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Actuarial Spread
White Paper

The Credit Research Initiative (CRI)
National University of Singapore

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ABSTRACT

Actuarial Spread (AS) is an alternative credit risk measure to the CRI Probability of Default (PD). It was introduced by the Credit Research Initiative (CRI) at the National University of Singapore in July 2014. Built on the design of conventional Credit Default Swaps (CDS) without involving an upfront fee, the AS reflects the credit risk of corporate obligors by summarizing the information embedded in the term structure of the physical CRI PD and the discount rate. In short, AS offers a new perspective on a public firm's credit worthiness and acts as an intuitive communication tool in a metric that is familiar among market participants.

CONTENT

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I. OVERVIEW

Introduced in 2014 by the CRI, Actuarial Spread (AS) provides a new perspective on corporate credit risk. Constructed on the design of conventional Credit Default Swaps (CDS) excluding the upfront fee, the AS reflects the credit risk of a firm by summarizing the information embedded in the term structure of the physical (real-world) CRI Probability of Default (CRI PD) and the risk-free discount rate. Therefore, it is equivalent to computing the CDS spreads based on their "*actuarial*" values by using the CRI PD. See Figure 1 for an example of historical time series of AS.

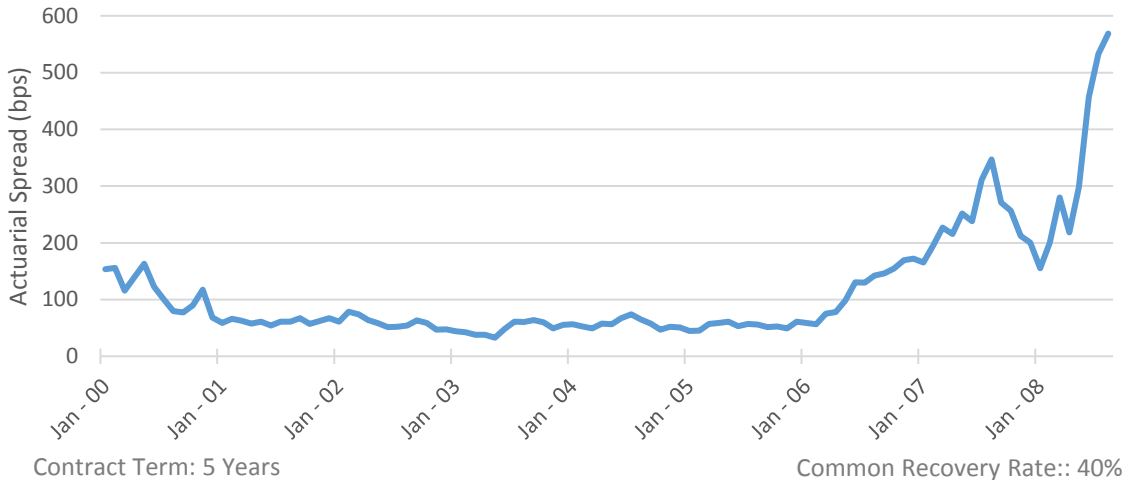

Fig 1. Historical 60m-horizon AS time series for Lehman Brothers
Parameters calibrated in Apr 2018 with data up to August 2008. Source: CRI, May 2018.

Coverage

The CRI provides AS with tenors ranging from a minimum of 1-year to a maximum of 5-year in one year increments for every public firms under its PD coverage, i.e., over 67,000 firms in 128 economies. The CRI AS are updated on a daily basis for over 34,000 active exchange-listed firms and are currently denominated in USD, computed using discount rate curves extracted from a combination of USD LIBOR and swap rates.

II. METHODOLOGY

CDS spreads have been widely used as a credit risk indicator of a reference obligor. As the spreads are analogous to the fees charged for default protection, obligors with higher spreads are often associated with higher credit risk.

Constructing the AS relies on the assumption that market participants are risk-neutral and the spread is such that no exchange of money is initially required. The AS shares the same features as a standard CDS contract without upfront fee, with one key difference: compared to the risk-neutral probability measure used in the CDS pricing, the AS is based on a physical probability measure.

In other words, because the AS leverages the term structure of physical CRI PD, as proposed by Duan (2014)[1], it can be interpreted as an equivalent to pricing CDS purely based on their actuarial values. This rate therefore is referred to as "*actuarial spread*".

More information about the AS computation can be found in section 6 of the RMI-CRI Technical Report (2017).

Other Exit Cases

The CRI AS is computed with the assumption that when obligors exit for reasons other than default, the CDS protection is shifted to the merged or acquiring entity, with the successor potentially experiencing subsequent default or other exit with the same forward intensity probability as the original obligor.

Discount Rate Curve

Computing AS requires an appropriate discount rate curve, which is naturally currency specific. In the CRI implementation, the curve is extracted from a daily combination of USD LIBOR and Swap rates, and is applied to all the firms under coverage.

[1] Duan, J.-C. (2014) *"Actuarial Par Spread and Empirical Pricing of CDS by Decomposition" Global Credit Review*, Vol. 4, 51-65.

Therefore, it is more sensible to compare the AS to USD-based CDS spreads. AS deniminated in other currencies such as Euro can be similarly computed but are currently not supported by the CRI.

The discount rate curve is constructed through a bootstrap technique. Missing rates are filled in by linearly interpolating the available interest rates (in continuous compound form).

III. APPLICATION

There exists an empirical relationship between actively traded CDS spreads and the AS. This relationship can help one benchmark credit - especially for companies which have no CDS or which have CDS that are not liquid enough to assess the risk of default in neither a timely nor an accurate manner.

Example for Empirical Pricing of CDS[2]

Eastman Kodak was an American company that produced imaging, printing and photography products. It filed for Chapter 11 bankruptcy protection on January 19, 2012 and later emerged back from bankruptcy on September 3, 2013. Its shares began to trade under a different ticker in NYSE on November 1, 2013. In Figure 2a, Kodak's market CDS spreads (Bloomberg) and Kodak's AS are plotted for the last year before its bankruptcy filing.

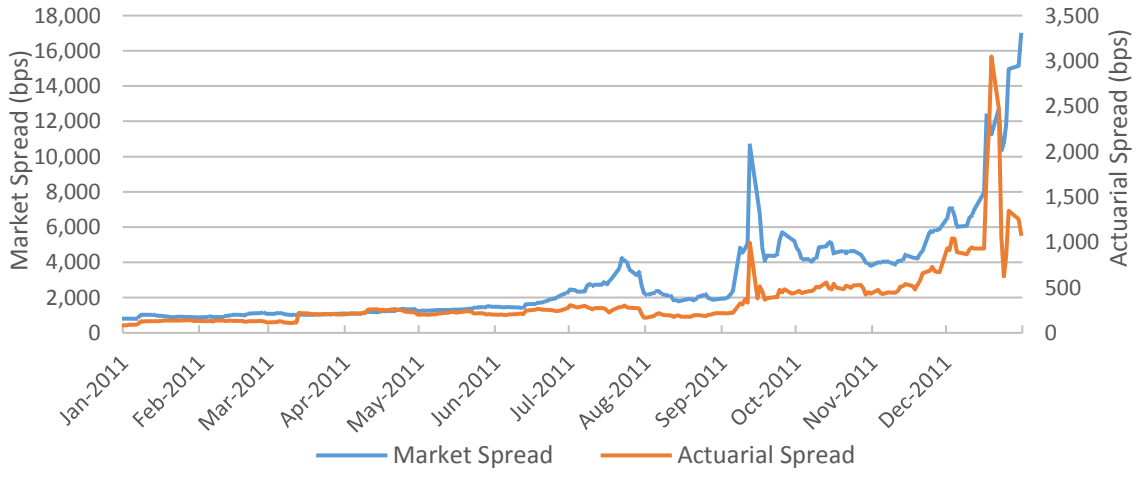

Fig 2a. Actuarial spread vs. Market spread of Eastman Kodak Co.

Daily time series of 5-year CDS market spread and 5-year CRI AS
one year before Eastman Kodak bankruptcy filling on January 19, 2012
Source: Duan 2014.

[2] Example and data extracted from Duan (2014) *Actuarial Par Spread and Empirical Pricing of CDS by Decomposition*" Global Credit Review, Vol. 4, 51-65.

Even though the CDS spread is usually much larger than the AS, the two time series generally moved in tandem, which points to the possibility of establishing some empirical relationship between the two spreads.

By plotting the log Spread ratio with its lagged value shown in Figure 2b, we observe that there is a strong statistical relationship between the two. A simple lagged regression of the log ratio of the CDS spread over its corresponding AS yields a high R^2 of 85% with the predictive equation:

$$\ln\left(\frac{S_t}{S_t^{(a)}}\right) \approx 0.1487 + 0.9296 \times \ln\left(\frac{S_{t-1}}{S_{t-1}^{(a)}}\right)$$

Where S_t refers to the CDS spread at time t and $S_t^{(a)}$ refers to the AS at time t.

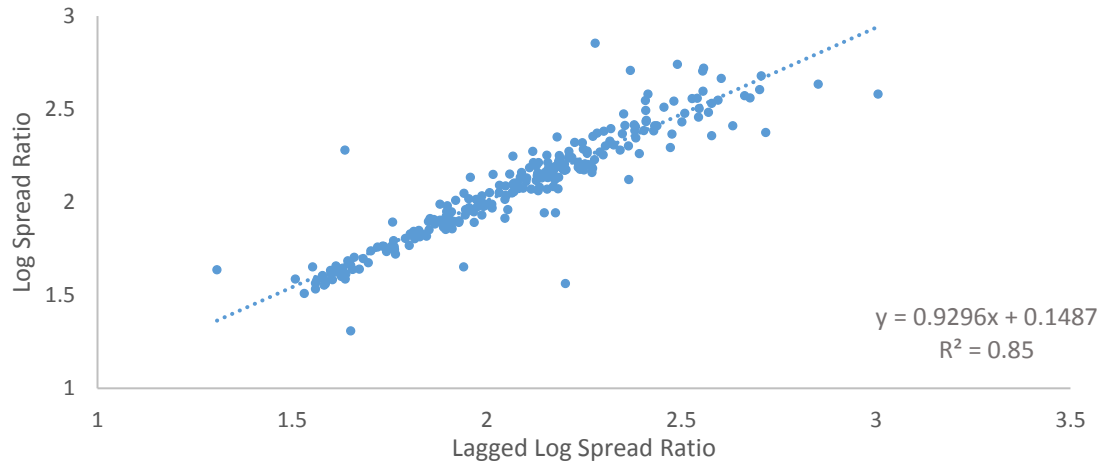

Fig 2b. Lagged regression of the log spread ratio of Eastman Kodak Co.
The Log-ratio of the 5-year CDS spread over its corresponding AS vs. the same log-ratio on the previous trading day
Source: Duan 2014.

IV. CONCLUSION

The AS offers a new perspective on credit risk by reflecting the credit risk of corporate obligors, which is summarized in the term structure of the CRI physical PD. It acts as an intuitive communication tool in a metric that is familiar among market participants. The computation of the AS is based on the features of standard CDS contracts using the CRI PD. An additional benefit of using the AS is that it is available for a much larger set of firms when comparing to the use of CDS as a risk benchmark.

ABOUT THE CREDIT RESEARCH INITIATIVE

The Credit Research Initiative (CRI) was launched by Professor Jin-Chuan Duan in July 2009 at the Risk Management Institute of the National University of Singapore. Aiming at "Transforming Big Data into Smart Data", the CRI covers over 67,000 public firms and produces daily updated Probabilities of Default (1-month to 5-year horizon), Actuarial Spreads (1-year to 5-year contract) and Probability of Default implied Ratings on over 34,000 currently active, exchange-listed firms in 128 economies. The CRI also distributes historical time series of over 33,000 inactive firms due to bankruptcy, corporate consolidation or delisting for other reasons. In addition, the CRI produces and maintains Corporate Vulnerability Indices (CVI), which can be viewed as stress indicators, measuring credit risk in economies, regions and special portfolios.

As a further step, the CRI converts smart data to actionable data to meet the customized demands of its users and offers bespoke credit risk solutions leveraging on its expertise in credit risk analytics. A concrete example is our development of the BuDA (Bottom-up Default Analysis) toolkit in collaboration with the IMF. BuDA is an automated analytic tool based on the CRI PD system, enabling IMF economists to conduct scenarios analyses for the macro-financial linkage.

The CRI publishes Weekly Credit Brief and Quarterly Credit Report, highlighting key credit-related events, offering insights based on the CRI PD of the entities involved, and providing useful statistics on credit risk of economies and sectors.

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