" exhibits the static pool adjusted for withdrawals. Withdrawals are shown in a separate column on the right-hand side marked "withdrawals".

- An issuer continually rated from the middle of CY14 to the middle of CY19 would appear in the four consecutive one-year transition matrices from CY15 to CY18. It would not form part of the CY19 Static Pool, as the rating was not outstanding for the entire static pool period.
- Likewise, all CY05 static pool members still rated at 23:59 on December 31, 2020, have sixteen one-year transitions, while issuers with outstanding ratings between 00:00 January 1, 2020, and 11:59 PM December 31, 2020 have only one.

The transition matrix is constructed in the **cohort** method. The method considers the rating position at the beginning and end of a period only and ignores the dynamic processes (interim rating actions) found within the period. Hence, it is limited in the sense that it loses considerable information and suppresses transition trends, especially in times of increased rating activity. This limitation of the static pools can be overcome by increasing the frequency at which static pools are formed. Closer static pool spacing captures a greater number of rating changes and default events. Some international and regional rating agencies form monthly static pools. PACRA forms annual static pools as it believes this adequately reflects its through-the-cycle approach for ratings.<sup>iii</sup>

**Transition Rate Calculation:** Transition rates compare issuer ratings at the beginning of a time period with ratings at the end of the period. An issuer that remains rated for more than one period is counted as many times as the number

of periods in which it is rated by PACRA. Transition Rates are categorized into: (i) Upgrade Rates, and (ii) Downgrade Rates.

These transition rates are calculated by the number of issuers that experienced rating upgrades or downgrades within the static pool period, divided by the total number of rated issuers at the beginning of the Static Pool period, adjusted for withdrawals. There may be several varieties of rating transitions. A description of these are as follows:

**One-year Transition Matrix:** Each one-year transition matrix displays all rating movements between rating categories at the notch level from the beginning of the year through year-end. For each rating listed in the matrix's left-most column, there are thirteen ratios listed in the rows corresponding to the ratings from **AAA to D**.

		End of Year (CY21)																		
Transition (Years): 1	Withdrawal Adjusted Static Pool	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC-C	D	Withdrawals
		AAA	8.00	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AA+	11.00	9.1%	90.9%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
AA	22.00	-	9.1%	90.9%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00
AA-	20.00	-	-	5.0%	95.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
A+	16.00	-	-	-	-	93.8%	6.3%	-	-	-	-	-	-	-	-	-	-	-	-	0.00
A	33.00	-	-	-	-	15.2%	84.8%	-	-	-	-	-	-	-	-	-	-	-	-	0.00
A-	63.00	-	-	-	-	-	17.5%	82.5%	-	-	-	-	-	-	-	-	-	-	-	3.00
BBB+	20.00	-	-	-	-	-	-	10.0%	90.0%	-	-	-	-	-	-	-	-	-	-	1.00
BBB	25.00	-	-	-	-	-	-	16.0%	80.0%	4.0%	-	-	-	-	-	-	-	-	-	3.00
BBB-	17.00	-	-	-	-	-	-	5.9%	5.9%	23.5%	64.7%	-	-	-	-	-	-	-	-	3.00
BB+	5.00	-	-	-	-	-	-	-	-	20.0%	80.0%	-	-	-	-	-	-	-	-	1.00
BB	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00
BB-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
B+	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
B	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
B-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
ccc-c	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00

Sample One-Year Transition Matrix

For instance, the one-year transition matrix (above) which corresponds to the CY21 static pool, shows that, out of 28 BBB rated companies at the beginning of that year, three issuers were withdrawn during the year. Out of the remaining 25 BBB rated companies, 80.0% were rated the same at year-end, while PACRA has upgraded 16.0% to BBB+ and downgraded 4.0% to BBB- – thus adding up to 100% of the transition for the BBB notch level.

**Multi-year Transition Matrix:** Multi-year transitions are also calculated. In this case, the rating at the beginning of the multi-year period is compared with the rating at the end. Otherwise, the technique is identical to that used for single-year transitions.

For instance, the three-year transition matrix is the result of comparing ratings at the beginning of the year CY18 with the ratings at the end of the year CY20, ignoring all interim rating transitions in between the period.

**Average Transition Matrix:** Average transition matrices (for instance, an average transition of three one-year transitions; CY18, CY19, and CY20) are calculated on the basis of both single-year and multi-year transition matrices. The idea is to smooth out periods of unusually high/low rating activity.

## Default Rate

**Withdrawal-adjusted Default Rates:** PACRA computes withdrawal-adjusted Default Rates. The withdrawal-adjusted method of calculating default rates recognizes that there are three possible end-of-period outcomes for an outstanding rating: (i) default; (ii) survival; and (iii) rating withdrawal. As these three possible outcomes are mutually

exclusive, issuers that default and have their ratings withdrawn in the same time period are considered as defaults and not withdrawals. PACRA computes the following varieties of Default Rates:

**Marginal Default Rates (MDRs):** A **marginal default** rate captures the default rate on a one-year **measurement period**. An ADR is the number of issuers defaulting in a year expressed as a proportion of the number of issuers in the static pool at the beginning of the year, adjusted for withdrawals. MDRs can also be expressed as **Annual Default Rates (ADRs)**

**Cumulative Average Default Rates (CDRs):** **Cumulative average default** rates express the default rates over one year or years. CDRs are calculated by subtracting the compounding of the inverse of constituent weighted average MDRs from one. For instance, a three-year CDR (CDR3) has a measurement period of three years and would take into account only those static pools that have been seasoned for three years. The average cumulative default rate represents an estimate of expected cumulative default probabilities. Average CDR is calculated by taking the averages over many pool periods. This serves to capture the effects of several macroeconomic and credit cycle peaks and troughs<sup>iv</sup>.

- For instance, if 2 entities Defaulted in CY20 and 1 was withdrawn, and the CY20 original static pool consisted of 100 issuers at the beginning of the year, the resulting ADR for all Ratings in CY20 would be 2.02% (2/99), adjusting the denominator for withdrawals.
- CDR3 calculated for the last three years at the end of CY20 would include only one static pool, that of CY18 with three complete years of seasoning.
  - CY19 and CY20 have only been seasoned two and one year(s), respectively.
- Similarly, a CDR5 calculated for the last ten years at the end of CY20 would include six Static Pools, that of CY11, CY12, CY13, CY14, CY15 and CY16 with five complete years of seasoning.
  - CY17, CY18, CY19 and CY20 pools have only been seasoned four, three, two and one year(s) respectively, hence, they do not qualify for being included in the calculation of CDR5.
  - Furthermore, CDR5 would reflect the probability of default of each constituent static pool from the time of its formation up to and including the subsequent five-year time horizon.

**Time-to-Default:** Time-to-default is exhibited in units of months and years. The higher or lower a rating is on the rating scale, the farther or nearer it should be to default in terms of this measure. PACRA calculates the following time-to-default statistics(i) Time-to-default from initial ratings, (ii) Time-to-default from all ratings.

PACRA's default rates are issuer-weighted default rates, that is, they are calculated based on the number of issuers rather than the Rupee amounts (value) affected by defaults or rating changes. Although Rupee amounts provide information about the portion of the market that is affected by defaults or rating changes, issuer-weighted averages are considered by PACRA a more useful measure of the performance of ratings.

### Regulatory Requirements

Regulatory Requirements & Best Practices for PACRA Performance Disclosure: A Snapshot	
Forum	Regulatory requirement/international best practice
<p><b>Securities Exchange Commission of Pakistan</b> [SECP Credit Rating Companies Regulations, 2016, September 19, 2022]</p>	<p><b>11-A: Conduct of business:</b> “A credit rating company shall;</p> <ul style="list-style-type: none"> <li>(k) upon the occurrence of default of an entity/instrument rated by it, the credit rating company shall prepare a descriptive default note and disseminate the same to the securities exchange, the Commission, State Bank of Pakistan, Mutual Fund Association of Pakistan, Pakistan Banking Association, NBF and Modaraba Association of Pakistan and publish the same on its website for public information. The default notes must describe the definition of default, the reasons for the defaults, historical transitions and the factors overlooked, if any, by the credit rating company;</li> <li>(l) publish annually, within one month of the calendar year, a comprehensive default and transition study developed in line with methodologies practiced by credit rating agencies globally. The annual default and transition study must contain cumulative default rates (CDRs) and transitions for each rating grade for periods 1, 3 and 5 years;”</li> </ul> <p><b>ANNEXURE H - Other Information to be Disseminated on the Website of a Credit Rating Company/Agency:</b></p> <p>“... credit rating companies shall disseminate on their websites the following information:</p> <ul style="list-style-type: none"> <li>(3) Detail of transitions/changes in the credit ratings reviewed during the last five years. The detail should contain the ratings upgraded, downgraded and those that remained unchanged. For ease of comparison both the rating i.e. before and after the review and the number of notches upgraded or downgraded should be disclosed.”</li> </ul> <p>PACRA publishes its default studies (“Transition to Default”) within two months after the occurrence of a Default.</p>
<p><b>State Bank of Pakistan</b> [SBP Eligibility Criteria for Recognition of External Credit Assessment Institutions (ECAIs), July 2005]</p>	<ul style="list-style-type: none"> <li>A) Objectivity of the methodology: “ECAI should have methodology of assigning credit rating that is rigorous, systematic, continuous and subject to validation. To establish that ECAI fulfills this primary component of eligibility criteria, it must demonstrate that it meets minimum standards given below:</li> <li>5. ECAI should demonstrate that the rating methodologies are subject to quantitative back testing. For this purpose, ECAI should calculate and publish default studies, recovery studies and transition matrices. For the purpose, the ECAI should have a definition of default that is equivalent to international standard and is relevant to domestic market.”</li> <li>d) <b>Disclosure:</b> “... ECAI is therefore expected to make public following information: <ul style="list-style-type: none"> <li>2. Definition of default</li> <li>6. Actual default rates experienced in each assessment category</li> <li>7. Transition matrices”</li> </ul> </li> </ul>

<p><b>Association of Credit Rating Agencies in Asia (ACRAA)</b> [ACRAA Code of Conduct Fundamentals for Domestic Credit Rating Agencies, April 2011]</p>	<p>“The Default study should provide details of the following:</p> <ul style="list-style-type: none"> <li>i. Annual Default rates for each rating category;</li> <li>ii. 3-year average cumulative Default rates;</li> <li>iii. 1-year transition rates”</li> </ul>
<p><b>International Organization of Securities Commission (IOSCO)</b> [IOSCO Code of Conduct Fundamentals for Credit Rating Agencies, March 2015]</p>	<p>3. CRA Responsibilities to the Investing Public, Rated Entities, Obligors, Originators, and Arrangers</p> <p>A. Transparency and Timeliness of Credit Rating Disclosure</p> <p>3.18 “To promote transparency and to enable investors and other users of credit ratings to compare the performance of different CRAs, a CRA should disclose sufficient information about the historical transition and default rates of its credit rating categories with respect to the classes of entities and obligations it rates. This information should include verifiable, quantifiable historical information, organized over a period of time, and, where possible, standardized in such a way to assist investors and other users of credit ratings in comparing different CRAs. If the nature of the rated entity or obligation or other circumstances make such historical transition or default rates inappropriate, statistically invalid, or otherwise likely to mislead investors or other users of credit ratings, the CRA should disclose why this is the case.”</p> <p>5. Disclosure and Communication with Market Participants</p> <p>“A CRA should publicly and prominently disclose free of charge on its primary website: information about the CRA’s historic performance data;”</p>

## Computing Cumulative Average Default Rates (CDRs)

Cumulative default rates (CDRs) are calculated on the basis of marginal default rates (MDRs). Depending on the measurement period to be covered by the CDR, the first step is to calculate MDRs for each successive time interval. The MDRs then are averaged across similar time intervals and are weighted by the size of the withdrawal adjusted static pool to reach weighted average MDRs (WMDRs) for each interval. These WMDRs are then chain-linked into survival rates and subtracted from one to get the CDR for a particular time interval.

The computation of three (3) year CDR (CDR<sub>3</sub>) for the last four years at the end of CY17 (December 31, 2017) passes through the following schematic steps:

### STEP 1: Selecting the appropriate number of static pools for CDR<sub>3</sub>

Which Static Pools* are to participate in calculating CDR <sub>3</sub>		
Static pools (for last four years)	Static pool notation	Status
CY14 static pool	C <sup>CY14</sup>	Included
CY15 static pool	C <sup>CY15</sup>	Included
CY16 static pool	C <sup>CY16</sup>	Excluded as these two static pools have not experienced three years of seasoning
CY17 static pool	C <sup>CY17</sup>	

\*Original (withdrawal-unadjusted) static pools are to be considered here, that are later on adjusted for withdrawals.

### STEP 2: Calculate MDRs for each static pool (included) separately

#### MDRs for C<sup>CY14</sup>

$$MDR_1^{CY14} = \frac{\text{Defaults in CY14 out of } C^{CY14}}{C^{CY14} - W_{C^{CY14}}^{CY14}}$$

$$MDR_1^{CY14} = \text{Marginal Default Rate for Year 1 of CDR} - 3$$

$$W_{C^{CY14}}^{CY14} = \text{Withdrawals in CY14 out of } C^{CY14}$$

$$MDR_2^{CY14} = \frac{\text{Incremental Defaults in CY15 out of } C^{CY14}}{(C^{CY14} - W_{C^{CY14}}^{CY14} - W_{C^{CY14}}^{CY15}) \times (1 - MDR_1^{CY14})}$$

$$MDR_2^{CY14} = \text{Marginal Default Rate for Year 2 of CDR} - 3$$

$$W_{C^{CY14}}^{CY15} = \text{Withdrawals in CY15 out of } C^{CY14}$$

$$MDR_3^{CY14} = \frac{\text{Incremental Defaults in CY16 out of } C^{CY14}}{(C^{CY14} - W_{C^{CY14}}^{CY14} - W_{C^{CY14}}^{CY15} - W_{C^{CY14}}^{CY16}) \times (1 - MDR_1^{CY14})(1 - MDR_2^{CY14})}$$

$$MDR_3^{CY14} = \text{Marginal Default Rate for Year 3 of CDR} - 3$$

$$W_{C^{CY14}}^{CY16} = \text{Withdrawals in CY16 out of } C^{CY14}$$

#### MDRs for C<sup>CY15</sup>

$$MDR_1^{CY15} = \frac{\text{Defaults in CY15 out of } C^{CY15}}{C^{CY15} - W_{C^{CY15}}^{CY15}}$$

$$MDR_1^{CY15} = \text{Marginal Default Rate for Year 1 of CDR} - 3$$

$$W_{C^{CY15}}^{CY15} = \text{Withdrawals in CY15 out of } C^{CY15}$$

$$MDR_2^{CY15} = \frac{\text{Incremental Defaults in CY16 out of } C^{CY15}}{(C^{CY15} - W_{C^{CY15}}^{CY15} - W_{C^{CY15}}^{CY16}) \times (1 - MDR_1^{CY15})}$$

$$MDR_2^{CY15} = \text{Marginal Default Rate for Year 2 of CDR} - 3$$

$$W_{C^{CY15}}^{CY16} = \text{Withdrawals in CY16 out of } C^{CY15}$$

$$MDR_3^{CY15} = \frac{\text{Incremental Defaults in CY17 out of } C^{CY15}}{(C^{CY15} - W_{C^{CY15}}^{CY15} - W_{C^{CY15}}^{CY16} - W_{C^{CY15}}^{CY17}) \times (1 - MDR_1^{CY15})(1 - MDR_2^{CY15})}$$

$$MDR_3^{CY15} = \text{Marginal Default Rate for Year 3 of CDR} - 3$$

$$W_{C^{CY15}}^{CY17} = \text{Withdrawals in CY17 out of } C^{CY15}$$

### STEP 3: Compute WMDRs for each time interval

Static Pools		Sets of MDRs (As calculated in STEP 2)	
$C^{CY14}$	$MDR_1^{CY14}$	$MDR_2^{CY14}$	$MDR_3^{CY14}$
$C^{CY15}$	$MDR_1^{CY15}$	$MDR_2^{CY15}$	$MDR_3^{CY15}$

$WMDR_1$  = Weighted Average MDR for Year 1

$WMDR_2$  = Weighted Average MDR for Year 2

$WMDR_3$  = Weighted Average MDR for Year 3

$WMDR_1 =$

$$\frac{MDR_1^{CY14} \times (C^{CY14} - W_{C^{CY14}}^{CY14}) + MDR_1^{CY15} \times (C^{CY15} - W_{C^{CY14}}^{CY15})}{(C^{CY14} - W_{C^{CY14}}^{CY14}) + (C^{CY15} - W_{C^{CY14}}^{CY15})}$$

$WMDR_2 =$

$$\frac{MDR_2^{CY14} \times (C^{CY14} - W_{C^{CY14}}^{CY14} - W_{C^{CY14}}^{CY15}) + MDR_2^{CY15} \times (C^{CY15} - W_{C^{CY15}}^{CY15} - W_{C^{CY15}}^{CY16})}{(C^{CY14} - W_{C^{CY14}}^{CY14} - W_{C^{CY14}}^{CY15}) + (C^{CY15} - W_{C^{CY15}}^{CY15} - W_{C^{CY15}}^{CY16})}$$

$WMDR_3 =$

$$\frac{MDR_3^{CY14} \times (C^{CY14} - W_{C^{CY14}}^{CY14} - W_{C^{CY14}}^{CY15} - W_{C^{CY14}}^{CY16}) + MDR_3^{CY15} \times (C^{CY15} - W_{C^{CY15}}^{CY15} - W_{C^{CY15}}^{CY16} - W_{C^{CY14}}^{CY15})}{(C^{CY14} - W_{C^{CY14}}^{CY14} - W_{C^{CY14}}^{CY15} - W_{C^{CY14}}^{CY16}) + (C^{CY15} - W_{C^{CY15}}^{CY15} - W_{C^{CY15}}^{CY16} - W_{C^{CY14}}^{CY15})}$$

### STEP 4: Computation of $CDR_3$

$$CDR_3 = 1 - [(1 - WMDR1) \times (1 - WMDR2) \times (1 - WMDR3)]$$

A numerical example illustrates the computation of  $CDR_3$

### NUMERICAL EXAMPLE: Computation of $CDR_3$

#### STEP 1: Data input for original static pool $C^{CY17}$ for each year covered by this $CDR_3$

Year	Defaults	Withdrawals
CY15	$D_{C^{CY15}}^{CY15} = 2$	$W_{C^{CY15}}^{CY15} = 7$
CY16	$D_{C^{CY16}}^{CY16} = 1$	$W_{C^{CY16}}^{CY16} = 8$
CY17	$D_{C^{CY17}}^{CY17} = 1$	$W_{C^{CY17}}^{CY17} = 10$

#### STEP 2: Calculating withdrawal-adjusted static pool & Survivors at risk of default (SRD)

Year	Withdrawal Adjusted Static Pool	Survivors* at the Risk of Default (SRD)
<b>CY15</b>	$C_1 = C_0 - W_{C^{CY15}}^{CY15}$ $= 100 - 7 = 93$	$SRD_1 = C_1$ $= 93$
<b>CY16</b>	$C_2 = C_0 - W_{C^{CY15}}^{CY15} - W_{C^{CY16}}^{CY16}$ $= 100 - 7 - 8 = 85$	$SRD_2 = C_2 \times S_1$ $= 85 \times 97.85\% = 83.20$
<b>CY17</b>	$C_3 = C_0 - W_{C^{CY15}}^{CY15} - W_{C^{CY16}}^{CY16} - W_{C^{CY17}}^{CY17}$ $= 100 - 7 - 8 - 10 = 75$	$SRD_3 = C_3 \times S_1 \times S_2$ $= 75 \times 97.85\% \times 98.80\% = 72.50$

\*Survivors (S) to be calculated in STEP 3

### STEP 3: Calculating MDRs & Survivors (S)

Relevant Static Pool	Ratings Outstanding (As of formation date of Static Pool, January 1, 2015)	
$C^{CY14}$	$C_0 = 100$	
<b>Year</b>	<b>MDRs</b>	<b>Survivors (S)</b>
<b>CY15</b>	$MDR_1^{CY15} = D_{C^{CY15}}^{CY15} / SRD_1$ $= 2/93 = 2.15\%$	$S_1 = 1 - MDR_1^{CY15}$ $= 100\% - 2.15\% = 97.85\%$
<b>CY16</b>	$MDR_2^{CY15} = D_{C^{CY15}}^{CY16} / SRD_2$ $= 1/83.2 = 1.20\%$	$S_2 = 1 - MDR_2^{CY15}$ $= 100\% - 1.20\% = 98.80\%$
<b>CY17</b>	$MDR_3^{CY15} = D_{C^{CY15}}^{CY17} / SRD_3$ $= 1/72.5 = 1.38\%$	$S_3 = 1 - MDR_3^{CY15}$ $= 100\% - 1.38\% = 98.62\%$

### STEP 4: Calculating CDR<sub>3</sub>

**PLEASE NOTE:** Since CDR<sub>3</sub> is based on only one static pool, MDRs = WMDRs

$$CDR_3 = 1 - [(1 - WMDR1) \times (1 - WMDR2) \times (1 - WMDR3)]$$

$$= 100\% - [97.85\% \times 98.80\% \times 98.62\%] = 4.66\%$$

### Appendix

Defined Terms	
<b>Accuracy</b>	Ratings accuracy refers to the correlation between ratings and the risk of Default
<b>Annual or Marginal Default Rates (ADRs)</b>	An ADR or MDR reflects “actual” default experience over a one-year measurement period of an issuer that is part of a Static Pool in the beginning of a particular year by the end of the same year. This empirical information may serve as an estimate of the probability of default of the measurement period underlying the ADR
<b>Credit Rating</b>	“A process of evaluating credit worthiness of a person which expresses its ability or willingness to meet financial obligations in full and on time;” <i>Credit Rating Companies Regulations, 2016, Regulation Chapter I, 2. (1)(b)</i>
<b>Credit Substitution</b>	<p>Passing through the guarantor’s applicable credit rating to the principal obligor (issuer whose obligations are guaranteed) under the expectation that the guarantor will not assert any defenses to payment in the event that the principal obligor defaults. Hence, if the guarantor is rated Triple A ‘AAA’; the same rating would be applied to the principal obligor</p> <p>“A guarantee is a legally enforceable promise in which one party (the guarantor) agrees to fulfill the obligations of another party (the principal obligor) should it fail to pay or perform under the terms of its indenture, debt agreement or other contract with a third party. Guarantees appear in a wide variety of transactions that Moody’s rates. The intent of a guarantee is to enhance credit by substituting the obligor’s credit profile with that of the guarantor, typically a more creditworthy entity. Credit substitution can result from unambiguously worded guarantees in which the guarantor has the unconditional and irrevocable obligation to pay or perform on a full and timely basis without the ability to raise defenses to its liability.”</p> <p><b>Adapted from SPECIAL COMMENT: <i>Moody’s Identifies Core Principles of Guarantees for Credit Substitution</i>; pp. 1 &amp; 2; Moody’s investors Services, November 11, 2010</b></p>
<b>Cumulative Average Default Rates (CDRs)</b>	<p>A CDR reflects “actual” default experience over one/multiple-years measurement periods of an issuer that has survived in a Static Pool up to the beginning of each subsequent year of the Measurement Period underlying the CDR by the end of last year of such Measurement Period. This empirical information may serve as an estimate of the probability of default of the measurement period underlying the CDR</p> <p><b>Marginal Default Rates (MDRs):</b> A MDR is an incremental default rate for each year covered by the Measurement Period underlying a CDR. For instance, a CDR<sub>3</sub> has three constituent MDRs:</p> <p>MDR<sub>1</sub> reflects “actual” default experience of an issuer that has survived in the Static Pool (C<sub>0</sub>) up to the beginning of Year 1 covered by CDR<sub>3</sub> by the end of Year 1</p> <p>MDR<sub>2</sub> reflects “actual” default experience of an issuer that has survived in the Static Pool (C<sub>0</sub>) up to the beginning of Year 2 covered by CDR<sub>3</sub> by the end of Year 2</p> <p>MDR<sub>3</sub> reflects “actual” default experience of an issuer that has survived in the Static Pool (C<sub>0</sub>) up to the beginning of Year 3 covered by CDR<sub>3</sub> by the end of Year 3</p>

<b>Default</b>	<p>PACRA defines <b>DEFAULT</b> as:</p> <ol style="list-style-type: none"> <li>1. Failure of an obligor to make timely payment of principal and/or interest under contractual terms of any financial obligation</li> <li>2. A distressed restructuring whereby the restructuring has the effect of allowing the obligor to avoid a payment default</li> </ol> <p>This definition is uniformly applied both for capital market instruments and bank facilities.</p>
<b>Initial Rating</b>	<p>The rating assigned by PACRA for the first time. Ratings are also termed “<b>Initial</b>” when a previously:</p> <ol style="list-style-type: none"> <li>1. Private rating converts into a public rating</li> <li>2. Preliminary rating is finalized</li> <li>3. Withdrawn rating comes back to PACRA with a fresh Mandate</li> <li>4. Defaulted rating emerges from Default and assigned a rating</li> </ol>
<b>Measurement Period</b>	<p>The time horizon between the beginning and end of a Static Pool formation. It also refers to the time period measured by a CDR.</p>
<b>Methodology</b>	<p>The analytical framework used to specify various factors to analyze and assess the relative standing of the underlying entity/issue on the basis of qualitative and quantitative factors.</p>
<b>Model</b>	<p>An aggregator, derived from the Methodology, that converts qualitative and/or quantitative input factors into quantitative estimates based on pre-assigned formulae and weightages.</p>
<b>Preliminary Rating</b>	<p>The rating assigned to a debt instrument/mutual fund yet to be issued based upon its proposed terms and conditions</p>
<b>Public Rating</b>	<p>A rating opinion available in the Public Domain</p>
<b>Rating Criteria</b>	<p>A set of standards, established by PACRA, ensuring that a given Methodology and Model is applied in a careful, uniform and consistent manner, as determined by PACRA</p>
<b>Rating Factors</b>	<p>Factors being assessed as per PACRA established Methodology to reach a rating decision</p>
<b>Rating Modifiers</b>	<p>Rating Modifiers are refinements about a rating opinion that PACRA may use: <i>PACRA employees two modifier listings:</i></p> <ol style="list-style-type: none"> <li>1. Rating Outlook: Indicates the potential and direction of a rating over the intermediate term in response to trends in economic and/or fundamental business/financial conditions. It is not necessarily a precursor to a rating change</li> <li>2. Rating Watch: Alerts to the possibility of a rating change subsequent to, or in anticipation of, a) some material identifiable event and/or b) deviation from expected trend. But it does not mean that a rating change is inevitable</li> </ol>
<b>Stability</b>	<p>Stability refers to the frequency and magnitude of rating changes, as well as the likelihood that these rating changes would prove enduring. Hence, Stability is the ability of a rating to maintain itself where it was originally assigned</p>
<b>Static Pool (or Cohorts)</b>	<p>Static Pools are groupings of data that stay together in the group for the entire length &amp; breadth of the Measurement Period of the pool</p>

<p><b>Time-to-Default</b></p>	<p>Time-to-default is a general term referring to how far a rating lies from the time of its Default. It can be calculated both in terms of rating categories and at the notch level. There are various Time-to-Default statistics that are preferred. However, PACRA chooses to publish Time-to-Default as follows:</p> <ol style="list-style-type: none"> <li>1. Time-to-Default from Initial ratings: Measures the time elapsed between the Initial rating (<i>As assigned by PACRA</i>) and Default</li> <li>2. Time-to-Default from all ratings: Measures the rating path to Default, tracking from the time of Initial rating to all successive rating changes/transitions on the rating scale prior to Default</li> </ol>
<p><b>Transition &amp; Default Study</b></p>	<p>A Set of Standardized tools &amp; analyses for a CRA ratings' performance appraisal</p>
<p><b>Transition Rates</b></p>	<p>Statistics quantifying the migration of ratings on the rating scale. There are three kinds of Transition Rates:</p> <ol style="list-style-type: none"> <li>1. Upgrade Rate: The rate of upward rating migration (Ceiling: Triple A "AAA")</li> <li>2. Downgrade Rate: The rate of downward rating migration (Floor: Single C "C")</li> <li>3. Default Rate: Proportion of entities/issues that have been assigned a Default "D" rating (<i>As per PACRA Default Policy "What is Default"</i>) to the total entities/issuers</li> </ol>

<sup>i</sup> See PACRA's Methodology - "**Recognition of Default**" @ [www.pacra.com](http://www.pacra.com)

<sup>ii</sup> A Withdrawn rating means that a previously issued rating has been withdrawn and no longer outstanding in PACRA's universe. A rating is withdrawn on: a) termination of rating Mandate, b) cessation of underlying entity, c) the debt instrument is redeemed, d) the rating remains suspended for six months, or e) the issuer Defaults. PACRA considers Default an "all consuming" state for the rating which stands Withdrawn at the time of this event. Any rating review is considered an Initial rating. Debt instruments, assigned a D rating, remain under surveillance (till fully settled) and are updated using both public and non-public sources, on a best effort basis.

<sup>iii</sup> The cohort method is based on Jafry and Schuermann (2004) work. It offers a simple estimation process. However, the method has a very rigid assumption that time is discrete; therefore, rating activity cannot be analyzed holistically. The method considers the rating position at the beginning and end of a period only, excluding the dynamic process found within the period in the form of interim rating actions.

<sup>iv</sup> PACRA derives its methodology for calculating CDRs using Moody's discrete-time hazard rate method as described in Moody's publication **SPECIAL COMMENT** – Measuring Corporate Default Rates, November 2006