

Impact Analysis of Wrong-Way Risk in CVA Calculation: A Focus on KRW Interest Rate Swaps

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Transition in Swap Pricing





Swap Pricing to Incorporate Collateral





Standard CSA & Standard Discounting

	Standard CSA	Standard Disc ounting	Remark				
USD Swap	USD Cash, US Treasury	USD/SOFR	From OIS market		Actual CSA •Funding risk]	Valuation Adjustment
GBP Swap	GBP Cash <i>,</i> UK Treasury	GBP/SONIA	From OIS market	Anything deviated			Credit & Funding Risk
EUR Swap	EUR Cash, EURO Treasury	EUR/ESTR	From OIS market	from Standard CSA?	No CSA •Funding risk •Credit risk		to be incorporated
JPY Swap	JPY Cash, JPN Treasury	JPY/TONAR	From OIS market				into swap pricing
KRW Swap	KRW Cash, KOR Treasury	KRW/KOFR	To be from OIS market				



Valuation Adjustment

- Firstly, swap is priced by OIS rates, regardless of collateral.
- Secondly, any deviation from Standard CSA should be incorporated into swap value, which is so called the valuation adjustment



Interest Rate Swap for CVA Calculation

• Trade date: 2023-12-29

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(A) KRW unsecured paid IRS

- Swap dealer: pay fixed rate / receive • Recovery rate: 40% floating rate • Risk-free discount rate: swap rate • Counterparty: receive fixed rate / pay • Additional details: 10-year maturity, 1 floating rate • Swap rate (r_{10}) : 2.99% as of 2023-12-29 million KRW face value, coupons paid every 3 months, counterparty credit rating • Trade date: 2023-12-29 AA (B) KRW unsecured received IRS • Swap dealer: receive fixed rate / pay • Recovery rate: 40% floating rate • Risk-free discount rate: swap rate • Counterparty: pay fixed rate / receive •
- floating rate Additional details: 10-year maturity, 1
- Swap rate(r_{10}): 2.99% as of 2023-12-29 million KRW face value, coupons paid
 - every 3 months, counterparty credit rating

Expected Positive Exposure & CVA Formula





EPE Calculation by Using Ho-Lee Binomial Tree





EPE for Paid and Received Swap





Concept of Wrong-Way Risk

- WWR is defined as the positive dependence between the swap dealer's exposure and the counterparty's probability of default.
- WWR indicates that as exposure increases, the counterparty's probability of default also increases, leading to greater losses.
- WWR is particularly likely to become significant during periods of stress, such as recessions or sudden inflation spikes.



General WWR & Specific WWR

- GWWR is influenced by macro variables such as interest rates, exchange rates, and inflation.
- WWR indicates that as exposure increases, the counterparty's probability of default also increases, leading to greater losses.



 SWWR is driven by specific individual factors that affect the counterparty 's credit quality.





WWR CVA Formula & Credit Worthiness Index



*Vasicek ASFM (Asymptotic Single Factor Model) is widely used to construct credit indices. The use of CWI can represent the dependence between exposure and default probability. Changes in swap rates that are reflected in CWI through the correlation are contributing to the swap dealer's exposure



WWR EPE & EPE for Paid and Received Swap





Calculation of CVA & WWR CVA for IRS

CVA for paid and received IRS

(Amount in KRW)

	CVA for paid IRS		CVA for received IRS
ρ = zero	16,253	p = zero	18,730
$\rho = -0.25$	21,859	p = 0.25	27,109
$\rho = -0.5$	24,574	ρ = 0.5	31,027

- As correlation increases, both exposure and the probability of default increase simultaneously, resulting in a higher CVA.
- CVA represents the expected loss that the swap dealer must bear in the event of the counterparty's default, as the swap dealer does not receive collateral.
- However, if the characteristics of WWR are ignored, the swap dealer will underestimate the potential loss.

Economic Significance of WWR CVA

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- One key point is that if WWR characteristics exist, capturing them allows for an accurate assessment of default risk and enhances the reliability of valuations.
- Another significance is that WWR CVA enables swap dealers to accurately calculate required capital, avoiding the risk of holding insufficient capital.
- Moreover, calculating WWR CVA effectively improves the risk management practices of swap dealers.
- WWR CVA can also improve the asset allocation strategy of swap dealers, allowing them to manage risky transactions in advance.
- Lastly, regulatory authorities require swap dealers to comply with regulations, i.e. WWR CVA enhances the transparency of the risks held by swap dealers.



It is difficult to define exactly what a fair price is, but it is clear that the market is constantly pursuing it.

Thank You!!