PROBABILITY OF DEFAULT IMPLIED RATING WHITE PAPER

Credit Research Initiative of the National University of Singapore

(First version: March 2nd, 2017; This version: June 14th, 2017)

ABSTRACT

Introduced by the Credit Research Initiative (CRI) in 2011, the Probability of Default Implied Rating (PDiR) complements the CRI 1-year Probability of Default (PD) by providing a convenient and intuitive overview on the credit quality of a firm through the mapping of the CRI PD into letter grades used by major rating agencies. This paper seeks to provide a transparent and simplistic understanding of the PDiR, using a methodological walkthrough and illustrations.

CONTENT

OVERVIEW	2
COVERAGE	3
METHODOLOGY	3
MODIFIERS	5
USAGE	6
CONCLUSION	7



OVERVIEW

Credit ratings in the form of alphabetical letter grades are intended to give users a convenient and intuitive overview of a firm's creditworthiness. The CRI Probability of Default Implied Rating (PDiR) was introduced in 2011 to complement the high granular CRI Probability of Default (PD) by assigning a letter grade to each firm according to a systematic mapping of PD based on historically observed default rates from credit rating agencies' ratings.

The CRI PD evaluates the credit quality of a firm using its underlying likelihood of default; the higher the likelihood of default, the lower the firm's credit quality. The PDiR segregates firms into alphabetical categories by mapping their PDs to the equivalent letter grades according to Standard & Poor's (S&P) rating system using the historical observed default rates over the past ten years as the benchmark. In short, the PDiR provides a grade to a firm's 1-year forward looking credit quality, using S&P classification. Table 1 presents the CRI PDiR mapping table as of February 2017. For example, a firm's CRI PD in the range of 0~0.16 bps can be understood as an AAA-rated firm by S&P criteria.

Rating Category	PD Lower Bound (bps)	PD Upper Bound (bps)
AAA	0	0.16
AA	0.16	2.39
А	2.39	9.28
BBB	9.28	35.95
BB	35.95	139
В	139	539
CCC/CC/C	539	10,000

Table 1: PDiR Mapping Table as of February 2017



COVERAGE

CRI provides the PDiR for all the firms which PDs have been produced. Therefore, it has the same coverage as the CRI PD, spanning about 65,000 public firms in 120 economies. The PDiR is also updated daily for about 33,000 active firms in this database.

METHODOLOGY

Mapping the CRI PD to the respective PDiR requires defining the upper bound for all rating cohorts (or categories). The boundary values of the PDiR categories are obtained by taking the geometric average of the Average Default Rates (ADR) of two neighboring categories and are updated annually.

CRI computes the ADR based on the data published by the European Securities and Markets Authority (ESMA) Central Ratings Repository¹. ESMA publishes the default rates and the default numbers for rating grades and time horizons. By filtering the data by periods, one is able to obtain the number of firms at the beginning of a particular period, and the corresponding number of defaults experienced by this group at the end of the period for each cohort using the transition matrices.

The ADR's formula for cohort p at time T is as follows:

 $ADR_p^T = \frac{\sum_{i=T-10}^{T-1} \text{ number of defaults from firms rated } p \text{ in year } i}{\sum_{i=T-10}^{T-1} \text{ number of firms rated } p \text{ in year } i}$

For the ratings of CCC, CC and C, the numbers are aggregated to form a combined category of CCC/CC/C.

The orange triangles in Figure 1 below indicate the logarithm of the observed ADR for firms rated by S&P from CCC/CC/C to AA. It is observed that a linear relationship exists between the values of ln(ADR) and the ratings. Therefore, we derive the upper rating bounds by interpolating ln(ADR), and correspondingly we perform an Ordinary Least Squares regression for this purpose.



¹ https://cerep.esma.europa.eu/cerep-web/

Due to the lack of observed defaults for AAA firms rated by S&P, the ln(ADR) for the rating AAA is undefined. To overcome this issue, a line of best fit can be plotted through the six observed values of ln(ADR) for the other rating grades to extrapolate the green squares shown in Figure 1. However, taking the default rate based on the first extrapolated green square results in a boundary that leads to a far larger fraction of PDiR-rated AAA firms as compared to actual rated AAA firms. Thus the boundary between AA and AAA is taken as a mid-point between the first and second green squares. The observed ln(ADR), the fitted ln(ADR) and the extrapolation of the fitted ln(ADR) for AAA are shown in Figure 1.



Figure 1: Plot of In(ADR) and Rating Categories

The upper boundary of the rating CCC/CC/C is fixed at 10,000 bps as it represents the lowest credit quality. The upper boundary values of the ratings B to AA are then calculated by taking the average of the two consecutive fitted values of ln(ADR), denoted by $ln(\widehat{ADR})$, through the formula:

$$UB_p = \exp\left(\frac{\ln(\widehat{ADR_P}) + \ln(\widehat{ADR_q})}{2}\right)$$

where p and q represent two consecutive ratings with $p \in \{AA,A,BBB,BB,B\}$, and q being a rating lower than p with one notch, and UB_p stands for the upper bound of rating p.

Finally, the upper boundary value between categories AAA and AA is taken as the average between the extrapolated In(ADR) depicted by the two green squares in Figure 1.



MODIFIERS

Large PD variations that cause a firm to move into a different risk category (for example from BBB to BB) are informative as they give an update on the firms' financial health. However, in some instances, slight PD variations may also trigger a shift in credit rating when the firm's default probability is on or near the boundary between two risk bands. Credit rating shifts may be misinterpreted as small changes would be represented in the same way much larger changes.

In order to reduce the frequency of rating changes due to residual borderline PD fluctuations, we use a risk modifier "*/+" and "*/-". This modifier allows a firm to retain its previous credit rating, but adds a mention "*/+" when this firm's rating should be in the next upper category, and "*/-" when this firm's rating should be in the next lower category.

For instance, when the default probability of a firm rated A places it on the edge of the border between category A and category BBB, and its rating drops in the upper edge of BBB, this firm will have a rating of $A^*/-$ instead of BBB as illustrated in Figure 2 below.







USAGE

The PDiR offers a qualitative measure of a firm's credit quality based on the historical observed default rates of the S&P rating system. By mapping the CRI PD to the respective PDiR, one is able to have a sense of a firm's credit quality. PDiR also provides convenience when looking into firms of similar risk profiles. For example, one will be able to identify a group of speculative-grade equivalent firms based on PDiR classifications.

From a temporal perspective, one can observe the changes in credit quality of a firm over time. By observing the time series data, the PDiR provides a relative assessment of the firm's credit quality. While the CRI PD offers a high granular quantitative measure for an in-depth analysis of the firm's credit quality, the PDiR presents a convenient and intuitive overview.

Figure 3 below presents the PDiR and the CRI PD of a selected firm from Jan 2011 to Aug 2014. As seen from the chart, the PDiR are inversely related to the PD. A higher PD indicates a higher likelihood of default and conversely, a lower credit quality and PDiR. The firm defaulted in September 2014, about one year after the PDiR dropped to CCC/CC/C.



Figure 3: PDiR and 1-year PD of a selected firm



CONCLUSION

The CRI PDiR complements the CRI 1-year PD by providing a quick and convenient overview on the credit quality of firms. It offers an intuitive understanding of credit risk by benchmarking the PD to historical observed default rates of the S&P rating system. While the PDiR allows for a simplified approach to credit risk assessment, it is recommended that users also refer to the CRI PD for a more granular credit assessment.



©2017 NUS Risk Management Institute (RMI). All Rights Reserved.

The content in this white paper is for information purposes only. This information is, to the best of our knowledge, accurate and reliable as per the date indicated in the paper and NUS Risk Management Institute (RMI) makes no warranty of any kind, express or implied as to its completeness or accuracy. Opinions and estimates constitute our judgment and are subject to change without notice.

NUS Risk Management Institute (RMI) – Credit Research Initiative Address: 21 Heng Mui Keng Terrace, I³ Building, Level 4, Singapore 119613 Tel: (65) 6516 3380 Fax: (65) 6874 5430 Website: http://rmicri.org/

