OPTIMIZING RISK WEIGHTED ASSETS FOR OTC DERIVATIVES THROUGH CENTRAL CLEARING AND PORTFOLIO COMPRESSION

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ABSTRACT

In the context of the Basel III guidelines, we try to measure the capital charge under Basel II and Basel III guidelines for a standard OTC interest rate swap and compare it with the collateral (in the form of margins) that would have to be posted to a Central Counterparty (CCP) that can clear the trade. We find that posting collateral to CCP to mitigate counterparty risk is less costly for a bank than holding capital as per Basel guidelines. We further investigate the process of 'Portfolio Compression' which helps to reduce outstanding notional and consequently provide capital relief. We discuss the advantages and challenges of portfolio compression by studying the process carried out by Clearing Corporation of India Limited (CCIL) which is India's CCP. We highlight the usefulness of compression for reducing bilateral credit limits, default handling cost and capital relief. We thus build a case for 'clearing' OTC derivatives through a CCP.

Keywords: central counterparty; portfolio compression; risk weighted assets; Basel capital charge

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1.0 Introduction

The Basel III regulation introduced in 2010 significantly increased the capital charge that banks were required to hold against their risk weighted assets (RWA). Banks now will be required to hold 4.5% as common equity and a total of 6.0% Tier-I capital (Basel III, 2010). Since common equity usually carries a high cost of capital, any derivative trade that results in higher RWA will incur a higher capital charge and consequently have an adverse impact on the cost of doing business.

It was observed during the 2008 crisis that roughly two-thirds of the losses faced by banks were due to the increase in the counterparty credit risk or mark-to-market losses in Credit Valuation Adjustment (CVA) (Press release, BIS 2011). Hence Basel III introduced additional charges to protect against CVA losses. By Basel committee estimates, these additional charges would double the capital requirements for counterparty credit risk under Basel III.

King (2009) estimates the cost of equity of global banks to be between 7-10% depending on the country. Given that derivative trades require increased Basel capital charge, banks must manage a return higher than the cost of capital. Hence the needs to find ways to reduce the riskiness of OTC trades and consequently reduce the capital requirements.

Under the Internal Ratings based approach, banks are allowed to have their own estimates of exposure, probability of default (PD) and loss given default (LGD) (Pluto and Tasche, 2010). The Basel II and III charges invariably depend on these parameters. The PD and LGD are static for any given trade; hence reducing the capital charges requires reduction in the exposure profile.

Posting collateral against a trade reduces the exposure on the trade (Gibson, 2005), hence providing capital relief. In the post-2008 regulatory environment, OTC derivative trades are required to be centrally cleared (Dodd-Frank Act, 2010). Hence it would be interesting and valuable to evaluate if banks are better off posting collateral and reducing exposure or hold the Basel Capital. This paper endeavours to evaluate these two alternatives..

‘Close out’ netting agreements allow banks to reduce outstanding exposure by netting trades (Mengle, 2010). However this applies only to bilateral trades. In a more sophisticated banking system (Cecchetti et al., 2009), multilateral netting is possible only in the presence of a Central Counterparty (CCP) that has a view of all the trades. A CCP can then undertake a portfolio compression cycle that effectively reduces the exposure of individual clients without altering their risk profiles (ISDA Study, 2012). The compression procedure has reduced notional principal by 38% at end of 2007 (Boughey, 2009).

Compression is a promising alternative to reduce outstanding exposure (hence providing capital relief) and at the same time ensuring systemic stability. Hence, using the experience of Clearing Corporation of India Limited (CCIL), the Indian CCP, this study examines the prospects and problems of implementing portfolio compression as an effective alternative to provide capital relief without in any way reducing the systemic risk in the financial system of the country.

2.0 Data & Methodology

To understand the trade-off between posting margin and holding Basel capital charge, we attempt to compute the margin requirement and the Basel capital charge. This study adopts the internal ratings based (IRB) model as it is a more sophisticated and comprehensive model than the standardized approach and provides more accurate estimates (Basel Committee, 2004). Banks can use their own estimates of PD and LGD and exposure at default (EAD). For the purposes of our analysis we consider a standard USD One Million 10Y OTC interest rate swap of AT&T Inc., USA. The US market was chosen due to the availability of liquid CDS prices. AT&T is part of the CDX.IG index. A similar analysis can be done for any corporate entity. The following set of data has been sourced from Bloomberg.

- USD Libor Zero rates for the last 250 days
- US historical swap rates
- AT&T Credit curve i.e. CDS price at various maturity
- Credit Spread of AT&T for one year period between 1 Jul 2008 to 1 Jul 2009

All data used for analysis has been sourced from Bloomberg. The analysis of the capital charges has been carried out using Matlab and can be split into the following components:

2.1 Exposure Calculation Methodology

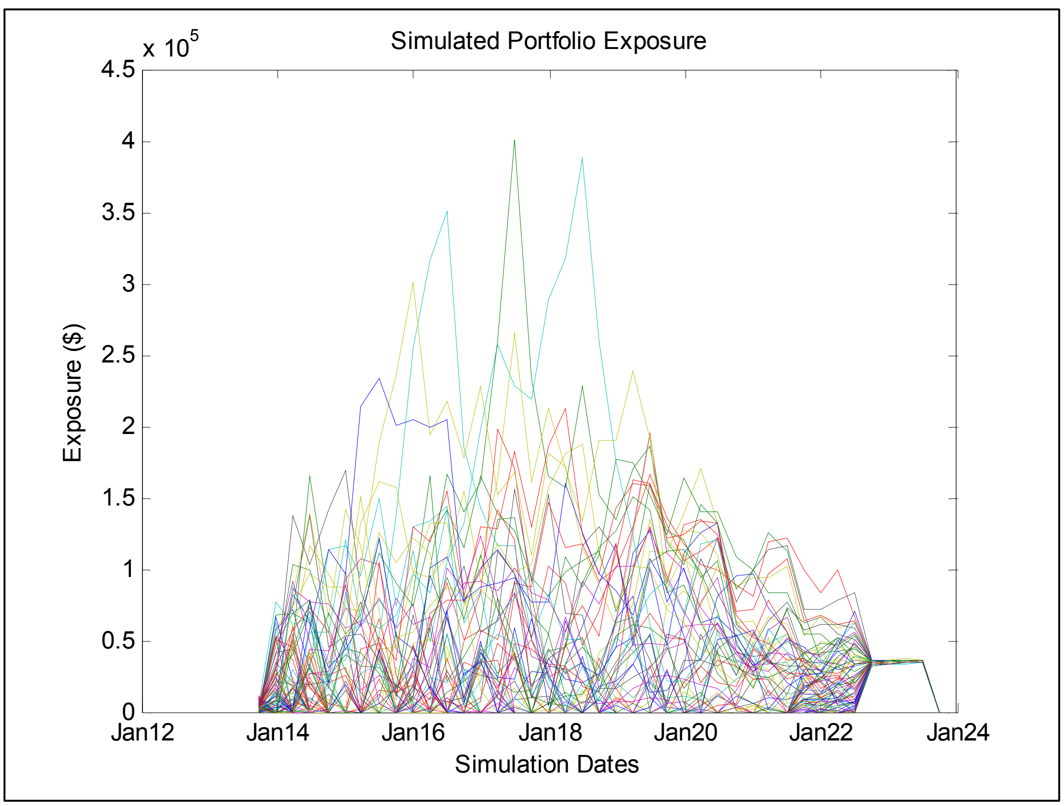
Calculation of Basel charges requires the calculation of EAD. For the purposes of our analysis we calculate EAD at discrete points (quarterly). This is consistent, as Basel Charges are reported in quarterly statements. We employ the Hull-White single factor model (Hull and White, 2001) to project future interest rate paths. The interest rate paths are simulated using standard Monte Carlo simulation. We have taken 100 simulations at each simulation date (40 dates = 10 years X 4 quarters each).

We first calculate the simulated mark-to-market (MtM) values of the swap based on the simulation. This is shown in Figure 1. The MtM value moves to zero at maturity, since the present value of remaining cash flow reduces as we approach maturity. While calculating the charges, our concern/interest is only the positive exposure i.e. the amount owed by the counterparty. We do not consider the negative part of the exposure (Lee, 2010).

$$Exposure = Max(MtM, 0)$$

Figure 1 shows the simulated values of positive exposure. Each line represents a simulated exposure. 100 such exposures have been plotted.

Figure 1: Positive exposure for 100 simulated Interest Rate Paths.



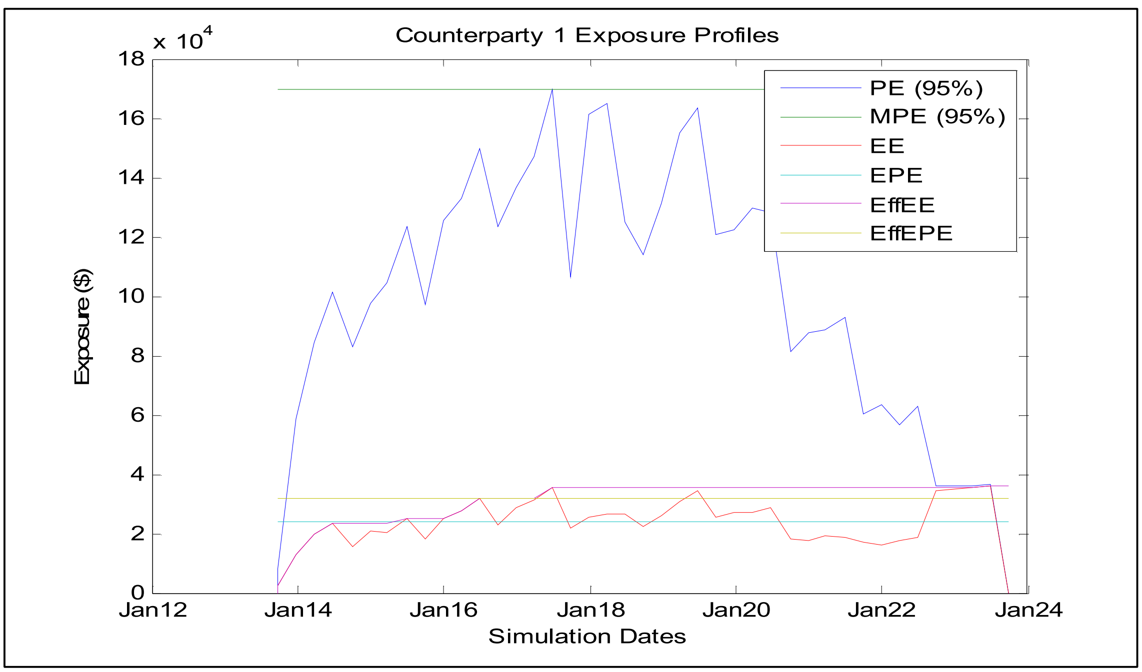
Each line represents a possible exposure for the swap at each time point. This forms a simulated distribution of exposures.

We thus have a distribution of exposure profiles. We can infer various measures of exposure from this distribution (Gregory J, 2010).

- Peak Exposure (PE): A high percentile (99%) of the distribution of exposures at any particular future date.
- Maximum Peak Exposure (MPE): Maximum peak exposure for the dates being considered.
- Expected exposure (EE): The mean of the distribution of exposures at each date.
- Expected positive exposure (EPE): Weighted average over time of the expected exposure floored at zero, i.e. the positive exposure.
- Effective Expected Exposure(EffEE): Average of expected exposure over the time horizon
- Effective Positive Expected Exposure(EffEPE): Average of the expected positive exposure over the time horizon

Figure 2 shows various exposure measures defined above.

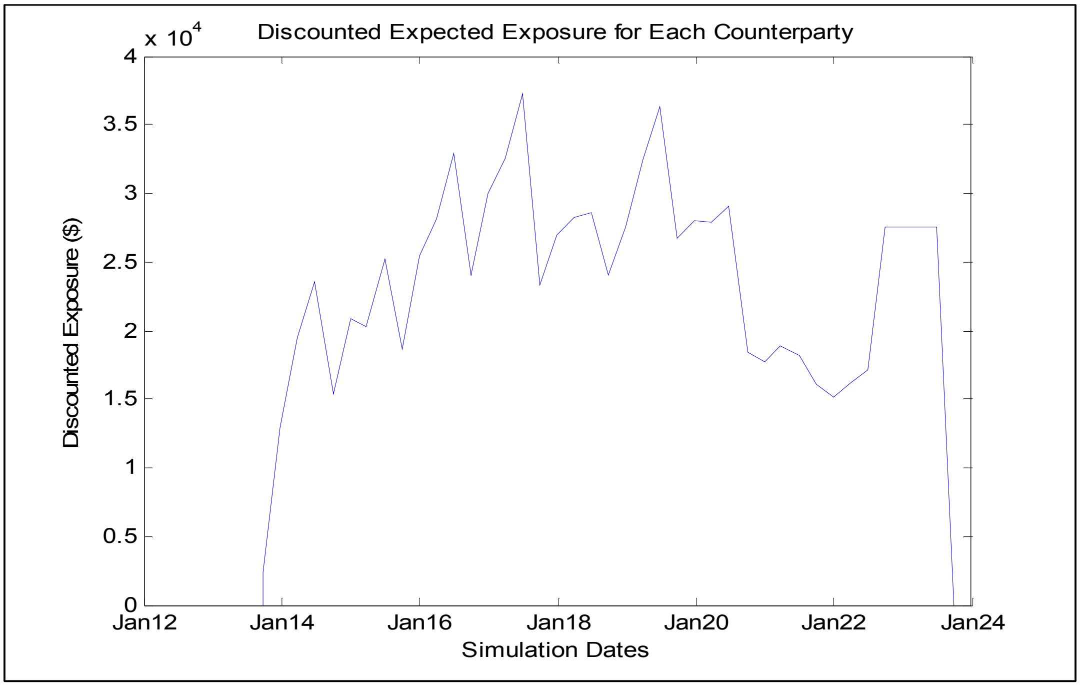
Figure 2: A Plot of the Different Measures of the Exposure Distribution (of Figure 1)



We now calculate the discounted expected exposure. The discount factors at each simulation date is calculated from the simulated interest rate path and multiplied with the expected exposure. The discounted EPE for each quarter is calculated. The discounted EPE is shown below in Figure 3

$disEPE_t$ = Discount $Factor_t$ x EPE_t

Figure 3: Discounted Expected Exposure Profile. A plot of the expected exposure at each time point discounted to present value



2.2 Bootstrapping Credit Curve

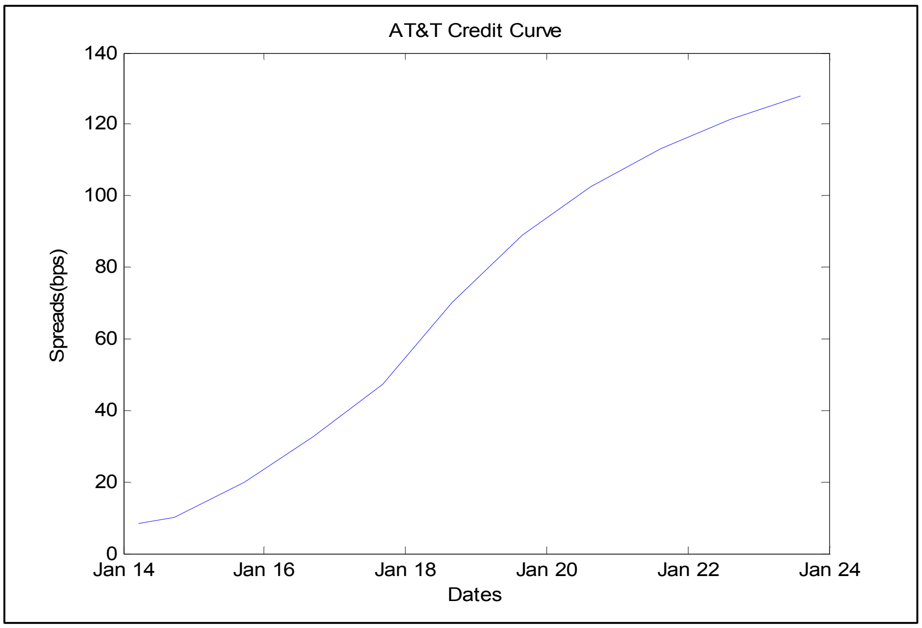
In order to calculate the Basel Charge we need to calculate one year probability of default and the survival rate for each quarter.

We employ a bootstrapping method to infer the cumulative probability of default from the market Credit Default Swap (CDS) prices of the counterparty (Hull and White, 1998). Table 1 and Figure 4 show the credit curve for AT&T. The default probability curve derived from the CDS curve is shown in Figure 5

Table 1: CDS Spreads for Different Maturities

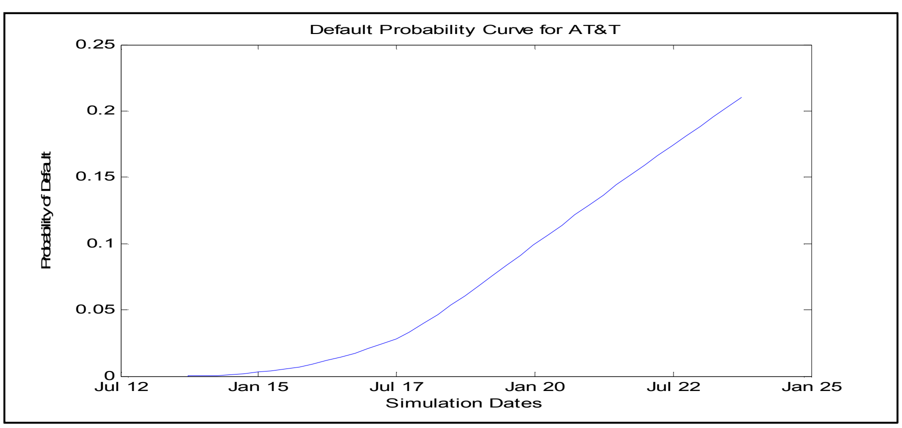
Date	Spread(bps)	Date	Spread(bps)
25-03-2014	8.23	**31-08-2018**	70.165
21-09-2014	10	**26-08-2019**	88.995
16-09-2015	19.675	**20-08-2020**	102.415
10-09-2016	32.58	**15-08-2021**	113.195
05-09-2017	47.16	**10-08-2022**	121.515
		05-08-2023	128.065

Figure 4: CDS curve of AT&T Inc.



The CDS curve derived from market rates of 1Y,2Y….CDS of AT&T Inc

Figure 5: Default Probability Curve derived from the CDS Curve (of Figure 4)



Using the curve we can derive the probability of survival for any quarter under consideration. For e.g. the probability of default in quarter 3 from valuation date would be the difference of the cumulative probability of default of quarter 2 and 3.

PD (Quarter 3) = PD (t<Quarter 3) – PD (t<Quarter 2)
Survival Probability PS (Quarter 3) = 1 - PD(Quarter 3)

Similarly we can calculate the survival probability in each quarter under consideration

2.3 Basel II Capital Charge

The IRB approach has been used to calculate the Basel II capital charge. The IRB formula uses the single factor Vasicek formula (Thomas and Wang, 2005). A key feature of the formula is that it is portfolio invariant i.e. the risk depends only on the loan and not on the portfolio it is added to.

The one year probability of default (PD) is inferred from the default probability curve from Figure 5 above. The loss given default (LGD) is assumed to be 40%, in line with prevailing market practice. The exposure is derived from the exposure calculation methodology discussed in section 2.1 above.

The regulatory formulae for Basel Capital charge is taken from "An Explanatory Note on the Basel II IRB Risk Weight Function" (2004).

Basel II charge = Base Capital K' x Maturity Adjustment x EPE.

Where Base capital K' =
[LGD * N [(1 - R) ^-0.5 * G (PD) + (R / (1 - R)) ^0.5 * G (0.999)] - PD * LGD]
Where R = correlation coefficient
N = cumulative normal function
G = inverse probability function
Maturity Adjustment = (1-(1.5*b(PD))^(-1) x (1+(M-2.5)*b(PD))
where b(PD) = (0.11852-0.05478*log(PD))^2

A full maturity adjustment is employed with cash flow maturity capped at five years (Douglas and Pugachevsky, 2012).

Appendix - 1 shows the results from the calculation for Basel II capital charge. The Basel II capital charge based on the above calculation is **USD 62,593**

2.4 Basel III Capital Charge

The Basel III capital charge is calculated using the regulatory CS01 formula (Basel III Global Regulatory framework, 2010). Basel III requires calculating the 10 day 99% VAR of CVA for the current one-year period and another for a one-year stressed period (Douglas and Pugachevsky, 2012). The stressed period used in this study is 1st July 2008 to 1st July 2009.

The CSO1 formula requires the spread at discrete times. We use the CDS spreads from Table 1 above to find intermediate spreads using linear interpolation (Figure 6).

CSO1 = 0.0001 x $\sum\left(ti\exp\left(-\frac{Siti}{LGD}\right) - (ti')\exp(-Si'ti')(EEi\,Di - EEi'\,Di')\right)$ ….i'= i-1

S_i = Spread at interval i

EE_i = Expected Exposure at i

D_i = Discount factor

To calculate the spread sensitivity we take the CDS spread data for the last one year and the stressed period of 2008. The standard deviation of the daily spread change is calculated.

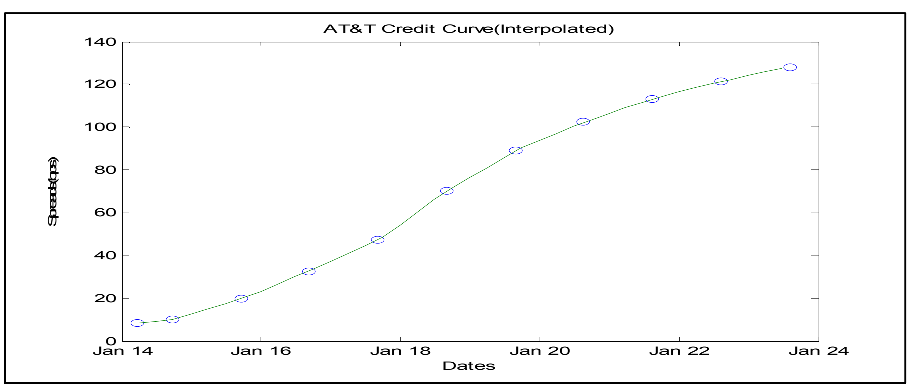
Spread Volatility = Standard Deviation of daily spread change.

Basel III RWA = 3 * CSO1 * (normal spread + stressed period spread)

Capital Charge = 8% * RWA.

Appendix - 2 shows the results from the calculation for Basel III capital charge. The Basel III capital charge based on the above calculation is USD **28,376**

Figure 6: Plot of CDS spreads of AT&T interpolated for 40 quarters



2.5 Calculating Initial Margin

When clearing trades, a CCP will take initial margin upfront from both the parties involved in the trade, to protect against the maximum loss that the portfolio can incur during the holding period. For e.g. in case a party defaults the CCP would have to close out the trade, hence it must cover any losses that occur in the time it takes to close-out the position. (CCIL has a holding period of 3 days).

Historical simulation has been employed for calculating initial margin. The zero rates for the last 250 days have been considered (USD Libor). At each standard tenor the return series is calculated. For e.g. the change in the 1Y rate is obtained for the last 250 days. We calculate the volatilities using the GARCH approach. We use a decay factor $\lambda = 0.94$ (JP Morgan, 1996). The probability distribution of a market variable, when scaled by an estimate of its volatility, is often found to be approximately stationary. This suggests that historical simulation can be improved by taking account of the volatility changes experienced during the period covered by the historical data (Hull and White, 1998).

$\sigma_{i+1}^2 = \lambda\sigma_i^2 + (1-\lambda)h_i^2$
Adj. Factor $h_i^* = \sigma_N/\sigma_i * h_i$
Where h = daily return of interest rate
N = valuation date
i = 1 to 250 historical dates
σ = volatility
λ = decay factor (=0.94)

The adjustment factors are calculated as the ratio of current volatility to historical date volatility. The zero rate returns are then scaled using the adjustment factor. This generates a set of 250 returns which are applied on the current zero rates. Thus we get 250 historical scenarios. We do this for 2Y, 3Y and so on.

With a new set of simulated zero curves, the swap is valued again. The fifth percentile value is taken as the 1% VAR. For the above data set this comes out to be USD 34,882. Considering a 3 day holding period (used by CCIL) the upfront initial margin would be USD 60,417 (34,882 x $\sqrt{3}$).

Apart from the initial margin a CCP charges an MtM margin and volatility margin. However these keep fluctuating on a daily basis. The initial margin remains with the CCP as a 'deposit'.

3.0 Analysis

This study has analyzed a standard fixed-float 10Y interest rate swap of USD One Million notional. The swap has been priced at zero valuation with an effective date of 26th September 2013.

We see from our analysis that the Basel II capital charge is USD 62,593 and the Basel III charge is USD 28,376. Hence the total Basel capital (Basel II + Basel III) that must be kept aside is USD 90,969. On the other hand the initial margin required is only USD 60,417. Hence we see that initial margin requirement is lower than the Basel charge. Additionally Basel capital must be in the form of equity and tier-2 capital. Equity capital is expensive and a bank must continuously consider how best to utilize the limited equity capital it has. Initial margin on the other hand can be posted in the form of cash and government securities. Hence assets of the bank (that are not part of its active trading book) can be posted as initial margin and in turn provide capital relief. In fact in some cases marketable securities other than cash or treasury lying on the balance sheet can be used as collateral, e.g. sovereign BB+ bonds may be accepted as collateral with a 15% haircut (Basel III, 2010).

The opportunity cost of posting securities is the market repo rate associated with them, which is significantly lower than the cost of equity capital. Hence not only are the initial margin requirements lower but are also cheaper than Basel capital.

From our exposure calculation we see that the maximum discounted MtM at any time is USD 37,272. Hence if the bank were to maintain this level of collateral on a daily basis it can potentially offset its exposure.

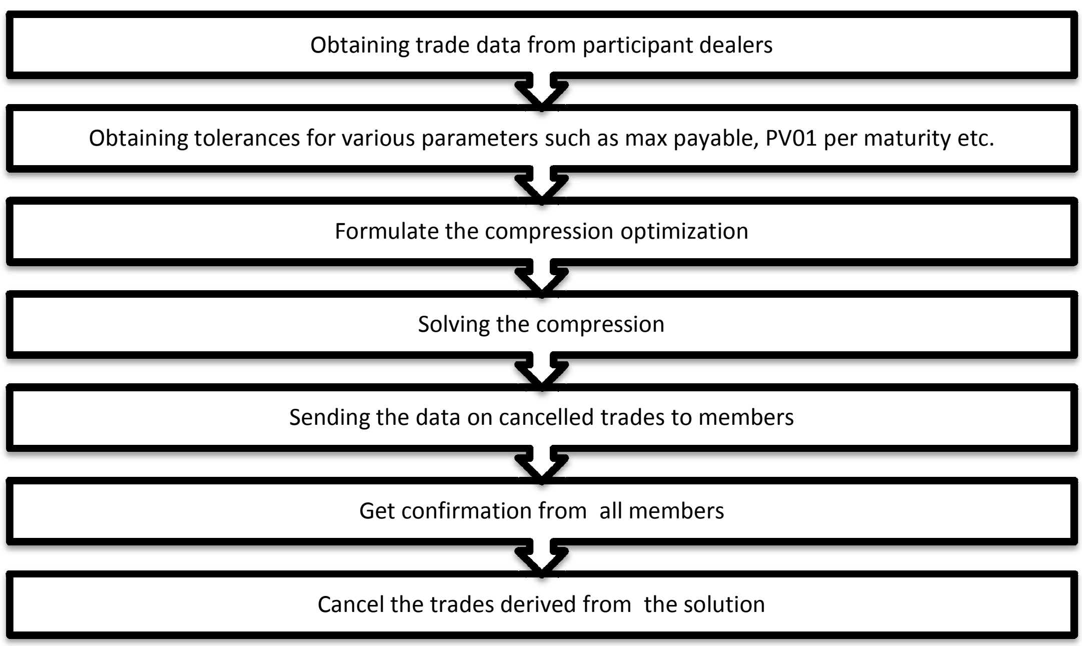
4.0 Compression Methodology

The arguments presented in the preceding section clearly point to the advantage of maintaining initial margin with CCP. The same CCP could undertake 'Portfolio Compression' to further reduce the outstanding 'notional' in an OTC market and thereby provide further significant capital relief.

A vast majority of derivative trades are two-way market making trades. Banks make money from the bid-offer spread on the instrument. Once the bank has taken a position and sold an equivalent position, it has made a profit and has no further need to hold on to both the positions. Holding both the positions only costs them money. Portfolio compression is a process of multi-lateral netting (ISDA Study, 2012). IRS positions across multiple dealers are taken and 'torn apart' so as to remove the trades without drastically reducing the risk profile. Appendix 3 provides a brief description of the compression process. ISDA estimates that the volume of global notional IRS trades would have been 30% higher if not for portfolio compression.

Compression was first introduced by TriOptima in 2003. Since then it has carried out compression across multiple CCP's. However, in India, due to concerns of trade data integrity, CCIL has developed its own propriety system for portfolio compression.

The process of compression broadly follows the steps below:



We have looked at the compression process carried out by CCIL to further explore the extent to which it reduces outstanding notional and consequently provide capital relief.

Based on our discussions with the team from CCIL, we gathered information about the process, the challenges and benefits of compression. CCIL has carried out five cycles of IRS compression, the results are summarized below.

Table 2: Summary of Compression results carried out by CCIL

Cycles	No. of Participants	Total Trades	Trades Compressed	Compression Ratio	Reduction in Notional principal (USD Million)
Sep-2013	24	9246	7855	84.96%	59,455.74
Mar-2013	20	4231	3608	85.28%	38,111.06
Sep-2012	22	11507	9744	84.68%	95,989.62
Mar-2012	21	19698	17790	90.31%	1,44,418.72
Jul-2011	14	14447	13624	94.30%	1,17,930.00

As can be seen from table above portfolio compression has given significant reduction in notional outstanding, the percentage of trades compressed has always been above 80%.

In the following sub-section we provide a qualitative assessment of the reasons why compression is relevant in the contemporary global market scenario.

4.1 Information Asymmetry

Bilateral netting works well when both the dealers have off-setting positions with each other and they agree to remove the trades from their book. This is often the practice and works quite well. However consider the scenario of three swap dealers A, B and C. A has a pay-fixed position with B and receive fixed with C. B has a pay-fixed position with C. Now these 3 trades can be torn up and removed from the system of A, B, C dealers. But dealer A does not know of the trade between B and C and vice versa. Due to this lack of information they would not approach each other to terminate the trades. Since most dealers keep trade data confidential there is little scope for the three dealers to know about each other's trades. The CCP on the other hand has a view of all the trades between the dealers and hence is well placed to compress the trades.

4.2 Bilateral Counterparty Limits

Most banks have notional limits for each counterparty that they trade with. Hence once a bank has exhausted this limit it can take no further positions with that counterparty. Post compression the notional outstanding with a counterparty reduces since redundant trades are cancelled. This frees up limits for the bank and enables it to carry out further trades with the counterparty, without in any way adversely impacting the 'counterparty risk'.

4.3 Bringing down gross Contingent Liability

Contingent liability that banks report on their balance sheet is in notional terms. For instance, as of financial year-ending March 2013, ICICI Bank Ltd in India reported a contingent liability of INR 8,023,830 Million (USD 129,417 Million) compared to total assets of INR 5,367,940 Million (USD 86,580 Million). Normally contingent liability is reported in its raw form in the media (and often the subject of scrutiny and adverse comments) although the real risk in derivative transactions such as swaps, which make up a significant component of contingent liability, is only the MtM value. Compression reduces the notional outstanding on trades and consequently the reported contingent liability.

4.4 CCP default handling cost

If a counterparty defaults then the CCP has to close out all its trade in the market. The more the number of trades the higher the burden on the CCP, as liquidating huge positions in the market has the potential to move the market adversely, especially if the other market participants get wind of the default.

Hence compression helps the CCP in reducing this burden. Liquidating positions post compression will be less cumbersome for a CCP. A similar argument for close-out netting is presented in Mengle, 2010.

4.5 Capital Relief

This is perhaps the most important advantage of portfolio compression. Consider three dealers A, B, C as above. A has potentially offsetting trades but with different counterparties. Hence he has to maintain the Basel Capital for the long and the short positions. Post compression however the trades are cancelled. Hence the outstanding exposure decreases and consequently the Basel capital required also reduces, thereby freeing up expensive capital for the bank. Portfolio compression can go a long way in providing relief from higher Basel requirements, particularly under Basel III.

Portfolio compression has many advantages as seen above, but implementing it has its own set of challenges. We enumerate some of these challenges in the following sub-sections.

4.6 Payables post compression

Post Compression the MtM value of the trades that were torn apart has to be settled. Many a time this net payable amount might be large and participants may be reluctant to pay this large amount. In fact many a time the maximum payable is one of the constraints while optimizing the trades to be compressed.

4.7 Trade Repository

The more the number of offsetting positions the more is the benefit of compression. Hence the CCP must have information on all trades eligible for compression. In the case of CCIL, it maintains a trade repository of all OTC trades. Hence looking up the trades becomes easier for compression. Market participants have to merely indicate the trades that they wish to submit for compression. If the trade repository is maintained independent of CCP, then participants have to provide the relevant trade information.

4.8 Tolerance per maturity

Portfolio compression is essentially an optimization problem. The main advantage of compression is that it can compress trades without significantly altering the risk profiles. However trades selected may not be perfectly 'off-settable'. For instance, a pay fixed 10Y swap and receive fixed 10Y swap that started 10 days ago cannot be offset perfectly. Hence the need for participant-specific risk limits that they can tolerate post compression. The risk tolerance is specified in terms of the PV01 for each tenor. These now become additional constraints for compression. The tighter the constraints the lesser will be the compression efficiency.

4.9 Security of trade information

Trade information is highly confidential to dealers. If compression is carried out by the CCP then the security threat is minimal as the cleared trades are already available to the CCP; however, security concerns could exist if compression is done by a third party vendor. Perhaps for this reason, CCIL preferred to develop the compression algorithms and related technology in-house rather than use a third party service.

5.0 Conclusion and Recommendation

We observe from the analysis that banks can benefit by voluntarily posting collateral. Hence clearing bilateral OTC trades with a recognized CCP will offer the advantage of capital relief. Further a CCP can perform compression services which will further reduce notional outstanding and provide capital relief.

This study has considered a standard swap for analysis. We see from the analysis that the Basel capital charges that needs to be held for a 10Y USD1Million swap is of the order of USD 90,000. The initial margin on the other hand that would have to be maintained with the CCP is of the order USD 60,000. Hence compensating for the counterparty risk by posting initial margin is more optimal than holding Basel Charges. Equity capital is scarce for most banks. On the other hand, Collateral can be posted in cash or Government securities, which well managed banks hold in their inventory.

As the counterparty becomes more risky the Basel charges become more punitive. Hence it becomes more difficult for banks to do business with such counterparties. 'Collateralized clearing' can become a safe but less expensive alternative for trading with such counterparties.

The advantages of collateralized clearing can be taken a step ahead in the form of portfolio compression. Advantages in the form of reducing outstanding notional, counterparty risk limits and default handling cost can be realized. Hence for un-cleared swaps, portfolio compression provides a mechanism to reduce capital charges, without adversely impacting the underlying risk profile.

Some complex OTC products are not 'clearable' and hence arriving at future exposure in such cases could be difficult. However the analysis can be extended to standard products like FX forwards, CDS etc.. Many banks might take the benefit of posting initial margin by entering into a two-way CSA (Credit Support Annexure) agreement. In such an agreement both parties post margin to each other based on the mark to market of the trade. This also has the potential to reduce the counterparty risk without involving a CCP. However with the regulatory environment moving to mandatory central clearing, the above arguments provide a good incentive for central clearing through a CCP.

Appendix 1

Calculation of Capital Charge as per Basel II

Probability of Default	PD	0.17%
Loss Given Default	LGD	40%
Correlation coefficient	R	0.3502
Maturity Adjustment	b	0.2189
Capital Requirement	K'	0.0338
Basel 2 Charge	USD	62,594

Quarter	Dates	EPE	Time to maturity	Maturity Adjustment	BaselII Charge(USD)
0	27-Sep-13	2410.575	0		
0.25	27-Dec-13	12891.35	0.25	0.76	329.37
0.25	27-Mar-14	19520.33	0.50	0.84	552.45
0.25	27-Jun-14	23537.13	0.76	0.92	732.34
0.25	27-Sep-14	15436.54	1.01	1.00	523.72
0.25	27-Dec-14	20830.8	1.27	1.09	764.68
0.25	27-Mar-15	20300.26	1.52	1.17	801.07
0.25	27-Jun-15	25262.11	1.77	1.25	1067.93
0.25	27-Sep-15	18661.28	2.03	1.33	841.38
0.25	27-Dec-15	25406.75	2.28	1.42	1216.20
0.25	27-Mar-16	28160.15	2.53	1.50	1426.35
0.25	27-Jun-16	32925.6	2.79	1.58	1760.34
0.25	27-Sep-16	23981.41	3.04	1.67	1349.60
0.25	27-Dec-16	30052.85	3.30	1.75	1774.90
0.25	27-Mar-17	32519.76	3.55	1.83	2010.08
0.25	27-Jun-17	37272.81	3.80	1.91	2408.72
0.25	27-Sep-17	23341.02	4.06	2.00	1574.04
0.25	27-Dec-17	26987.55	4.31	2.08	1895.04
0.25	27-Mar-18	28287.66	4.56	2.16	2064.17
0.25	27-Jun-18	28619.5	4.82	2.24	2168.89
0.25	27-Sep-18	24039.46	5.00	2.30	1870.31

0.25	27-Dec-18	27582.83	5.00	2.30	2145.99
0.25	27-Mar-19	32490.01	5.00	2.30	2527.78
0.25	27-Jun-19	36336.16	5.00	2.30	2827.01
0.25	27-Sep-19	26714.2	5.00	2.30	2078.41
0.25	27-Dec-19	27954.6	5.00	2.30	2174.91
0.25	27-Mar-20	27863.41	5.00	2.30	2167.82
0.25	27-Jun-20	29112.2	5.00	2.30	2264.98
0.25	27-Sep-20	18384.67	5.00	2.30	1430.36
0.25	27-Dec-20	17727.79	5.00	2.30	1379.25
0.25	27-Mar-21	18865.44	5.00	2.30	1467.76
0.25	27-Jun-21	18157.81	5.00	2.30	1412.71
0.25	27-Sep-21	16104.14	5.00	2.30	1252.93
0.25	27-Dec-21	15139.28	5.00	2.30	1177.86
0.25	27-Mar-22	16197.43	5.00	2.30	1260.19
0.25	27-Jun-22	17176.79	5.00	2.30	1336.38
0.25	27-Sep-22	27486.94	5.00	2.30	2138.53
0.25	27-Dec-22	27491.99	5.00	2.30	2138.92
0.25	27-Mar-23	27506.4	5.00	2.30	2140.04
0.25	27-Jun-23	27511.28	5.00	2.30	2140.42
0.25	27-Sep-23	0	5.00	2.30	0.00

TOTAL = USD 62,594

Appendix 2

Calculation of Capital Charge as per Basel III

Regulatory CSO1(USD)	17.4137
Model Multiplier	3
Asel IIINormal Spread	1.6910
Stressed Spread	5.0988
Basel III Charge	USD 28,376

Quarters	Dates	Interpolation	EPE	CSO1

		Spreads		
0	27-Sep-13	0.07%	2410.57	
0.25	27-Dec-13	0.08%	12891.35	0.19
0.5	27-Mar-14	0.08%	19520.33	0.40
0.75	27-Jun-14	0.09%	23537.13	0.54
1	27-Sep-14	0.10%	15436.54	0.48
1.25	27-Dec-14	0.13%	20830.80	0.45
1.5	27-Mar-15	0.15%	20300.26	0.51
1.75	27-Jun-15	0.17%	25262.11	0.56
2	27-Sep-15	0.20%	18661.28	0.53
2.25	27-Dec-15	0.23%	25406.75	0.53
2.5	27-Mar-16	0.27%	28160.15	0.64
2.75	27-Jun-16	0.30%	32925.60	0.72
3	27-Sep-16	0.33%	23981.41	0.66
3.25	27-Dec-16	0.37%	30052.85	0.62
3.5	27-Mar-17	0.41%	32519.76	0.70
3.75	27-Jun-17	0.44%	37272.81	0.77
4	27-Sep-17	0.49%	23341.02	0.65
4.25	27-Dec-17	0.54%	26987.55	0.51
4.5	27-Mar-18	0.60%	28287.66	0.54
4.75	27-Jun-18	0.66%	28619.50	0.53
5	27-Sep-18	0.72%	24039.46	0.47
5.25	27-Dec-18	0.76%	27582.83	0.46
5.5	27-Mar-19	0.81%	32490.01	0.51
5.75	27-Jun-19	0.86%	36336.16	0.56
6	27-Sep-19	0.90%	26714.20	0.50
6.25	27-Dec-19	0.94%	27954.60	0.43
6.5	27-Mar-20	0.97%	27863.41	0.43
6.75	27-Jun-20	1.00%	29112.20	0.41
7	27-Sep-20	1.04%	18384.67	0.34
7.25	27-Dec-20	1.06%	17727.79	0.25
7.5	27-Mar-21	1.09%	18865.44	0.25

7.75	27-Jun-21	1.12%	18157.81	0.24
8	27-Sep-21	1.14%	16104.14	0.21
8.25	27-Dec-21	1.16%	15139.28	0.19
8.5	27-Mar-22	1.18%	16197.43	0.19
8.75	27-Jun-22	1.20%	17176.79	0.19
9	27-Sep-22	1.22%	27486.94	0.25
9.25	27-Dec-22	1.24%	27491.99	0.30
9.5	27-Mar-23	1.26%	27506.40	0.29
9.75	27-Jun-23	1.27%	27511.28	0.27
10	27-Sep-23	1.28%	0.00	0.16

Appendix 3

Illustration of IRS Compression(ISDA Study, Feb 2012)

IRS portfolio compression is built on a simple idea. As dealer firms continue to trade swaps with each other, trades can begin to be removed without impacting the interest rate risk profile of the swap portfolio

The benefits of compression between two dealers are obvious. To achieve meaningful reductions in notional outstanding, however, bilateral compression is a cumbersome exercise. If applied across the dealer community, meaningful results for the industry would involve literally hundreds of compression exercises per currency. Multi-lateral compression, on the other hand, can produce tremendous results in a very efficient manner provided there is widespread acceptance by market participants.

Consider, for example, a closed world where there are only four dealers: A, B, C and D. Consider as well their interdealer swaps in five year maturity bucket as shown in the table below.

As can be seen, the total Net Amounts of R's are 100 and the total Net Amounts of P's are 100. This is a closed system. All the swaps among the four have to net to zero. In a bilateral compression world, the dealers will not be able to compress any trades because in this simple world they only have one swap with each other dealer.

In a multi-lateral compression world, all the work can be done at once. Dealer A needs to receive fixed for 25 and Dealer B needs to receive fixed for 75. C and D need to pay fixed for 50 each. The compression will result in A receiving 25 from C and B receiving 25 from C and 50 from D. We started with 400 of notional and are down to 100.

Dealer	Dealer	P(ay)/R(eceive)	Amount
A	B	P	100
A	C	R	50
A	D	R	75
Net: A		**R**	**25**

B	A	R	100
B	C	R	50
B	D	P	75
Net: B		**R**	**75**

C	A	P	50
C	B	P	50
C	D	R	50
Net: C		**P**	**50**

D	A	P	75
D	B	R	75
D	C	P	50
Net: D		**P**	**50**
		Net of all swaps	**0**

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