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Avoiding Collateral Surprises: Managing Multi-Currency CSAs

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This article explores multi-currency credit support annexes (CSAs) in the derivatives area and their potential impact on pricing for treasurers and other financial professionals. Related challenges that practitioners face in terms of collateral management and optimisation is also explored. It highlights why efficient collateral management is fundamental in the new post-crisis world, and identifies why cheapest-to-deliver (CTD) collateral can be necessary for profit, effectiveness and liquidity.

With the derivative markets having changed dramatically since the 2008 financial crisis, regulatory reform and structural changes to the financial markets have resulted in the increased collateralisation of trades and a move to central clearing of vanilla trades. Financial practitioners are witnessing increased usage of collateral as a way to mitigate the risk of counterparty default. Many of these changes have had a dramatic impact on how derivatives are fundamentally priced, with collateral choices impacting the discounting curves used in valuations. Adding to the post-crisis drama has been the divergence in rates and significantly widened basis swap spreads. Traders acting on behalf of treasurers and other financial practitioners also face challenges surrounding the overwhelming complexity of the Credit Support Annex (CSA) in terms of embedded optionality.

This study goes on to give several illustrative examples on how to construct cheapest-to-deliver (CTD) curves and demonstrates how they enable practitioners to select appropriate collateral. It also provides several pricing case studies involving interest rate swaps. As we come to better understand the complexity of current CSA agreements, the article seeks to uncover what the future might look like with the new standard CSA to reduce optionality.

The Complexity of CSA Agreements

A significant number of CSAs allow counterparties to choose collateral from a big list of eligible currencies and securities; furthermore, different currency collateral and types of collateral have different impacts on valuation. Given that almost every CSA agreement is unique, it is no wonder that a lack of transparency prevails and valuation discrepancies between counterparties abound, even for the simplest of trades. Many market participants have come to see that it is nearly impossible to compare prices between dealers.

The Growing Need for a Central Collateral Management Process

The combination of these factors have led many practitioners to realise the importance of developing a central collateral management process, including the ability to identify the CTD collateral. However, many market practitioners face challenges due to disparate systems and varying processes for each over-the-counter (OTC) desk. Difficulties exist when it comes down to validating the large number of CSAs and keeping track of the huge flows of collaterals. Other market participants also face challenges with big data input. In addition, CTD may not always be the most optimal choice. Clearly, practitioners need to consider the massive amounts of rules and requirements surrounding CTD, depending on the funding rates and available assets in the firm. The bottom line: 'Will it be cheaper to source new collateral or use an existing one?'

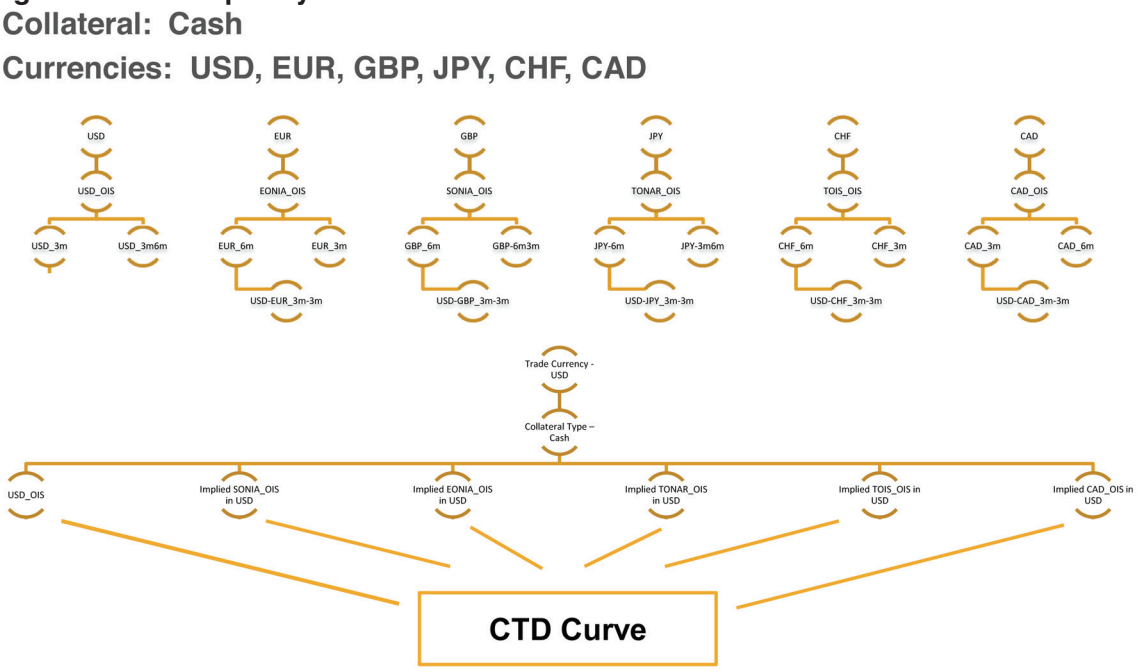
PART I: Case Study - How to Construct aCTD Curve

Most dealers agree that discounting should be based on the CTD collateral in order to enable the best funding benefits and highest rate of return. The CTD curve is a blended collateral discounting curve, optimised through the trade life cycle among the different currency collateral curves. The CTD needs to be determined frequently over time, with the choice of the collateral currency becoming crucial in order to optimise profit, effectiveness and liquidity.

When it comes to constructing a CTD curve, each of the following five steps adds an additional layer of complexity. This case study will explore the construction and the complexities involved with CTD, beginning with five basic steps:

Step 1. Construct appropriate curves – Overnight Indexed Swap (OIS), Swap, Basis Curves, Cross-currency (XCCY) curves.
Step 2. Translate curves in different currencies to the trade currency.
Step 3. Pick cheapest throughout the life of the trade.
Step 4. Construct blended CTD curve.
Step 5. Discount cash flows with CTD curve.

Figure 1. The Complexity of CTD Curve Construction.



The Complexity of CTD: 6 Cash Collateral Currencies = 29 Curves to Build!

Source: Numerix

The Complexity of CTD Curve Construction and Optionality

What Practitioners Need to Consider: When it comes to CTD and optionality, market participants need to carefully consider various factors, including the choice of currency and collateral type, in addition to calibration; initial margin; up and down thresholds; minimum transfer amounts; and consistency with their counterparties.

Background: Constructing a CTD Curve – Collateral and Corresponding Curves:

The basics: The following chart indicates types of collateral/currency and their corresponding curves:

Collateral/Currency	USD	EUR	CAD	GBP	JPY	CHF
Cash	USD FedFunds OIS Curve	EONIA OIS Curve	CORRA OIS Curve	SONIA OIS Curve	MUTAN OIS Curve	TOIS Curve
Corporate Bonds	USD LIBOR+ Spread	EURIBOR+ Spread	CDOR + Spread	GBP LIBOR + Spread	MUTAN OIS Curve	CHF LIBOR+ Spread

As the case study unfolds, we will go through the five basic steps outlined earlier for curve construction.

Curve Construction Step-by-Step:

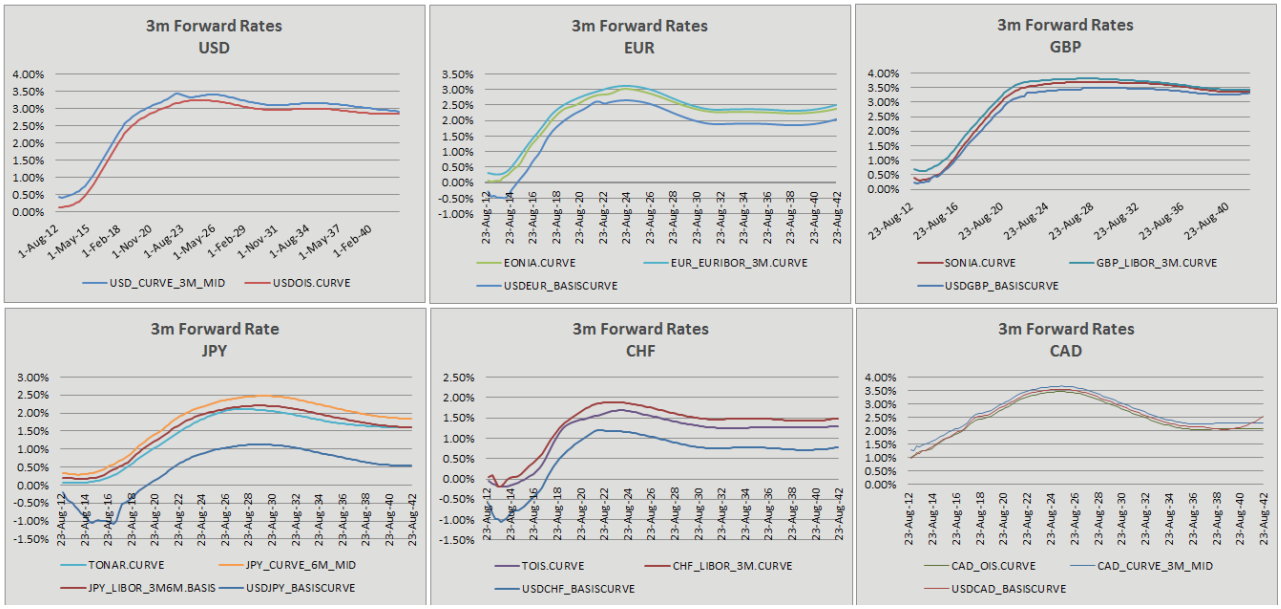
Step 1: Construct Appropriate Curves – OIS, Swap, Basis Curves, XCCY Curves:

First, we will need to construct all the appropriate curves necessary to build OIS curves and standard London Interbank Offered rate (Libor) curves. We need to construct basis curves used in XCCY curve construction and XCCY Basis curves to be used in translating local curves into trade currency.

Step 2: Translate Curves in Different Currencies to the Trade Currency:

Figure 2 below represent an example of curve construction for six currencies, including: US dollar (USD),euro (EUR), pound sterling (GBP), Japanese yen (JPY), Swiss franc (CHF) and Canadian dollar (CAD). As we can see, the graphs illustrate three month forward rates of OIS curves, standard Libor curves and basis curves for each currency, as well as implied XCCY curve for USD vs. appropriate currency basis spreads.

Figure 2. Curve Construction for Six Currencies.



Source: Numerix

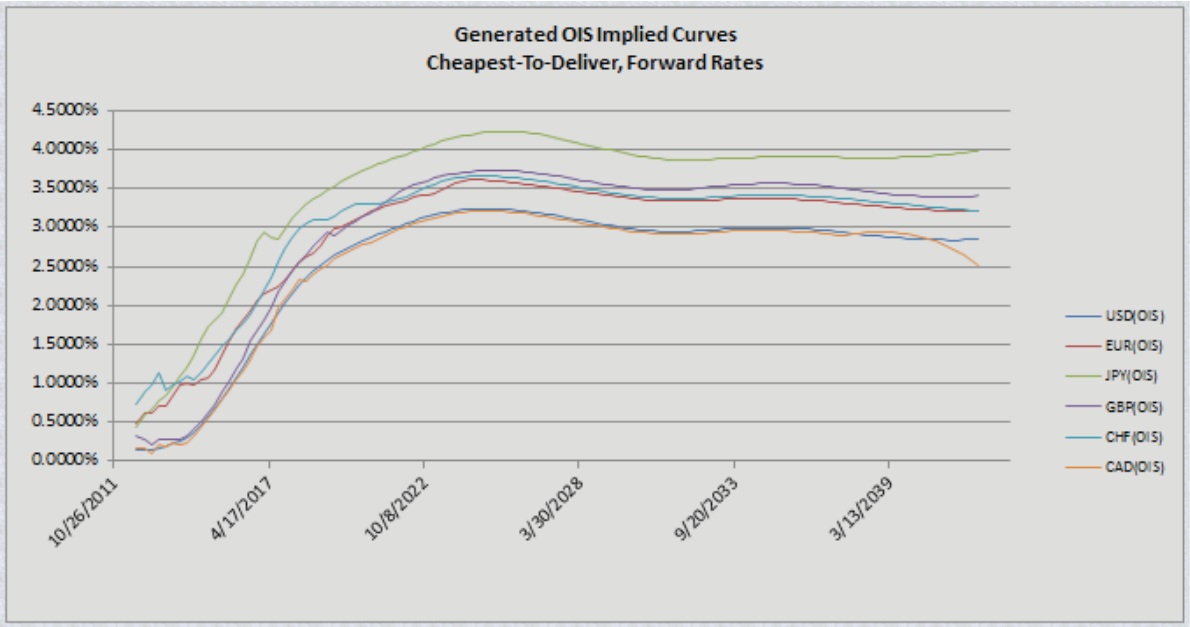
Step 3: Pick Cheapest Currency Throughout the Life of the Trade

After we obtain all of the appropriate curves in Steps 1-2, we should compare instantaneous forward discount rates of collateral curves at each point of time and pick the max one, which corresponds to the lowest discount factor. The highest (max) forward rate represents the highest return rate on the corresponding collateral.

Step 4: Construct Blended CTD Curve

In the end, the blended CTD curve is constructed from obtained max forward rates, which can be applied to discount future cash flows of the trades and derivatives.

Figure 3. OIS Implied Curves, CTD, Forward Rates.



Source: Numerix

What Does Your CTD Tell You?

The CTD curve is unique for each counterparty and has become an effective analysis tool for identifying the cheapest collateral. It allows practitioners to incorporate the assumption of frequency of collateral switch, as well as indicating when this cheapest collateral switches to a different one.

With the application of CTD collateral to pricing, we can see the effect of present value (PV) of trades with various counterparties and collateral assumptions, thereby enabling the ability to negotiate and match counterparties. Also, it allows the user to see the risk exposure against different collateral currencies, as well as enabling FX rate sensitivity analysis.

Summarising the Complexities of CTD

Clearly, we have observed that CTD curve construction can be extremely tedious, with six currencies requiring 20+ curves. The different curves needed to approximate cash, Treasury bonds and corporate bonds, add to the complexity. In addition, interpolation and smoothing must also be considered, along with proxies for currencies that may not be that liquid. Moreover, ultimately, CTD may not always be the most optimal choice.

PART II: Pricing Case Studies – Interest Rate Swaps

In the examples that follow, we observe how the choice of collateral can significantly affect the price of the trade and ultimately the bottom-line: profit.

Pricing Portfolio

Pricing Case Study 1. The first case study below prices par swaps with different currency cash collateral.

The following case study demonstrates a representation, in very simple terms, of how different choices of collateral affect interest rate (IR) swap pricing. The example showcases par swaps under USD OIS discounting of different swap maturities (from five years to 30 years). Further, we discount these swaps with different assumptions of collateral posted (i.e. USD, EUR, JPY, CAD, CHF, GBP cash types.) Though this is not a real market case scenario, it provides important insights regarding how much pricing of the trade can vary under different collateral discounting as well as showing explicit numbers without the necessity of scaling by notional, fixed rate, maturity and moneyness of the swap.

Figure 4. Pricing Case Study 1: IR Par Swaps USD Set-up.

Setup:

Collateral Type\Currency	USD	EUR	JPY	GBP	CHF	CAD
Cash/Treasury	☑	☑	☑	☑	☑	☑
Corporate Bonds	☐	☐	☐	☐	☐	☐

Generated Implied Curves							Cheapest-To-Deliver
OIS	USD_OIS	EUR_EONIA	JPY_TONAR	GBP_SONIA	CHF_TOIS	CAD_OIS	USD.CTD
LIBOR							

Value Date	8/21/2012
Trade Currency	USD
Interpoltion Method	Cubic
Interpolation Variable	ContRate
Collateral Switch Frequency	3m
Quote Side	LAST

Calculate | Update Market Data | Price Trades Blotter | Clean Workbook

Portfolio of par swaps:

ID	Instrument	Currency	Pay/Receive	Effective Date	Maturity	Rate %	Notional $
1	FixFloat Par Swap	USD	Pay 3m LIBOR	23-Aug-12	5y	0.7158%	100,000,000.00
2	FixFloat Par Swap	USD	Pay 3m LIBOR	23-Aug-12	10y	1.6509%	100,000,000.00
3	FixFloat Par Swap	USD	Pay 3m LIBOR	23-Aug-12	15y	2.1182%	100,000,000.00
4	FixFloat Par Swap	USD	Pay 3m LIBOR	23-Aug-12	20y	2.3075%	100,000,000.00
5	FixFloat Par Swap	USD	Pay 3m LIBOR	23-Aug-12	30y	2.4702%	100,000,000.00

Source: Numerix

Figure 5. Pricing Case Study 1: IR Par Swaps USD: Different Cash Collateral Assumptions + CTD.

Price par swaps with different cash collateral assumptions + CTD:

Value Date	8/21/2012
Spot Date	8/23/2012
Trade Currency	USD
Collateral	Cash - USD, EUR, GBP, JPY, CHF, CAD

ID	Pay/Receive	Maturity	Rate %	Notional $	Duration		USD Cash	EUR Cash	GBP Cash	JPY Cash	CHF Cash	CAD Cash	CTD Cash
1	Pay 3m LIBOR	5y	0.7158%	100,000,000.00	4.94	PV	$0.00	$15,053.67	$2,335.12	$28,937.38	$18,740.76	$163.41	$28,938.93
						BPS running	0.00	0.30	0.05	0.59	0.38	0.00	0.59
						BPS upfront	0.00	1.51	0.23	2.89	1.87	0.02	2.89
2	Pay 3m LIBOR	10y	1.6509%	100,000,000.00	9.45	PV	$0.00	$112,531.30	$41,544.57	$232,298.11	$141,247.97	$4,861.89	$232,318.21
						BPS running	0.00	1.19	0.44	2.46	1.49	0.05	2.46
						BPS upfront	0.00	11.25	4.15	23.23	14.12	0.49	23.23
3	Pay 3m LIBOR	15y	2.1182%	100,000,000.00	13.32	PV	$0.00	$202,955.51	$113,143.76	$403,024.50	$261,276.11	$7,195.16	$421,334.32
						BPS running	0.00	1.52	0.85	3.03	1.96	0.05	3.16
						BPS upfront	0.00	20.30	11.31	40.30	26.13	0.72	42.13
4	Pay 3m LIBOR	20y	2.3075%	100,000,000.00	16.62	PV	$0.00	$256,813.09	$172,713.48	$462,676.49	$340,779.34	$55,098.50	$540,934.37
						BPS running	0.00	1.54	1.04	2.78	2.05	0.33	3.25
						BPS upfront	0.00	25.68	17.27	46.27	34.08	5.51	54.09
5	Pay 3m LIBOR	30y	2.4702%	100,000,000.00	21.92	PV	$0.00	$318,792.63	$253,769.93	$439,974.77	$449,518.21	$174,556.25	$723,088.06
						BPS running	0.00	1.45	1.16	2.01	2.05	0.80	3.30
						BPS upfront	0.00	31.88	25.38	44.00	44.95	17.46	72.31

Source: Numerix

Key Highlights and Observations

There are several key observations worth noting in this case study. The main observation is that the difference becomes systematically larger for longer-term swaps. We also observe that a comparison of the actual results of the cheapest collateral in Figure 3 reveals that USD collateral is one of the most expensive.

Therefore, the numbers appearing in the above table in the 'CTD Cash' column are significantly different from the USD cash discounting. Taking these numbers into consideration, we can also observe that the range for running basis points (bps) is between 0-3bps, and that for upfront bps, it goes up to 72 bps (highest forward rates, lowest discount factors).

Pricing Case Study 2. Pricing IR Swaps in EUR VS. JPY

Let us next examine the two cases highlighted in Figure 6 below. In the first case, we have trades in EUR currency against counterparty A, with the CSA agreement allowing us to post collateral in USD, EUR, GBP and cash. The set of trades represents a sample set of IR swaps with various maturities and fixed rates.

The second case below assumes a set of vanilla IR swaps in JPY currency against counterparty B, with the CSA agreement allowing cash collateral in the following set of currencies: USD, EUR, and JPY.

We follow the five steps described earlier in our study to construct the CTD curve and apply different assumptions of collateral choices, including the CTD curve to discount these swaps. (Note that CTD discounting is equivalent to the assumption that the counterparty would post collateral in the most efficient way.)

Figure 6. Portfolio of IR Swaps in EUR and JPY.

Portfolio of IR Swaps in EUR:

Value Date	8/21/2012
Spot Date	8/23/2012
Trade Currency	EUR
Collateral	Cash
Collateral Currency	USD, EUR, GBP, JPY

ID	Instrument	Currency	Pay/Receive	Effective Date	Maturity	Rate %	Notional, EUR	EONIA	USD Cash	GBP Cash	CTD Cash
IR1	FixFloat IR Swap	EUR	Pay 6m EURIBOR	23-Mar-06	10y	4.0235%	80,000,000.00	10,196,382.38	10,298,681.28	10,282,101.33	10,091,189.49
IR2	FixFloat IR Swap	EUR	Pay 6m EURIBOR	14-Dec-07	15y	4.9095%	80,000,000.00	25,872,680.58	26,386,378.48	26,251,048.88	25,349,999.02
IR3	FixFloat IR Swap	EUR	Pay 6m EURIBOR	15-Jan-07	20y	4.4145%	80,000,000.00	24,835,772.26	25,407,362.85	25,212,782.01	24,253,419.96
IR4	FixFloat IR Swap	EUR	Pay 6m EURIBOR	4-May-09	30y	3.7760%	80,000,000.00	24,523,508.82	25,341,340.89	24,872,691.95	23,709,487.07
IR5	FixFloat IR Swap	EUR	Pay 6m EURIBOR	19-Nov-12	10y	1.9909%	80,000,000.00	501,271.73	442,775.51	466,722.82	563,727.18
IR6	FixFloat IR Swap	EUR	Pay 6m EURIBOR	10-May-10	15y	3.6270%	80,000,000.00	14,631,111.45	14,926,011.55	14,842,495.61	14,334,485.25
IR7	FixFloat IR Swap	EUR	Pay 6m EURIBOR	16-Jun-11	20y	3.7755%	80,000,000.00	19,028,790.74	19,537,132.69	19,318,984.88	18,523,437.12
IR8	FixFloat IR Swap	EUR	Pay 6m EURIBOR	17-Aug-12	30y	3.7755%	80,000,000.00	25,688,802.27	26,622,110.73	26,056,327.30	24,768,447.33
							Sum IR	€ 145,278,320	€ 148,961,704	€ 147,303,155	€ 141,594,192
							% of CTD	2.60%	5.20%	4.03%	

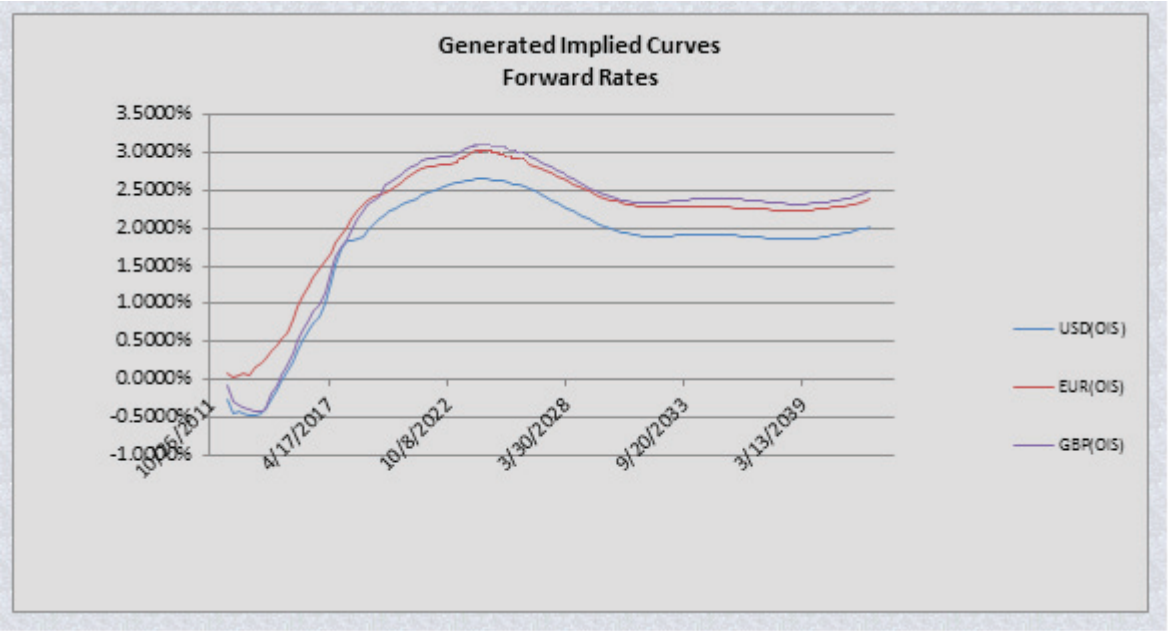
Portfolio of IR Swaps in JPY:

Value Date	8/21/2012
Spot Date	8/23/2012
Trade Currency	JPY
Collateral	Cash
Collateral Currency	USD, EUR, GBP, JPY

ID	Instrument	Currency	Pay/Receive	Effective Date	Maturity	Rate %	Notional, JPY	JPY OIS	USD Cash	EUR Cash	CTD Cash
IR9	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	10-May-06	10y	1.8700%	79,000,000.00	4,842,833.21	4,935,374.15	4,889,485.65	4,842,828.39
IR10	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	25-Jan-08	16y	2.4550%	79,000,000.00	13,087,407.75	13,653,848.96	13,370,706.29	13,087,101.05
IR11	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	26-Feb-07	20y	2.3675%	79,000,000.00	13,090,598.96	13,626,637.72	13,358,133.02	13,091,012.40
IR12	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	15-Jun-09	30y	1.9140%	79,000,000.00	4,571,812.08	4,442,066.67	4,507,189.03	4,466,787.35
IR13	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	8-Oct-12	10y	0.9260%	79,000,000.00	466,928.17	384,009.03	422,885.36	466,875.70
IR14	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	21-Jun-10	15y	2.0240%	79,000,000.00	9,164,957.92	9,499,823.87	9,331,813.36	9,164,336.83
IR15	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	28-Jul-11	20y	1.9750%	79,000,000.00	6,605,425.68	6,701,082.04	6,653,083.50	6,571,876.97
IR16	FixFloat IR Swap	JPY	Pay 6m JPY LIBOR	28-Sep-12	30y	1.7960%	79,000,000.00	1,921,258.76	1,585,313.52	1,753,330.89	1,761,929.08
							Sum IR	¥53,751,223	¥54,828,150	¥54,286,627	¥53,452,740
							% of CTD	0.56%	2.57%	1.56%	

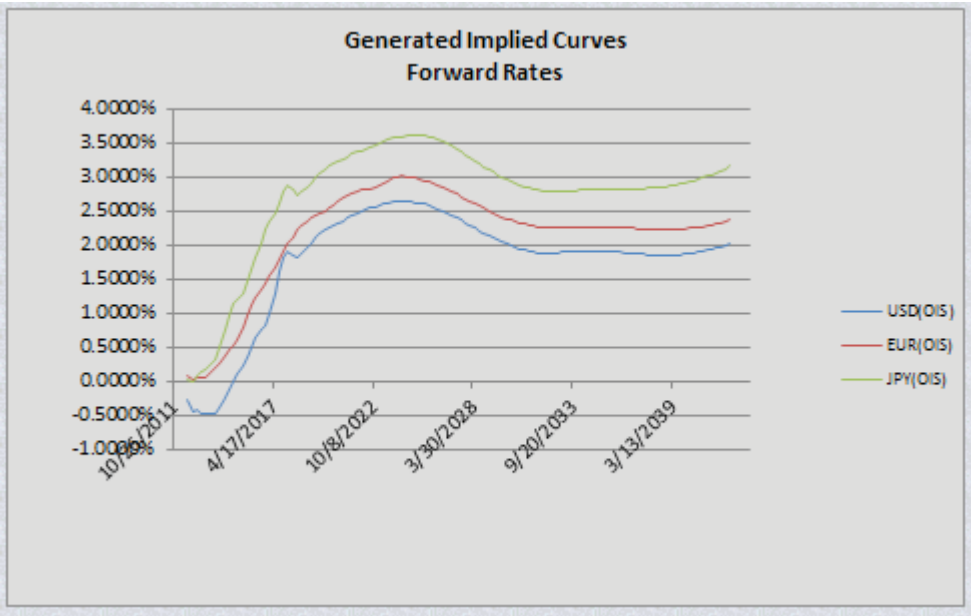
Source: Numerix

Figure 7. Corresponding Implied Curves for USD, EUR and GBP Collaterals Case 1, Forward Rates.



Source: Numerix

Figure 8. Corresponding Implied Curves for USD, EUR, JPY Cash Collaterals for Case 2, Forward Rates.



Source: Numerix

Conclusion

In conclusion, as of the 21 August 2012 date where we compare the PVs of swaps and corresponding curves of various collaterals, we observe that the cheapest collateral to post would be EUR cash for the next seven years for Case 1; and then we would switch to the GBP currency afterwards. This picture might change with some market shocks in the future. However, we can observe that the results obtained in the curve graphs are reflected in the output PVs of swaps under the different collateral choices.

Also, from the table, we can see that discounting under the CTD curve would lead us to the lowest PV. If we then chose to post collateral in USD dollars for these trades, our portfolio PV would be mispriced by more than 5% compared to the CTD curve price. In addition, we confirm the same observations with JPY currency trades against counterparty B, where the cheapest collateral to post throughout the life of the trades is Japanese Yen; and, this is what we reconfirm by looking at the numbers in the table for Case 2. Please note: this is the snapshot of market data as of 21 August 2012 for a particular sample CSA agreement. These results may vary significantly throughout the life of the trade, as well as with different CSA agreement assumptions.

Summary

With trade prices varying depending on collateral choices, a central collateral management system is increasingly important in today's world, including a CTD tool to analyse the optimal collateral choices. Cheapest is not always optimal, and practitioners should consider the rules and requirements on top to fully understand what would actually be the most optimal collateral choice.

Can A 'Perfect World' of Collateralisation Exist?

Progress is definitely achievable, but perhaps not perfection. The new standard International Swaps and Derivatives Association (ISDA) standard credit support annex (SCSA) agreements should reduce valuation disputes by eliminating the embedded optionality within the existing contracts. However, while the new standard CSA should eliminate optionality, implementation is only just starting. Market practitioners still need to handle existing CSAs that will be on the books for many years to come and will still need to have all the curves for netting.

Clearly, the standard CSA cannot eliminate cross-currency risk and other complexities. For example, there remain concerns about dollar dominance and two systems existing in parallel - for old and new cross-currency settlement risk (PVP vs. netting) - in addition to slow initial development. On the positive side, many market practitioners believe that, in time, standard CSAs will help to resolve discrepancies in counterparty valuations and with CTD modelling and optionality, and boost liquidity in the OIS market overall.

*This article follows an earlier related piece: Collateral Discounting: Rethinking the Interest Rate Pricing Framework from its Basic Concepts

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