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Time for Stability in Derivatives Markets –

A New Look at Central Counterparty Clearing
for Securities Markets

THORSTEN V. KOEPL



In this issue...

Exactly what role can central counterparties play in bringing stability and resilience to financial markets?

THE STUDY IN BRIEF

THE AUTHOR OF THIS ISSUE

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In the aftermath of the recent financial crisis, many efforts are under way to improve the stability and resilience of the global financial system. One particular solution is to manage the risk of default in securities markets through so-called central counterparties (CCPs), institutions that interpose themselves between counterparties in financial transactions. This *Commentary* offers a new look at what these institutions can achieve in the context of derivatives and short-term funding markets. It places the emphasis on the core services a CCP provides: the diversification of counterparty risk and the redistribution of default losses among its members.

For derivatives markets, this perspective opens up an avenue for also including customized derivative products in CCP clearing, which is crucial to avoid future episodes of instability in the financial system. CCP clearing needs to concentrate more on insuring against counterparty default, not merely on ensuring proper risk management and valuation of contracts, which presumes a high degree of standardization of financial derivatives. As argued in the *Commentary*, such a shift would put more emphasis on how the design of a CCP can avoid adverse effects on market discipline once insurance against counterparty risk has been introduced.

For short-term financing markets, this *Commentary* points out that the case for a CCP is less clear, as most transactions are backed by high-quality collateral. Nonetheless, the current move toward a CCP in Canada could be seen as a market-based solution that would prevent a collapse in short-term funding for financial institutions in times of a crisis. But this potential solution is not foolproof: CCPs themselves can fail, in which case governments may feel compelled to bail them out because of their systemic importance. This raises the challenge of how to balance the benefits of a CCP in terms of enhanced financial stability with how much risk the central bank or the government is willing to bear in backing up, implicitly or explicitly, a CCP's liquidity needs or losses.

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The financial crisis of 2007 and 2008 has moved the importance of proper clearing arrangements for financial trades from the obscurity of back offices into the limelight of policymakers. Differences in how financial markets fared, especially in the wake of the Lehman Brothers default in the fall of 2008, are stunning.

On the one hand, trading on central marketplaces like stock and derivative exchanges continued in the usual orderly fashion, despite sharp falls in asset values and increased volatility. On the other hand, markets where trading takes place on a bilateral, ad-hoc basis – such as over-the-counter (OTC), interbank and repo markets – went into a deep freeze: trading stopped, and it took almost a full year and multiple interventions by central banks and treasury departments around the world to restore somewhat orderly trading.

A prime suspect for this markedly different performance is readily identified: the presence or absence of a proper clearing infrastructure. When trades take place on an exchange, they normally come with a fixed, mandated arrangement offered by a clearing house to manage the obligations from the trade. This process begins with establishing, reconciling and often making public the trade information, continues with the management of the risks associated with the counterparties and their financial trade, and is finalized with the settlement of the trade.

Such arrangements are limited in markets with bilateral trading where transactions are privately negotiated, often customized to the needs of the counterparties and without formal clearing

provisions. Hence, these markets are prone to suffer from uncertainty about counterparty risk and asymmetric information about the exposures from trades. But they also involve higher risk when a counterparty defaults, as customized assets are often not fungible; i.e., they cannot be readily sold in the marketplace to limit losses.

This has led to the common perception that trading in some bilateral markets together with inadequate clearing is a major weakness in the current financial system. As a consequence, the political process was quick to pressure regulators and the financial industry to design a better infrastructure, especially for dealing with counterparty risk issues.¹

One particularly favoured solution is to introduce or extend central counterparty (CCP) services for many financial trades. A CCP assumes the counterparty risk from financial trading while putting in place proper risk management of the associated trading positions. More concretely, there are two developments that will significantly affect financial markets worldwide as well as in Canada: first, a general move toward standardizing OTC contracts in order to have them centrally traded and cleared through (possibly non-Canadian and internationally operating) CCPs; and second, the introduction of a CCP for the Canadian repo market through the Canadian Derivatives Clearing Corporation (CDCC).

This *Commentary* will first discuss the nature, limits and challenges associated with CCP clearing, before assessing whether current proposed solutions are well designed. My conclusion is that most of the discussion surrounding CCP clearing appears fundamentally misguided in several ways: first, it focuses mostly on the risk dimension, but does not consider efficiency considerations and incentive distortions; second, it has made netting

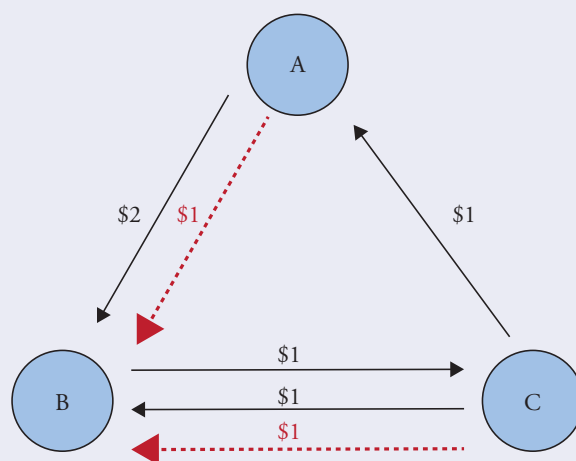
I would like to thank Walter Engert, Alejandro Garcia, David Longworth and Cyril Monnet for their comments on this *Commentary*. Deborah D'Arcy, Nicolas Labelle and George Kormas provided very helpful background information on the repo market in Canada and the current proposal for central counterparty clearing in this market. However, all views and material presented here are entirely my own.

- 1 See for example the (in)famous commitment of the G20 summit in Pittsburgh that: “[all] standardized OTC derivative contracts should be traded on exchanges or electronic trading platforms, where appropriate, and cleared through central counterparties by end-2012 at the latest. OTC derivative contracts should be reported to trade repositories. Non-centrally cleared contracts should be subject to higher capital requirements.”

Box 1: Core CCP Service Netting, Novation and Mutualization

I consider here an example of trade exposures among three institutions to demonstrate how a CCP clearing changes the risk associated with these exposures. The first graph shows the initial bilateral trade exposures. Each trade is normalized to an exposure equal to \$1. Counterparties B and C have an offsetting exposure of one trade to each other, while C owes \$1 to A, and A in turn owes \$2 to counterparty B arising from one and two transactions, respectively. The total gross number of transactions and exposures is thus five and the total exposure \$5.

Figure 1 : Multilateral Netting

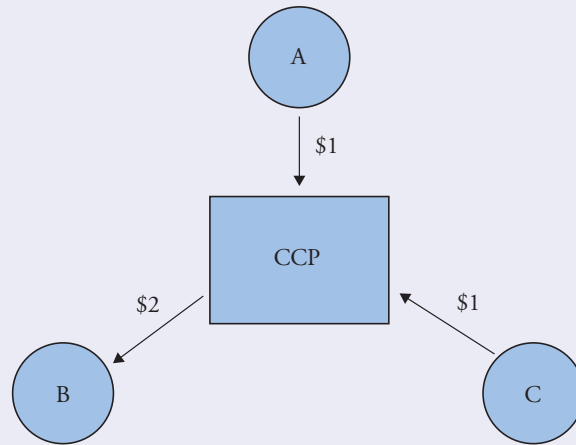


I first look at the possibility to net exposures.* With bilateral netting, one could erase the exposures between B and C as they are directly offsetting. With multilateral netting, the possibility to compress trades is larger. The net exposure of both A and C is \$1 each, with A passing on the settlement of his trade with C – which is equal to \$1 – to settle one trade with B. Hence, one can net the exposures, so that both A and C have the obligation to pay \$1 to B, which is shown by the dotted arrows in the graph.

Such netting avoids default spreading contagiously through the financial system. Without netting, if C defaulted on its payment, A would also default if he needed \$1 from C to settle his own trades with B. As a consequence, B faces default from A on the full position of \$2. But with netting, he only faces the direct default of C, which is only \$1.

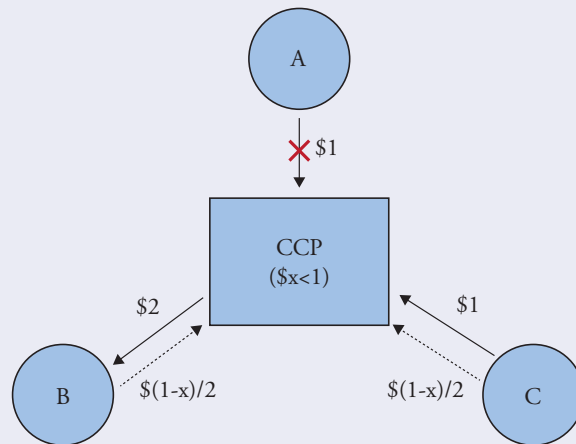
* I do not distinguish here between the netting of trade positions or the netting of settlement obligations deriving from those positions. With multilateral netting of trade positions, it is usually required to novate the trade, which involves a substitution of the original transactions with new transactions between different counterparties.

Figure 2 : Netting and Novation through a CCP



When a CCP novates the trades, it interposes itself as the counterparty to any trade among A, B and C. Hence, the CCP is the counterparty to all five original transactions, and the three original counterparties have no direct exposure to each other. If the CCP employs netting together with novation, it replaces the original exposures with a netted exposure. The aggregate exposure without default is zero for the CCP.

Figure 3 : Mutualization of Losses



Suppose now counterparty A defaults within the CCP arrangement and does not pay \$1. As the CCP has taken over the obligations from the trade, it now lacks \$1 to settle its obligation with B. Assuming it has \$x as a reserve from posted collateral or from its own capital, it can pay out $1+x$ to B which I have assumed to be less than \$2. When losses are mutualized among clearing members of the CCP, however, they have to jointly make up these losses with additional contributions. Both survivors, B and C, have then to contribute $\frac{(1-x)}{2}$ to cover the losses on the original trades between A and B. In this sense, C takes part of the loss, even though he was originally not exposed to any default risk of A.

the main issue, resulting in calls for more standardization and less trading of customized assets; and third, central clearing has often been heralded as a solution for every financial market without assessing whether the characteristics of a particular market actually warrant CCP clearing.

How Does CCP Clearing Mitigate Risk in Financial Markets?

Clearing is the process of managing the obligations arising from a financial trade. One often talks about a trade being (formally) cleared only if a specialized institution, called a clearing house, is involved.² The clearing process begins with the reconciliation of the terms of trade so that they become legally binding. This is followed by managing the risk associated with the trade. The main risk factor here is that a counterparty might not honour its obligations from the trade (counterparty risk). In such an event, the original trade has to be re-established or replaced (replacement cost risk).

The most prominent tool for dealing with these risk factors is to require collateral, often in the form of margins in cash or securities that are posted to secure a financial trade. But this gives rise to additional risk, since the value of the collateral that secures the position can fluctuate (collateral risk). Another risk is that calls for additional margin or collateral might not be honoured (sometimes called liquidity risk). Finally, clearing ends with the settlement of the obligations by the counterparties.

When a clearing house functions as a CCP, it replaces the original trade with two contracts, one between the buyer and itself and another between the seller and itself. In other words, the CCP takes on the role of counterparty within every transaction that it clears. Importantly, it is not involved in trading per se, but substitutes as the counterparty to both sides of the trade in the clearing stage. As such, it assumes the obligations arising from the

trade against the original buyer and seller. This process is called novation by a third-party and is the essential nature of CCP clearing.

As a consequence, if the CCP is able to fulfil the contract, it eliminates the idiosyncratic risk born by a trader that his particular counterparty may default. As the CCP takes on the obligations from a trade, it is however itself immediately exposed to the replacement-cost risk of a potential counterparty default.

To cover this risk, CCPs rely mainly on three lines of defence. First, a CCP sets requirements for direct membership to ensure that its members are financially sound. Second, it requires that an adequate amount of collateral is posted on the original position, which is maintained until the financial contract matures. Finally, institutions that have direct access to the CCP (so called clearing members) have to post contributions in a default fund to cover any losses. Beyond these measures, clearing members often have the obligation to make up losses that exceed the default fund from their own capital.

At the centre of CCP clearing is the pooling of counterparty risk and the mutualization of any losses due to defaults on financial transactions. From an economics perspective, CCP clearing is a form of diversification and mutual insurance against default risk.³ This directly improves the resiliency of financial markets. Participants are exposed only to the risk that the CCP itself may default, but not their original counterparty. As such, CCP clearing is often seen as a requirement for markets where trading is anonymous as is the case on many modern exchanges with electronic trading platforms.

There are other services that a clearing house can offer and are frequently, but falsely, attributed as defining characteristics of CCP clearing. The prime example is the multilateral netting of positions. Through netting, offsetting positions can cancel each other out with only the net exposure being retained among the obligations

² When no clearing house is involved, the trade is cleared bilaterally, with the two counterparties maintaining their post-trade relationship entirely through their back offices.

³ See Koepl and Monnet (2010).

from a set of trades. This procedure has the benefit that it can save on collateral requirements since only the smaller net position needs to be settled and, hence, secured. But more importantly, it reduces systemic risk in a financial market. As many different financial institutions engage in trades with each other, a single default can set off a chain reaction of other defaults. Netting reduces this risk considerably by lowering the overall risk exposure of individual clearing members.⁴

The potential for such risk reduction depends, however, on the degree of fragmentation. When one or several CCPs offer multilateral netting for a specific financial market or product, it is possible that bilateral netting between counterparties across different markets or products achieves a higher risk reduction.⁵ This provides an argument for having only a limited number of CCPs that clear across different markets or products.

Some experts in the clearing industry have also argued that a CCP cannot offer netting across all possible financial products. There are fixed costs associated with clearing any particular specific financial product, and specialized financial transactions require particular knowledge to assess the risks involved, knowledge that is commonly hard for third parties to access. Hence, such customized assets are often considered impossible to clear for CCPs. As a consequence, much of the discussion has unfortunately shifted toward standardization of assets in order to improve the scope for multilateral netting within a CCP.

Formal clearing with a clearing house generates information on prices for financial transactions and on individual trading positions of clearing members. Such information increases transparency and is a prerequisite for proper regulation and

oversight of financial markets. Having better information seems to be particularly important in OTC markets where trading is fragmented, and details on transaction prices are generally hard to come by.

Some data warehouses – often called trade repositories – have already been set up as a response to the turmoil in these markets during the recent financial crisis that was partly driven by a lack of knowledge concerning counterparty risk exposures.⁶ Making this data publicly available could increase trading efficiency since it would curtail market power for dealers who usually have better information about market prices.

Aggregating trade data is also essential for assessing both the overall market position and the situation of individual participants. A CCP could use this data for a collateral policy that takes into account not only the circumstances of individual trades, but also the aggregate market situation. This is important in times of a crisis, when counterparty risk has increased and market participants become reluctant to trade.

Collateral requirements, if set by individual counterparties, would increase in such a situation. In other words, such requirements are procyclical, worsening the stress in the market and leading to even higher collateral demands. Here, a CCP could be a stabilizing force by making its collateral policy contingent on general market conditions, effectively breaking such a vicious margin cycle.⁷

Another important aspect of CCP clearing is that it ensures uniform risk management within markets. Many commentators have pointed out that OTC trades are quite frequently uncollateralized or not sufficiently collateralized relative to what would be considered appropriate

4 Netting need not be offered, however, within a CCP. For example, in some payment systems, netting takes place without settlement guarantees. And historically, netting was offered even without a formal clearing house, in the form of ring netting. For more on this, see Kroszner (1995) or Monnet (2010). Even when markets are under severe stress, netting can work quite effectively without a CCP. After the Lehman failure in 2008, an emergency round of compressions on OTC transactions was conducted among market participants and new net positions were established that reduced considerably the risk of contagion. For more on this, see IMF (2010).

5 See Duffie and Zhu (2009).

6 For example, the Depository Trust and Clearing Corporation (DTCC) has taken on the function of a global trade repository and information warehouse for OTC derivatives.

7 For a more detailed discussion on margin, collateral and haircut policies, see Longworth (2010).

within a formal clearing arrangement. As a consequence, collateral requirements and, hence, costs of collateral will certainly rise with the introduction of mandatory CCP clearing.⁸

But the current lack of collateralization need not necessarily be a symptom of savings on collateral costs or of myopia about the risks involved with trading. One could also interpret it as a sign that many trades are indirectly secured through market discipline, an argument pursued below. With netting, however, only a net exposure remains for the counterparties, which allows for a reduction in collateral – only a net margin is required – to secure the risk exposures. Hence, a CCP offering netting could also reduce collateral costs for market participants.⁹

To summarize, a CCP reduces the risk and uncertainty that obligations arising from financial trades may not be settled. But through its risk management regime, a CCP also redistributes the risk and the costs from any default. Notwithstanding the reduction in risk, one needs to realize that a CCP can be costly in the form of additional collateral requirements. Hence, safety and efficiency arguments must be evaluated jointly when considering whether to introduce a CCP for a particular market. But this necessitates a shift away from a discussion about risk and its allocation within the market toward a consideration of the costs and benefits of clearing with a CCP. Since these costs and benefits will vary across different markets, it is imperative to distinguish CCP clearing in different segments of the financial market.

I will next evaluate the case for a CCP in OTC derivative markets, before shifting the discussion to repo markets for short-term lending.

CCP Clearing for OTC Derivatives

Even before the default of Lehman Brothers in the fall of 2008, policymakers were worried about the potential for systemic risk in the OTC derivatives market. In particular, credit derivatives such as credit default swaps (CDS) were singled out as a ticking time bomb. This fear materialized when AIG ran into trouble meeting additional margin requests to secure the immense portfolio of CDS contracts it had issued on counterparties such as Lehman.

The OTC derivatives market is large compared to the trading of derivatives on exchanges, outstripping the latter by about five to one.¹⁰ The most important segment by far of the OTC derivatives market is interest rate derivatives, followed by commodity and foreign-exchange-related derivatives transactions. It seems, therefore, unfortunate that the discussion concerning CCP clearing in OTC derivatives has focused so much on credit derivatives, which make up a non-negligible, but rather small size of the overall market. Nonetheless, this segment played an important role during the recent financial crisis due to the fact that trading is primarily dominated by financial institutions and dealers. In other segments, both commercial entities and financial institutions are involved in trades with the latter taking up a large share of transactions.

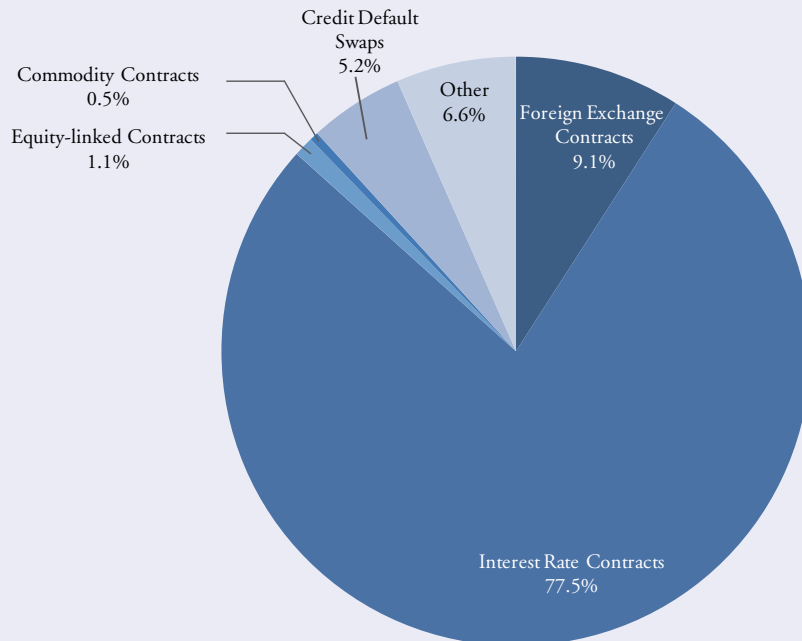
The size of the OTC derivatives market, the large exposures involved and the causes of the economic crisis certainly justify a hard look at how to improve risk management in this market segment. I will discuss here only how CCP clearing for OTC derivatives markets could be improved in general without looking at the specific types of contracts being traded in these

8 A related issue is that many financial institutions, especially dealers, re-use collateral they receive from counterparties to fulfil their collateral requirements arising from their own trading. This process is called re-hypothecation and is a way to save on costly collateral. It can lead to a suboptimal level of collateral in the market, thereby making markets more fragile. The Lehman failure is a case in point, where clients withdrew their trading – and with it, their collateral – so that the investment bank could not meet its own collateral requirements as re-hypothecation was no longer available as a source of cheap, short-term funding.

9 Koepl and Monnet (2008) show, however, that a third-party is necessary for posting collateral to secure against two-sided risk that a counterparty could become insolvent. In such a case, netted collateral does not cover the principal counterparty exposure from a trade. A CCP can resolve this problem by acting as an independent third party holding collateral in escrow for both parties to the trade.

10 This somewhat overstates the relative size of the OTC derivatives market as exchange-traded derivatives have a larger potential for netting.

Figure 4 : OTC Derivatives: Amounts Outstanding and Share of Financial Institutions



Source: BIS (2010).

markets. My main point is that it is necessary to include customized derivatives in CCP clearing. While this challenges conventional thinking, I argue that it is indeed feasible but requires a move from the narrow view of operational risk-management to the broader consideration of the economic benefits that arise from CCP clearing.

Feasibility of CCP Services

Exchanges for option and futures trading such as the Montreal Exchange use or own a CCP to carry out the clearing of trades. So, why have CCPs not been introduced in the far larger OTC market? Contracts traded on an exchange are standardized. Crucial features such as the underlying asset, the delivery time or the price at which a transaction is executed are fixed. This implies that the contract itself is fungible: it can be replaced at any time in the market.

The economic terms of OTC derivatives contracts are by their very nature often customized to the needs of the counterparty, which reduces their fungibility and makes it harder to exactly replace a transaction.¹¹ Of course, the range of products and counterparties will also be much broader than with standardized trading on an exchange where there are strict requirements on who can trade what contract. This ultimately implies that the underlying risk in OTC trades is much higher and harder to assess.

One can even argue that the form of clearing itself distinguishes trades on an exchange from OTC trades. While the former – as part of the trading – pre-determines a clearing procedure (for example, through a CCP), bilaterally negotiated transactions such as OTC trades always include a choice of how to clear.¹² In this sense, an OTC trade is customized when it comes to clearing – with formal clearing through a CCP being a

11 Customization here refers exclusively to the economic terms of a derivative contract. Derivatives can also be customized with respect to their legal and operational terms. There seems to be wide agreement, however, that derivatives should be standardized with respect to these later aspects.

12 This important distinction was first formalized by Koepl, Monnet and Temzelides (2009).

choice for the counterparties. This implies that counterparties need an incentive to submit an OTC derivatives contract to a clearing house for formal clearing independent of the contract itself being customized or not.¹³

The general push for more standardization in the derivatives market has culminated in eliciting a commitment from dealers to submit a large percentage of trades, both in value and volume, to central trading platforms and, hence, to formal clearing. To enforce this commitment, regulators intend to levy additional capital charges for non-CCP cleared derivatives transactions. Such capital charges would certainly prevent dealers from making derivatives transactions slightly “non-standard” to avoid central clearing. Once contracts are more standardized and centrally traded, netting would be facilitated and a CCP could readily offer the benefits from novation and mutualization since derivatives trades tend to be fungible.

Customized derivatives will nonetheless still play an important future role in financial markets. Indeed, it is very likely that future threats to the financial system will arise exactly in this area. After all, the economic crisis can be linked to highly customized derivatives. One possibility of minimizing such a threat would be to discourage their use. However, it is far from clear that this would be efficient. Customization is important, especially for non-financial institutions that have particular hedging needs. Hence, large benefits from customization are likely to disappear once dealers and investment banks move out of this market.

Is it worth paying this price for less risk? The answer to this question points to a classic trade-off between stability and efficiency. But as I argue

next, CCP clearing and customized contracts need not rule each other out – a crucial point that is largely missing from the current debate about clearing OTC derivatives.¹⁴

Customization, Risk Reduction and Risk Allocation

When customized derivatives are hard to value due to the specific terms of their transactions, a third-party CCP often cannot determine the current market price of the derivative. The CCP would then not be able to set an appropriate so-called variation margin that could control the risk position for the counterparties over time. Conventional wisdom suggests that clearing customized derivatives then becomes all but impossible. Experts argue, however, that this problem can be solved by requiring the counterparties to supply a valuation model when clearing the derivatives contract with a CCP.¹⁵ This would enable the CCP to calculate appropriate margins over time that are acceptable to the counterparties – according to their own valuation models – in controlling their mutual exposure.

While this is an important idea to pursue further, it still focuses entirely on replacement cost risk. But the economics of CCP clearing are based on insuring against counterparty failure. At its heart, novation simply pools and diversifies counterparty risk.¹⁶ But novating a trade in a customized derivative need not involve a guarantee of its terms, meaning replacing the exact trade in the event of a default. It really means insuring the expected risk of a counterparty’s bankruptcy – not the risk of any particular derivative contract failing. And this admittedly implies a fundamental shift in the way how we think about CCP clearing.

13 There is a grey zone of exchange-traded derivatives also being OTC-traded. This situation arises, for example, when a financial institution cannot carry out a trade during exchange hours and enters into a deal after hours. It can also arise in financial engineering where several exchange-traded contracts are combined to create a new derivative. In both scenarios, risk tends to be transparent and fungibility ensured, but the transaction could easily be customized along several additional dimensions.

14 See, for example, Canadian OTC Derivatives Working Group (2010).

15 See Hull (2010) for an excellent exposition of this argument. There may still be a problem, however, if some financial institutions lack the expertise to continuously value some of their transactions. This has led to a push toward requiring financial institutions to develop such methods with the requirement of making them available to market regulators.

16 The discussion here is again related to the theoretical work of Koepl and Monnet (2010) on CCP clearing for OTC markets.

For a CCP to offer such insurance, it would need to calculate initial margins according to the overall risk of a member's bankruptcy. Since this risk is pooled, such a margin would cover the joint exposures among all clearing members against counterparty risk in a particular market segment or class of derivative contracts. Hence, CCP clearing looks very much like a mutual insurance scheme where premiums in the form of initial margins cover potential losses among the members of the scheme.

Importantly, this insurance neither relies on multilateral netting of positions, nor does it require incentives to discourage the trading of such derivatives. Indeed, it would add additional value and stability to the OTC market of customized derivatives as it diversifies against counterparty risk.

Of course, novation of customized derivatives would necessarily leave some risk exposure uncovered.¹⁷ In case of a default, the CCP would not necessarily pay out the full current value of any trade it insures. The margins would not have been designed to cover the potentially high replacement cost of a customized trade under all circumstances (so-called tail risk). Instead, the settlement payout on every performing contract within a class of transactions would be reduced by a certain percentage to cover the default losses the CCP incurs. Hence, all contracts will face what looks like a deductible when defaults occur.¹⁸

The bottom line for clearing customized derivatives is thus to look at the counterparty risk and not the replacement-cost risk specific to a transaction. As a consequence, initial margins become more important relative to variation margins that fluctuate with changes in the

replacement-cost risk. This requires the CCP to mainly assess overall counterparty default risk as opposed to the market conditions that determine risk exposures with respect to individual transactions. Of course, market conditions also drive cyclical variations in counterparty risk and expected payouts from derivatives contracts – unless the CCP were to change margins in response to these variations.¹⁹

Inefficient risk allocation further complicates matters in the OTC market for customized derivatives. As large dealers run most of this market, they have considerable market power and are likely to ignore the gains from customization relative to the risk involved. It has been shown²⁰ that with such market power there is too little volume in trades with a high gains-to-risk ratio and too much volume in other trades.

A CCP could be helpful in correcting this inefficiency by using margin requirements that differ from customization gains. The major problem with such an approach is that financial institutions do not necessarily have an incentive to submit OTC transactions for formal clearing if the costs are too high. A well-designed CCP, however, could offer benefits from clearing – through novation, as discussed above – that could give an incentive for counterparties to submit these trades for formal clearing, even if it involves a cost in the form of higher margin requirements.

Still, it is pivotal here that the CCP can observe at least some proxies for the market power of dealers and for the risk and gains involved in particular transactions. A CCP could rely on data about pricing and volume of contracts by dealers. Also distinguishing trades with respect to the counterparty involved could be a possibility. For

17 Indeed, if a CCP started to guarantee trades in customized derivatives, it would become necessary to re-allocate losses further among clearing members. The members will be reluctant to take on this exposure as losses from such transactions are hard to assess and concerns of moral hazard are likely to be important.

18 Technical default when the counterparty is solvent but does not fulfil its obligations from the trade according to the negotiated terms also would not be covered. But clearing houses have different mechanisms to discourage such defaults, such as fines or loss of membership.

19 CCP clearing would then entail a pro-cyclical component. This however might not be acceptable from a macroprudential point of view, as it would reduce financial stability. See, for example, CFGS (2010).

20 See again Koepl and Monnet (2010).

example, speculative trades by hedge funds could be treated differently than transactions by large corporate customers, which presumably are for hedging purposes.

To conclude, the policy debate should move away from requiring more standardization to discussing proper ways of organizing clearing in the customized derivatives market. Of course, CCP clearing has technical limitations in that it is hard to clear every single product according to its exact specifications. Nonetheless, one can imagine that a CCP could offer clearing of specific derivative classes even though their terms are fairly specialized. After all, financial institutions engage in managing risk for such positions, and it is not clear why a specialized entity such as a clearing house could not do likewise along the lines I have described.

Simply requiring more standardization does not address risk and stability in a crucial market for risk transfer, especially once one realizes that it is trivial to circumvent mandatory CCP clearing of standardized contracts.

High capital charges on customized, non-centrally cleared derivatives transactions might provide some incentives for dealers to move toward standardized contracts that are CCP-cleared – but at the expense of losing the benefits from using customized derivatives. However, this concern ignores that it is actually beneficial and feasible to control risk in customized contracts through central clearing. A more sensible debate among policymakers, industry and academics, therefore, must focus on how to clear customized derivatives and, hence, on improving stability in this important market segment.

Market Discipline and the Cost of Collateral

Assessing the cost and adverse incentives of clearing through a CCP has often been pushed to the background. The reason is that considerations of market failure related to risk-taking and improper risk management have played, perhaps,

too prominent a role in the wake of the financial crisis. Many observers point out that there is often not enough collateral posted to fully secure OTC derivatives transactions, which is commonly seen as a sign of financial institutions taking on too much counterparty risk.²¹ The reasons are readily identified as inadequate collateral management, imperfect information about counterparty risk, or a myopic and socially inefficient motive to save on collateral costs.

But a significant part of OTC trading is based on long-term, repeated relationships, often intermediated or directly carried out between large dealers. Hence, lower collateral postings could be an indirect consequence of market discipline governing some transactions. Monitoring among large financial institutions and maintaining a reputation as a good counterparty limit risk-taking in general and thus can function as an alternative to collateral for securing a trade. CCP clearing, with collateral deemed necessary to cover the risk in a trade, would then be a mere substitute – and a costly one for such monitoring. But more damaging, one could face the unintended consequence of moral hazard in the behaviour of market participants when they engage in trades that are backed by a CCP. This could arise not only because losses are insured, but also because CCP clearing could upset peer monitoring as a disciplining device in long-term bilateral trading relationships.

This situation suggests an important trade-off that has been routinely overlooked. Collateral can basically serve two functions: as an incentive device to decrease risk-taking or as an insurance device against counterparty default. A CCP can save on collateral since it provides cheaper insurance in the form of novation and mutualization of losses. But a CCP needs to rely more heavily on collateral to limit incentives for risk-taking. Hence, collateral requirements might very well increase significantly with CCP clearing as pointed out by some large dealers.

21 See IMF (2010).

The International Dimension

Several big clearing houses plan to, or already have, introduced CCP services for OTC derivatives that are traded worldwide. Most of these clearing houses are associated with leading international exchanges.²² As I have pointed out, the efficiency of insurance against counterparty risk as well as the reduction of systemic risk decreases with the number of CCPs within a market and across different instruments. This understanding has led to suggestions that the number of clearing houses offering CCP clearing for OTC derivatives should be fairly small, even though this will increase operational risk and concentrate counterparty risk in a few systemically important parts of the financial market infrastructure.

The market for OTC derivatives in Canada is relatively small, and many of the leading Canadian financial institutions trade such derivatives worldwide with a wide variety of international counterparties. From an international perspective, it is thus questionable whether it is viable to create a Canadian CCP that clears Canadian dollar denominated trades or trades that involve only Canadian counterparties. Also, large Canadian institutions already have a strong incentive to join internationally operating clearinghouses for OTC derivatives in order to stay attractive as a counterparty in the international financial market place.²³

Some commentators have worried that without a Canadian CCP there would be a problem of access for Canadian institutions to proper clearing. However, some large Canadian banks are already general clearing members with non-Canadian clearing houses and could provide intermediated access for Canadian institutions that would view direct membership as too costly.²⁴

Still, a common oversight problem would occur. Canadian institutions would increasingly be exposed to foreign counterparty and infrastructure risk. Spillovers from foreign capital markets would be an increased probability. This problem would be compounded if Canadian regulators did not have a direct influence on proper risk-management regulations and oversight of systemically important infrastructure located outside Canada. However, experience with crucial international market infrastructures such as the Continuously-Linked-Settlement Bank for foreign exchange settlement and the success in harmonizing regulation within the framework of the Committee for Payment and Settlement Systems (CPSS) which is run by the Bank for International Settlements (BIS) provide reason to believe that coordinating oversight responsibilities across different jurisdictions is not impossible.

A CCP for the Canadian Repo Market

The Structure of the Short-term Financing Market

Markets where financial institutions allocate liquidity and provide short-term funding to each other are considered vital for the proper functioning of a financial system. These markets are by their very nature bilateral in the sense that two counterparties directly engage in providing short-term loans to each other. They are also considered systemically important as any disruption to these markets would cause severe illiquidity and reduced market-making activity that could ultimately feed into large price movements and widespread defaults. As such,

22 ICE Credit Clear, LCH.clearent and the Depository Trust and Clearing Corporation (DTCC) are already offering OTC derivatives clearing.

23 There could be an intermediate solution where multiple clearing houses are linked and interoperable. However, it is not now clear how such a structure would function, especially with the transfer and usage of collateral across different CCPs, as well as the allocation of losses among clearing members of different CCPs.

24 Also, a Canadian CCP would most likely have relatively broad membership across financial institutions in Canada. Broad membership implies a wide variety of institutions, differing in size and risk profile, the features clearing houses worry about when negotiating default-fund contributions from their members. Larger and safer institutions would presumably be less willing to supply capital to a clearing house that has such an extended membership structure.

these markets are viewed as core funding markets that need to function continuously for the financial system to be resilient.²⁵

There are three key markets for short-term funding. In the interbank market, large financial institutions provide uncollateralized loans to each other – mostly on an overnight basis to allocate funds for end-of-day settlement of obligations.

In the repo market, participation among financial institutions is more widespread. Borrowing is collateralized and the terms of the loan can be up to one year. It is useful to distinguish between two different functions of this market. A *general* collateral repo primarily serves short-term cash financing needs. The *general* collateral repo derives its name from the fact that the lender is willing to accept any collateral from a class or basket of assets. In contrast, the *special* collateral repo market concerns the lending of cash against pre-specified collateral. Here, the function is often to finance a particular position for a dealer in the underlying security. It is also used to settle transactions in this security.

The other, less important, short-term funding market concerns securities lending against collateral (usually in the form of cash), which is different from repo markets in that the legal ownership of the security does not change hands.²⁶ This market is usually dominated by institutions such as pension funds or insurance companies that try to achieve an extra return on their long-term security portfolio.

The Current Canadian Derivatives Clearing Corporation (CDCC) Proposal

Repos as a short-term funding source have steadily increased in popularity globally and have become the main funding vehicle for many dealers and brokers. They view repos as a convenient source of

financing for their trading and inventory of securities because of their low transaction costs and relatively standardized terms. In Canada, however, the repo market is less significant for two reasons. First, institutional investors perceive Canadian banks as extremely safe, making traditional unsecured wholesale deposits an attractive alternative short-term investment. Second, Canada lacks the infrastructure that facilitates repo transactions.

The latter point became apparent during the recent global economic crisis, when the Canadian repo market experienced periods of stress. Interestingly, this was seemingly not related to concerns about the quality of the collateral or the counterparties involved, but rather to an increased demand for repo funding. Banks and dealers in the repo market tried to protect against too much leverage on their balance sheet by declining to take on more repo transactions, which usually have low profit margins. This raised concerns about the general availability of repo funding, causing the market to become illiquid.

The financial industry was quick to point out to policymakers that the Canadian repo market lacked a proper infrastructure, but needed to be considered as a potential core funding market. As a result, the Investment Industry Association of Canada asked CDCC to develop CCP clearing for the domestic repo market. CDCC's initial suggestion concerns only special collateral repos using specific Canadian government debt as collateral. But CDCC is also working on providing clearing for general collateral repos, which would allow more efficient netting of repo transactions. Under this scenario, it is envisioned that CDCC would first novate the trades and then net the obligations arising from such repos rather than netting the positions in specific repos.²⁷ It is still open, however, how the baskets

25 See Fontaine, Selody and Wilkins (2009).

26 For excellent expositions on repo markets, see Fleming and Garbade (2004) and Reid (2007).

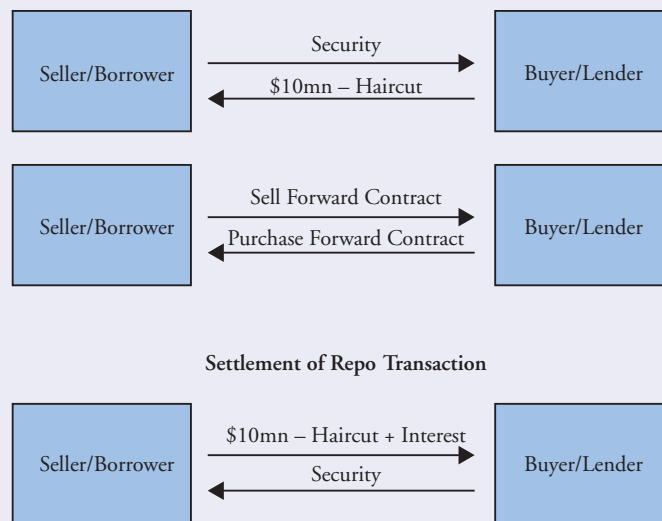
27 The service FinNet offered by the Canadian settlement provider and securities depository CDS allows only position netting which often cannot be used with repo financing as the collateral or the length of financing differs across repo transactions. CDCC plans here to transform term repos with a maturity longer than one day into multiple overnight repos, which then can be used to net obligations across different maturities.

Box 2: Repo and Reverse Repo Transactions

A repurchase agreement (repo) is a contract to sell and subsequently repurchase securities at a specific date and price. A reverse repurchase agreement (reverse repo) is simply the mirror image of a repo. These transactions can be decomposed into two separate transactions. For a repo, the borrower sells the security to the lender against cash. In the example, the value of the transaction is \$10 million. At the same time, the borrower sells a forward contract to the lender, agreeing to purchase the same security at a future date at a pre-specified price. This price includes the interest agreed in the repo transaction to be paid by the borrower.

While the security usually remains on the balance sheet of the seller/borrower,* the legal ownership changes hand at the start of a repo transaction, putting the security up as collateral with a high seniority for the lender. The security can thus be seized in case of a default by the borrower. This exposes the lender to price risk on the collateral, which is usually covered by a margin – or haircut – on the collateral exchanged. The haircut is set to cover the risk that the market value of the collateral declines over the term of the repo. The actual amount of cash exchanged (here \$10 million) is reduced by this haircut.

Figure 5 : Repo Transaction



When a CCP clears repos, it usually does not retain the security that functions as collateral for the transaction. The CCP also splits the transaction into its two formal parts, a cash trade and a forward transaction. Since the cash portion of the repo does not involve any risk, the CCP will then employ its risk management only with respect to the forward position, requiring margin to secure the exposures of both parties with respect to the forward portion of the transaction. It is important that the margin is posted by both parties, as there can be circumstances where the repo lender has no incentive to return the security to settle the repo transaction.

* From an accounting perspective, such a repo transaction is sometimes called financial as compared to a sale repo where the security is taken off the repo lender's balance sheet.

for collateral will be structured, even though it appears that only high-quality public debt would be allowed as collateral in any of the repos cleared by CDCC.

Are CCP Services Necessary for Repo Markets?

There are two potential reasons causes for repo markets to shut down during a crisis: counterparty risk and so-called rollover risk. Counterparty risk, however, is limited when collateral is of high quality and very liquid. This is usually the case with special collateral repos, which normally use “on-the-run” – heavily traded and, hence, usually recently issued – government debt as collateral. Here, collateral is of good quality, making potential losses from a counterparty insolvency small.

Furthermore, repo transactions are mostly short-term, limiting the price and liquidity risks associated with the collateral. Nonetheless, these risk factors might play a bigger role with general collateral repos, where the collateral can be of a different and lower quality, especially if proper haircuts are not applied. Also, when netting is involved in general repos, the collateral basis to secure transactions is smaller, given the uncertainty about the actual collateral held for a transaction. This uncertainty can increase the stress in the repo market during a crisis.

Rollover risk, however, plays a more important role. Since repos are short-term financing tools, they need to be rolled over quite frequently. If market participants expect liquidity to be low in the future, as uncertainty about counterparty risk mounts, they are less willing to lend out short-term funds for two reasons. First, if they, themselves, need liquidity in the short-run, they might have difficulty procuring it. And, second, the likelihood of default increases when a counterparty, even though solvent, cannot fulfil its obligations due to

the impossibility of rolling over a loan. Consequently, there can be a market breakdown purely as a result of a coordination failure when financial institutions hoard liquidity because they expect that they will be unable to obtain such liquidity when they need it, themselves.

The Bank of Canada, as the ultimate provider of liquidity in the Canadian financial system, has deemed repo markets a key sector that needs to function continuously in order not to destabilize the entire financial sector. Hence, at the height of the economic crisis the Bank of Canada supplied ample excess liquidity to short-term funding markets, taking pressure off the repo market as well.

But this raises an important question. If the main problem is one of coordination failure rather than addressing primary or secondary systemic counterparty risk, why do we need a formal clearing solution, especially in a market where the central bank stands ready in times of a crisis?

One argument is that a CCP is a permanent solution that ensures liquidity in the market, based on the industry itself bearing any costs of possible market disruptions. In reality, however, a central bank backing the market is an ad hoc solution that might create adverse incentives in terms of risk-taking and peer monitoring. But this seems a strange distinction, as a central bank would invariably also back a CCP as an institution that is too large to fail.²⁸

Of course, some benefits would derive from novation. A CCP would provide insurance against collateral risk and ensure settlement associated with the repo transaction. It could also enforce proper risk management in the form of haircuts. Both arguments apply especially to the general collateral repo market where more risky collateral tends to be posted.

In times of general market stress, the prices of such collateral can vary widely, and thus

28 In the US market, repo funding is largely organized as a tri-party repo. There, two custodian banks organize the collateral management of repo positions. Most of the repos are general collateral ones with a wide variety of securities serving as collateral, including asset-backed securities. The custodians take on large intraday exposures with respect to the collateral, as they re-shuffle it during the day to adjust for changes in overnight and term repo financing. The economic crisis has shown this model to be a very fragile structure especially prone to runs. It appears that the only reason to stick to such a structure or to improve upon it by moving to a (possibly government run) CCP is to deem this approach vital in providing sufficient short-term funding to the market.

counterparties might be unwilling to accept it in the absence of a CCP guarantee. More generally, a CCP would certainly contribute to the proper functioning of the repo market as it enforces proper settlement of repo transactions and deals with technical and outright default.²⁹ But all these benefits have to be set against the additional operational costs of CCP clearing.

A far more intriguing argument could be that a CCP is well positioned to improve market conditions during times of crisis. Market participants jack up haircuts on collateral in stressed markets as price volatility increases. This can set off so-called margin spirals, which sharply decrease liquidity and thus inhibit the proper functioning of the repo market.

A CCP could choose to keep lower haircuts against insuring collateral risk, thereby assuming a portion of that risk. This could maintain funding liquidity in the market at a time when it is most needed. The potential losses from such a policy would then be borne by the clearing members, which tend to be the largest financial institutions. Other institutions indirectly participate in funding these losses by paying clearing fees when they are members of the CCP intermediate clearing house. In conclusion, the case for CCPs in the repo market seems to be far less obvious than in the OTC derivatives market.

CCP Solutions for Other Markets

OTC derivatives and repo markets are not alone as cornerstones for the financial system. Other markets have been deemed core markets. These are markets for unsecured short-term lending, foreign exchange markets and markets for securities lending.³⁰ Surprisingly, there has not

been much discussion about improving the clearing infrastructure for these markets. For completeness, I offer a brief review of these markets.

Markets for Short-term Unsecured Funding

The Bank of Canada's main instrument for monetary policy in Canada is setting a target for the overnight rate at which banks can refinance themselves overnight. If one views the Bank of Canada as the apex of the financial system, the overnight and short-term lending markets are in fact the most important core funding markets. Why then has there then been no discussion about a CCP in such markets, where lending is unsecured?

The answer I believe is straightforward. If these markets freeze up due to liquidity hoarding and uncertainty about counterparty quality, a central bank will be forced to provide funding through special (term) repo transactions. The recent economic crisis has shown that in such a situation a central bank would have no choice but to become the de facto central counterparty to all short-term lending among financial institutions.

Furthermore, as monetary policy is implemented by a so-called channel system, large banks can directly borrow from the Bank of Canada, albeit at a penalty rate, at a special lending facility – called the Standing Liquidity Facility (SLF) – to satisfy any overnight borrowing. It is in that sense that the Bank of Canada can be seen as implicitly providing a back-up in a crisis situation, making it the de facto CCP in times of extreme market distress.³¹

Foreign Exchange Markets

I have pointed out earlier that OTC derivatives markets could benefit from proper clearing,

29 For example, money market funds would receive additional insurance through CCP clearing so that they would not fall short of maintaining their fund value at par. Hence, CCP clearing could induce a thicker repo market, especially in Canada where many institutional investors prefer short-term, unsecured lending to the larger banks over repo transactions.

30 See again Fontaine, Selody and Wilkins (2009). These markets comprise the unsecured interbank market, which is relatively small in Canada, and the more important private money markets (such as bankers' acceptances) where banks obtain short-term refinancing.

31 Of course, this implies that the Bank of Canada is exposed to credit risk that it cannot take on under its current mandate. But it is hard to see how not taking on credit risk could be enforced in a crisis situation, as recent experience – especially in Europe – has demonstrated.

independent of the underlying asset for the derivative. Interestingly, many observers have suggested excluding foreign exchange swaps and other derivatives from the current proposals. For one thing, they argue that foreign exchange swaps are usually very short-term and concern the exchange of principals in the form of cash. Hence, the volatility and risk involved in crisis times are supposed to be limited. In addition, there exists already some infrastructure such as the Continuously-Linked-Settlement Bank that appropriately deals with counterparty risk and which functioned well in the recent financial crisis.

Securities Lending

Securities lending improves the liquidity in many asset markets and aids the price-finding process by supporting short sales. Large long-term asset management companies are heavily involved in lending securities against cash collateral to market-makers and dealers in order to seek additional profits on their securities portfolios.

However, some observers point out that the market for securities lending is fragmented and dominated by large intermediaries such as custodian banks. This not only leads to decreased price transparency, but also to some concentration of counterparty risk. Hence, in this market the foremost gains are likely to arise from improvements to the trading infrastructure and more trade information. Furthermore, securities lending could always be structured as a repo transaction from an economic point of view, even though there are different legal implications.

These considerations might explain why there is currently no real discussion about introducing formal clearing services for securities lending. For example, within the CDCC's current proposed CCP solution, securities lending can occur only within a formal, special collateral repo transaction. This means that lenders such as insurance companies or pension funds seeking formal clearing for securities repo lending have to use intermediaries that are direct clearing members of CDCC. In the future, there might be pressure to

expand the set of counterparties that can access CDCC directly as clearing members.

Conclusion

The telling tale of the financial crisis has been counterparty risk, especially in markets where trading is bilateral with directly negotiated terms such as in OTC derivatives and short-term funding markets. The absence of formal clearing arrangements has been identified as the main reason such markets did not function properly at the height of the crisis. As a response, regulators have hailed CCP solutions as a necessary condition to improve the resilience of financial markets.

For OTC derivatives markets, much of the policy discussion has focused on how formal clearing can provide better information, reduce systemic risk in the market and ensure that trades are properly collateralized. Without doubt these benefits would arise, but they are not necessarily the core elements of CCP clearing. In fact, the major benefits would be the diversification of counterparty risk through novation and the redistribution of such risk through mutualization of losses.

The current focus on non-core elements of CPP clearing is unfortunate for two reasons. Too much attention is being paid to standardizing derivative contracts in order to increase the efficiency of netting arrangements, lowering systemic risk as a consequence. But customized contracts can also provide important benefits, especially to non-financial counterparties. Furthermore, such derivatives were at the centre of the recent crisis and arguably are an important source of potential future financial instability. Hence, it is necessary to find innovative solutions for moving customized derivatives to formal CCP clearing arrangements.

CCP clearing has, of course, technical limitations. Mainly, it is hard to clear every single product according to its exact specifications. Nonetheless, one can imagine that a CCP could offer clearing of specific derivative classes, even though their terms are fairly specialized. Designing ways of centrally clearing customized derivatives should be a key priority. One route is enabling

CCPs to use the proprietary valuation models of its members to value contracts. An alternative, innovative route is to move away from designing CCPs as guarantors of financial transactions to CCPs offering true counterparty risk insurance.

Equally important, the costs of a CCP solution have been pushed back in the discussion in favour of systemic risk considerations. Many sources have pointed out that there is often not enough collateral posted to fully secure OTC derivatives transactions, which is commonly interpreted as a sign of financial institutions taking on too much risk.

But thinking about a CCP providing novation as its core function helps to frame the discussion in a very different light. That many derivatives transactions are not fully collateralized need not be a sign of excess risk-taking in the market. Indeed, to a certain degree, it can be attributed to peer monitoring and reputation as an incentive device. Such market discipline will decrease when a CCP offers insurance against counterparty risk and, as a consequence, needs to increase collateral to contain moral hazard. In short, CCP solutions entail costs in the form of higher collateral requirements, and these must be balanced against any associated benefits.

In Canada, the development of a CCP solution for the repo market has made more progress than for OTC markets, most likely because the relevant market can be more clearly defined. But this is still surprising as the benefits of CCP clearing are less obvious. As all exposures are automatically collateralized by design, benefits are not really related to counterparty, but more to liquidity and collateral risk. Both tend to be small, however, if collateral is of good quality (e.g., government bonds) and appropriate haircuts are applied, making the case for a CCP solution less compelling from a pure risk perspective.

The main argument for a CCP approach must thus be based on the possibility of a coordination failure when, in times of a crisis, financial institutions cannot roll over short-term funding or collateral requirements and haircuts are tightened. But, even in the absence of a CCP, a central bank could still play a fundamental role by intervening in such situations and providing sufficient liquidity support in the short-term funding market. Hence, while a case for CCP for the repo market seems to be far less clear than for the OTC market, this solution can be seen as a market-based solution to this coordination problem. Such a solution levies the costs of market disruption on the financial sector as much as possible and thus reduces the likelihood of a central bank intervention.

As CCP clearing gains in importance, we will face institutions that are automatically too large to fail. This raises the spectre of a central bank having to provide a back-stop to such institutions, which leads to a moral hazard problem. Furthermore, such an approach runs counter to most current central bank mandates that prohibit taking on credit risk. Hence, a discussion is needed of how much aggregate, through-the-cycle risk the financial sector and CCPs can shift to public institutions.

Finally, CCP solutions will take on an increasingly international character with the continuing integration of global markets. This poses the challenge of how to regulate these institutions across different jurisdictions and of how to limit risk spillover that is propagated across different countries through the clearing infrastructure. While some countries have made progress – see for example the creation of the European Systemic Risk Board – more effort is needed to coordinate macroprudential regulation and oversight.

References

- Bank for International Settlement. 2009. "Central Counterparties for Over-the-counter Derivatives." *Quarterly Review*. March: 45-58.
- Bank for International Settlement. 2010. *Capitalisation of Bank Exposures to Central Counterparties*. Consultative Document. December. Available at <http://www.bis.org/publ/bcbs190.htm>.
- Canadian OTC Derivatives Working Group. 2010. *Reform of Over-the-Counter (OTC) Derivatives Markets in Canada*. Discussion Paper. October. Available at www.bankofcanada.ca/en/financial/reform.pdf.
- CCP12 (The Global Association of Central Counterparties). 2009. *The Value of Proposition of Central Counterparty Clearing Houses*. Working Paper. Available at <http://ccp12.org/w/page/13831338/CCP12-Papers>.
- Committee on the Global Financial System. 2010. *The Role of Margin Requirements and Haircuts in Procyclicality*. CGFS Paper No. 36. Available at www.bis.org/publ/cgfs36.pdf.
- Deutsche Bank Research. 2010. "OTC Derivatives: A New Market Infrastructure is Taking Shape." Available at [PROD0000000000256894.pdf](http://www.prod0000000000256894.pdf).
- Duffie, Darrell, and Haoxiang Zhu. 2009. "Does a Central Clearing Counterparty Reduce Counterparty Risk?" Stanford University Graduate School of Business. Available at: www.stanford.edu/~duffie/DuffieZhu.pdf.
- Fleming, Michael, and Kenneth Garbade. 2004. "Repurchase Agreements with Negative Interest Rates." Federal Reserve Bank of New York. Available at http://www.newyorkfed.org/research/current_issu/s/ci10-5.html.
- Fontaine, Jean-Sebastien, Jack Selody and Carolyn Wilkins. 2009. "Improving the Resilience of Core Funding Markets." Bank of Canada *Financial Stability Review*. December. Available at http://www.bankofcanada.ca/en/fsr/2009/index_1209.html.
- Hull, John. 2010. "OTC Derivatives and Central Clearing: Can All Transactions Be Cleared?" Banque de France *Financial Stability Review*. July. Available at www.banque-france.fr/gb/publications/.../rsf/2010/etude09_rsf_1007.pdf.
- International Monetary Fund. 2010. "Making Over-the-counter Derivatives Safer: The Role of Central Counterparties." *Global Financial Stability Report*. April. Chapter 3.
- Koepl, Thorsten, and Cyril Monnet. 2008. "Central Counterparties." Frankfurt, Germany. Center for Financial Studies. Available at https://www.ifk-cfs.de/fileadmin/downloads/publications/wp/08_42.pdf.
- _____. 2010. "The Emergence and Future of Central Counterparties." Working Paper 1241. Queen's University. Available at http://www.econ.queensu.ca/working_papers/papers/qed_wp_1241.pdf.
- Koepl, Thorsten, Cyril Monnet and Ted Temzelides. 2009. "Optimal Clearing Arrangements for Financial Trades." Working Paper 1222. Queen's University. Available at http://www.econ.queensu.ca/working_papers/papers/qed_wp_1222.pdf.
- Kroszner, Randall. 1999. "Can the Financial Markets Privately Regulate Risk? The Development of the Derivatives Clearing Houses and Recent Over-the-counter Innovations." *Journal of Money, Credit and Banking*. March 31: 569-618.

Longworth, David. 2010. "Warding Off Financial Failure: How to Avoid Squeezed Margins and Bad Haircuts." Backgrounder 135. Toronto: C.D. Howe Institute.

Monnet, Cyril. 2010. "Let's Make It Clear: How Central Counterparties Save(d) the Day." Federal Reserve Bank of Philadelphia *Business Review*. Q1, 1-10.

Reid, Christopher. 2008. "The Canadian Overnight Market: Recent Evolution and Structural Changes." *Bank of Canada Review*. Spring, 15-29.

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