Concentration risk and the optimal number of central counterparties for a single asset

Fabien RENAULT
Payment Systems and Market Infrastructures Directorate
Banque de France

We model the central counterparty (CCP) clearing of a single asset traded over-the-counter by two groups of banks in two currencies. We compare a variety of different clearing set-ups involving one or two CCPs according to their ability to withstand a combined market and banking crisis. Using stress testing, the model shows that the question of the optimal clearing set-up for a specific asset is complex and depends on many parameters such as the level of funding available to the CCP(s), the degree of integration between the different groups of participants and the particular risk profiles of these different groups.

On the whole, however, a single CCP solution appears less resilient than a two-CCP arrangement when the magnitude of the crisis is large and only more resilient when the magnitude of the crisis is small in relation to the clearing fund of the CCP(s). Another interesting outcome is that the two-CCP set-ups perform better than the single CCP set-up for low levels of participation.

NB *The views in this paper are those of the author [*fabien.renault@banque-france.fr*] and do not necessarily reflect those of the Banque de France. Many thanks to Margherita Redaelli, Mathieu Gex, Nadège Jassaud and Wilko Bolt for their help with this paper.*

The recent crisis has shown the need to improve risk controls for OTC credit derivatives and several authorities have expressed strong support for CCP (central counterparty) clearing of OTC credit derivatives (McCreevy, 2008, FRBNY, 2008, US Treasury, 2009). As the market is moving forward in this direction, the debate has now shifted to the question of the most appropriate market set-up for the clearing of OTC credit derivatives, in particular the number and location of CCPs dedicated to this task.

Despite its crucial importance, the question as to the most appropriate set-up for the clearing of a given asset has not yet been extensively researched by academics and central bankers. A first quantitative contribution by Jackson and Manning (2007) showed that CCP clearing can offer significant risk mitigation when compared with bilateral arrangements. Another paper, from Duffie and Zhu (2009), investigates the issue of the optimal number of CCPs for a given asset. They found that whenever it is efficient – in terms of netting efficiency – to introduce a CCP, it cannot be efficient to introduce more than one CCP for the same asset.

However, when assessing the suitability of a single CCP solution as against a two-CCP set-up, it is important to take into account not only the maximum netting ratio achieved by the single CCP solution, but also the concentration of risk in a single infrastructure that this solution entails. For this reason, in this paper we use different metrics than those used in Duffie and Zhu (2009). Instead of looking at the netting efficiency, we perform a series of stress tests and consider that the most resilient set-up will be the most appropriate one. The stress tests consist in simulating the outcome of a crisis that would result in the simultaneous default of several banks together with a sharp variation in the cleared asset price, hence leading to some replacement costs for the CCPs. Should the losses incurred by a CCP exceed its clearing fund, the CCP will default, strongly affecting the smooth settlement of all trades cleared by the defaulting CCP. The metrics we use to compare and assess the different clearing set-ups is the expected average value of the trades cleared by a CCP that has defaulted.

This paper focuses exclusively on a comparison between a single CCP solution and a two-CCP set-up. A realistic comparison between bilateral clearing and CCP clearing calls for careful modelling of the domino effect that could be triggered by the default of a single bank in the bilateral clearing scenario, and would require a more complicated model. In order to take into account the potentially different risk profiles of the participants, we model a world divided in two zones with distinct currencies and populated by distinct sets of banks and we allow for the possibility that the two zones are affected by the crisis to different degrees. We study different set-ups for the clearing of a single global product over these two zones, taking into account the fact that banks can trade in both currencies and with banks from the other zone.

1| MODELLING CCPs' DYNAMICS DURING FINANCIAL TURMOIL

1|1 Designing the financial environment

We model a world divided in two zones, which we will call respectively America and Europe for the sake of convenience. Each zone is characterised by its respective currency – dollar or USD for America and euro or EUR for Europe – and by its set of domestic banks that we will call American and European banks respectively. Both European and American banks engage in OTC trading activities on a given single asset or product (CDS in this paper). The banks are free to trade with banks that belong to their own zone or with banks that belong to the other zone. We will refer to these trades as domestic and cross-zone trades respectively. All types of trades – domestic European, domestic American and cross-zone trades – can be made in either of the two currencies. For example, two European banks can trade the asset with each other for dollars or euro.

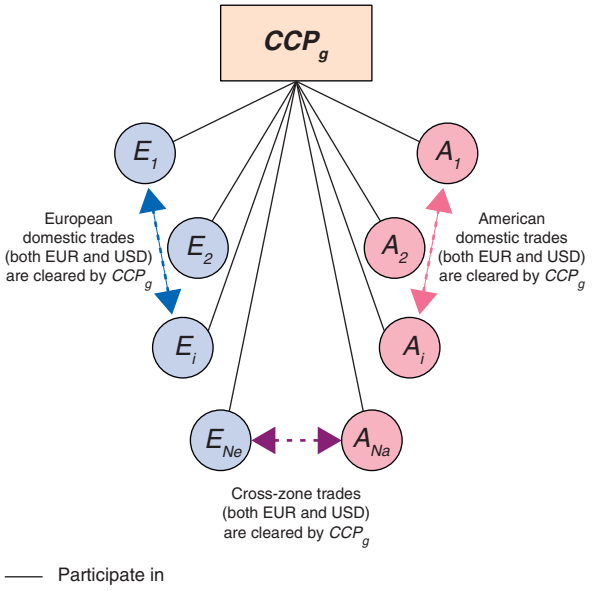
The model includes one or two CCPs that clear the OTC trades concluded between the banks. All trades

are cleared by a CCP, meaning that we do not allow for the possibility of bilateral clearing. We assume that the CCPs do not face principal risk, which is reasonable nowadays thanks to the development of delivery-versus-payment arrangements. CCPs in Europe and the US typically have three lines of defence to protect themselves against the default of a participant: margins called from the participants; a clearing fund; and the CCP's own assets. In the model, we ignore the third line of defence, or rather consider that the CCP's assets can be merged into its clearing fund. We thus assume that all CCPs rely on both a clearing fund and on margins posted by the participants (taken in the model as proportional to the absolute value of the net position of participants with regard to the asset).

1|2 Different clearing set-ups

When more than a single CCP is involved, the organisation of the clearing can take diverse forms, depending on the transactions cleared by each CCP. We do not model competition between CCPs here, and the perimeter of each CCP is taken as exogenous.

Figure 1
Participation structure and organisation of clearing in Set-up 1



Here are the different set-ups that were considered:

- ***The single CCP model (Set-up 1).*** There is only one CCP, called CCP_g, in which all European and American banks participate directly. This single global CCP clears all trades irrespective of the nature (American domestic, European domestic, or cross-zone) and of the currency of the trade (see Figure 1).

- ***Two-CCP model with a clearing link between CCP_e and CCP_a (Set-up 2).*** There are two CCPs, one American, called CCP_a, in which only American banks participate, and one European, called CCP_e, in which only European banks participate. CCP_a clears all American domestic trades (both EUR and USD) while CCP_e clears all domestic European trades (both EUR and USD). Cross-zone trades (both EUR and USD) are cleared through a bilateral clearing link established between CCP_e and CCP_a (see Figure 2).

- ***Two-CCP model with a link between CCP_e and CCP_a cleared through a CCP of CCPs (Set-up 3).*** Same as Set-up 2 except that cross-zone trades (both EUR and USD) are cleared through CCP_e and CCP_a's common participation in CCP_c, a CCP for CCPs (see Figure 3).

Figure 2
Participation structure and organisation of clearing in Set-up 2

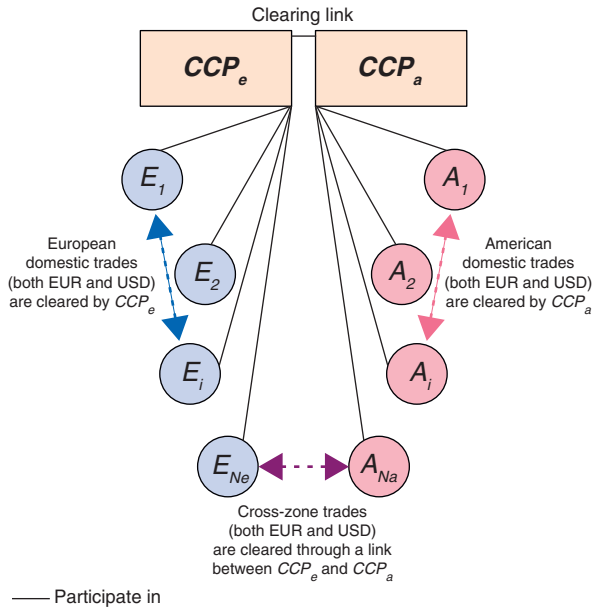


Figure 3
Participation structure and organisation of clearing in Set-up 3

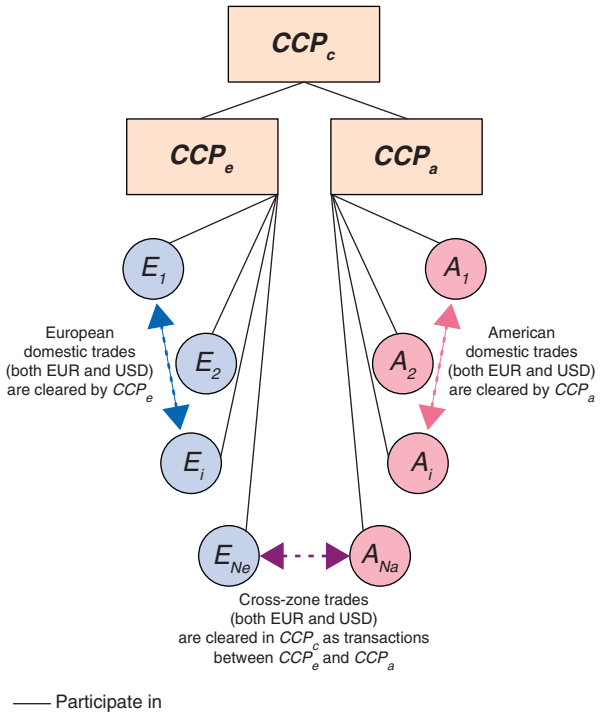


Figure 4
Participation structure and organisation of clearing in Set-up 4

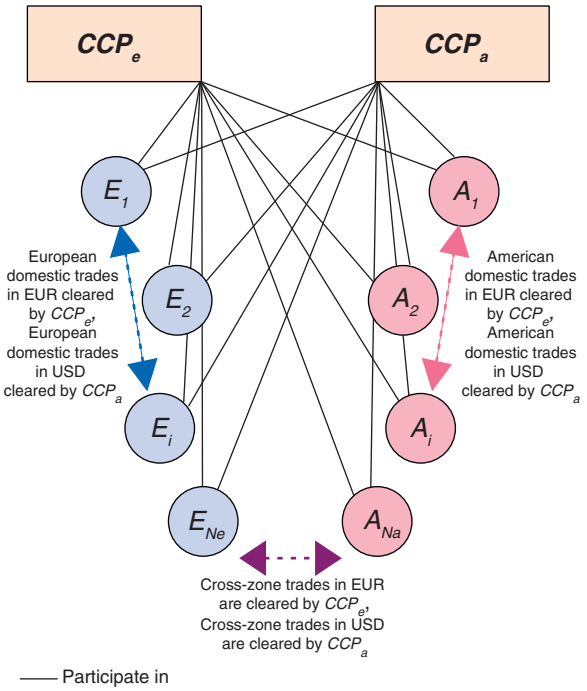
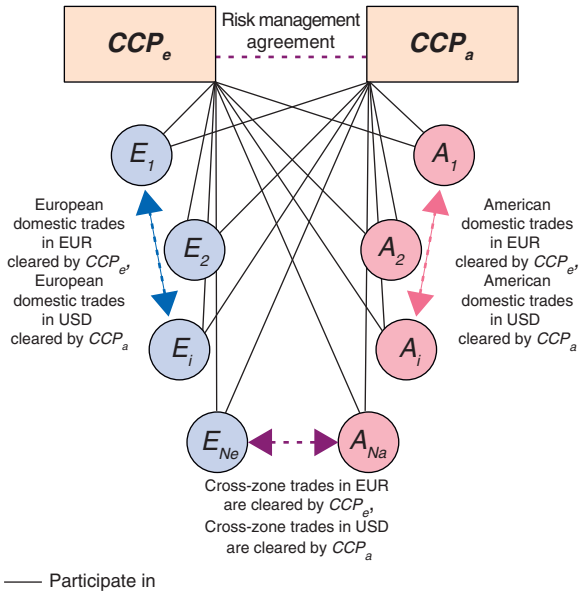


Figure 5
Participation structure and organisation of clearing in Set-up 5



• ***Two regional CCPs clearing their respective currencies (Set-up 4).*** All banks participate both in CCP_a (which clears all trades denominated in USD) and in CCP_e (which clears all trades denominated in EUR) (see Figure 4).

• ***Two regional CCPs clearing their respective currencies, with a risk management agreement in place between the two CCPs (Set-up 5).*** Same as Set-up 4, with a risk management agreement in place between the two CCPs. The risk management agreement includes cross-margining and possible transfer of positions of defaulting participants (see Figure 5).

The ability of the different aforementioned set-ups to withstand a crisis is investigated in the following section. CCP guarantee funds were chosen so as to ensure compliance with CPSS-IOSCO (Committee on Payment and Settlement Systems and International Organization of Securities Commissions) Recommendation 5 for Central Counterparties (BIS, 2004) which requires CCPs to "maintain sufficient financial resources to withstand, at a minimum, a default by the participant to which it has the largest exposure in extreme but plausible market conditions." In order to allow for a fair and meaningful comparison between the different set-ups, the total amount of cash immobilised (margins + guarantee funds) is always the same in all set-ups. Thus in the two-CCP set-up, the sum of the guarantee fund of the two CCPs is equal to the guarantee fund of the single CCP in the single CCP arrangement.

2| TESTING THE RESILIENCE OF THE DIFFERENT CLEARING SET-UPS

2|1 Crisis model and testing metrics

As CCPs only face replacement cost risk in the model, they are only vulnerable to a participant's default simultaneous with a large market movement. Thus, the model includes both a market crisis, represented as a large and sudden drop in the asset price, and a banking crisis, represented as the simultaneous failures of several banks. The bank defaults are modelled by giving each bank a certain probability of default, which leads to a random number of defaults, rather than by imposing a certain number of defaults. Such an approach was thought to more realistically capture the nature of global crises. For example, with 100 banks in each zone, imposing a 3% default probability for all banks in both zones can lead to 3 defaults in each zone (with a probability of 5%) or to 1 default in one zone and 4 in the other zone (with a probability of 2.5%). The two zones having the same risk profile only means that the average expected number of defaults will be the same in both zones, not that the actual realisation of the crisis will be systematically the same in both zones.

The bank defaults will lead to losses for the CCPs, which will be covered by the margins posted by the defaulting banks and by the CCPs' clearing fund. A CCP is considered as defaulting when its clearing fund is unable to cover all of its losses. A series of simulations were performed using an OCTAVE[1] implementation of the model described, with the objective of trying to assess the previously presented clearing set-ups. The impact of the crisis is characterised by the total value of affected trades. A given trade is considered "affected" if and only if the CCP clearing this trade has defaulted, regardless of the possible default of the two banks at the origin of the trade.

2|1 The model's findings

The relative performance of the set-ups will depend on the topology of the cleared transactions (including the number of participating banks, the number of transactions, the degree of integration between the two zones, the proportion of transactions that are concluded in the home currency), on the level of margins and guarantee fund of the CCPs, and on the type and magnitude of the crisis (which can affect only one of the two zones or both, and can be severe or mild). Each of these parameters was varied away from a base case in order to investigate the effects at work. Despite the model's limitations, it yields the following findings.

The first finding is that a two-CCP solution is more resilient than a single CCP when the magnitude of the crisis is large. This effect is greatest when the crisis affects only one of the two zones. Basically, a single CCP allows for the mutualisation of the losses between the two zones, which is effective in weathering mild local crises but allows the propagation of local crises from one zone to the other.

The second finding is that a two-CCP solution appears all the more appropriate when the degree of integration between the two zones considered is moderate. When there is a low level of integration between the two zones, a two-CCP solution allows for perfect insulation of the two zones, and thus provides a very high level of resilience against severe local crises.

The third finding is that the level of participation has a complex effect on the resilience of CCPs. All other things being equal, increasing the number of participants decreases the uncertainty of the outcome. This tends to make the situation better or worse depending on the existing balance between the level of funding of the CCP(s) and the magnitude of the crisis. An interesting and to some extent unexpected outcome is that a high level of participation does not favour the two-CCP set-ups compared to the one-CCP set-up. On the contrary, two-CCP set-ups perform better than the single CCP set-up for low levels of participation.

The fourth finding is that when more than one CCP is involved, the organisation of the clearing between the different CCPs plays an important role. In particular, the existence of risk management agreements between the CCPs (such as cross-margining and the transfer of the position of the defaulting participants) is shown to greatly increase their resilience.

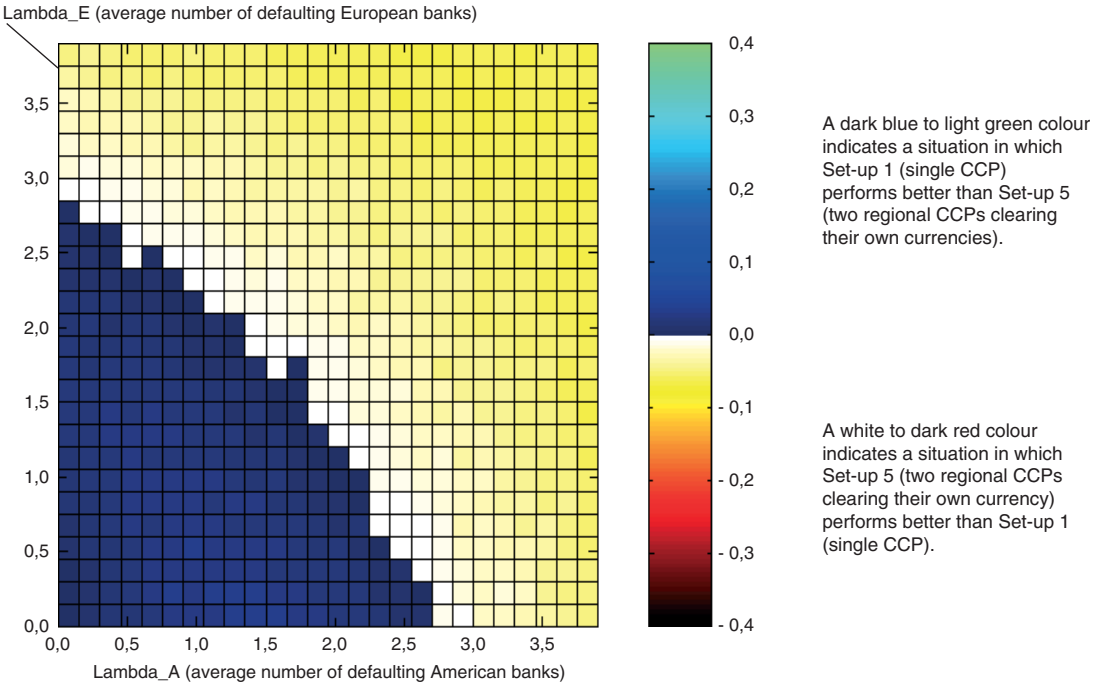
1 *www.octave.org*

2|3 Assessing clearing resilience empirically

In addition, we make an initial attempt to apply the model to the clearing of credit derivatives. To do so, we select a sample of major US and European credit derivatives dealers[2] and use public data from banks' financial statements and supervisory reports (Office of the Comptroller of the Currency's quarterly report[3] on bank trading and derivatives activities).

Regarding the clearing of credit derivatives, Set-ups 4 and 5 (two regional CCPs each clearing their own currency) are probably the most appropriate two-CCP set-ups since they would allow access to central bank money for each of the two CCPs. As Set-up 5 combines some interesting features of the single CCP set-up and of the two-CCP arrangement, it was the chosen set-up for this investigation. Figure 6 presents a comparison between Set-up 5 and Set-up 1 (the single-CCP set-up). The x-axis corresponds to the magnitude of the banking crisis in the American zone and the y-axis to the magnitude of the banking crisis in the European zone. Each cell results from the averaging of 10,000 simulations performed, and the colour of the cell provides the average difference between the observed fraction of trades affected by the crisis in set-up 5 and in set-up 1. According to the chosen colour scale, a dark blue to light green colour corresponds to crisis parameters for which set-up 1 is more resilient (fewer affected trades), while a white to dark red colour corresponds to crisis parameters for which set-up 1 is less resilient (more affected trades). Figure 6 clearly shows that a two-CCP set-up would be more resilient than a single CCP arrangement for severe crises. Using these real data, it confirms that a single CCP set-up might not be the most appropriate solution in terms of financial stability. However, this warrants being validated by further research using real trade-by-trade data.

Figure 6
Compared impact of the crisis in Set-ups 5 and 1
Impact of the crisis in Set-up 5 minus impact of the crisis in Set-up 1



2 *We consider banks whose notional amount of traded credit derivatives is above USD 1,000 billion. We obtain the following sample of American banks: JPMorgan, Bank of America, Goldman Sachs, Morgan Stanley, Citigroup; of European banks: Deutsche bank, Barclays, BNPP, Société Générale, Crédit Agricole, HSBC.*
3 *The OCC report is available at www.occ.treas.gov/deriv/deriv.htm.*

The model shows that the question of the optimal number of CCPs for a specific market is extremely complex and depends on many parameters such as the level of funding available to the CCP(s), the degree of integration between the different zones that make up the market and the particular risk profiles of these different zones. In particular, the likelihood of a severe local crisis is of prime importance.

There is therefore no general answer to the question as to the optimal number of CCPs for a specific market and only a case-by-case detailed analysis could provide some insight into the most efficient solution to be implemented. This would require a more comprehensive assessment using real net exposures data on all types of products. Furthermore, risks other than credit risk should be taken into account. For example, a global CCP clearing multiple currencies will typically rely on one or several commercial settlement banks to operate. Thus it would face higher settlement bank risk than a CCP operating in a single currency that uses the central bank as settlement agent. More generally, swift access to central bank money has proven to be extremely important for CCPs in times of crisis.

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