

Is there a
“race to the bottom”
in central counterparties
competition?

- Evidence from LCH.Clearnet SA,
EMCF and EuroCCP

DNB
Occasional Studies

Siyi Zhu

Central bank and prudential supervisor of financial institutions

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Abstract

The European trade and post-trade industries have seen increased competition in the past few years. As a result of the intensifying competitive market pressure, a series of tariff reduction and alterations of risk management models have been implemented by some central counterparties (CCPs) in Europe, which raises the concern of overseers and regulators that the financial soundness and risk mitigation capacity of CCPs could be threatened, leading to a “race to the bottom”. To address the concern, this paper presents CCPs’ competitive responses both in the field of tariffs and risk management based on the practices of the three CCPs in European equity market-LCH.Clearnet SA, EMCF and EuroCCP. It concludes that, 1) competition in the pan-European equity clearing industry has given rise to CCPs’ tariffs-cutting activities, which in part enhances market efficiency; 2) there’s no fit-for-all risk management mechanism: the CCPs studied apply a common framework while they employ certain different specifications in modeling and loss sharing procedures; 3) no solid evidence implies that competition among CCPs has led to a deterioration in the robustness of CCPs’ risk management.

Key words: Central counterparty, competition, risk management, loss mutualization

I Introduction

Central counterparties (CCPs), which interpose themselves between counterparties as a seller to the buyer and a buyer to the seller, have received increasing attention given their vital role in the financial market infrastructure. They novate contracts, redistribute, and manage counterparty credit risk through multilateral netting, generating a risk reduction benefit and an enhancement of economic efficiency. As CCPs are obligated to fulfill the terms of the original contract between a seller and a buyer at the current market conditions if one of these parties defaults before the transaction is finally settled, they are typically exposed to various risks, namely replacement cost risk, liquidity risk, operational risk, legal risk and settlement risk. Moreover, from a systemic point of view, concentration risk is involved as the system relies on the substitution of one legal entity to the contractual commitment of other market participants in case of failures. In view of that, it is of great importance that the risk management process of CCPs is soundly founded and adequately operated in ways that minimize the risk of “single point of failure”.

Since the introduction of the MiFID¹ and the Code of Conduct², the European trade and post-trade industries have seen severer competition, as evidenced by the emergence of new trading platforms (Multilateral Trading Facilities, MTFs) and CCPs, as well as the request for establishing inter-CCP links to enable members of the linked CCPs to benefit from a broader connection to trading venues, thereby creating a horizontally consolidated structure. In the wake of increasing competitive pressure, the pan-European equity CCPs have implemented a series of tariff reductions and amendments to their risk management models. The consequence may be two-fold. On the one hand, competition could in part promote market efficiency and provide welfare-improving benefits by driving down costs of clearing in the form of lower fees, encouraging industrial innovations and broadening the access of market participants to central clearing, which in turn has risk reduction benefits through increased use of CCPs. But on the other hand, if insufficiently monitored, competition could also be associated with some inappropriate responses. For example, CCPs may apply less stringent access criteria, or compromise margin policies and other risk controls to attract more trade flows. That would form a

¹ Markets in Financial Instruments Directive, see details in <http://www.mifidirective.com/>

² European Code of Conduct for Clearing and settlement, see http://ec.europa.eu/internal_market/financial-markets/docs/code/code_en.pdf

competitive “race to the bottom”³ which will weaken CCPs’ capacity to deal with member defaults.

In light of CCPs’ systemic importance, concerns have been raised among regulators and overseers about the effect of the competitive behaviors on the resilience of CCPs. This report studies the behaviors of the three CCPs competing in the pan-European equity market and seeks to provide an overview of the ongoing competition and to examine whether the soundness of CCPs’ risk management model is endangered through the so-called “race to the bottom”. The CCPs studied in the report are LCH.Clearnet SA, EMCF and EuroCCP, because they are most relevant to De Nederlandsche Bank (DNB)’s oversight. To outline the changes and make comparisons, the historical and current information about CCPs’ fee schedules and the risk management models are collected from various resources such as press releases, CCPs’ rulebooks and instructions, etcetera. It is important to mention, however, that information availability is one of the report’s major limitations, owing to the lack of a complete dataset keeping track of CCPs’ activities. Another limitation of the report is that the competition between CCPs is taking place at European level, having a broader scope than the three CCPs. Furthermore, it is worthwhile bearing in mind that, in comparison to EMCF and EuroCCP, LCH.Clearnet SA has a larger product range, covering small- and mid-cap securities and derivatives in addition to blue-chip stocks. Hence, the setup of fee schedule and risk management model has been scaled to the extent that they can be applicable to these products.

The report is structured as follows. Chapter 2 provides a literature review introducing CCPs’ function and their economic and risk implications. It also briefly demonstrates the competitive position of the three CCPs in the European equity market. Chapter 3 and Chapter 4 respectively present the development of CCPs’ tariffs and risk management models in the context of competition. Chapter 5 summarizes the analysis and puts forward some policy implications.

³ A “race to the bottom” is a situation whereby firms remain engaged in a costly price-cutting battle for successive periods, each hoping the competitor will eventually withdraw (Market Structure Development in the Clearing Industry, CPSS, November 2010).

2 CCPs and the competitive environment

Clearing, in the most general sense, is a post-trade, pre-settlement process which contains various procedures such as trade capture, matching and confirmation, position netting and obligation calculation for trade counterparties. It performs as a crucial phase in the life cycle of securities transaction (See Box 1 for more information). Therefore, the functionality of clearing houses or central counterparties in some markets is largely influencing the efficiency and stability of financial markets.

2.1 What is a central counterparty?

A central counterparty is an entity that interposes itself between the original counterparties of a trade, thereby acting as a seller to the buyer and a buyer to the seller. The legal process of such contract substitution is called trade *novation*. Novation is one of CCPs’ primary roles as it diversifies risk by pooling idiosyncratic counterparty risk (Koepl and Monnet, 2010). Another function of CCPs is multilateral netting, which delivers significant reductions in both risk exposures and total pre-settlement costs (Jackson and Manning, 2007; IMF, 2010), as CCPs combine each party’s open positions on a multilateral basis and proceed with netted positions. Furthermore, CCPs require exposures to be collateralized to mitigate risks. Through novation and *multilateral netting*, CCPs are able to centrally monitor and manage risks in an efficient manner, and are also able to absorb shocks by mutualizing remaining losses among the entire member base after using certain financial buffers. Hence, well-run CCPs lower the probability a systemic disruption.

Given the contribution of CCPs to financial stability being discussed, it is also vital to understand that CCPs become important connection points in the financial system which can, on the other hand, increase systemic risk (Pirrong, 2011). The theory of economies of scale and scope suggests that a multi-asset CCP can deliver additional risk reduction benefits through netting and diversification effects (Jackson and Manning, 2007; Duffie and Zhu, 2010), but a multi-product CCP that concentrates all the transaction will in turn cause a threat of “single point of failure” to the financial system. Moreover, the loss-sharing feature of CCPs will inevitably induce moral hazard problem to the extent that information of creditworthiness is asymmetric.

Box 1 Security trading, clearing and settlement

Trading

When investors, both a buyer and a seller, agree on the bid and ask levels of a particular trade, they send orders to their respective brokers for trade confirmation and execution. Instructions for executing the trades are routed to the clearing and settlement system.

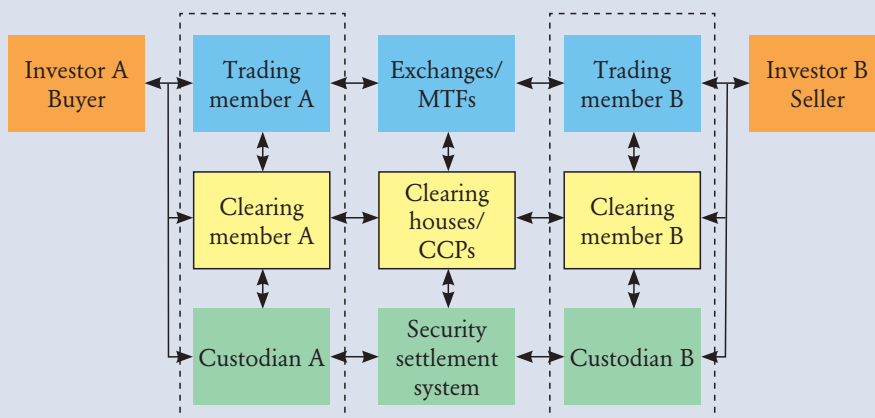
Clearing

Security clearing is the process of transmitting, reconciling and, in some cases, confirming security transfer instructions prior to settlement, potentially including the netting of instructions and the establishment of final positions for settlement. The clearing house, in some markets as a central counterparty, may capture, match and confirm trades, as well as calculating obligations relating to securities transfer instructions prior to settlement⁴.

Settlement

Security settlement is a process of delivering fund against securities. It involves the transfer of cash from the buyer to the seller, and the transfer of security from seller to the buyer. Typically, the security account is held by the Central Securities Depository (CSD) and the cash account is held by a settlement bank, such as a central bank or a commercial bank.

The graph below presents a simple process of trading, clearing and settlement. For some securities that are not exchange-traded, trades can take place in an over-the-counter (OTC) market. In practice, many security service providers are acting as trading members, clearing members and custodians, or at least two of the three, in the interest of cost-efficiency for end investors.



⁴ The payment system, European Central Bank, 2010

2.2 The competitive environment

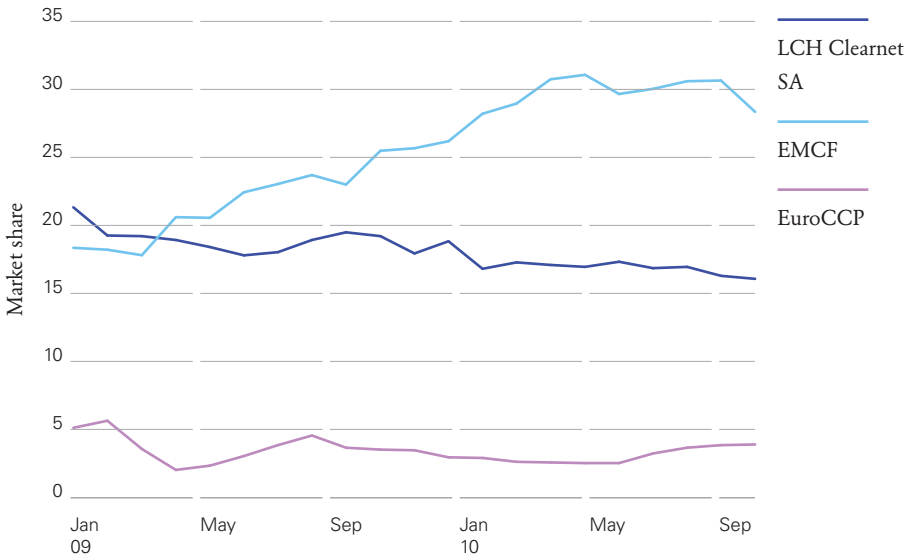
Economic theory suggests that competition is a way to promote market efficiency and transparency, as it will benefit consumers in terms of greater choices, driving down prices, as well as stimulating innovations in markets. With the MiFID and the Code of Conduct in effect, one of the most remarkable developments seen in the European trade and post-trade industries is the startup of new trading venues and CCPs. Since the new entrants (e.g. Chi-X and BATS Europe) offer trading services overlapping with the traditional exchanges but at a lower trading cost, they have captured a sizable market share from the incumbent exchanges (e.g. NYSE Euronext). Consequently, CCPs connected with these MTFs, namely EMCF and EuroCCP, have significantly increased their market coverage, presenting a competitive business challenge to the incumbent CCPs like LCH.Clearnet SA. An overview of the three CCPs’ ownership structure and their served exchanges/MTFs is displayed in Annex 1.

Figure 1 exhibits the market shares of the three CCPs in the pan-European equity market during the period from January 2009 to September 2010. The market share occupied by LCH.Clearnet SA has gradually slid down from 22% to 16%, while EMCF has gained a substantially broader market, increasing from 19% to 29%. The upward development of EMCF’s market coverage can be attributed to the increasing popularity of the new trading venues like Chi-X Europe and BATS Europe, as well as the inception of providing clearing services to NASDAQ OMX Nordic market in 2009. The market share for EuroCCP is relatively small and stable over time.

As Figure 1 illustrates, the competitive pressure among the three CCPs is evident. CCPs can take several actions to position themselves against the competitors in hope of attracting trade feeds at different trading venues. One of them is to introduce lower prices for the clearing services. Furthermore, CCPs may apply a risk management model that broadens the access to CCPs and requires less financial burden for the activity of their clearing participants. For instance, CCPs may introduce margin rules that are less scrutinized in securing open positions. Seeking for interoperability is another form of competition. In reality, in the absence of a wide implementation of interoperability⁵, CCPs other than the incumbent clearing provider of an exchange/MTF can hardly access the order flows of that particular trading venue. An interoperable arrangement allows the linked CCP to gain connection to the trade feeds at other trading platforms, and thereby enables the clearing participants of an interoperable CCP to consolidate their clearing with that CCP and to benefit from cost reduction and multilateral netting. Last but not least, CCPs can compete by providing new products ahead of the rest of the market and

⁵ Note that an interoperable arrangement between SIX X-clear and LCH.Clearnet Ltd already exists. Upon completion of the report, an inter-CCP configuration between four CCPs - EMCF, EuroCCP, LCH.Clearnet Ltd and SIX X-clear - has been set up on trading venues BATS Europe and Chi-X Europe.

Figure 1 Market shares of the three CCPs in the pan-European equity market



Source: BATS Trading⁶

offering cross-asset margin to the benefit of clients. On the other hand, clearing, as one of the competitive differentiators as well as a possible source of revenues, can also influence the position of the trading platform in return. Hence, given that the relationship between CCPs and exchanges/MTFs would be mutually beneficial, competition among CCPs is also to a large extent related to the competition among the trading platforms. That would suggest, for example, that CCPs may actively seek a connection with upcoming trading venues, and/or keep in close cooperation with the incumbent platforms to attract more order flows by offering new or more tailored services, attaining the first-mover advantages.

Although competition creates efficiency and transparency benefits, it reinforces CCPs’ trade-off between scrutiny risk management and profitability. If insufficiently overseen, excessive competition may force CCPs to take inappropriate actions that will harm their financial soundness and risk management capacity. Aiming

⁶ Based on data from BATS Trading, market share for an exchange/MTF is the proportion of individual market value to total market value. Then the market share for a specific CCP is the sum of the respective market share of all exchanges/MTFs served by the CCP. NB: the market share represented here might be subject to accuracy concerns, because some exchange/MTFs (e.g. London Stock Exchange) have more than one CCP to provide clearing services (for separated markets). The rest of the CCPs preserving a market share are Eurex Clearing, CC&G, SIX X-Clear, etc.

at identifying the possible manifestations of a “race to the bottom” in CCPs’ behavior, this report will focus primarily on CCPs’ competitive responses in tariffs and risk controls, which will be discussed in the next two chapters respectively, because these reactions, among others, will have a direct and prompt impact on the adequacy of CCPs’ financial resources and risk mitigation capacity, potentially affecting the resilience of financial system.

3 Competitive response in tariffs

Compared with changes in the risk management models, reducing tariffs is a more visible and explicit form of competition. Here, tariffs are directly paid by the clearing participants who have connected to CCPs, and ultimately passed on to the end-users. A typical fee schedule consists of one-off or periodic membership fee, clearing fee and other miscellaneous fees⁷. Based on the public releases, this chapter will first demonstrate the time evolution of the clearing tariffs during the period from 2007 to November 2010. Table 1 summarizes the historical fee cuts of LCH.Clearnet SA, EMCF and EuroCCP. It implies that pricing pressure in the market has increased notably over the past three years. More precisely, several trends have been observed.

First, the pricing levels of all three CCPs have dropped remarkably. The average clearing fees for Dutch stocks charged by LCH.Clearnet SA and EMCF are shown in Figure 2. For LCH.Clearnet SA, more than 90% of the clearing fee for cash equity has been progressively reduced since January 2007 (from EUR 0.65 to EUR 0.05), on the face of the emergence of the new entrants and the resulting increase in competition. Likewise, EMCF has lowered its clearing fee by approximately 80% (from about EUR 0.28 to EUR 0.05 or even lower depending on the transaction volume).

⁷ Depending on CCPs’ specific services, other miscellaneous fees can take the form of settlement fees which are charged on behalf of corresponding settlement agents, connectivity fees, cancellation fees and etcetera.

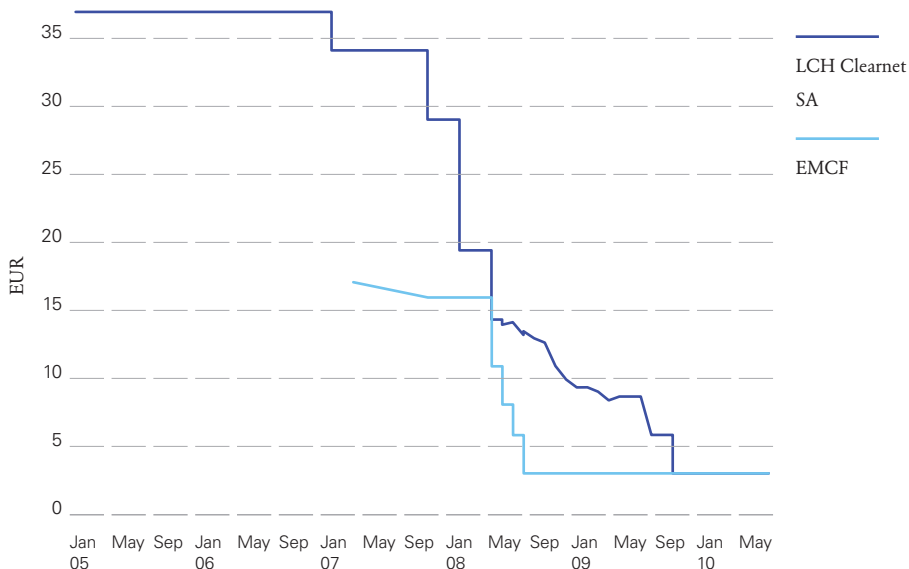
Table 1 Evolved clearing fee structure

Announce	Effective	CCP	Changes in fees
01/2007	01/2007	LCH.Clearnet SA	15% reduction
06/2007	10/2007	LCH.Clearnet SA	35% reduction
12/2007	04/2008	LCH.Clearnet SA	25% reduction
02/2008	03/2008	EMCF	From € 0.28 to € 0.19
04/2008	05/2008	EMCF	From € 0.19 to € 0.14; From € 0.15 to € 0.12 for UK;
06/2008	07/2008	EMCF	From € 0.14 to € 0.1
07/2008	08/2008	EMCF	From € 0.10 to € 0.05
03/2009	04/2009	EuroCCP	Depends on monthly average market sides: From: € 0.06 for < 400,000; € 0.0525 for 400,000 to 800,000; € 0.025 for > 800,000 (since September 2008) To: € 0.05 for < 800,000; € 0.025 for > 800,000
04/2009	07/2009	LCH.Clearnet SA	30% reduction
04/2009	04/2009	EMCF	UK clearing fee to € 0.03 per trade; Non UK € 0.05 per execution
05/2009	06/2009	EMCF	More flexible pricing model: choice between the current flat fee per execution and a flat fee per order ⁸ ; UK € 0.03, Non UK € 0.05 per execution; or UK € 0.05, Non UK € 0.07 per order € 0.03 per internalized trade
09/2009	10/2009	EuroCCP	New fee structure on average daily volume for individual: € 0.03 for <100,000; € 0.01 for 100,000 to 500,000 € 0.002 for >500,000
09/2009	01/2010	LCH.Clearnet SA	Replace ad-valorem structure with a fixed fee structure: € 0.05 for blue chip stocks postings and € 0.10 for others
06/2010	07/2010	EMCF	Per order: € 0.05 for <75,000; € 0.03 for >75,000; Per execution: € 0.03 for < 100,000; € 0.01 for > 100,000; € 0.01 per internalized trade

Source: Fee schedules and press releases from the website of LCH.Clearnet SA, EMCF and EuroCCP up to November 2010

⁸ The difference between an execution and an order is that an order can be settled with several executions in operation.

Figure 2 Average CCP clearing fees for Dutch stocks ⁹



Source: Position paper from AFM and DNB (2010) and additional information from the website of the CCPs

That said, with the increasing popularity of algorithm trading, the reduction in the clearing price might be less substantial in value-adjusted rather than transaction-based terms. Since the introduction of high frequency trading, the average posting value of transactions has seen a sharp decrease, indicating that the reduction in the per-transaction fee may not be entirely competition-driven. Change in the trading pattern that results in more low-value transactions may be another contributor. Put differently, even though the absolute level of clearing fee per transaction is brought down, as demonstrated in Figure 2, the clearing fee per value cleared may remain relatively sizable if the trading flow is dominated by a large number of transactions having small ticket sizes and high frequencies. However, due to limited availability of detailed data on this issue, an average clearing fee per value cleared is not yet measurable and therefore will not be covered in this report.

Secondly, an enhanced flexibility of the fee models has been observed. In 2009, EMCF started to implement a flexible pricing scheme, allowing the clients to

⁹ Data on average fee of EuroCCP is not available because in 2008 the clearing fee was dependent on the average volume of the market it cleared and since March 2009 the clearing fee has been based on the individual’s average daily volume. EMCF introduced a flexible flat pricing model in May 2009. The fee displayed here is based on the choice of ‘per execution’. After EMCF’s implementation of a variable fee structure in June 2010, the average fee can hardly be estimated and therefore is not displayed in this figure.

choose from two options for the tariff payment – a flat fee schedule, calculated either per execution or per order - based on the trading activities. See the details of the pricing model in Table 1.

Finally, higher competition contributes to a simplification of the fee grids, leading to greater transparency. In April 2009, LCH.Clearnet SA remedied the cash fee grid by decreasing the number of bands and the levels of caps and floors. A second change implemented in 2010 was to replace the ad-valorem fee scheme with a fixed-rate pricing model, which is simpler and more transparent. Besides, EuroCCP altered the fee structure from market-based to individual-based in 2009, enabling its clearing members to more directly measure and predict its own cost of clearing.

As far as fees are concerned, two additional issues need to be addressed. First of all, LCH.Clearnet SA offers clearing services to the small- and mid-cap securities and derivatives whereas the other two CCPs do not. A higher fee is demanded for clearing the less liquid securities. Secondly, the tariffs charged by the CCPs may also include settlement fees (for CCPs using settlement agents like EuroCCP and EMCF), treasury fees (for CCPs with treasury desks like LCH.Clearnet SA) and other miscellaneous fees. Comparably speaking, these hidden fees are less publicly witnessed, reported and circulated than clearing fees. Typically, settlement fees charged by the (I)CSDs or the settlement agents are recharged directly to members, but it may depend on the bilateral agreement between CCPs and the related settlement entities. Provided that the clearing price has nearly bottomed and the room for reduction is almost exhausted, charges other than the clearing tariffs, for instance a higher collateral management cost or more deduction of interest gained on collateral, could potentially become a possible revenue resource for some of the CCPs. Nevertheless such income streams might be less sustainable in the long run due to increasing competition.

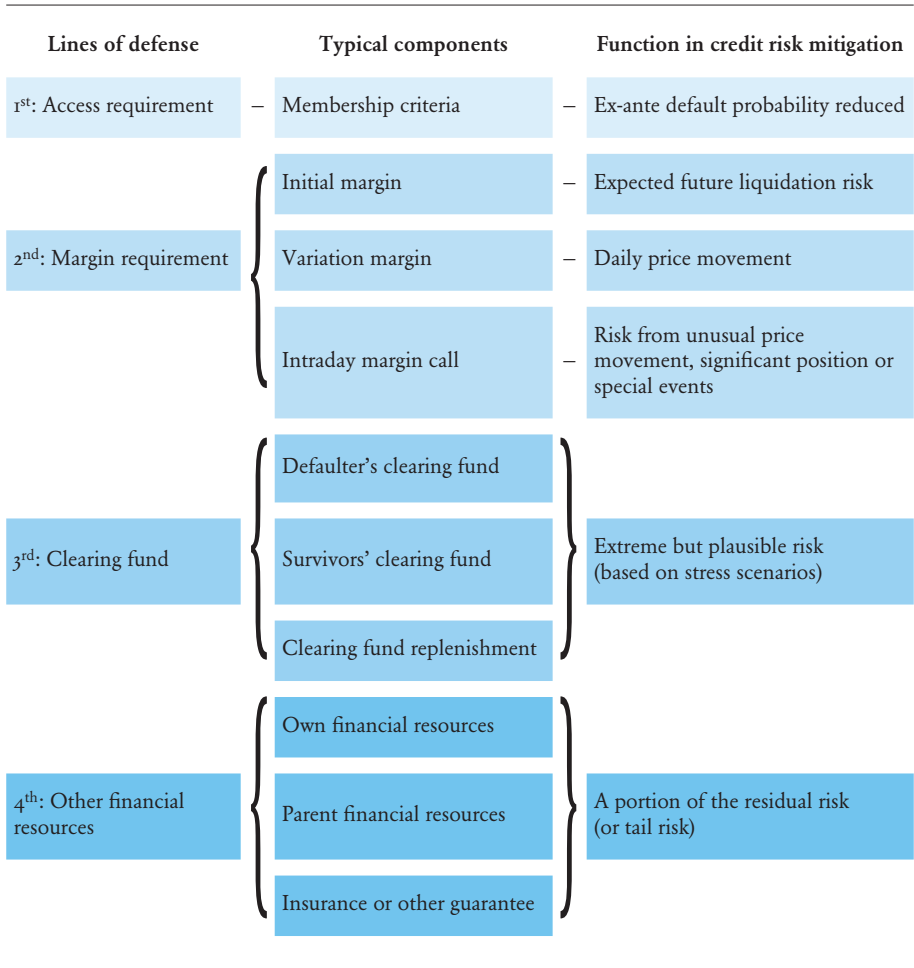
4 Competative response in risk management models

The function of CCPs underscores the essential role of risk management in CCPs operations. Typically, CCPs are exposed to various risks, such as counterparty credit risk, liquidity risk, legal risk, operational risk, settlement bank risk, to name a few. Counterparty credit risk, consisting of replacement cost risk and principal risk, is faced by CCPs given their responsibility in the contractual relationship towards buyer and seller. Principal risk, defined as the risk that a CCP fulfils its contractual obligation while its counterparty fails to do so, can be eliminated largely by the delivery versus payment mechanism. However, CCPs are inevitably linked with the replacement cost risk because of their unique role in substituting the contractual obligation. Replacement cost risk is the risk that, if a clearing member defaults before the transaction is finally settled, the relevant CCPs need to replace the contractual commitment at the current - plausibly unfavourable - market conditions, which might cause a loss to the CCPs or even insolvency of the CCPs if they do not have access to sufficient financial resources to absorb the losses¹⁰. In view of the systematic role of CCPs in the financial market infrastructure, it is of great importance that CCPs’ risk exposure is minimized through a robust risk mitigation mechanism.

Moreover, although CCPs specialized in equity markets share some similarities in risk management framework with CCPs for derivative products, the former may have certain different specifications from the latter - for example different parameter sets and models for margining. In recognition of that, the analysis of this chapter will be applicable to CCPs involved in equity business only. Before listing the development observed on risk management ground, we present a holistic description of the risk controls that the studied CCPs usually undertake to manage and mitigate risks.

¹⁰ More formally, replacement cost risk is defined as “the risk that a counterparty to an outstanding transaction for completion at a future date will fail to perform on the settlement date. This failure may leave the solvent party with an un-hedged or open market position or deny the solvent party un-realized gains on the position. The resulting exposure is the cost of replacing, at current market prices, the original transaction.” (BIS, 2003).

Figure 3 Construction of CCPs’ risk management mechanism



4.1 CCPs risk management mechanism

The risk management models of CCPs are designed in a similar structure, comprising several lines of defense for risk-bearing, being an ex ante access criteria for the clearing participation, margining requirement, clearing fund¹¹ contribution pledged by the members, and other financial resources including own capital and additional default recourses such as capital from the parent companies in some cases. Figure 3

¹¹ In some cases, it is also named as default fund or guarantee fund. For simplicity’s sake, we use clearing fund throughout this report.

displays a constitution of CCPs’ risk mechanism and the typical components used in practice.

First line of defense: Access requirement

As is shown, the process of risk mitigation starts initially from the membership criteria. Applying an entry hurdle as the first filter is an important tool to ensure a sufficient level of operational experience, financial stability and creditworthiness of the members. Access requirement will help to reduce, in general, the likelihood of members’ failure to fulfill their obligation, and thereby provides an ex-ante protection for the soundness of the mechanism.

Based on the three CCPs’ admission criteria stated in the Rulebooks¹², the largest discrepancy lies in the capital requirements. To begin with, CCPs set capital rules depending on the type of clearing participants. Some members are acting as General Clearing Participants (GCPs) while others have the status of Individual Clearing Participants (ICPs) or Direct Clearing Participants (DCPs)¹³. The distinction between the two groups is that ICPs or DCPs only accept and clear trades for own or on behalf of their customers, while GCPs accept and clear trades for themselves, for their customers and for firms that are Non-Clearing Participants (NCPs). As GCPs confront with more credit risk as they incorporate the trades of NCPs in their clearing process, they need to be better funded than the ICPs or DCPs.

EMCF requires the clearing participants to maintain a capital of no less than the highest of 1) EUR 25 million for GCPs and EUR 7.5 million for DCPs; or 2) 10% of 30-day average Aggregate Margin requirement; and 3) 10% of 250-day average Aggregate Margin requirement. EuroCCP has a minimum capital requirement of EUR 70 million Excess Regulatory Capital¹⁴ for GCPs, and EUR 20 million Excess Regulatory Capital for ICPs. For a GCP, the financial criteria applied by LCH.Clearnet SA range from EUR 25 million to EUR 37.5 million based on the number of its Trading members, while for an ICP, LCH.Clearnet SA demands a capital of EUR 10 million. Furthermore, if the minimum capital threshold is breached but the capital is no less than EUR 15 million and EUR 5 million for a GCP and an ICP respectively, a Letter of Credit in favor of LCH.Clearnet SA with a sufficient value to cover the shortfall is acceptable as a back-up.

Second line of defense: Margin requirement

The second layer is the margin system. In seeking to minimize the replacement cost risk that CCPs are exposed to, clearing participants are required to collateralize the netted positions so that the potential losses can be covered by means of margin.

¹² Rulebooks of LCH.Clearnet SA (2010), EMCF (2009) and EuroCCP (2009).

¹³ EuroCCP and LCH.Clearnet SA use the term of General clearing participant and Individual clearing participant while EMCF uses General and Direct clearing participant.

¹⁴ The capital above and over the regulatory requirements.

Setting margins at an optimal level requires making trade-offs between prudential protection for CCPs and the opportunity costs for clearing participants. A widely used margin system in practice contains three components: initial margin, variation margin and intraday margin (see Box 2 for more details).

Daily initial margin and variation margin are called against the risk associated with the daily transaction in a normal market circumstance. The initial margin is designed to cover the potential risk in liquidating the open positions for a defaulting member, which may occur over a specified time horizon. The essence of

Box 2 - Typical Margin Composition of CCPs

Initial margin

Initial margin is set up to cover the liquidation risk to CCPs when they interpose themselves between sellers and buyers should the open position be settled in a default event. Therefore it reflects CCPs' prediction of potential loss during the liquidation process of the position.

A large stream of literature has attempted to discuss the optimal margin design by quantifying the potential exposure of clearing houses over one or more days. Knott and Mills (2002) provide a review on a number of academic studies in this range, and summarize that three main types of modelling approaches are adopted: statistical models, optimisation model and option pricing approaches. However, these theoretical models have limitations due to strong assumptions about the distribution of asset price and focus on single assets rather than a portfolio (Knott and Mills, 2002). To cope with the limitations, progress has been made in addressing other margining modelling techniques, for example portfolio margining (e.g. SPAN model), a margin system based on a VaR method.

In practice, initial margin is only afforded to cover the potential risk in liquidating the position, which may occur over a specified time horizon under normal price movements. Recommendations for CCPs (ESCB-CESR, 2009) defines "normal" market conditions as price movements that produce changes in exposures that are expected to breach margin requirements or other risk control mechanisms only 1% of the time. In other words, losses that result from 99% of price movements should be sufficiently covered by initial margin.

Variation margin

More straightforward than initial margin, the variation margin or mark-to-market margin component represents a gain or loss on the open positions, calculated by taking the difference between current market price and trading price or reference price. It is a dynamic adjustment according to the latest price, keeping track of

market conditions and trading positions. Market risk, particularly generated by the daily price movement, is to a large extent reduced by the process of daily marking-to-market. In practice, some equity CCPs apply contingent variation margin, which takes into account the difference between reference price and last quoted price in calculating variation margin. Therefore, it means that only the negative price movement will be secured in the form of additional margin.

Intraday margin call

Since the initial and variation margin for the obligations arising from trade date (T) are calculated based on the end-of-day open positions of the trade date (T) but deposited at start-of-day on the following trade date (T+1), additional risks driven by an abnormal price movement or large trading positions will emerge during the next trade day (T+1). To mitigate intraday risk, CCPs usually have the possibility to call for additional intraday margin to ensure sufficient margin coverage. It is stated in Recommendations for CCPs that, a CCP should establish procedures to make intraday collateral calls on a routine basis or at a minimum when pre-specified thresholds are breached, for example, when price changes reach predetermined levels set by a CCP or when large positions have been built up by a participant during a trading day. However, issuing intraday margin call is not without cost. See the evaluation of benefits, costs and side effects of intraday margin in Wendt (2006).

determining the initial margin is to predict the potential loss coming up in closing out the positions. The key model elements are the prediction methodology, the assumed time length of liquidation (i.e. *liquidation period*), how much loss needs to be covered by the margin (i.e. *margin coverage or confidence interval*) and the netting and offsetting rules that count for the correlation between various assets in the portfolio. By comparison, variation margin covers the daily profits and losses of the positions due to the daily market movements, therefore calculating the variation margin is relatively straightforward -taking the difference between the latest market price and the trade price. Since the initial and variation margin for the obligations arising from trade date (T) are calculated based on the end-of-day open positions of the trade date (T) but deposited at start-of-day on the following trade date (T+1), additional risks driven by an abnormal price movement or large trading positions will emerge during the next trade day (T+1). To cater for that, CCPs usually issue an intraday margin call when potential losses breach the deposited margin to ensure sufficient margin coverage.

With respect to the surveyed CCPs, the methodology used to determine the initial margin requirement varies (see the details in Annex 2): EuroCCP utilizes the Value at Risk method (VaR), LCH.Clearnet SA uses the scenario based portfolio analysis (SPAN), and EMCF has developed a model using scenario based principal

component analysis (Correlation Haircut Model, CoH). However, some of the input parameters such as confidence level and liquidation period have displayed more resemblances. The similarity in the confidence level can be attributed to the minimum requirement of 99% stated in the Recommendations for CCPs (ESCB-CESR, 2009). In the absence of a regulatory requirement regarding the time needed to eliminate the exposure, as that would depend on the time of the default declaration from the clearing member and on the liquidity of the security, recent market development has seen a convergence towards a common assumption of liquidation period (it will be discussed later in this chapter). One can regard it both as an implication of competition and as a consequence of market harmonization. Moreover, the transparency of margin models differs across CCPs. The extent to which the margin model is published depends on CCPs' own judgement.

Third line of defense: Clearing fund

The third line of defense is the clearing fund, to which members make initial contributions at the start of their membership. The essence of the pre-funded financial resource is to mutualize the remaining risks that are not covered by the margin and clearing fund contribution of a default member among the other clearing participants. The clearing fund allows CCPs' access to additional default resources if the margin and clearing fund contribution posted by the defaulter proves insufficient to meet potential losses under extreme but plausible market conditions. It ensures that CCPs can sufficiently withstand at least a default of the participant to which it has the largest exposure. Depending on the origin, the fund can be classified into defaulter's contribution and survivors' contribution, both of which will be drawn on in a predetermined order by CCPs on the occurrence of defaults. Moreover, all three CCPs' rules mandate that any withdrawal from the clearing fund as a result of allocated losses could lead to a round-up of replenishment among the non-defaulting participants to again reach the desired size. Annex 3 gives an overview of the three CCPs' clearing fund calculations.

All the CCPs concerned are maintaining a clearing fund composed of individual contributions on the commencement of membership, which is a risk sharing mechanism among the entire member base. Most CCPs review the size of clearing fund on a daily basis, and call for additional contribution monthly or on the emergence of stress scenarios where the risk exceeds the total amount of margin and contribution. Therefore, stress testing plays an important role in CCPs' risk management system. It is a methodology to determine and evaluate the adequacy of CCPs' financial resources to absorb the hypothetical default loss of the largest participant in extreme but plausible market conditions.

In addition to similarities, studying CCPs' clearing fund policies also illustrates differences in their practices. First, in the absence of a common definition of "extreme but plausible" market conditions, the assumption of the stress scenarios

are internally validated and justified by CCPs based on their own experience. In addition, the total magnitude of the clearing fund may be influenced by the cap and floor imposed by some CCPs (e.g. LCH.Clearnet SA and EMCF), and by the size of the membership in the case of some CCPs (e.g. EMCF and EuroCCP). Furthermore, clearing member’s initial contribution is calculated in various ways. The clearing fund of LCH.Clearnet SA is primarily determined by the largest uncovered risk (i.e. the gap between stress risk and current margin) of all the members, and then allocated proportionally to individuals in accordance with their own uncovered risk. EMCF imposes a differentiated minimum contribution depending on the membership status, taking into account the past end-of-day aggregated margin amount simultaneously. EuroCCP utilizes a combined system. A large part of the clearing fund is based on the stress test, which results in a global figure shared among all clearing members in proportion. On top of that, each individual participant is subject to extra capital provision if the required margin exceeds the excess regulatory capital or its credit status is deteriorated.

Fourth line of defense: Other financial resources

If the aforementioned safety nets are inadequate to cover the close-out losses from the insolvent participant, other financial resources are used to fill the outstanding risk gap. CCPs’ own capital, its parental guarantees and sometimes the additional insurance or guarantee are typical forms of the “last resort”.

How does the mechanism work? - “default waterfall”

Following the discussion of the risk management model and the lines of defense in the previous sections, it is necessary to investigate how the mechanism functions to absorb the default losses. In other words, consideration is given to the effectiveness of the “default waterfall”. CCPs’ waterfalls are formed by various financial buffers which are either paid-in or set up as promissory resources upon contingent claim. The new CPSS-IOSCO principles¹⁵ in addition suggest that the rules of CCPs should expressly set out which financial resource to utilize under which circumstances and in which order in case of a member default.

Here, the concepts of *mutualized* and *non-mutualized* risk-sharing need to be underscored and distinguished. The capital posted by a defaulting participant, in the form of both margin and clearing fund contribution, is a non-mutualized financial resource, while the clearing fund provision and the (sequential) replenishment from non-defaulting participants are deemed a risk mutualized resource. By making a combination of the two, both efficiency and safety considerations are incorporated in minimizing and managing the default losses. With respect to the three CCPs’ practices on loss allocation procedures, the most significant distinction is the orderly utilization of the mutualized financial buffers for loss-bearing, after the defaulter’s

¹⁵ Principles for financial market infrastructure, consultative report, CPSS-IOSCO, 2011

paid-in resources are depleted. LCH.Clearnet SA then applies the clearing fund contribution from the survivors. EMCF operates a double-layered clearing fund to cover the excess default damage - the initial fund is physically paid-in when the membership is started, while the second round payment is callable in a default event. In contrast, EuroCCP itself may decide whether to share the incurred loss by providing a certain amount of own capital before activating the non-defaulter's clearing fund contribution. All the three CCPs have defined specific formulas to computer a survivor's pro rata share of such loss allocation.

Another point worth noting is the surviving members' obligation of clearing fund replenishment in case any amount of the clearing fund has been paid out for loss distribution in the aftermath of a default occurrence. From a non-defaulter's point of view, capping the potential liability at certain level is decisive in visualizing the extent to which the risk will be mutualized. An equally important question is the condition for employing the replenished fund to absorb the remaining loss. In practice, CCPs limit the capital re-provision induced by the first default and usually apply it in the situation of subsequent defaults. For instance, the members of EMCF will not be responsible for more than the amount of the contribution at the time the breach occurred. For the clearing participants of LCH.Clearnet SA, obligatory replenishment calls can be issued during the three-month period after an initial default event, up to a maximum of the original contribution amount. The amounts received from the replenishment of the clearing fund can only be used for subsequent defaults. Clearing members therefore have a capped exposure equal to twice their pre-default-event clearing fund contribution. A participant of EuroCCP can also cap the potential liability by terminating the membership within a certain timescale, so that the maximum liability will not exceed an amount equal to two times the sum of its margin amount and the required guarantee fund contribution prior to the loss allocation.

The key distinctive characteristics in the risk management frameworks of the CCPs' are summarized in the table below¹⁶.

¹⁶ The table has been prepared solely for the purpose of providing high-level information, and is not aimed at identifying the best risk management practice among the three CCPs. For simplicity and equal treatment reasons, points listed reflect only a high-level summary of several rules that are relevant. We do not include detailed information such as the exact criteria and concentration limits of eligible assets, or the formula with which individual proportion is calculated.

Table 2 Overview of the key distinctive factors in the three CCPs’ risk management framework

	EMCF	EuroCCP	LCH.Clearnet SA
Capital requirement	<ul style="list-style-type: none"> The higher of a fixed amount or 10% of average aggregate margin in previous trading days 	<ul style="list-style-type: none"> A fixed amount of Excess Regulatory Capital 	<ul style="list-style-type: none"> A range depending on the number of trading members for GCPs; a fixed amount for ICPs
Margin Calculation of initial margin	<ul style="list-style-type: none"> Scenario based PCA 99% confidence interval Assume liquidation in 3 days Based on portfolio level 	<ul style="list-style-type: none"> VaR model 99% confidence interval Assume liquidation in 3 days Based on portfolio level 	<ul style="list-style-type: none"> Portfolio based model SPAN 99.7% confidence interval Assume liquidation in 3 days Based on liquidity class level
Eligible collateral	<ul style="list-style-type: none"> Cash, government bonds, certain corporate, bank and municipal bonds, stocks Remunerated rate unknown No collateral movement fee, other fees unknown 	<ul style="list-style-type: none"> Cash, sovereign bonds, and Letters of Credit Pass through all interest earned Fees unknown 	<ul style="list-style-type: none"> Cash, central bank guarantee, government bonds and stocks Remunerate on cash collateral at a deducted overnight rate Fees on the amount of security, central bank guarantee and collateral movement
Clearing fund Calculation	<ul style="list-style-type: none"> Summation of individual contribution, reviewed by stress scenario of 40% price movement Minimum fixed amount for individual contribution, incorporating recent average aggregated margin data Total size depends on stress test and # of clearing participants 	<ul style="list-style-type: none"> 3 largest member exposure using 50 stress scenarios over 10 years’ historical market Distribute uncovered loss proportionally, plus individual adjustment based on margin, capital and credit rating Total size depends on stress test and # of clearing participants 	<ul style="list-style-type: none"> Largest single member’s uncovered risk using stress test Distribute uncovered loss among members on pro rata basis Total size depends on stress test, a floor and a cap

¹⁷ Principal Component Analysis, identifies the most important factors that capture the largest data variability.

¹⁸ In total there are four liquidity classes: Class 1: stocks in main indices (AEX, BEL20, CAC40, PSI); Class 2: other continuously traded stocks; Class 3: ETFs, investment funds; Class 4: fixing traded stocks and others.

<i>Vervolg</i>	EMCF	EuroCCP	LCH.Clearnet SA
Eligible collateral	<ul style="list-style-type: none"> • Cash, government bond and bank guarantee • Interest paid without deduction of overnight rate on cash deposit • No collateral movement fee, other fees unknown 	<ul style="list-style-type: none"> • Cash, sovereign bonds, and Letters of Credit • Pass through all interest earned • Fees unknown 	<ul style="list-style-type: none"> • Cash, government bonds and central bank guarantee • Interest paid without deduction of overnight rate on euro cash; rest same as margin collateral • Fees on collateral movement and central bank guarantee
Own capital	€ 18 million (Dec. 2010)	Figures not available	€ 168,30 million (Dec. 2010)
Default Loss waterfall sharing order	<ul style="list-style-type: none"> • Defaulter's margin • Defaulter's contribution • Survivors' contribution • 2nd round survivors' contribution • EMCF's own capital • Parent guarantee 	<ul style="list-style-type: none"> • Defaulter's margin • Defaulter's contribution • EuroCCP retained earning or undistributed income, at EuroCCP's discretion • Survivors' contribution 	<ul style="list-style-type: none"> • Defaulter's margin • Defaulter's contribution • Survivors' contribution • LCH.Clearnet SA's own capital
Survivors' obligation	<ul style="list-style-type: none"> • Replenish no more than the amount of the contribution at the time the breach occurred • Maximum exposure twice the original default contribution 	<ul style="list-style-type: none"> • Maximum exposure twice the sum of pre-default margin and the guarantee fund contribution by ending membership 	<ul style="list-style-type: none"> • Replenish the amount same as the last call, once during three month after the initial default event • Maximum exposure twice the original default contribution

Source: EMCF: Rulebook (2009), Regulation Clearing fund (2010), Regulation Collateral (2011), Regulation Margin (Jun 2009); EuroCCP: Rulebook (2009), Procedure (2011), Service overview (2009); LCH.Clearnet SA: Rulebook (2010), Instruction IV (2010).

4.2 Changes in risk management model

The design of CCPs risk management mechanism reflects the approaches that CCPs undertake in managing and mitigating risks. These risk controls need to be

Table 3 Evaluation of the “race to the bottom” manifestations in risk controls

Possible manifestations	Observed changes	Impact of the changes on the risk management
Lowering the access requirement	No change observed in the membership criteria	No impact
Offering less stringent margin requirements or lower default contribution	<p>Margin:</p> <ul style="list-style-type: none"> Liquidation period reduced by two CCPs, while increased by another CCP, consequently resulting in a harmonized market practice EMCF introduced a liquidity risk based margin component to cater for the additional risk. <p>Clearing fund:</p> <ul style="list-style-type: none"> EMCF raised clearing fund requirement in 2010. LCH.Clearnet SA has increased the cap and floor of the clearing fund since 2008 	The overall size of the financial resources has not been diminished. The reduction in the liquidation period is compensated by other financial buffers.
Raising the remuneration on assets pledged as collateral	<ul style="list-style-type: none"> Interest rate paid by EMCF on euro cash collateral increased by 25 bps in Feb. 2008. But no current remuneration published. As from Jan. 2010, LCH.Clearnet SA increased the charge on collateral: 2 bps from 0 bps on central bank guarantee and 10 bps from 5 bps on securities. Interest paid on euro cash was deducted by 25 bps, from 13 bps 	No material harm to the soundness of risk management. Some CCPs can profit from the gains on collateral.
Lowering quality of collateral accepted	<ul style="list-style-type: none"> EMCF has a broader range of eligible assets since the services to Nordic market started No changes of the other two CCPs observed 	No big impact on the soundness of risk mitigation capacity

Source: EMCF: Liquidity risk add on (2010), Regulation clearing fund (2010), Regulation Fees and Penalties (2007, 2010); LCH.Clearnet SA: Cap and floor of clearing fund (2011).

updated in a timely fashion and to be time-varying by reason of dynamic market conditions. Hence, CCPs’ amendments on the ground of risk management can be attributed to various reasons. For instance, CCPs change the collateral haircut according to different market conditions on an ongoing basis; the recent burst of financial crisis may affect CCPs’ assumption of the extreme scenario in stress testing, which consequently leads to a stringent requirement of clearing fund contribution. Therefore, we have attempted to separate the competition-driven activities from a normal market response in identifying the behaviors that might be relevant to justify the existence of a “race to the bottom”. For that reason, an evaluation of

the observed evidence is conducted against the proposed manifestations of a race-to-the-bottom phenomenon in Market Structure Development in the Clearing Industry (CPSS, November, 2010). The comparison is summarized in Table 3. Aside from that, the consequences of the alterations witnessed are set out in the last column.

First of all, given the information from the rulebooks, no evidence has shown that the access criteria of the surveyed CCPs have been amended. This may be because, as the admission requirement is the first tier of risk prevention, a small release in the participant standards may result in a serious threat to the quality of the clearing members' financial situation and creditworthiness. Besides, a lower entry threshold may be unacceptable by the incumbent members considering the risk-sharing feature of the clearing fund.

Regarding less stringent requirements for the margin and clearing fund contribution, only tentative evidence is observed on the shortening of the liquidation period, but it becomes less accountable as a reverse change has been implemented by another competitor. Consequently, it results in a harmonized market practice on the assumption of liquidation period, which is seemingly a competition-accelerated development towards a common ground. Furthermore, the reduction in liquidation period is eventually compensated by requiring additional financial buffers such as an enlarged clearing fund. For example, in 2010 EMCF implemented a liquidity risk add-on to cater for additional illiquid risk rises from large positions. Additionally, EMCF has required a higher clearing fund contribution since 2010: the applicable base deposit increased from EUR 2 million to EUR 3 million for GCPs and the percentages of average aggregate margin in preceding 30 days and 250 days increased from 2% to 7.5%. In parallel, LCH.Clearnet SA has executed a higher cap of EUR 1,250 million on the total size of clearing fund since the beginning of 2011. These actions give weight to the role of risk mutualization in CCPs' default waterfall. To sum up, the overall usable financial resources have not been diminished.

Thirdly, with respect to the remuneration on assets pledged as collateral, the interest paid on cash deposit has a different rate applying to margin account and clearing fund account. Evidence of an increased interest compensated for euro cash is observed when EMCF raised the rate by 25 basis points (bps) in February 2008. In this context, it is important to note that the remuneration rate on cash pledge rests heavily on the overall level of the base interest rate. Given that the current level of EONIA is substantially lower than the pre-crisis situation, the compensation rate is not sizable. On the contrary, LCH.Clearnet SA has employed a higher collateral fee and lower remuneration rate. As from January 2010, LCH.Clearnet SA increased the treasury fee charged on collaterals - from 0 bps to 2 bps on central bank guarantee and from 5 bps to 10 bps on securities. In parallel, the interest remunerated on euro cash was EONIA deducted by 25 bps, instead of 13 bps.

Last but not least, given the limited information on historical development, no evidence indicates that the CCPs studied have accepted a lower quality of collateral. The eligibility of asset classes and the haircuts associated are determined by the market volatility, risk profile of different instruments, as well as CCPs’ risk appetite and preference.

5 Conclusion and policy implications

5.1 Conclusion

This report presents a study on the behaviours of CCPs competing in the European equity market based on the practices of the three CCPs that are the most relevant to DNB’s oversight, namely LCH.Clearnet SA, EMCF and EuroCCP. The analysis looks into CCPs’ competitive response in two areas - tariffs and risk management models. In general, several conclusions can be drawn.

Firstly, competition in the pan-European securities clearing industry has intensified the competitive market pressure on cutting tariffs. All of the CCPs studied in this report have sequentially changed their fee schemes, not only the prices but also the structural features, leading to a significant decrease in the costs of clearing for clearing participants and a simplified, more flexible and transparent fee grid. Examining the clearing fees implies that the absolute level of clearing fee charged by CCPs is consequently reaching the bottom line and the room for reduction is shrinking. However, it should be noted that, as an increasing number of transactions having small ticket size but high frequency are created by algorithm trading, the reduction might be less substantial in the case of clearing fee per value cleared. In that sense, the extent to which sequential fee cuts have diminished the profitability of the CCPs may be less substantial. Furthermore, the tariffs charged by the CCPs may contain other costs in addition to clearing fees. For some CCPs, investment earnings on the assets pledged could become a potential revenue resource. But nevertheless, the feasibility and sustainability of such income streams might be challenging in a competitive market circumstance.

Secondly, investigating CCPs’ risk management model reveals that a similar framework is shared by the risk mitigation practice of the CCPs surveyed. CCPs setup selection criteria for clearing participants, implement risk-based margining as the second defense, distribute extra stress test-based risk exposure among clearing participants, and finally use own capital or other financial resources under certain conditions. However, in spite of divergence in the methodology that determines the relative magnitude of each component, CCPs specify different orders in which the mutualized financial buffers can be applied to bear the remaining losses after the defaulter’s paid-in or the non-mutualized resources are depleted. Another

discrepancy is the degree of transparency of the risk management models. In short, it seems that there is no best or fit-for-all model. The risk management system needs to be assessed entirely, taking into account other relevant information such as business model, ownership structure and so on.

Thirdly, several changes in CCPs' risk management practice have been observed, but comparing to the possible behaviors of a "race to the bottom" mentioned in Market Structure Development in the Clearing Industry (CPSS, November, 2010), there is no solid evidence indicating that the soundness of CCPs' risk management has been weakened.

- Firstly, the access criteria have not been changed in the past two years.
- Secondly, the observed evidence indicates that the cutting-off in liquidation period could be a competitive response. But in view of a reverse change from another competitor, the process is more in line with a competition-accelerated market harmonization seeking for a common practice. Apart from that, the shortening of the liquidation period is compensated by imposing a higher requirement of other financial buffers. Hence, the overall usable financial resources have not been diminished.
- With respect to the remuneration, only tentative evidence is observed that EMCF increased the interest rate by 0.25% on euro cash deposit in February 2008, while an opposite change is implemented by LCH.Clearnet SA as from January 2010.
- Finally, given the limited historical information at hand, there is no significant evidence indicating a lower quality of eligible collateral.

5.2 Policy implications

For policymakers and overseers, the study sheds lights on several points.

First of all, competition has been promoted in the pan-European equity market. As a driving factor in shaping CCPs' behaviors, competition has given rise to a significantly reduction in the cost of clearing and an increase in market efficiency partly. Although there is no solid evidence suggesting that competition has forced CCPs to take drastic actions that will result in a "race to the bottom", a prudential oversight on CCPs' response to the increasing competition is vital to ensure the functioning of CCPs and the resilience of the financial market infrastructure, particularly in light of the recent development regarding interoperability which is expected to shape the post-trade landscape and level the playing field. By the launch of interoperable arrangement, it is envisaged that competition among the pan-European CCPs will be noticeably sparked. Therefore, it is important for policymakers and overseers to make efforts to strike an appropriate balance between

safeguarding a sound and stable financial system and preserving the advantages of having a highly competitive market.

The order to apply various financial resources in a loss sharing procedure and the prompt availability and liquidity of these financial resources will have direct impact on the effectiveness of CCPs risk management mechanism in a default event. EuroCCP's retained earning and undistributed income is payable to a default loss after using the defaulter's margin and clearing fund contribution and before loss mutualization among survivors, but there is no specifically defined rule on whether to use and how much to use. An equally important observation is the double-layered structure of EMCF's clearing fund. On the occurrence of a default, EMCF will require a mandatory clearing fund contribution from the non-defaulting members, which are promissory but not paid-in. It is possible, in a financial crisis, that the survivors may face own insolvency problems, increasing the likelihood that CCPs' own capital is exposed to the induced losses if less funds are actually received than expected. Perhaps these uncertainties need to be incorporated into the regulatory assessments.

The members' potential obligations to the default losses should be noted. For risk mutualization and loss sharing purposes, it is compulsory that any paid-out of the clearing fund in absorbing the default damage will lead to a round of clearing fund replenishment from the non-defaulters, which is intended to maintain the clearing fund at the pre-loss level. Some CCPs limit the capital re-provision induced by the initial default, and apply it in the situation of subsequent defaults. It suggests an upper bound for survivors' exposure towards each loss event. However, in case of a more stressful market condition where consecutive defaults occur, the process of replenishment may be repeated and not limited to the number of defaults, which could have liquidity implications for the survivors. Given the experience of the 2008 financial crisis, potential liquidity impacts should not be underestimated. That said, to secure the solvency of the surviving clearing participants, capping the potential liability at certain level is essential to limit the degree of risk mutualization. This point is also mentioned in the consultative version of Principles for financial market infrastructures (CPSS-IOSCO, 2011), that the rules of the FMI should specify the order in which different types of resources will be used and this information enables participants to assess their potential future exposures from using the FMI's services. In the course of implementing new CPSS-IOSCO Principles, it is expected that the issue may be resolved. Nevertheless, changes in the arrangement of loss sharing must be contemplated and treated with great caution to prevent producing any deterioration in CCPs' accessibility to financial resources.

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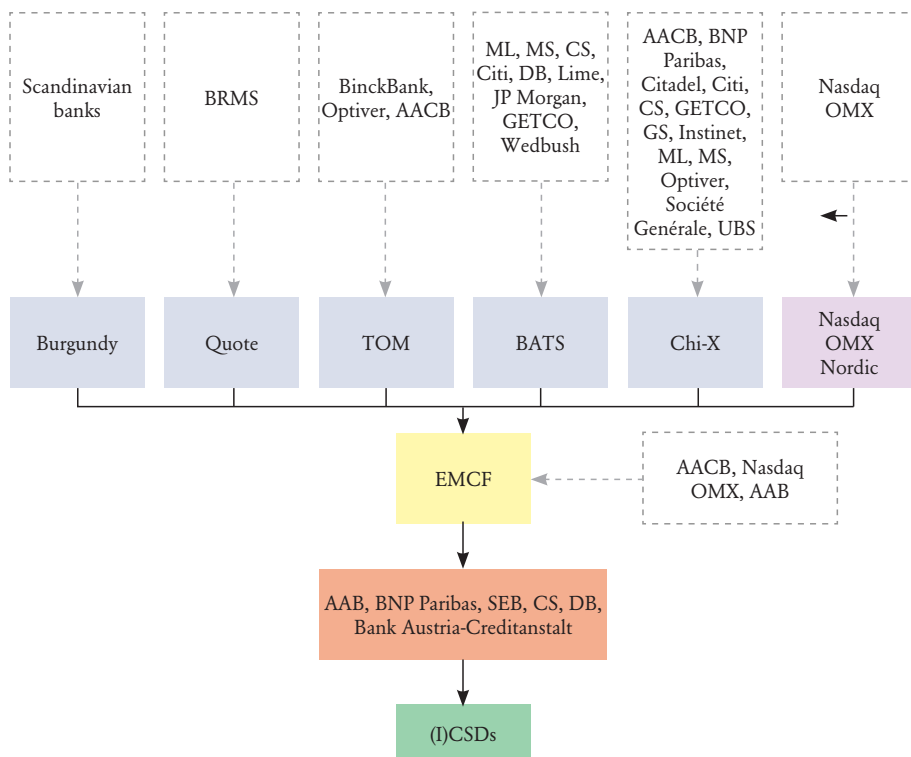
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Annex I Connection and ownership structure of Exchanges/MTFs and CCPs

EMCF: User owned/State owned (until June 2011)

ABN AMRO Clearing Bank N.V. has a 77% stake (a subsidiary of ABN AMRO Bank, owned by Dutch state), ABN AMRO Bank N.V. holds 1% and Nasdaq OMX AB (Owned by Borse Dubai which is a state-controlled holding) owns 22%.

Its settlement agents include ABN AMRO Bank, BNP Paribas, SEB, Credit Suisse, Deutsche Bank, Bank Austria-Creditanstalt.



MTFs:

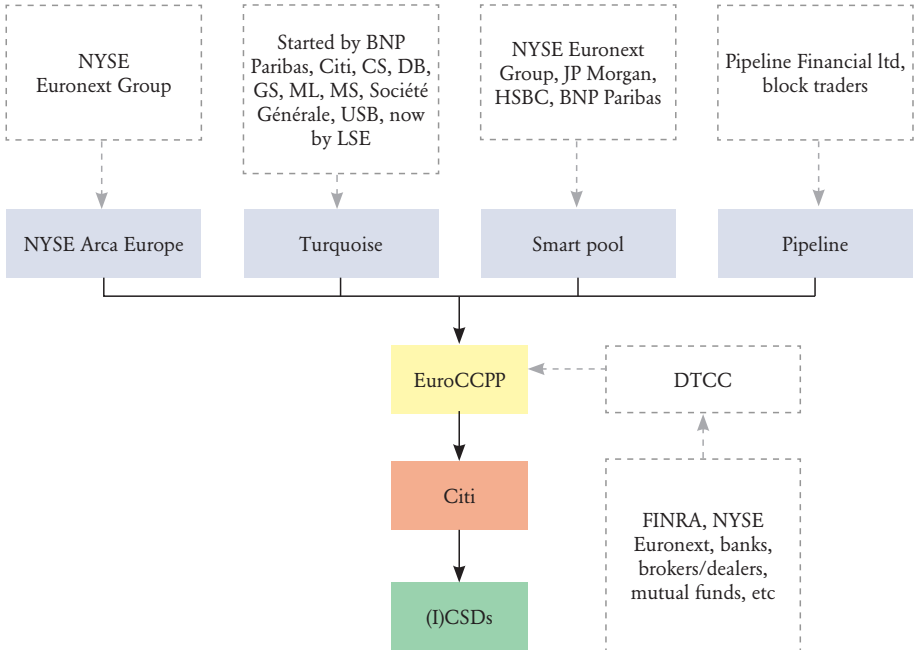
- **Burgundy:** an exchange that operates a regulated market and a multilateral trading facility for Nordic stocks, owned by Scandinavian banks such as Avanza Bank, Carnegie Investment Bank, Danske Bank, DnB NOR, Evli Bank, HQ, Neonet, Nordea, Nordnet, SEB, Svenska Handelsbanken, Swedbank, Ålandsbanken, Öhman
- **Quote:** a Hungary-based MTF, having 60% of the share capital owned by BRMS Holding, a Canada based company with activities in securities trading and MTF business (owned by Peter Beck, founder of Canadian securities dealer SwiftTrade), 40% of the share capital is owned by management, staff and partners.
- **TOM:** a Dutch MTF owned by BinckBank, Optiver and ABN AMRO Clearing Bank
- **BATS Europe:** is a wholly-owned subsidiary of BATS Global Markets, a privately-held company with majority ownership by the following firms: Bank of America Merrill Lynch (ML), Citi, Credit Suisse (CS), Deutsche Bank (DB), GETCO Holding Company LLC, JPMorgan, Lime Brokerage LLC, Morgan Stanley (MS), and Wedbush, Inc.
- **Chi-X Europe:** Chi-X Europe is an independent entity, owned by a consortium of major global financial institutions including ABN AMRO Clearing, BNP Paribas, Citadel, Citigroup, Credit Suisse, GETCO Europe Ltd, Goldman Sachs, Instinet Holdings, Merrill Lynch, Morgan Stanley, Optiver, Société Générale and UBS.

Exchanges:

- **Nasdaq OMX Nordic:** belongs to Nasdaq OMX Group, owned by Borse Dubai Ltd, investor Ab, Patricia holding Ab, Silver Lake Partners II TSA LP and management, staff and partners

EuroCCP: User-owned (until June 2011)

It is a subsidiary of Depository Trust & Clearing Corporation (DTCC). FINRA (who were previously known as NASD, National Association of Securities Dealers) and NYSE Euronext are stated as the preferred shareholders. It has approximately 330 shareholders as at the end of 2010, including international broker/dealers, correspondent and clearing banks, mutual fund companies and investment banks.

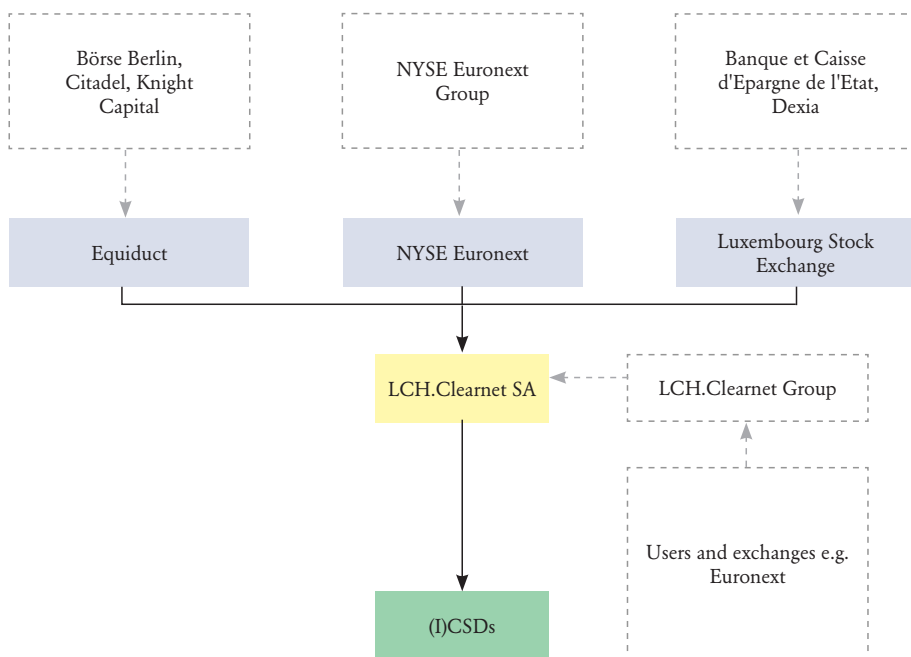


MTFs

- NYSE Arca Europe: NYSE Euronext’s MTF, fully integrated with NYSE Euronext systems
- Turquoise: founded by a consortium comprising BNP Paribas, Citi, Credit Suisse (CS), Deutsche Bank (DB), Goldman Sachs (GS), Merrill Lynch (ML), Morgan Stanley (MS), Société Générale and UBS, but in December 2009, it was acquired by London Stock Exchange (LSE) Group and merged with Baikal Global Limited, which is also owned by LSE Group. (2007 already appointed EuroCCP)
- Smartpool: SmartPool is a European dark pool created by NYSE Euronext in partnership with HSBC, J.P. Morgan and BNP Paribas.
- Pipeline: an alternative trading system for institutional block trading, the only block execution system that combines the high probability of block liquidity with the unmatched performance of predictive switching between best of breed algorithms. It partners with block traders.

LCH.Clearnet SA: *Hybrid (until June 2011)*

Holding company is LCH.Clearnet Group Limited, which is owned to 83% by users, 17% by exchanges which have a clearing relationship with LCH.Clearnet, including LME and Euronext. (Post trade service)



MTFs:

- Equiduct: operated by the regulated market Börse Berlin, Citadel Securities (US) and strategic investor Knight Capital Group Inc. (a large market share in French blue chips)

Exchanges:

- NYSE Euronext: the holding company created by the combination of NYSE Group, Inc. and Euronext N.V.
- Luxembourg Stock Exchange: has migrated its securities to NYSE Euronext platform: Banque et Caisse d'Epargne de l'Etat, Luxembourg; Dexia Banque Internationale à Luxembourg S.A. ; Etat du Grand-Duché de Luxembourg; Tradhold S.A, and others.

Annex 2 CCPs margining practice

EMCF

Initial margin is referred to as the haircut or the maximum theoretical loss of the portfolio under a predefined number of stress scenarios. It is calculated by EMCF's in-house Correlation Haircut model (CoH)¹⁹. The model generates a combined computation of Principal Component Analysis and scenario-based simulation²⁰:

1. Takes into account the correlation between the various products that are part of the portfolio
2. Determines the risk factors that have the greatest impact on the portfolio
3. Shift these components to find worst case scenario (maximum loss)
4. Attribute back the contribution per product in the determined worst case scenario

Variation margin is reflected in the definition of Net Liquidation Value, being the netted accumulation of settled and unsettled cash plus the mark-to-market value of all open positions in each account. State differently, the Net Liquidation Value is the total amount of currently remained cash in that account and the resulted losses or profits after liquidating all of the open positions at actual closing prices in that account. When the difference between Haircut of an account and the Net Liquidation Value of an account is positive, clearing members are obligated to deposit additional margin to EMCF.

Intraday margin call will be triggered by EMCF if the ratio of margin to collateral exceeds 110% and if the higher or supplementary margin exceeds one million EUR. Clearing members can either provide additional cash collateral or reduce risk by closing out respective open positions. Since September 2010, EMCF has introduced a risk add-on to cover the additional liquidation risk when the position of a clearing member in an instrument is significant compared with the overall market volume of the instrument, because the assumption of liquidation period of 3 days (reduced from 5 days in 2009) can fail in case of single large holding.

¹⁹ See details in EMCF Regulation Margin, 2009 and EMCF Liquidity Risk Add-on, 2010.

²⁰ Unfortunately it is not publicly acquired from EMCF, but based on correlation haircut summary by a presentation from ABN AMRO Clearing Bank (2010). Nevertheless it is regarded as informative since EMCF uses similar model system only with a few modifications.

EuroCCP

Different from the scenario-based margining in LCH.Clearnet SA and EMCF, margin system of EuroCCP is a derived application of Value at Risk (VaR) method. Four risk-based components are converged into the initial margin requirement²¹:

1. VaR on end-of-day positions: predicted maximum possible losses for a given portfolio at a specific confidence level (currently 99%) over a 3-day holding period. The price distribution of the portfolio is estimated using 100 days of pricing history (front-weighted).
2. VaR on intra-day positions: intraday risk of novating trades prior to the collection of margin in the following day, is estimated based on VaR on historical, front-weighted intraday activities by taking four daily snapshots over the preceding 60 days. Any shortfall between the predicted intraday VaR and the observed end-of-day risk shall be added to the margin requirement collected in the next morning.
3. Coverage component: EuroCCP also measures the model risk of VaR on a daily basis, back-tested using front-weighted 100 days portfolio history, in order to detect the instances where the coverage of VaR calculation is less than 95%. The deficiencies to reach 99%, if any, are added for collection.
4. Haircut on fails: an amount equivalent to a fixed percentage (larger than 5%) of the absolute value of failed transactions.

Variation margin on unsettled and failed trades is determined by the value change between the execution price and the current market price of the securities.

On top of the intraday risk prediction component of initial margin, any additional intraday margin deficit due to special events such as illiquid securities and large intra-day price swings shall be called from clearing members.

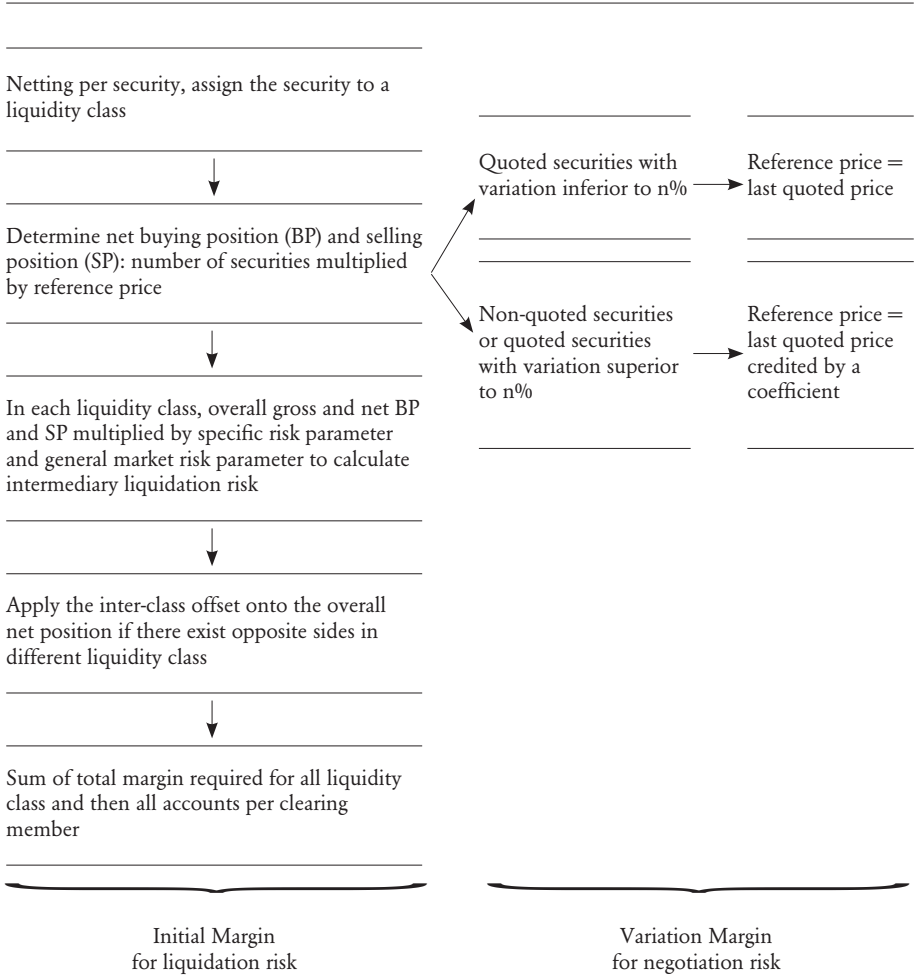
LCH.Clearnet SA

LCH.Clearnet SA uses Systematic Portfolio Analysis of Risk (SPAN)²² to determine the initial margin requirement. The figure below presents a flow chart demonstrating the calculation process of initial and variation margin, followed by further description. The left vertical flow of the figure represents the method to determine initial margin, while the right-handed branches indicates the quantified adjustment of reference price. Both of them are utilized to compute the required amount of margin. Margin parameters (marked red in the boxes) are published by LCH.Clearnet SA and are subject to periodically change based on market condition.

²¹ See EuroCCP Risk Management Approach and Processes, 2009 and EuroCCP Procedures, 2011.

²² See details in LCH.Clearnet SA Cash Product Margin Calculation SPAN, 2000.

LCH.Clearnet SA margin calculation process



Source: SPAN/cash clearing system (2000)

To be more specific, the computation of initial margin follows five steps as set forth below.

1. Assign the security to a liquidity class, each account per clearing member
2. In each liquidity class, calculate net buying/selling positions by securities: number of securities multiplied by their reference price
3. Sum up all buying position (BP) and selling position (SP) for each liquidity class to calculate specific risk and general market risk. Specific risk covers the

variation of a given stock that would move away from the general market movement because of its own characteristics, while the general market risk is the variations of a market segment and in SPAN, it is corresponding to one liquidity class. Therefore they are calculated on gross basis and on net position basis $x\% \times (BP + SP)$ and on net position basis $y\% \times |BP - SP|$, respectively.

4. Measure the inter-class offset. If there exist opposite sides of overall net position in different liquidity class, then apply

$$\text{Credit } (LIQ_a / LIQ_b) = - \text{Coef. Inter} \times \text{Min}\{|BP - SP|_a; |BP - SP|_b\}.$$

5. Determine the total margin requirement by gathering margin for all the liquidity class per account, and all accounts per clearing member.

Variation margin is calculated as the difference of the net buying/selling positions revalued at a reference price and at the trading price, at the level of net positions by security. It reflects the gain or loss should the open position be liquidated at the last market close, under the assumption that the future liquidation risk is covered by the initial margin. If the security is not quoted, or it is quoted but its price deviates from the previous day's reference price by superior to n%, a coefficient will be credited on its last quoted price. Otherwise reference price equals the last quoted price.

In addition to daily margin requirement, LCH.Clearnet SA is entitled to impose intraday margin call when necessary. Moreover, margins related to other specific risks which are not covered by the existing margin or clearing fund will be charged, but on a lower frequency. For instance, clearing members who use several delivery accounts entail de-netting risk, since the initial and variation margin are measured at the liquidity class or security level.

Annex 3 CCPs clearing fund calculation

EMCF

EMCF specifies individual’s contribution to the clearing fund to be the highest of (Rulebook 2009, and Regulation: Clearing fund, 2010):

1. The applicable base deposits are EUR 1,000,000 for a Direct Clearing Participant (DCP) and EUR 3,000,000 for a General Clearing Participant (GCP)
2. A percentage (7.5%) of an average amount of the end of day Aggregate Margin during the immediately preceding 30 Clearing Days
3. A percentage (7.5%) of an average amount of the end of day Aggregate Margin during the immediately preceding 250 Clearing Days

The level of the clearing fund is based on the outcome of stress tests that EMCF performs each day, in extreme market conditions (Post trade services description 2010) where simultaneously market prices move in the same direction by 40%.

EuroCCP

EuroCCP has a higher frequency on guarantee fund evaluation. It recalculates and collects the guarantee fund daily based on three components as set forth below (Procedure, 2011):

1. Stress Test, determined in a global level, is allocated among participants in the following procedure:
 - 1) Stress scenario on 50 scenarios during 10 years’ historic market conditions and a multiple participant failure
 - 2) Exposures for each participant’s portfolio are simulated utilizing the stressed events
 - 3) Stress test amount = summed simulated exposures – current margin amounts
 - 4) Stress test amount is allocated among all members, based on a *measure* of volume and netting within each participant’s portfolio.
2. Capital risk premium is computed on individual level when participant’s required margin amount exceeds the excess regulatory capital computed. EuroCCP may, at its discretion, collect an amount *less than (or no)* calculated capital risk premium and *return* all or a portion of the premium if it believes that the imposition or maintenance of the premium is not necessary or appropriate. The premium is calculated by:

- 1) $\text{Ratio} = \frac{\text{Excess regulatory capital}}{(\text{required margin amount} + \text{required contribution})}$
- 2) $\text{Capital risk premium} = \text{Ratio} \times (\text{Required margin amount} - \text{Excess regulatory capital})$
3. Internal risk ratings, EuroCCP may adjust a participant's contribution by a factor or by a set amount due to a change in individual's credit status

LCH.Clearnet SA

Amount of the clearing fund is determined with an intention, in conjunction with other financial resources, to be sufficient in size to cover a default of the largest Admitted Persons²³, who is responsible for the highest uncovered risk. The highest uncovered risk is the largest difference between stress risk calculated using SPAN (procedure remains the same, only applying higher risk parameters) based on the end-of-day open position of a clearing participant and its margin, amongst all clearing members. Individual's provision is afforded on a pro rata basis, with the proportion equals to individual's uncovered risk to the sum of uncovered risk. The total size of the clearing fund has a cap and a floor of EUR 575 million and EUR 1,250 million, respectively.

The contributions to the clearing fund are reviewed against the average size of clearing fund in previous 60 days plus 3 standard deviations. Normally it is collected monthly, but if a member's stress risk breaches the level of the clearing fund on any given day, additional margin is required. Thus, the total size of the clearing fund is the average max uncovered risk in the previous 60 clearing days plus 3 standard deviations.

²³ Any Person that fulfils membership criteria identical to those set-out under Section 2.3.2 of Clearing Rule Book and admitted by LCH.Clearnet SA to clear Transactions, either under the conditions set-up in the Clearing Rules or in other legal documentation issued by LCH.Clearnet SA.

Annex 4 Memberships of CCPs

1. General Clearing Members (until December 2010)

EMCF	EuroCCP	LCH.Clearnet SA
ABN AMRO Clearing Bank N.V.	ABN AMRO Clearing Bank N.V.	ABN AMRO Clearing Bank N.V.
BNP Paribas Securities Services S.A.	BNP Paribas Securities Services S.A.	BNP Paribas Securities Services S.A.
Bank of America Merrill Lynch	Bank of America Merrill Lynch	Bank of America Merrill Lynch
Citibank Global Markets and Citibank International	Citibank International Plc	Citibank International Plc
JPMorgan Securities Ltd.	JP Morgan	JP Morgan Securities Ltd
Goldman Sachs International	Goldman Sachs International	Goldman Sachs International
Skandinaviska Enskilda Banken	Skandinaviska Enskilda Banken AB (publ)	Skandinaviska Enskilda Banken, London
KAS BANK N.V.	KAS BANK N.V.	KAS BANK N.V.
Parel S.A.	Parel S.A.	Parel S.A.
Deutsche Bank AG	Deutsche Bank AG, Frankfurt Branch	Deutsche Bank AG Amsterdam Branch
Citigroup	Citigroup Global Markets Limited	ABN AMRO Bank N.V.
MF Global UK Ltd	MF Global UK Ltd	ADM Investor Services International Ltd
CACEIS Bank Deutschland	Pershing Securities Ltd	Banco Comercial Portugues S.A.
Danske Bank	Santander Investment, S.A.	Pershing Securities Ltd
ABG Sundal Collier Norge	Timber Hill (Europe) AG	Banco Espirito Santo S.A.
DnB NOR Bank		Banco Invest S.A.
Deutsche Bank (London Branch)		Banco Santander Totta S.A.
HSBC Trinkaus & Burkhardt		Banque Degroof S.A.
Istituto Centrale delle Banche Popolari Italiane SpA		BPN - Banco Portugues de Negocios S.A.
Interactive Brokers		CACEIS Bank Deutschland GmbH
KBC Bank N.V.		CACEIS Bank S.A.
Nordea		Caixa Geral de Depositos S.A.
Swedbank		Credit Agricole Corporate and Investment Bank (CIB)
		Dexia Banque Belguim S.A.
		EXANE S.A.
		FINIBANCO S.A.
		ING Bank N.V.
		KBC Bank N.V.
		Oddo&CIE
		Rabobank Nederland (Cooperatieve Centrale Raiffeisen-Boerenleenbank B.A.)
		SNS Bank N.V.
		UBS Ltd

2. Direct/Individual Clearing Members (until December 2010)

EMCF	EuroCCP	LCH.Clearnet SA
Credit Agricole Cheuvreux	Credit Agricole Cheuvreux	Credit Agricole Cheuvreux S.A.
Credit Suisse Securities (Europe) Ltd	Credit Suisse Securities (Europe) Ltd	Credit Suisse Securities (Europe) Ltd
Morgan Stanley International Plc	Morgan Stanley & Co. International Plc	Morgan Stanley & Co International Plc
RBS Bank N.V.	The Royal Bank of Scotland N.V. London Branch	The Royal Bank of Scotland N.V.
Instinet Europe Ltd.	Instinet Europe Ltd	Banco de Investimento Global
Morgan Stanley Securities Ltd.	Morgan Stanley Securities Ltd	Banco Popular Portugal
Numis Securities Ltd	Numis Securities Ltd	Banco Portugues de Investimento S.A.
UBS Ltd	UBS Ltd	BANIF- Banco de investimento S.A.
Barclays Capital Securities Ltd.	Barclays Capital Securities Ltd	Banque & Caisse d'epargne de l'etat, Luxembourg
Alandsbanken Abp	Deutsche Bank AG, London Branch	Banque delen & de Schaetzen S.A./N.V.
Alandsbanken Sverige AB		BNP Paribas Equities France
Amagarbanken A/S		Bourse Direct S.A.
Arbejdernes Landsbank A/S		CM-CIC Securities
Avanza Bank AB		Dierickx, Leys & CIE Effectenbank N.V.
Carnegie Bank A/S		DUBUS S.A.
Dexia Securities France		Financiere D'uzes
E-Trade Bank		Keytrade Bank S.A.
Eik Bank A/S		Leleux Associated Brokers S.A./N.V.
EQ Bank Ltd.		Natixis S.A.
Evli Bank Plc		Nomura International Plc
FIM Bank Ltd.		Procapital S.A.
GETCO Ltd.		SG Private Banking N.V./S.A.
Handelsbanken		SNS Securities N.V.
Jefferies International Ltd.		Timber Hill (Europe) AG
Knight Capital Markets		Van de Put & Co Effectenbank CVA/SCA
Lan & Spar Bank A/S		
Nordnet Bank AB		
Nomura International Plc		
Nykredit A/S		
Pohjola Bank		
RBC Capital Markets		
Saxo Bank A/S		
Spar Nord Bank A/S		
Sparekassen Kronjylland A/S		

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