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Optimal Funding Term of Posted Collateral

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This paper investigates what factors determine the optimal funding term of posted collateral. We show that it is different for the initial margin and variation margin. The funding term for the initial margin is determined by the liquidity and maturity of the derivative. For the variation margin, the funding term should be determined by the liquidity of the other assets on the balance sheet and the existing funding for these assets.

Introduction

Posting collateral is an excellent way to reduce credit risk in a derivatives transaction. However, it exposes the parties in a transaction to liquidity risk. Large movements in the mark-to-market (MtM) of transactions can lead to large liquidity outflows. Since MtM movements of derivatives are unpredictable and can be erratic, this poses a significant challenge to liquidity risk management.

In this paper, we consider over-the-counter (OTC) derivatives transactions that are out-of-the-money for which the bank has posted cash collateral. The collateral covers the variation margin and initial margin as prescribed by the BIS-paper on margin requirements for non-centrally cleared derivatives [1]. The question we address is: what is the proper funding term for this collateral.

Since cash collateral earns the overnight (ON) rate, one might argue that it should be funded on an ON-basis. However for a 30-year swap that is far out-of-the-money the collateral will very likely be needed to be posted for years. Therefore even though the rate earned is ON, this is not the correct funding term.
Should the collateral then be term funded, so that the bank is ensured to have funding for the posted collateral? This seems quite conservative for a 30-year swap. Indeed, we will show in this paper that this is not necessarily correct either.

However, here the truth does not lie somewhere in the middle, but rather somewhere else. We argue that the optimal funding term for collateral posted for variation margin is not determined by the term of the transaction, but rather by the liquidity of the other assets on the balance sheet. Only the optimal funding term for the initial margin is determined by the derivatives term and liquidity.

Funding term for posted collateral required by the variation margin

Variation margin can have various features: minimal transfer amounts, thresholds, collateral choice options, etc. Here we assume the simplest case of cash collateral and daily margining without any complicating features. In particular we assume that the variation margin equals the MtM of the derivative transaction at any time. Furthermore, this section considers only variation margin and assumes the absence of initial margin. We postpone the discussion of initial margin to a later section.

Consider the following stylized balance sheet:

A=100	L=80
	E=20

At this point, this bank enters into a swap with a counterparty. The swap turns out to be a bad investment, and the MtM of the swap decreases from 0 to -10. Therefore, the equity has reduced from 20 to 10. Also, the bank has posted 10 units of cash collateral and has issued extra debt to fund this collateral.

The resulting balance sheet is:

A=100	L=80
	E=10
Posted collateral=10	Swap=10
	Debt=10

The question is what is the right funding term for this extra debt issued to fund the collateral? Well, as may be seen from the balance sheet an alternative (and better) interpretation is that the debt does not fund the collateral but replaces the funding previously provided by equity.

The swap, which has turned into a liability, funds the collateral. The term of the swap and the posted collateral match exactly (under the assumptions mentioned above). In particular, when the swap matures the posted collateral also disappears from the balance sheet. Although the issued debt provided the cash that was needed for the collateral, it replaces the funding provided by equity to the other assets. Therefore, its optimal term is determined by the other assets on the balance sheet. For example if all the assets are ON deposits then the issued debt should be ON as well, if these are long-dated illiquid loans, the issued debt should optimally fund these.

It may be useful to consider what happens with above balance sheet if subsequently the MtM of the swap rises from -10 back to 0. Compared to the initial balance sheet there is an additional 10 cash on the asset side and the liability side an additional 10 debt.

A=100	L=80
	E=20
Posted collateral=0	Swap=0
Cash=10	Debt=10

The term of the debt is determined by the assets and will, therefore, be longer than the term of cash (ON). The cash can be returned to the equity-holder (if capital requirements permit this), re-invested, or held as a liquid asset buffer. The debt funds 10 units of the assets and replaces the funding provided by equity before.
In general, the debt issued to post VM collateral should have a term that optimally funds the assets given existing funding (liabilities+equity).

This conclusion is not changed if we consider a netting set with many derivatives instead of a single swap. It does somewhat change if threshold amounts and minimal transfer amounts are introduced, but it still provides a useful limiting case.

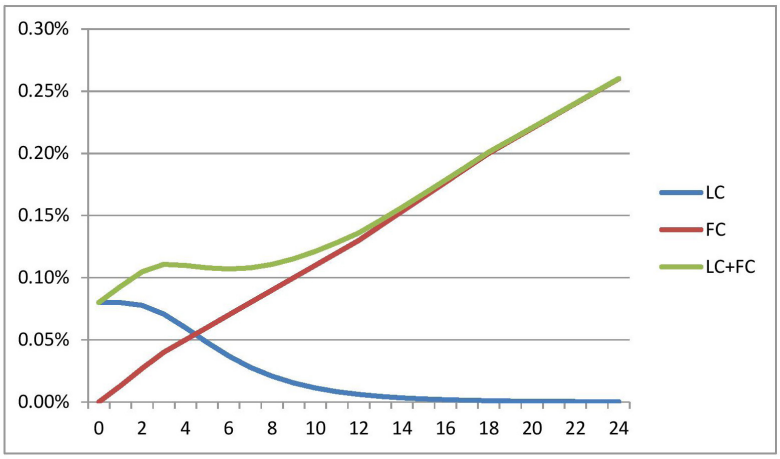
To determine the optimal funding term of other assets and initial margin, we use the framework developed in [3], which we briefly recap in the next section.

Liquidity Risk and Funding

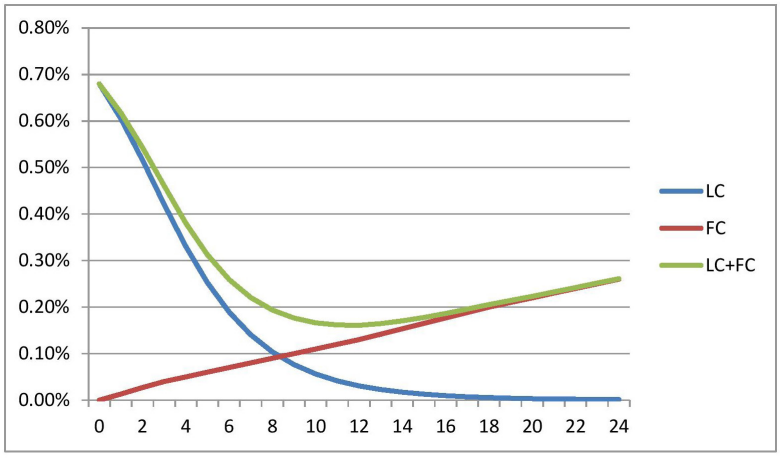
To find the optimal funding term of an asset, we need to consider funding costs and liquidity risk. The main idea is that liquidity risk and funding costs are so-to-say two opposing forces: liquidity risk pushes to longer funding terms, funding costs pushes to shorter funding terms.

Liquidity risk generates an expected loss due to events that force the bank to sell assets at a discount . This expected loss depends on the liquidity of the asset but also on the funding term. If the asset is term-funded, the expected loss is zero. If the asset is short-term funded, the probability that it needs to be liquidated in a liquidity stress event (LSE) is larger. In that case, the resulting loss depends on the liquidity of the asset, in particularly the liquidation value in an LSE.

In [3] calculations are performed by assuming a lognormal distribution of the duration of LSEs. Also, a simple, piecewise linear dependence of the liquidation value of the asset on the duration of the LSE and funding term is assumed. Using these assumptions the expected loss due to liquidity risk can be calculated analytically.



a) A liquid Asset



b) An illiquid asset

Figure 1: Funding and liquidity costs as a function of the funding term for a liquid and illiquid asset. The y-axis indicates the costs per annum. The x-axis indicates the funding term in months

In Figure 1 examples are shown for expected loss of a liquid asset (with a minimal liquidation value of 90%) and an illiquid asset (with a minimal liquidation value of 0%). The line ``LC" denotes the expected loss (LC stands for liquidity cost). For the liquid asset, we see that the expected loss is 8bp for ON funding and decreases with the funding term to less than one bp beyond one year. The expected loss for the illiquid asset is much larger at 68bp for ON funding and decreases to a few basis points at one year. In both figures also a funding spread ``FC" is included. The funding spread as a function of funding term is the same for both assets. It increase from 0bp for ON funding to 26bp at two years.

There is currently no consensus on exactly which funding curve to use. Discussion of this choice is beyond the scope of this paper. In [3] we discuss this issue in the context of valuation. The risk magazine article [2] discusses practices at different banks in the context of the funding valuation adjustment.

Furthermore, Figure 1 shows the combined costs, denoted by ``LC+FC". The minimum of these total costs determines the optimal funding term. We see that the optimal funding term for the liquid asset is ON, and for the illiquid asset with a maturity beyond one year the optimal funding term is 12 months in this example.

Note that the optimal funding term of 12 months depends on the assumptions made regarding the duration of the LSE. We have chosen the same parameters in this example as in [3]. The probability of an LSE is 5%, the severity of the LSE in terms of the fraction of assets that need to be liquidated is 16%, and the median of the duration of is 6 months. The lognormal volatility of the duration of the LSE is set at 0.5 which implies a probability of an LSE with a duration larger than 12 months of approximately 8%.

If the probability of an LSE longer than 12 months is estimated to be larger, then the optimal funding term would be larger as well. Below table shows the sensitivity of the optimal funding term w.r.t. the probability and the median duration of an LSE (keeping volatility and funding curve fixed).

Prob. LSE	Median duration	liquid	illiquid
5%	6m	ON	12m
5%	12m	ON	21m
5%	3m	4m	6m
10%	6m	8m	14m
10%	12m	ON	25m
10%	3m	5m	7m

Note that the optimal funding term of the illiquid asset is only mildly sensitive to the probability of an LSE, but quite sensitive to the median duration of the LSE. The liquid asset is sensitive to both parameters. Especially the increase from ON to 8m when the probability of an LSE is increased from 5% to 10% is noticeable.

Because these parameters are uncertain and cannot be implied directly from market data it may be prudent to choose a funding term that is somewhat conservative.

For example, a bank's best estimate of the median LSE duration is 6 months. However, the bank is uncertain about this estimate, and the median LSE duration might be as large as 12 months. In that case, the bank may be prudent and chose the largest of the optimal funding term for the range of median durations, which would imply in the above example a funding term of 25 months. In the following we will use the optimal funding term directly: 12 months for illiquid assets and ON for liquid assets.

Irrespective of specific choices the section shows how a funding term can be estimated from choosing the optimum of the combined funding costs and expected liquidation losses.

[1] In case of securities, it may be possible to generate liquidity by repo transactions in an LSE. There could still be a loss due to an increased haircut of an off-market spread.

Optimal Funding Term of Collateral

We use the example of the previous section to estimate the optimal funding term for collateral posted for a 5-year out-of-the-money OTC swap. We assume the swap is the only transaction in the netting set.

The swap is illiquid, and since it is a 5-year swap, the volatility in the initial margin may be limited. Therefore, the funding term for the initial margin would be that of an illiquid asset, which in the previous example was 12 months.

The funding term for the collateral posted for the variation margin is determined by the liquidity of the other assets. For a typical bank most assets are illiquid, although the bank should also hold a buffer of liquid assets. If we assume that only part of the illiquid assets are term-funded or optimally funded then the optimal funding for the variation margin is determined by the illiquid assets and is 12 months as well.

Consider as a second example a short position in a 1-month option, which we consider to be the only transaction in the netting set. In this case, the optimal funding for the variation margin is 12 months, but for the initial margin one month, clearly showing the different drivers of the funding term for initial and variation margin.

As a final example where the optimal funding term for initial and variation margin differs, consider a liquid derivatives transaction. In that case, the optimal funding for the initial margin is ON, for the variation margin it is, as before, 12 months.

Summary

The funding term for initial margin and variation margin can differ significantly. In a netting set with a single transaction, the liquidity and term of that transaction determine the optimal funding term for the initial margin posted. The posted collateral for variation margin requirements is funded by the derivative itself. Therefore, the optimal term of the debt issued to meet collateral requirements depends on the liquidity and term of the other assets on the balance sheet. More specifically its optimal term should optimize the value of the assets given the term of liabilities already present.

The optimal funding term of an asset minimizes the sum of funding costs and expected losses from liquidity risk. Examples for a liquid and illiquid asset illustrate the optimization of the funding term.

Note that in case of multiple transactions in a netting set, the conclusion regarding the variation margin does not change (as long as cash collateral is posted that match the MtM of the netting set). The initial margin funding term is more complicated to determine in that case, as it will depend on liquidity and term of all transactions in the netting set. A possible way to estimate this is to allocate the initial margin to the different transactions and optimize per transactions, but this requires further research.

Acknowledgements

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References

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