The possible impact of OTC derivatives central clearing on counterparty credit risk

Illustrative examples and their implications for policy

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1. Introduction

The central clearing of OTC derivatives represents an important change to the financial system. Limited clearing was originally mandated by the G-20 as part of the response to the financial crisis; subsequently clearing mandates have been extended. For instance both the United States' Dodd Frank Act and the European Union's *Regulation on OTC derivatives, central counterparties and trade repositories* requiring the clearing of many OTC derivatives.

Counterparty credit risk arises for an OTC derivatives market participant when the portfolio of derivatives that they have with a counterparty

- has positive value to them, i.e. on a mark to market basis, the counterparty owes them money; and/or
- its close out value differs from its mark to market value. This can happen for instance because there will typically be a time gap between the last successful margin call prior to default[1] and the close out of the portfolio, and the portfolio changes in value during this period. We will call this risk 'close out risk'.

Margining practice can mitigate both of these risks. Variation margin ('VM') reflects changes in mark to market, so that a dealer might agree that if a counterparty owed it money on any given day based on the mark to market ('MTM') of their joint portfolio of derivatives, then the counterparty would post a cash amount equal to that MTM value to the dealer. Agreements which require daily MTM and daily margin posting of the full amount in cash by both parties are very common.

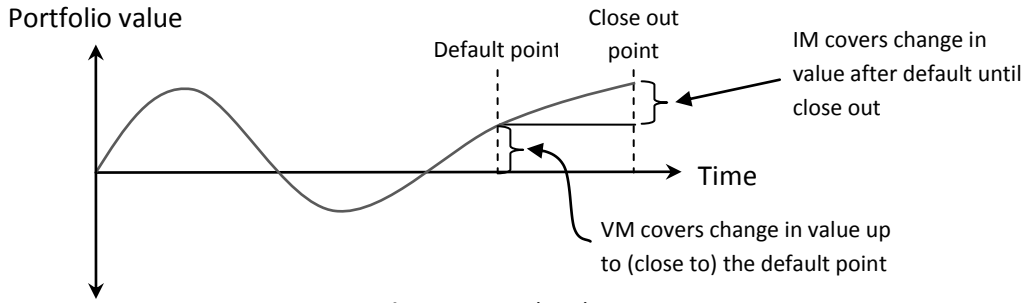

Figure 1: Initial and variation margin

[1] Since failing to pay a valid margin call is usually an event of default and margin is usually called daily, the last successful margin call before default is typically the previous day.

Initial margin ('IM') in contrast is an amount which is taken to cover close-out risk, as Figure 1 (taken from [Mur12]) illustrates. Typically IM is calculated using a some form of risk model which attempts to estimate how far a given portfolio of derivatives might move to some degree of confidence in a close-out period. Thus for instance IM might be set at the 99% 5 day value at risk of the portfolio.

The impact of OTC derivatives central clearing on the amount of counterparty credit risk in the financial system is unclear. This is because there are (at least) four countervailing phenomena:

- Clearing serves to *reduce* counterparty credit risk where a dealer's bilateral exposures to two parties are both cleared, and thus the dealer's exposure to the CCP is that of the aggregate net position[2]. (This benefit is known as *multilateral netting*.)
- However, clearing serves to *increase* exposure when a bilateral netting set between a party and a counterparty is split into a cleared and an uncleared piece.
- Moreover, regulatory requirements to clear certain exposures in certain jurisdictions, and the use of different CCPs for different asset classes, means that the maximum level of netting theoretically available through clearing is not achieved in practice. Instead, the set of cleared contracts is split between multiple CCPs.
- Finally, by demanding IM that would otherwise not be posted, and to a lesser extent by imposing VM discipline, CCP practices can enhance systemic stability.

The net effect of these phenomena is unclear, and there has been no complete study of the phenomena in practices. Various works [DZ11, HV11, MSOW11, Sin10, Sin11] have looked at aspects of the issue, but analysing the complete problem is very hard not least because it requires access to transaction level data on OTC derivatives. Moreover, assumptions about the future shape of clearing have to made[3].

Our first aim here is to simply illustrate the phenomena with concrete examples. Specifically we look at the simplest possible situation which illustrates the main issue, that of a dealer who has two types of exposure – IRS and CDS say – with two different counterparties. We assume that IRS and CDS are cleared at different CCPs, which reflects the current situation where different CCPs dominate in each asset class.

The second section of the paper gives a simple example illustrating how clearing can affect the mark to market amounts owed by each party to the other in this situation. Thus we begin with an example bilateral exposure, and construct from it plausible exposures where some but not all of the bilateral contracts are cleared. This illustrates the possible effect of clearing on direct bilateral MTM exposures, and hence on VM amounts.

In the third section we go on to look at how clearing may effect close out risk. Our aim here is simply to provide a concrete example of how clearing can increase how exposed market participants are to this component of counterparty credit risk.

[2] The CCP will typically take margin against this exposure. From the dealer's perspective, margin paid to the CCP increases exposure if the return of margin is a claim against the CCP (as for instance if the margin has passed by title transfer). This is not a concern if the CCP simply has a security interest in the margin.

[3] Such as, for instance, what will be cleared where, whether a single CCP will come to dominant an asset class within a given jurisdiction or whether there will be multiple CCPs, and whether product standardization will increase the amount of trades which are clearable.

The phenomenon of clearing changing counterparty credit risk in the abstract is well known [*op cit*.], but there are few concrete illustrations of it in the literature, so we think that it is useful to show exactly how risk can increase due to clearing.

This potentially unhelpful phenomena is due to the splitting of bilateral netting sets into one or more smaller cleared sets and an uncleared piece. The fourth section shows how one of the advantages of clearing – the benefit of margin discipline – can be gained without the need for a CCP and hence without netting sets being split. The idea is simply to introduce a new party, the *central margin custodian* to hold and settle margin without being a party to trades.

Central margin custodians ('CMC's) perform one of the two main roles of a CCP; the other is guaranteeing counterparty performance on trades[4]. Thus CCPs can be thought as a CMC plus a credit guarantor. Our fifth section examines this decomposition and studies the structure of this credit guarantor. The final section then concludes with a discussion of the policy implications of our analysis.

In what follows, we assume an understand of OTC derivatives central clearing background to clearing. For further background see [CGH09,Gro10,Laz11,Mur12,Pir11].

2. Mark to market

We begin with a simple example of bilateral OTC derivatives trading relationships. These are illustrated in Figure 2. Here a dealer has exposures to two counterparties, A and B; in both cases it trades IRS and CDS with the counterparty, and these contracts are conducted under the same master agreement, so only the net value of the aggregate portfolio matters. The numbers shown are the net exposures (in millions of dollars, say) from the perspective of the dealer.

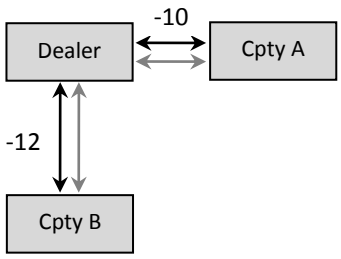

Figure 2: A simple view of two bilateral relationships from the dealer's perspective. The IRS with each counterparty are shown in black and the CDS in gray; figures give the MTM of the total portfolio (IRS & CDS).

If the dealer were to have a collateral agreement with its counterparties which permitted daily margining with zero threshold (as is common for instance between large market counterparties), then the total VM paid by the dealer would be 22; 10 to counterparty A and 12 to counterparty B.

The next figure disaggregates the exposure into possible exposures on the sub portfolios in each asset class separately.

[4] In fact CCPs do not simply guarantee counterparties, they *are* the counterparty to cleared trades. However considering them as guarantors rather than counterparties clarifies their role. Note that CCPs either do or can also perform other functions such as trade reporting, monitoring clearing member credit worthiness and default management, but these are not essential to the argument.

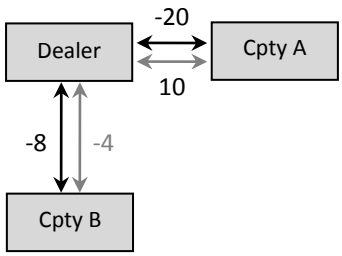

Figure 3: The same relationships with CDS and IRS disaggregated

Since margin is on a net basis under the bilateral master, the total VM is still 22.

Again for illustration, we then further disaggregate each portfolio into clearable and unclearable parts. Typically firms use simple (and hence often clearable) instruments to hedge complex (and hence unclearable) ones, so even though the universe of clearable instruments may be a large percentage of total products, there may be a substantial offset between cleared and uncleared portfolios. Thus cleared and uncleared portfolios may, on a standalone basis, have substantial mark to markets (albeit in offsetting directions). Thus the following is not implausible:

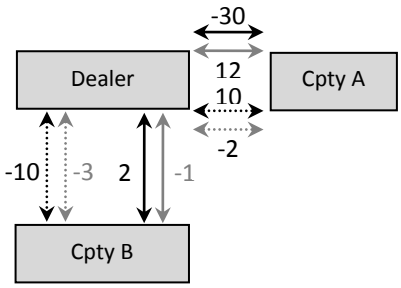

Figure 4: The same relationships with clearable (solid) and non-clearable (dashed) CDS and IRS disaggregated.

Since margin is on a net basis under the bilateral master, the VM is still 22. This however changes when we introduce clearing, as in the next figure. The simplest situation is to have a single CCP which clears both IRS and CDS. In that case the picture would be:

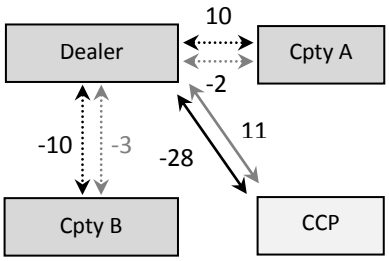

Figure 5: The same relationships with clearable trades cleared at a single clearing house

The margin flows for the dealer are now 30 paid (13 to counterparty B and 17 to the CCP), and 8 received (from counterparty A). (Here we assume that our CCP uses the typical practice on VM of calling for the whole mark to market amount.)

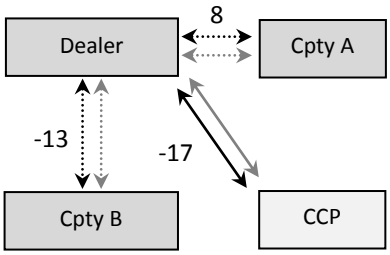

Figure 6: The same relationships showing the aggregate MTM with a single clearing house

Thus *in toto* there are more margin flows in the system, and exposures have been transformed. Specifically, in the bilateral situation, dealer owed counterparty A 10 and counterparty B 12: now after clearing it is owed 8 by counterparty A, it owes counterparty B 13, and the CCP 17.

We now make the picture more realistic by clearing the IRS and CDS at two different CCPs:

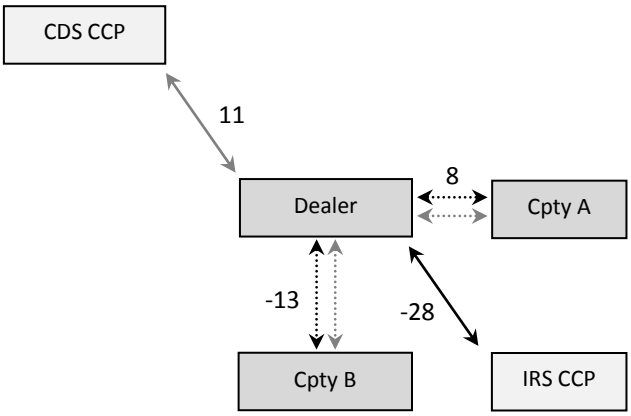

Figure 7: The same relationships with clearable trades cleared at different clearing houses for IRS and CDS

The situation is now that the dealer is owed 8 by counterparty A, it owes counterparty B 13 as before. However it is owed 11 by the CDS CCP, and it is owes 28 to the IRS CCP. VM flows would reflect this: the dealer would pay a total of 41 in margin and receive a total of 19.

3. Risk

We now illustrate some possible changes in risk in the same passage from bilateral to cleared market as before. By the 'risk' of a portfolio we will mean some measure of close out risk, and we will identify IM with this risk measure.

Unlike mark to market (and hence VM), risk is not additive: if a portfolio has risk x, and the portfolio is split into two parts a and b, then risk(a) + risk(b) does not have to be x. Indeed the two risks can be any amounts subject only to the constraints

$$\text{risk}(a) + \text{risk}(b) \geq x$$

$$\text{risk}(a) - \text{risk}(b) \leq x$$

(Assuming that risk(a) ≥ risk(b).) This reflects respectively that the risk of a portfolio cannot be bigger than that of its parts, and that the maximum risk offset between two portfolios is simply the risk of one minus the risk of the other; a situation which of course only occurs when the risks of two portfolios are have correlation -1.

We will assume that all IRS and CDS portfolios are completely uncorrelated. This is not true in general, but it will allow us to calculate the risk of the combined portfolio using

$$\text{risk}(\textit{combined portfolio}) = (\text{risk}(\textit{IRS portfolio})^2 + \text{risk}(\textit{CDS portfolio})^2)^{½}$$

This principle is known as the root-mean-square or RMS rule.

The risk of the bilateral portfolios between the dealer and counterparties A and B is assumed to be as follows:

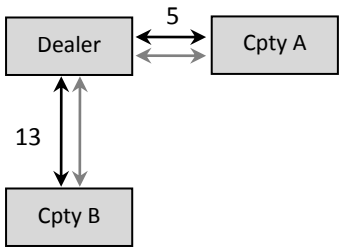

Figure 8: A simple view of two bilateral relationships from the dealer's perspective. The IRS with each counterparty are shown in black and the CDS in gray; figures give the risk of the total portfolio (IRS & CDS).

If IM was charged by the counterparties to the dealer, then the total amount paid would be 18. Note however that is relatively uncommon for dealers to charge margin (or 'initial amount') to each other. Margin between a dealer and an end-user client is more common but by no means universal [ISDA11].

Given our zero correlation assumption, an example of the risks of the bilateral portfolios which would give the total risk shown above is:

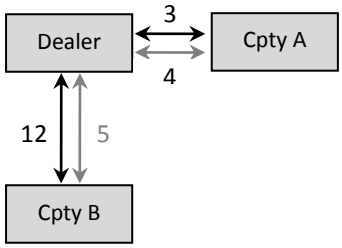

Figure 9: The same relationships with the risks of CDS and IRS portfolios disaggregated

Note here that the total IM paid by the dealer would be 18 = 5 + 13 as before, and we have $3^2 + 4^2 = 5^2$ for counterparty A and $12^2 + 5^2 = 13^2$ for counterparty B.

We now give an example which disaggregates the risk of the clearable and unclearable portfolios which each counterparty. To illustrate a range of situations, we have made the following decisions:

- The portfolio of CDS with counterparty A is split such that the uncleared piece completely hedges the cleared piece, i.e. risk(*cleared*) – risk(*uncleared*) = risk(*combined*).
- The portfolio of IRS with both counterparties splits into pieces which hedge each other to some degree, but not completely.
- The portfolio of CDS with counterparty B is split into clearable and unclearable pieces which do not hedge each other at all, so the risk of the total portfolio is the sum of the risks of the cleared and uncleared portfolios. This is the best case in terms of total risk.

Figure 9 illustrates one possible assignment of risks to each sub portfolio based on these decisions.

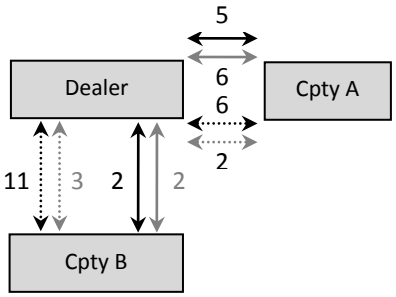

Figure 10: The same relationships with the risks of clearable (solid) and non-clearable (dashed) CDS and IRS disaggregated

To calculate the risk of the total uncleared portfolio with counterparty A and B, we use the RMS rule. We also assume that this applies to the total cleared portfolio, so the IRS IM on the cleared IRS portfolio is $(2^2 + 5^2)^{½} = 5.4$, and on the CDS portfolio $(2^2 + 6^2)^{½} = 6.3$.

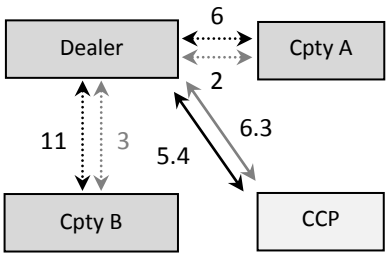

Figure 11: The same relationships with clearable trades cleared at a single clearing house

Total IM for dealer with the clearing house using the RMS rule is $(6.3^2 + 5.4^2)^{½} \approx 8.3$. If the dearer was charged IM by counterparty A and counterparty B, and the uncleared portfolios were uncorrelated, then these amounts would be respectively $(11^2 + 3^2)^{½} \approx 11.4$ and $(6^2 + 2^2)^{½} \approx 6.3$.

The total IM for the dealer, again assuming it is charged IM by everyone is 11.4 + 8.3 + 6.3 = 26. Thus despite the benefit of netting the cleared portfolios with Cpty A and Cpty B, the IM with clearing is *larger* than without. This is because the aggregate risk has increased due to splitting the portfolios into cleared and uncleared pieces. Figure 12 illustrates this.

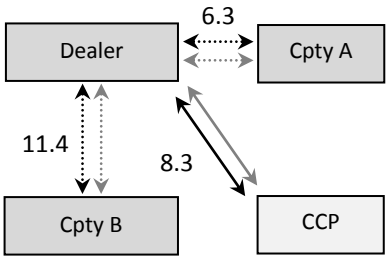

Figure 12: The same relationships showing the net risks between parties using a single clearing house

If IRS and CDS are cleared at different clearing houses, the situation gets worse, as we see in Figure 13.

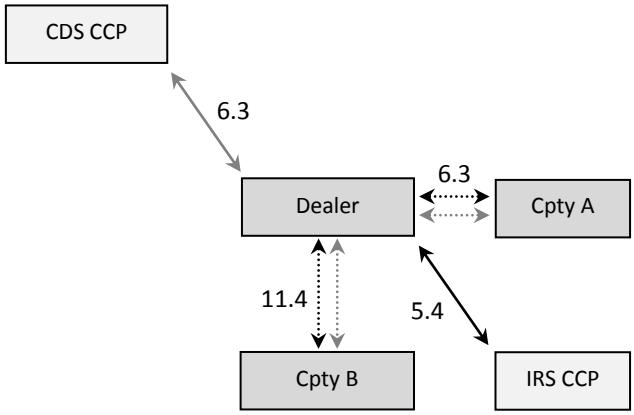

Figure 13: The same relationships showing risk with clearable trades cleared at different clearing houses for IRS and CDS

The total IM for the dealer using the same assumptions is 11.4 + 5.4 + 6.3 + 6.3 = 29.4, or 60% bigger than the bilateral situation. Of course, one could argue that since IM is not universal in the bilateral world, at least we now have ensure that the dealer pays 11.7 of initial margin (to the two CCPs) rather than nothing as it might have done bilaterally.

The change in risk is however interesting. Despite clearing, the dealer is now 26% *more* exposed to the close out risk on counterparty A, and its risk to B has only decreased by 13%; it has moreover acquired new risk exposure to the CCPs. Thus the total amount of credit risk in the system has *increased*, and the exposure of the dealer to bilateral counterparties has not materially decreased.

4. Central margin custodians

Any illustrative example is by definition arbitrary: there are an infinite number of other choices. Moreover, different choices sometimes lead to different conclusions. All that can be stated definitely is that sometimes clearing increases credit exposure and leads to larger gross margin flows. Given this though, it is logical to ask whether we can obtain some of the benefits of clearing without splitting netting sets and hence increasing risk.

One possible answer is that the benefit of risk reduction obtained from IM and VM discipline is possible without clearing. A new class of entity, the *central margin custodian* or CMC could be introduced. Market participants trade bilaterally as before, but rather than posting margin to each other, they post margin to the CMC. Specifically:

- Regulation would require all large market participants to use CMCs, and for a given bilateral relationship (between A and B say) only one CMC would be used;
- CMCs would make and settle daily variation margin calls;
- CMCs would in addition call for IM and hold it as custodian. The IM calculation would be approved by the CMC's supervisor.

Thus both IM and VM would be charged for *all* trades between A and B, not just for cleared ones. If A were to default, B would have a claim on the IM posted by A, and vice versa. However, A and B would still be liable for losses above IM. The CMC therefore would take no counterparty credit risk[5] and hence would not need substantial financial resources[6]. Moreover, the incentive for counterparties to assess each other's credit risk properly is not blunted by risk mutualisation[7]. CMCs in short would provide some of the benefits of clearing, without the splitting of netting sets.

Figure 14 shows how CMC would work in our illustrative example: recall that there the dealer owed 10 of VM to Cpty A and 12 to Cpty B. IM (which of course is paid by both parties) was 5 on the portfolio with A and 13 on the portfolio with B. For diagrammatic clarity, we use different CMCs for the Dealer-to-A and the Dealer-to-B trades.

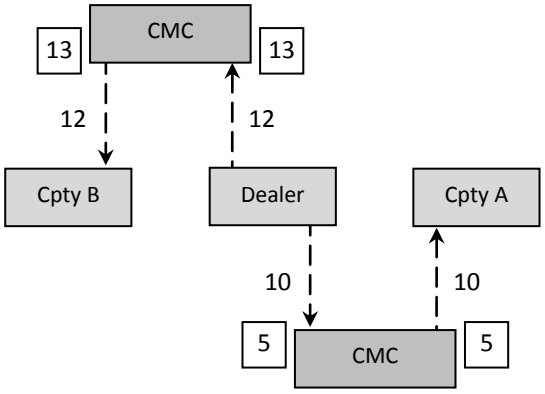

Figure 14: The bilateral relationship between the dealer and the two counterparties using CMCs. Long dashed lines show VM flows, boxed numbers show IM held at the CMC.

The simplicity of this diagram is in marked contrast with the complexity of the cleared situation, as illustrated in Figure 15.

[5] It would have a small amount of credit risk (settlement risk) between making and receiving a margin call.
[6] CMCs would run operational risk, and hence it would require some capital against this risk. See [Mur12] for a further discussion of the financial resources requirements of CCPs.
[7] This is an important point. If risk is fully mutualised so that parties are not required to take responsibility for their own decision to trade with a counterparty, and parties have no control over the risks their portion of the mutualised fund supports, then there is little incentive to assess the credit of counterparties.

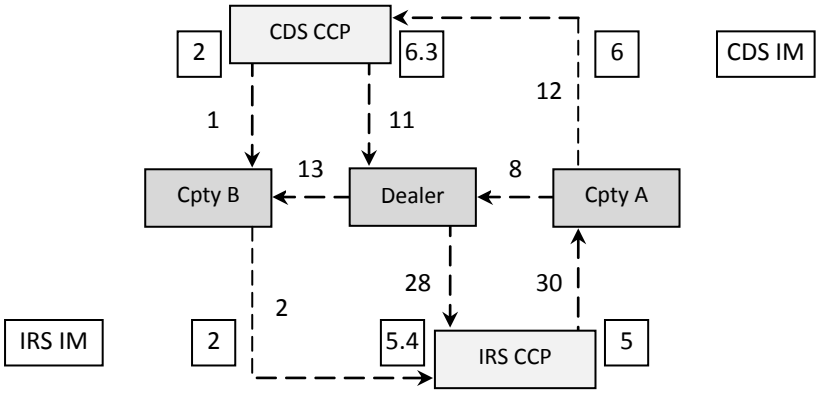

Figure 15: The IM amounts (in boxes) and VM flows (on dashed arrows) between the dealer and its counterparties in the situation where two CCPs clear IRS and CDS separately.

The use of CMCs would not be unambiguously good, of course. IM would be held at the CMC and, unlike the bilateral case, it would not be available for rehypothecation. While that ensures that margin is available when it is needed, it also has an impact on liquidity [HV11,MA10]. Moreover CMC margin calculations would have to be carefully designed to ensure that they were not so procyclical that increased IM calls in a crisis caused substantial liquidity stress.

The main disadvantage of CMCs though is that they do not have any multilateral netting benefit. There is no netting between the dealer's trades with A and the dealer's trades with B, even if both are margined at the same CMC: in contrast, if they were (all) cleared at the same CCP, they would generate some netting benefit.

5. Counterparty risk guarantors

Conceptually, the function of OTC derivatives CCPs can be thought of as comprised of two pieces:

- They call for and clear margin movements on cleared portfolios; and
- They guarantee counterparty performance on cleared portfolios.

The first function is that of the CMC outlined above.

The second is essentially that of a mutual credit guarantor[8]. In a CCP, clearing members contribute funds to a central fund, *the default fund*, and this fund is available to meet counterparty credit risk losses due to clearing member default. CCPs have a default waterfall which determines exactly how losses are allocated. Leading CCP default waterfalls share the following features:

- After a clearing member default, initial margin is available to meet losses.
- Then the clearing member's default fund contribution is available if all losses have not yet been absorbed.
- Then some combination of the rest of the default fund and CCP equity is at risk;
- Finally the CCP has some form of capital call whereby it can require clearing members to contribute further funds.

[8] Another perhaps more precise analogy is that a CCP acts like a derivatives product company: see [RBG96] for more details of this type of institution.

This paradigm means that the credit guarantor part of a CCP can be thought of as guaranteeing clearing member default losses above IM, and supporting that guarantee with a capital structure comprising the default funds, its own equity, and (as an unfunded element of its resources) capital calls[9]. In a precise sense, then, CCPs are mutual guarantee companies. Counterparty credit risk above IM is mutualised, and that risk is supported by the CCP's financial resources.

6. Policy implications

Clearly it is important to get a sense of how real the concerns about an increase in credit risk due to clearing outlined above are. Therefore an important next step in understanding the impact of OTC derivatives central clearing is to perform a detailed impact study. One would select a number of representative real world bilateral portfolios, calculate their IM and VM, then assume that what must be cleared due to legislation is, and recalculate margins in this new scenario. This would give a good estimate of the impact of splitting netting sets vs. the multilateral netting benefits of clearing.

It can be argued that cleared of OTC derivatives is a good idea even if it does increase credit risk. For instance the arguments could be that CCPs bring a new layer of capital to the derivatives system[10]; or that they impose a much needed margin discipline; or that they provide transparency. While both margin discipline[11] and transparency do not require clearing, we make no judgement as to whether clearing enhances financial stability. What we do find unsettling, however, is that mandatory clearing has been imposed without the authorities having estimated whether it increases counterparty credit risk or not, and with no quantitative assessment of these other benefits.

Another possible argument in favour of clearing is that uncleared derivatives are the problem, and that a combination of higher capital requirements for these and mandatory clearing will slowly reduce the number of unclearable trades. Thus even if today the splitting of netting sets is a problem, it may not be in future. This certainly could come to pass, but even if it does, CMCs offer a potentially interesting way of getting some of the benefits of clearing while standardization is being forced through[12].

The insight that the risk mutualisation function of CCPs is essentially that of a credit guarantor suggests a good test for CCP financial resources, namely

> *How would a credit guarantor, which insured all the derivatives receivables cleared by a CCP, and which had as financial resources the CCP's equity, default fund, and capital call ability, be rated by a well-informed party?*

[9] Of course, other capital structures are possible. [Gro10,Mur12] have a further discussion of these issues.
[10] This author would find that argument more persuasive if CCPs had raised substantial equity capital in the public markets rather than relying on default fund – which comes from OTC derivatives market participants and hence is not 'new money' – for the majority of their funded financial resources.
[11] One could imagine for instance that central margin parties ('CMPs') were required, and that all OTC derivatives transactions had to be margined, with both IM and VM posted at these CMPs. Since these CMPs would have no credit risk, they would only require financial resources to cover gap risk on the movement of margin – a much smaller risk than that run by an OTC derivatives CCP. In the event of a default, a counterparty would have access to the IM posted at the CMP to mitigate its risk.
[12] Standardization could potentially increase financial stability but at the expense of making customized risk management products expensive (or even unavailable) to end users. This would in turn mean that risk that is currently held and hedged in the financial system would henceforth be left with corporates. Seen in these terms, standardization of derivatives is not clearly an unequivocal good for the larger economy.

If the answer is 'the highest rating', then we can take comfort that CCPs are appropriately resourced for the risks that they are taking. If not however – if indeed the credit guarantee part of a CCP looks perilously like a monoline insurer c. 2006, as some observers have suggested that it does[13] – then perhaps the relevant authorities [CI10] might consider imposing higher financial resource requirements for CCPs.

Bibliography

[CGH09] S. Cecchetti, J. Gyntelberg, M. Hollanders, *Central counterparties for over-the-counter derivatives*, BIS Quarterly Review, September 2009, available at www.bis.org/publ/qtrpdf/r_qt0909f.pdf

[CI10] CPSS-IOSCO, *Guidance on the application of the 2004 CPSS-IOSCO Recommendations for Central Counterparties to OTC derivatives CCPs*, Consultative report, CPSS Publications No 89, May 2010, available at www.bis.org/publ/cpss89.htm

[Dav11] E. Davis, *CCPs 'thinly capitalised' warns UniCredit's Mustier*, Risk, 14th April 2011, available at www.risk.net/risk-magazine/news/2043417/isda-agm-ccps-thinly-capitalised-warns-unicredits-mustier

[DZ10] D. Duffie, H. Zhu, *Does a Central Clearing Counterparty Reduce Counterparty Risk?* Stanford University Graduate School of Business 2010, available at www.stanford.edu/~duffie/DuffieZhu.pdf

[Gro10] A. Grody, *Central counterparties — New uses for a century-old market mechanism*, Journal of Risk Management in Financial Institutions, Volume 4, No. 2, 2010.

[HV11] D. Heller, N. Vause, *Expansion of Central Clearing*, BIS Quarterly 2011 available at www.bis.org/publ/qtrpdf/r_qt1106h.pdf

[ISDA11] ISDA, *Margin Survey*, 2011 available at www2.isda.org/functional-areas/research/surveys/margin-surveys

[Laz11] A. Lazarow, Lessons from *International Central Counterparties: Benchmarking and Analysis*, Bank of Canada Discussion Paper 2011-4, available at www.bankofcanada.ca/wp-content/uploads/2011/06/dp2011-04.pdf

[MSOW11] Morgan Stanley/Oliver Wyman, *The future of capital market infrastructure*, 2011

[Mur12] D. Murphy, *The systemic risks of over the counter derivatives central clearing*, Journal of Risk Management in Financial Institutions, 2012

[Pir11] C. Pirrong, *The Economics of Central Clearing: Theory and Practice*, ISDA Discussion Paper Number One, May 2011

[Sin10] M. Singh, *Collateral, Netting and Systemic Risk in the OTC Derivatives Market*, IMF Working paper 10/99, 2010, available at www.imf.org/external/pubs/ft/wp/2010/wp1099.pdf

[13] See for instance [Dav11].

[RBG96] E. Remolona, W. Bassett, and I. Geoum, *Risk Management by Structured Derivative Product Companies* Federal Reserve Bank of New York Economic Policy Review 1996, available at www.newyorkfed.org/research/epr/96v02n1/9604remo.pdf

[Sin11] M. Singh, *Making OTC Derivatives Safe—A Fresh Look*, IMF Working paper 11/66, 2011, available at www.imf.org/external/pubs/ft/wp/2011/wp1166.pdf

[SA10] M. Singh, J. Aitken, *The (sizable) Role of Rehypothecation in the Shadow Banking System*, IMF Working paper 10/172, 2010, available at www.imf.org/external/pubs/ft/wp/2010/wp10172.pdf