FSB FINANCIAL STABILITY BOARD

Committee on Payments and Market Infrastructures | BIS

OICV-IOSCO

Central Counterparty Financial Resources for Recovery and Resolution

10 March 2022

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Executive summary

In November 2020, the Chairs of the FSB, the Committee on Payments and Market Infrastructures (CPMI), the International Organization of Securities Commissions (IOSCO) and of the FSB Resolution Steering Group (ReSG) publicly committed to collaborate on and conduct further work on CCP financial resources in recovery and resolution.[1] Such work would consider the need for, and develop as appropriate, international policy on the use, composition and amount of financial resources in recovery and resolution to further strengthen the resilience and resolvability of CCPs in default and non-default loss scenarios.

To help consider the need for any new international policy, the Chairs agreed to undertake first evidence gathering and analysis on existing financial resources and tools for CCP recovery and resolution. The results are presented in this report. The first component assessed the current use, composition and amount of financial resources and tools available to cover CCP default and non-default losses in a sample of seven out of 13 CCPs that are considered systemically important in more than one jurisdiction (SI>1 CCPs). The second component consisted of a quantitative analysis and a qualitative review of the potential financial stability implications that may result from the use of the financial resources and tools covered by the existing CPMI-IOSCO guidance on recovery of financial market infrastructures (FMIs) and FSB guidance on CCP resolution.[2]

Financial resources and tools for default loss scenarios

The default loss analysis had the objective of testing whether existing financial resources and tools would fully allocate and absorb credit losses in scenarios potentially extreme enough to require the use of recovery and resolution tools. This analysis was based on calculations done at the level of individual service lines by the seven in-scope CCPs, supplemented by information from the relevant authorities. The results were reviewed by technical experts from the relevant authorities. The seven CCPs operate a total of 15 service lines. The analysis applied scenarios specific to each CCP that were based on the historical scenario each CCP had determined as its most severe one. The scenarios were intended to be significantly more severe than the "extreme but plausible" standard set out in the CPMI-IOSCO Principles for Financial Market Infrastructures (PFMI), whilst remaining credible.

Seven of the 15 CCP service lines were able to fully address the losses without using recovery tools under the specific scenario applied. Of the eight CCP service lines that used recovery tools, six required recovery cash calls to fully address the losses from the default, while two CCP service lines exhausted both their pre-funded and committed resources, including recovery cash calls, and used variation margin gains haircutting (VMGH) to cover residual losses.

When interpreting these results, it is important to understand the limitations and assumptions of the analysis. These include the limited number of CCPs covered and the use of historical stress

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1 See the FSB press release of 16 November 2020: *FSB releases guidance on CCP financial resources for resolution and announces further work*. In addition to the above-mentioned four Chairs, the CFTC Chairman participates in the Chairs' discussions in his role as co-chair of IOSCO's Financial Stability Engagement Group (FSEG).

2 See Annex 1.

test scenarios only, which was done to foster comparability across the CCPs. Further, the analysis was undertaken at the level of individual CCPs and did not take into account potential contagion, amplifying effects and interconnectedness across CCPs and in the broader financial system.

Financial resources and tools for non-default loss scenarios

For non-default losses, two hypothetical common scenarios were used for all CCPs in the sample. The first scenario focused on liquidity needs and assumed that the CCP loses access to the institution (other than the central bank) holding assets (securities and/or cash) on behalf of the CCP that would cause the largest liquidity need to the CCP. Further complicating assumptions were also applied to make this scenario more severe. The second scenario focused on credit losses and assumed a cyber theft, where a quantum of cash stolen from the CCP was assumed to equal the highest daily value of the sum of all cash the CCP transferred to any single investment agent or depository on a single day.

In the first scenario, all of the CCPs were able to address the resulting liquidity needs. When the two complicating assumptions were included, all but one CCP would have had sufficient liquid resources or liquidity arrangements to manage their liquidity needs. In the second scenario, only two CCPs' prefunded and recovery resources were sufficient to cover the loss resulting from the cyber theft. In the case of the other five CCPs, resolution would have needed to be triggered to generate sufficient resources to address the loss.

The most significant limitation of the non-default loss analysis is that the results are specific to the choice of the scenarios, which are hypothetical rather than grounded in actual experiences.

Financial stability implications

Impact of cash calls and VMGH on clearing member liquidity and solvency

The quantitative assessment of financial stability implications assessed the potential impact of the use of two CCP recovery and resolution tools, cash calls and VMGH, on the liquidity and solvency of clearing members, in stressed market conditions. It calculated the maximum amount of cash calls that bank clearing members could have been exposed to during the March 2020 'dash-for-cash' liquidity episode as well as VMGH applied to 100% of gains based on March 2020 payments. It then compared the liquidity and solvency impact from the use of these tools with the impact of pre-existing stress on bank clearing members. For data confidentiality reasons, the results were aggregated at the level of three clearing member buckets (large, medium-sized and small bank clearing members).

The quantitative analysis suggests that the use of cash calls and VMGH appear to have a notably less significant impact on bank clearing members' liquidity in comparison to their starting liquidity positions. Similarly, the impact of the use of cash calls and VMGH on bank clearing members' solvency was limited compared to their starting solvency position.

However, certain limitations apply to the chosen assessment methodology. First, given constraints stemming from data availability and confidentiality, the sample did not include non-

bank clearing members and clients or those foreign bank clearing members for which data was not available. Second, the aggregation of results within a bucket masks individual variance within the sample. Third, the methodology did not model system-wide, aggregate effects, for example, the possibility that a clearing member may be subject to cash calls or VMGH from multiple CCPs.

Qualitative review of financial stability implications

In addition to the quantitative analysis, a qualitative, judgment-based review of financial stability implications was undertaken. This review considered all the recovery and resolution tools covered in the relevant CPMI-IOSCO and FSB guidance, irrespective of whether or the extent to which they are currently available for use by CCPs or resolution authorities. The consideration of financial stability implications focused on potential consequences, in particular knock-on effects on the wider financial system, performance risk of the tools, and impact on market and public confidence in CCPs. This analysis concluded that the tools had varying effects across these factors.

Conclusions and next steps

Based on the results and challenges of the evidence gathering and analysis undertaken, there is merit to continuing work on CCP financial resources for recovery and resolution. While all the sampled CCPs would have had sufficient prefunded and recovery resources and tools to cover losses in the applied CCP-specific default loss scenarios, the analysis was subject to a number of limitations and assumptions that suggest that the results are to be interpreted cautiously. Moreover, one of the non-default loss scenarios applied would have resulted in the need to use resolution powers in the majority of the CCPs. Even though at the level of individual bank clearing members the analysis identified only limited impacts on their liquidity and solvency from the use of cash calls and VMGH by an individual CCP, it would be beneficial to enhance as much as possible the understanding of the potential complex system-wide effects of the use of recovery and resolution tools.

Informed by this evidence gathering and analysis, the FSB has decided to continue to review the sufficiency of the existing toolkit for CCP resolution, focusing in particular on non-default loss scenarios. Further work will consider the need for, and costs and benefits (including effectiveness and impact on incentives) of potential alternative financial resources and tools for CCP resolution. This further work, to be undertaken in cooperation with CPMI-IOSCO, will be initiated in Q2/2022. The FSB would welcome stakeholder views as input to this work by 29 April 2022. In addition, CPMI-IOSCO has work underway on CCP non-default losses in resilience and recovery.

It is also important that CCPs and resolution authorities have in place a set of recovery and resolution tools, respectively, that is consistent with the existing international standards and guidance. CPMI-IOSCO remain committed to full, timely and consistent implementation of the PFMI standards on CCP financial resources and tools for resilience and recovery, supplemented by the CPMI-IOSCO guidance on FMI recovery. The FSB will continue to conduct and enhance the monitoring of the implementation of the FSB guidance on CCP resolution.

Introduction and background

In November 2020, the Chairs of the FSB, CPMI, IOSCO and of the FSB's ReSG publicly committed to collaborate on and conduct further work on CCP financial resources in recovery and resolution.[3] Such work would consider the need for, and develop as appropriate, international policy on the use, composition and amount of financial resources in recovery and resolution to further strengthen the resilience and resolvability of CCPs in default and non-default loss scenarios.

The Chairs noted that the recent periods of market turmoil have demonstrated the benefits that central clearing brings for global financial stability. Progress in implementing the G20 regulatory reforms agreed after the 2008 financial crisis had promoted the use of CCPs, as well as enhanced CCP resilience, recovery planning and resolvability. However, the shift to central clearing had also further increased the systemic importance of CCPs. To this end, the Chairs noted that they are of the view that the international policy framework for CCPs needs to reflect the evolving role of central clearing in order to address risks to financial stability in an effective manner.

The Chairs agreed first to undertake evidence gathering and analysis on existing financial resources and tools for CCP recovery and resolution, in order to determine whether further policy work on the use, composition and amount of CCP financial resources and tools would be necessary. This report contains the outcome of the evidence gathering and analysis, which was structured in two components. The first component (Section 1.1 of this report) assessed the use, composition and amount of financial resources and tools available to cover CCP default and non-default losses. The sample of CCPs covered in the analysis consisted of seven out of the 13 CCPs considered to be systemically important in more than one jurisdiction (SI>1 CCPs). Each CCP's total losses under the applied default loss and non-default loss scenarios were compared with the existing financial resources and tools available to the CCP and/or to the resolution authority. Further details about the methodologies used in the assessment are provided in Section 1.1.1 (for default losses) and 1.1.2 (for non-default losses).

The second component (Section 1.2 of this report) consisted of a quantitative analysis applied to certain CCP recovery and resolution tools and a qualitative review of the potential financial stability implications that may result from the use of the financial resources and tools covered by the existing CPMI-IOSCO and FSB guidance on CCP recovery and resolution.[4] (See Sections 1.2.1 and 1.2.2 for the methodologies used for the quantitative assessment and qualitative review, respectively).

The evidence gathering and analysis built on the existing CPMI-IOSCO and FSB guidance on recovery and resolution tools. The content of the existing guidance is summarised in Annex 1.

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3 See the FSB press release of 16 November 2020: *FSB releases guidance on CCP financial resources for resolution and announces further work*. In addition to the above-mentioned four Chairs, the CFTC Chairman participates in the Chairs' discussions in his role as co-chair of IOSCO's Financial Stability Engagement Group (FSEG).

4 See Annex 1.

The findings of this report will inform any further work by the FSB, CPMI and IOSCO on CCP financial resources for recovery and resolution (see also the section on conclusions and next steps).

1. Evaluation of the adequacy of existing financial resources and tools

1.1. Use, composition and amount

The analysis of the use, composition and amount of financial resources and tools compared each CCP's total losses under specific default and non-default loss scenarios to the existing financial resources and tools available to that CCP and/or to the resolution authority. The sample covered seven SI>1 CCPs, some of which have multiple service lines, for a total of 15 service lines: LCH SA (France), Eurex Clearing (Germany), SIX x-clear (Switzerland), ICE Clear Europe (UK), LCH Ltd (UK), CME (US) and ICE Clear Credit (US). The products cleared by these CCPs include credit default swaps (CDS), equities, foreign exchange (FX), futures and options, interest rate swaps (IRS) and repo.

1.1.1. Default loss scenarios

Methodology

The default loss analysis had the objective of testing whether existing financial resources and tools would fully allocate and absorb credit losses in scenarios potentially extreme enough to require the use of recovery and resolution tools. The analysis applied CCP-specific historical scenarios that were intended to be significantly more severe than the "extreme but plausible" standard set out in the PFMI, whilst remaining credible (these are referred to as simply 'scenarios' for brevity below).

First, to enhance credibility and comparability of the CCP-specific scenarios, each CCP identified the historical scenario from its existing stress tests that would typically generate the largest losses above pre-funded resources. Second, to increase the severity of the historical CCP-specific scenarios, they were scaled up in a consistent way by: (i) applying a multiplier of 1.4 to each product class shock;[5] and (ii) assuming the default of the four clearing member groups causing the largest exposures to the CCP in the event of default.[6] The CCPs themselves then

[5] The multiplier of 1.4 was selected because it would, on average, double the margin period of risk (MPOR) under highly simplified assumptions. Such simplified assumptions include, for example, assuming that there is no correlation between the direction of moves on sequential days (for instance, if up days are more likely to be followed by down days, the resulting losses would be smaller). Consequently, the analysis cannot be interpreted as showing with any certainty what would happen if the MPOR doubled. CCPs were given some discretion in applying the 1.4x multiplier for specific products to ensure consistency with the CCP's own methodology (whether the CCPs´ stress tests apply to absolute or relative moves). CCPs had to exclude any scale-up of factors already applied in their stress testing approaches and exercise some (necessary) discretion in applying the multiplier to specific scenarios as well as to translate it to the options products. The application of the discretion was reviewed by technical experts from the relevant authorities.

[6] Where several affiliates from within one banking group are connected to the CCP as clearing members, these were counted as one clearing member for the purpose of this analysis.

calculated the resulting potential losses and the financial resources and tools that would be used to absorb the losses.

The objective of this approach was to apply a broadly comparable shock (in terms of historical severity, by using the most severe historical scenario for each CCP) for each of the CCPs. This comparable level of severity across CCPs would not have been achieved by using a common top-down scenario, given the differences in products cleared across the CCPs and the resulting differences in risk exposures.[7]

Finally, each CCP was requested to calculate its losses using actual portfolios on a single historical date (between July and September 2021) that would generally have been representative of contemporary portfolios at the CCP (e.g., by avoiding a date with significant seasonality or unusual position behaviour like contract expiration dates). The resulting losses were then compared with the actual financial resources and tools available to the CCP and the resolution authority on that date (see Annex 2 for a template for providing the information on total stress losses and default resources to perform the analysis).[8]

Limitations and assumptions

When interpreting the results, it is important to understand the limitations of this analysis. These include:

- *Scope.* The analysis was based on data from a subset of seven out of 13 SI>1 CCPs.
- *Forward-looking hypothetical stress test scenarios.* To foster comparability across CCPs, the analysis was done on the basis of CCP-specific historical stress test scenarios.[9] CCPs were not asked to take into account their hypothetical stress test scenarios when identifying their respective specific scenarios. CCPs' stress tests may include hypothetical scenarios that can result in more or less severe shocks than the worst historical stress test scenarios identified by CCPs.[10] However, as explained above, the CCP-specific historical scenarios were scaled up consistently and therefore they became hypothetical scenarios.
- *Concentration of participation varies across CCPs.* The impact of increasing the assumed number of participant defaults from two to four is, in part, a function of the relative size of the exposures to the two additional participants.

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7 A common scenario across all included CCPs could subject one or more CCPs to a scenario that might be less severe for them than their worst historical scenario.

8 Excess collateral (i.e., the amount of collateral held by the CCP in excess of initial margin requirements) was not included in the financial resources and tools available to the CCP and resolution authority.

9 Based on the fact that these CCPs are supervised in jurisdictions where final PFMI implementation measures are in place for CCPs, the CCPs' approach to historical stress testing is assumed to be robust.

10 Consistent with the PFMI, a multitude of historical and hypothetical scenarios are used in CCPs' risk management. Under Principle 4, Key Consideration 6 of the PFMI, CCP stress test scenarios "should include relevant peak historical price volatilities, shifts in other market factors such as price determinants and yield curves, multiple defaults over various time horizons, simultaneous pressures in funding and asset markets, and a spectrum of forward-looking stress scenarios in a variety of extreme but plausible market conditions".

- *System-wide and contagion effects and interconnectedness*. Because the scenarios were specific to each CCP, the results cannot be aggregated to simulate total losses at the level of the financial system for any particular scenario. Therefore, system-wide effects were not considered. The analysis did not take into account the underlying economic circumstances that could cause the simultaneous default of four clearing members at each of the seven CCPs, the likelihood of such circumstances, or the potential impact of the same clearing members defaulting in multiple CCPs. Neither did the analysis endeavour to model second and later order effects of the scenarios that might result in wider market stress, including potential increases in margin requirements, liquidity pressure and collateral scarcity. Finally, the analysis assumed that all non-defaulting participants continued to perform as they had committed to.

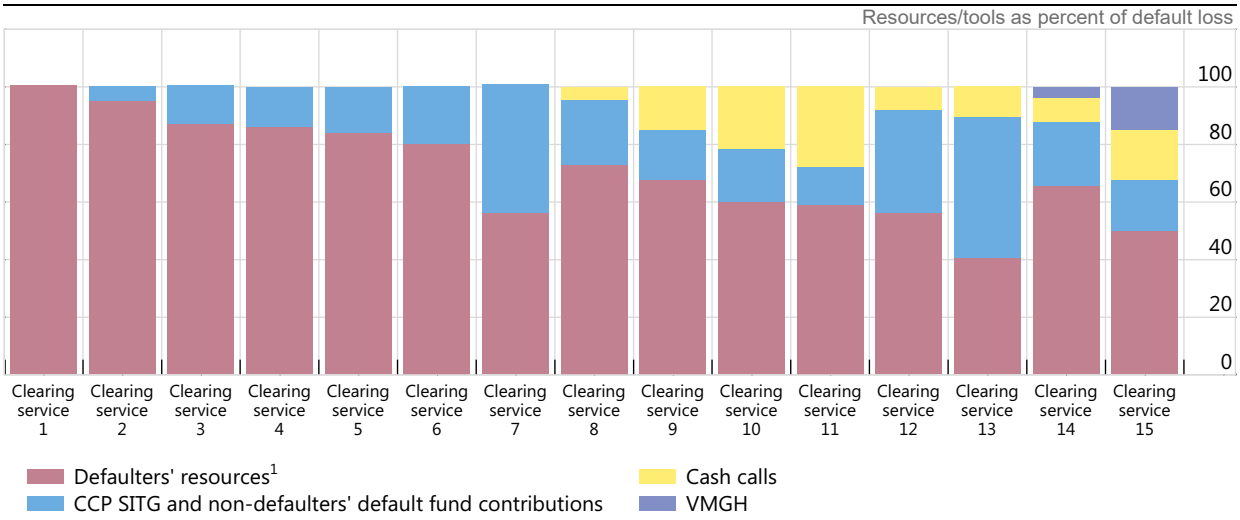
- *Other costs and resources have not been accounted for.* The analysis might underestimate the size of the potential losses because it did not take into account other costs (e.g., transaction costs, bid-ask spreads, wrong-way risk). At the same time, the analysis might underestimate the size of potential available resources, because it focused only on the market-risk related components of the CCPs' risk models. CCPs were asked to report only collateral collected to cover market risk, excluding add-ons such as liquidation and concentration charges. Furthermore, excess collateral was excluded from the resources available to the CCP, making this analysis more conservative. In practice, this excess collateral could be available to cover losses.

Findings

Subject to the above limitations and assumptions, seven of the 15 CCP service lines were able to fully address the losses without using recovery tools under the scenarios applied. Specifically, one service line managed the losses within the defaulters' resources and six did not go beyond the mutualised default fund. Of the eight CCP service lines that used recovery tools, six required recovery cash calls to fully manage the default, while two CCP service lines exhausted both their pre-funded and committed resources and used VMGH to cover residual losses. Graph 1 provides a breakdown of the financial resources and tools used by each CCP service line to cover the default losses arising from the applied scenario.

Breakdown of the financial resources and tools used by each CCP service line to cover the default loss

Graph 1



[1] Some CCPs draw upon the default fund resources of another service line.

Source: Jurisdictions' data

The total stress losses for the CCP service lines under the scenarios applied ranged from $62m to $48b.[11] In a manner corresponding to the respective waterfall provisions of each CCP, resources were applied to the losses in the following order: prefunded defaulters' resources, CCP's own capital contributions, prefunded non-defaulters' resources, committed but not pre-funded resources, and VMGH.

The first tranche of prefunded default resources applied from each CCP's waterfall consisted of defaulters' resources (defaulters' core initial margin (excluding add-ons or excess margin) available to cover losses[12] and defaulters' default fund contributions), CCPs' own capital contributions (skin in the game (SITG)), and non-defaulters' default fund contributions.

Consistent with the PFMI and relevant regulatory requirements, defaulters' resources covered a significant portion of the total stress losses. The defaulters' core initial margin available to cover losses covered 32% to 89% of total stress losses. Defaulters' default fund contributions ranged from $13.7m to $1.7b, representing between 6% and 51% of the total default fund at the CCPs analysed. The combination of defaulters' core initial margin and default fund contributions covered 41% to 100% of total stress losses. SITG, which ranged from $1.2m to $232m, was used to cover losses for 14 of the 15 CCP service lines; in all 14 cases, all available SITG was used. The non-defaulters' default fund contributions that were used ranged from $5.3m to $6.3b. For the six CCP service lines which used some, but not all, of their non-defaulters' contributions to the default fund, the percentage used ranged from 2.5% to 72%. In aggregate, the total prefunded default loss resources used ranged from $337m to $34.5b.[13]

[11] For purposes of this report, all values are reported in USD, using currency conversion rates from 25 October 2021. Variances shown in this section may be due to the different sizes of the service lines covered in the analysis, but also the products cleared and the concentration of membership.

[12] For purposes of this report, defaulters' initial margin respects customer segregation requirements and limitations on use and thus may reflect a value that is less than the total initial margin held on behalf of the defaulters.

[13] For two CCPs, the total prefunded resources also included the defaulting clearing members' contributions to the CCP's other service line, following the coverage of applicable losses attributable to that service line under the scenario.

The second tranche of resources generally consisted of committed resources that could be applied by the CCP in recovery (or by a resolution authority using the CCP's recovery powers) and committed resources available to the resolution authority only. Specifically, the first of these resources that could be applied were recovery cash calls (committed cash calls set forth in the CCP's rulebook) and excess CCP capital (i.e., the capital the CCP holds in addition to its regulatory capital requirement) for all CCPs analysed. The total available recovery cash calls for the CCP service lines ranged from $235m to $18.8b,[14] while excess capital ranged from $4.2m to $564m.[15] For the eight CCP service lines that used recovery cash calls in the scenario analysed, the percentage used ranged from 10% to 100%. No CCP used excess capital in the scenario applied. In addition, some CCPs have additional prefunded and committed recovery resources that include dedicated recovery capital, additional own funds that are used on a pro rata basis alongside cash calls and committed funds from parent companies.

In resolution, the next set of resources that could be applied include resolution cash calls and required CCP capital.[16] These resources are also considered part of the second tranche of resources. Under the FSB guidance, "jurisdictions may confer to the resolution authority an explicit statutory power to require non-defaulting clearing members to make contributions in cash to the CCP up to a specific limit".[17] Resolution cash calls are distinct from a resolution authority's ability to enforce any outstanding or uncalled recovery cash calls that are part of the CCP's ruleset. Currently, resolution authorities in some jurisdictions have the ability to implement resolution cash calls; some jurisdictions have legislation or proposals to undertake legislation that will confer the power to the resolution authority in the near-term; and the remaining jurisdictions do not give resolution authorities this power or have proposals to do so. Even where authorities have the power to make a resolution cash call, the amount of such a call may be subject to no creditor worse off (NCWO) protections. This is because resolution cash calls are not part of the insolvency counterfactual, if they are not set forth in the applicable CCP rulebooks. In determining the amount of a resolution cash call, an authority should consider whether the amount of the call would require a creditor to pay more than the losses it would suffer in a CCP insolvency.

No CCP needed to use resolution cash calls or its required capital in the scenario applied. However, the total theoretical amount of resources available in the second tranche was considered in the analysis. Two approaches to estimating the second tranche resources were applied. In the first approach it was assumed that authorities choose not to make a separate resolution cash call in light of the NCWO protections, so the resources were mainly recovery cash calls and required capital. Required capital ranged from $82m to $495m. In the second approach, a separate resolution cash call of one times the value of the non-defaulters' contributions to the default fund was considered. This second approach was applied to all CCPs in order to consider the impact of resolution tools covered in the FSB guidance that could potentially be added to an authority's toolkit, regardless of current availability. Under the second approach, potential resolution cash calls ranged from $167m to $6.3b. Overall, total second

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14 Where this is sized as a multiple of the default fund, the differences across CCPs will be partly explained by the relative size of the CCPs.

15 It was not possible to include one of the 15 CCP service lines in these estimates.

16 The amount of capital a CCP is required to hold varies based on jurisdiction-specific requirements.

17 2017 FSB Resolution Guidance Section 2.9.

tranche resources for recovery and resolution ranged from $381m to $19.6b without a potential resolution cash call and from $602m to $25.8b with a potential resolution cash call.

For the purposes of this report, loss absorbing resources of the CCP service line for default losses ("Cover-4 DL Resources") are the sum of the CCP service line's first and second tranche resources. Cover-4 DL Resources ranged from $704m to $54.1b without a resolution cash call and $925m to $60.3b with a resolution cash call.[18] The ratios of the first tranche (defaulters' IM and default fund, SITG, non-defaulters' contributions to the default fund, and other prefunded resources as noted above) and second tranche of resources (recovery cash call, required CCP capital, resolution cash calls, and other committed resources as noted above) to Cover-4 DL Resources are set forth in the table below.

Assessment step	Ratio of first tranche resources to Cover-4 DL Resources (without resolution cash call)	Ratio of first tranche resources to Cover-4 DL Resources (with resolution cash call)	Ratio of second tranche resources to Cover-4 DL Resources (without resolution cash call)	Ratio of second tranche resources to Cover-4 DL Resources (with resolution cash call)
Min	31%	26%	23%	31%
Median	52%	45%	49%	55%
Max	76%	69%	69%	74%

Finally, VMGH has the potential to address losses comprehensively, specifically when used in conjunction with a partial tear-up, a tool that returns the CCP to a matched book. VMGH allows a CCP to haircut the paying of gains to clearing members (theoretically up to 100%), mitigating or eliminating the need to rely on other loss allocation tools to cover remaining losses related to the defaulters' portfolios. Only two CCP service lines used VMGH in the scenario applied. While excluded from Cover-4 DL Resources in the above analysis, the amount of variation margin that was or could have been haircut in the scenario was also considered.[19] The two CCP service lines using VMGH after the exhaustion of recovery cash calls used $25m to $694m, representing 4% and 35%, respectively, of the potential haircut power. For the other CCP service lines, variation margin gains attributable to the non-defaulting clearing members ranged from $189m to $12.5b, which, if haircut, would provide significant loss absorbency in either recovery or resolution.[20]

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18 VMGH is excluded from this analysis because of the challenges in estimating the value of resources that would be available using VMGH.

19 For purposes of this report, VMGH was determined to be the capped amount of variation margin that could be haircut or the amount of variation margin to be paid out on the day of the scenario.

20 VMGH is not available to three of the CCP service lines due to the nature of the products cleared by those service lines (e.g., equities). In addition, some CCPs did not report a specific value for the haircut power, but the values of these data would fall between the values reported by other CCPs.

1.1.2. Non-default loss scenarios

Methodology

For non-default losses, two hypothetical common scenarios which were considered to be sufficiently severe were used for all CCPs in the sample.[21]

Scenario 1: Loss of access to an institution holding assets on behalf of the CCP

CCPs were asked to assume that they lose access to the assets (securities and/or cash) held at the institution (other than a central bank) (the "Institution")[22] that would have caused the largest liquidity risk to the CCP during the period between 1 January 2020 and 30 September 2021,[23] as well as considering any days of extraordinary volatility within a longer five-year lookback period.[24] The CCPs were further asked to assume that clearing members would also be unable to access their assets held at that Institution.

Two additional complicating assumptions were applied. The first complicating assumption assumed that the two clearing members (and their affiliates) that would generate the largest aggregate payment obligations to the CCP in extreme but plausible market conditions would default on their payments to the CCP during the period when the CCP does not have access to assets held at the Institution. In this case, the CCP would need additional liquidity for managing the default of these two clearing members because all or a portion of their collateral resources (e.g., initial margin or guarantee/default fund) are not available as a result of losing access to the Institution. CCPs were instructed to assume that assets held at the Institution would not be available for the entire period that it takes to manage the defaults.

In addition to the defaults in the first complicating assumption, the second complicating assumption considered that the loss of access happened while variation margin settlement funds were "in flight." That is, it was assumed that the loss of access to assets at the Institution took place at a point in time in the middle of the CCP's settlement cycle, such that the CCP had received all settlement payments due from clearing members with losses for that cycle but had not yet made any settlement payments to clearing members with gains. This would exacerbate the liquidity stress, because some of those settled funds may be unavailable as a result of losing access to the Institution.

For further details on this scenario and the assumptions used see Annex 3.

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21 The scenarios were chosen taking into account, among others, the scenarios developed by the FSB Cross-border Crisis Management Group for Financial Market Infrastructures for use by resolution authorities and crisis management groups. Therefore, many CCPs and authorities had already experience in applying these scenarios. The scenarios were further refined to make them somewhat more severe and to address implementation issues identified when the scenarios had been first applied. Given the lack of sufficiently severe historical non-default loss scenarios that could have been used as a basis of scaling up, hypothetical scenarios were used.

22 Examples of such institutions include central securities depositories and banks acting as custodians.

23 The reason for choosing this time period was to ensure that it would at least encompass the March 2020 market turmoil with large payment flows. Extending the primary window from January 2020 to September 2021 permitted the testing of the CCP markets, which have markedly grown in recent years. In addition, the scenario required the CCPs to consider earlier periods which could have had an even larger impact.

24 In the case of one CCP, because the loss of access would also have had significant operational consequences for the settlement of transactions, it was assumed that access was lost to the Institution (other than central bank) causing the second largest liquidity risk to the CCP.

Scenario 2: Cyber theft

In this scenario, the quantum of cash stolen was assumed to be equal to the highest daily value of the sum of all cash the CCP transferred to any single investment agent or depository on a single day during the period between 1 January 2020 and 30 September 2021, as well as considering any days of extraordinary volatility within a longer five-year lookback period.

For further details on this scenario see Annex 4.

The liquidity needs and losses calculated in these two non-default scenarios (including the variations of Scenario 1) were then compared with: (i) the liquidity and financial resources and tools available to the CCP and the resolution authority in the first NDL scenario; and (ii) the financial resources and tools in the second NDL scenario. Annex 5 includes the template for the stock-take of resources for non-default losses and Annex 6 the template for the stock-take of liquidity resources.

Limitations and assumptions

The most significant limitation of the NDL analysis is that the results are specific to the scenarios used in the analysis, which are hypothetical rather than grounded in actual experiences. The impact of these scenarios, like of most NDL scenarios, is affected by the business models of the CCPs. The scenarios did not take into account ways in which the CCP's operational arrangements or cyber security measures might reduce the risk or extent of loss. Nevertheless, the scenarios provide indications about the types of challenges NDL scenarios may pose to CCPs. In addition, considering the impact on clearing members of each of the scenarios is outside the scope of the analysis.

Findings

Scenario 1: Loss of access to an institution holding assets on behalf of the CCP

In the base scenario, all the CCPs were able to address the liquidity needs in the scenario. The CCPs lost access to collateral between approximately $2.4b and $72.6b.[25] When considering the two complicating assumptions, all but one CCP would have had liquid resources or liquidity arrangements in place that would have enabled them to manage their liquidity during a period of potential loss of access to the Institution causing the highest liquidity needs.

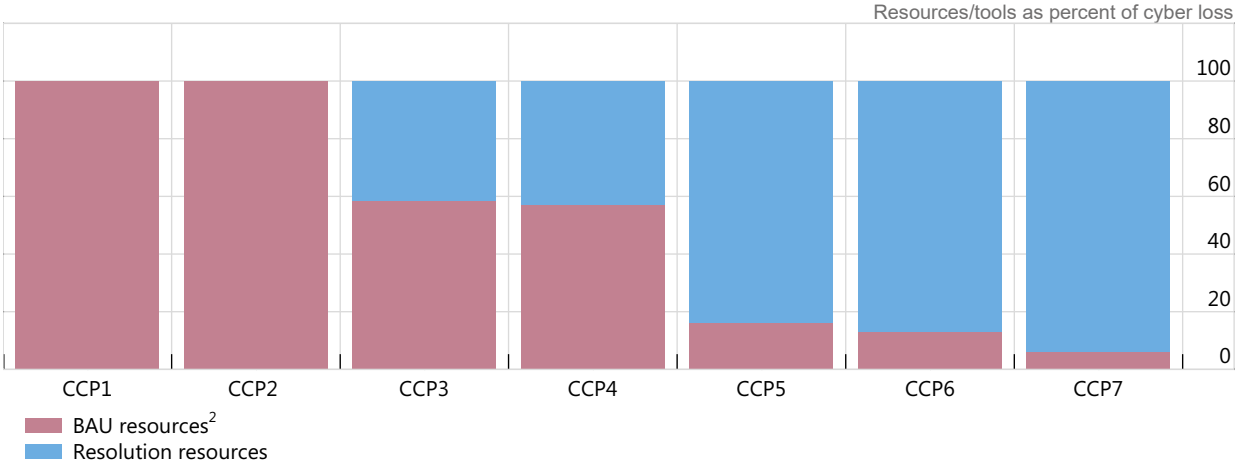
In addition, some of the CCPs have included conditions into their rulebooks, determining that a loss of access to or a failure of a custodian / central securities depository (CSD) would not result in a liquidity stress at the CCP but rather at the clearing member level, as the clearing members would be obliged to replace assets not accessible by the CCP. However, none of the CCPs had to rely on these arrangements to manage its liquidity in this scenario.

[25] For purposes of this report, all values are reported in USD, using currency conversion rates from 25 October 2021.

Scenario 2: Cyber theft

Potential losses in this scenario were between $623m and $14.6b. Two CCPs' prefunded and recovery resources were sufficient to cover the loss resulting from the cyber theft. One of these CCPs has provisions in place that provide for the loss to be transferred to its clearing members. For the other CCPs, the losses exceeding their prefunded and recovery resources reached between $265m and $11.8b. It is therefore likely that resolution would need to be triggered to generate sufficient resources to address the loss in the case of these CCPs. Graph 2 provides a breakdown of the financial resources and tools used by each CCP and resolution authority to cover the non-default loss arising from the applied scenario.

Breakdown of the financial resources and tools used by the CCP and resolution authority to cover the cyber theft[1] **Graph 2**



[1] This chart assumes availability of a set of resolution tools covered by the FSB guidance. [2] Resources available to the CCP in business as usual which includes both prefunded and recovery resources.

Source: Jurisdictions' data

In NDL resolution scenarios such as this, the 2017 FSB guidance states that resolution authorities should have a statutory power to write down, where appropriate, unsecured liabilities (where other sources of loss absorbency are not available). To the extent available under the jurisdiction's resolution regime, this power would provide an additional source of resources to absorb the loss and would be guaranteed to perform in stress. However, assessing the actual availability of the write-down power in the relevant jurisdictions did not form part of the analysis undertaken.

FSB guidance also states that jurisdictions may confer upon resolution authorities statutory access to a power in non-default loss resolution scenarios to require clearing members to make contributions in cash to the CCP (up to a specific limit). This would be a further alternative mechanism of generating additional funds to address losses experienced in resolution.

1.2. Effectiveness and efficiency

The assessment of the use, composition and amount of CCP financial resources and tools described in Section 1.1 was complemented by separately considering the financial stability implications arising from the composition and use of financial resources and tools. The latter assessment consisted of a quantitative analysis of the effect of using VMGH and cash calls on clearing members, and a qualitative review of potential financial stability implications arising from

the use of a broader set of recovery and resolution tools. The qualitative review included all tools covered in CPMI-IOSCO and FSB guidance and is independent of the extent to which the tools were actually used in the analysis described in Section 1.1.

1.2.1. Quantitative assessment

Methodology

The quantitative assessment of financial stability implications was limited to assessing the potential liquidity and solvency impact of the use of two CCP recovery and resolution tools, cash calls and VMGH, in stressed market conditions. This assessment calculated the maximum amount of cash calls that clearing members could have been exposed to during the March 2020 'dash-for-cash' liquidity episode as well as VMGH applied to 100% of gains.[26] Paired with this CCP level information was publicly available data on clearing members' liquidity (Liquidity Coverage Ratio (LCR), High Quality Liquid Assets (HQLA) and net outflows) and capital (Common Equity Tier 1 (CET1)).

In addition to comparing liquidity demands to business-as-usual HQLA levels (=100%), the demands were also compared to conditions where there was some level of pre-existing stress on members, represented by haircutting HQLA by 10%, 20%, 30%, 40% and 50%, respectively. The analysis used six different calibrations of cash calls and VMGH to produce a broad variety of resource demands. The primary focus of the analysis was on the most extreme scenario, which assumed 100% VMGH and the maximum amount of cash calls.

The clearing members selected for the analysis were divided into three buckets based on their default fund contributions: small, medium-sized and large clearing members. Authorities allocated clearing members to three groups where each group either represented a third of the total default fund contributions or where each group represented a third of the number of clearing members (ordered by the size of their default fund contributions).

The liquidity and solvency impact of VMGH and cash calls was assessed at a group level for each clearing member included in the sample, based on consolidated liquidity and solvency data. To maintain data confidentiality, the liquidity and solvency impacts were summarised and aggregated for each of the clearing member buckets for each CCP in the sample.

The analysis could not be carried out in one of the seven CCPs, so the results are based on six CCPs.

The details of the assessment methodology used are described in Annex 7.

Limitations and assumptions

Certain limitations apply to the chosen assessment methodology. First, given constraints stemming from data availability and confidentiality, the sample used was limited to clearing

[26] Note that, in practice, the use of 100% VMGH could only occur under very specific conditions, i.e., those where: i) all losses were concentrated in the set of defaulting clearing members and ii) the CCP had no resources available to cover any subset of those losses.

members that are banks. Non-bank clearing members and clients were not considered.[27] Each sample of clearing members also consisted only of clearing members for which participating authorities had or could gain access to the relevant data. Therefore, foreign clearing members for which data was not available were excluded.

Second, aggregating results within a bucket masks individual variance within the sample and, therefore, only the average impact on each clearing member bucket in each CCP could be presented. This means that even where the average performance within a bucket would be satisfactory, there could still be liquidity breaches at an individual clearing member level.[28]

Third, the methodology did not model hypothetical system-wide effects. It did not reflect the hypothetical possibility that multiple CCPs could simultaneously use cash calls or VMGH, nor did it explicitly model other potential demands on HQLA independent of the HQLA haircuts noted above. In addition, it did not consider that the impact of cash calls and VMGH could be different in case of a very adverse tail event. A system-level analysis would have required cumulating the data for each clearing member across several CCPs and assuming a consistent market event. In addition to not being possible under the data confidentiality limitations applicable to this analysis, this would have required substantial efforts in scenario design.

Findings

Liquidity impact

Based on the combination of the applied HQLA haircuts and the use of tools by a single CCP, the quantitative analysis suggests that the liquidity impacts of the use of cash calls and VMGH appear to have notably less significant impact on clearing members' liquidity in comparison to their starting liquidity positions.[29] Graph 3 compares the scale of impact on clearing member liquidity from external liquidity stress with the impact from the use of cash calls and VMGH.

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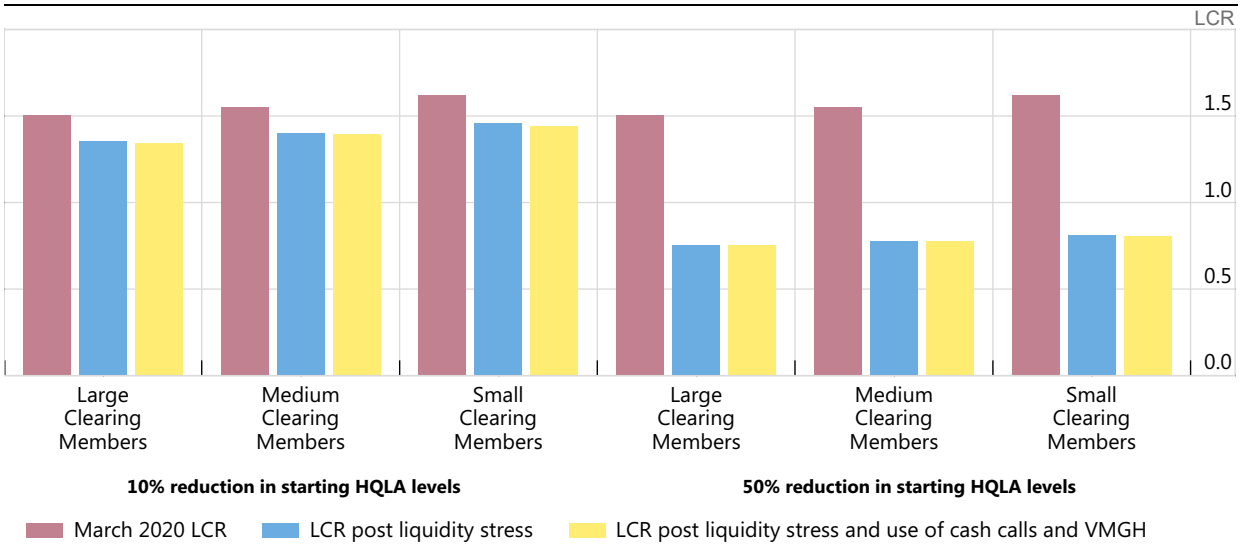
27 Non-bank clearing members are not generally among the largest clearing members at the CCP service lines covered by the analysis.

28 The identified outliers related only to a few individual clearing members, primarily but not exclusively in the small clearing member bucket. The financial system level impact would therefore most likely have remained limited.

29 This is further supported by the fact that the assessment did not account for potential mitigation actions by clearing members to improve their liquidity or capital positions (e.g., the assessment assumed consistent liquidity outflows). Such mitigation actions would be expected even if HQLA levels have only dropped 10% below BAU levels and would further reduce the overall impact of recovery and resolution tools.

Average impact of external liquidity stress and use of 100% cash calls and 100% VMGH on clearing members' liquidity[1] **Graph 3**



[1] One CCP is excluded from this analysis, as it does not operate variation margin.

Source: Jurisdictions' data

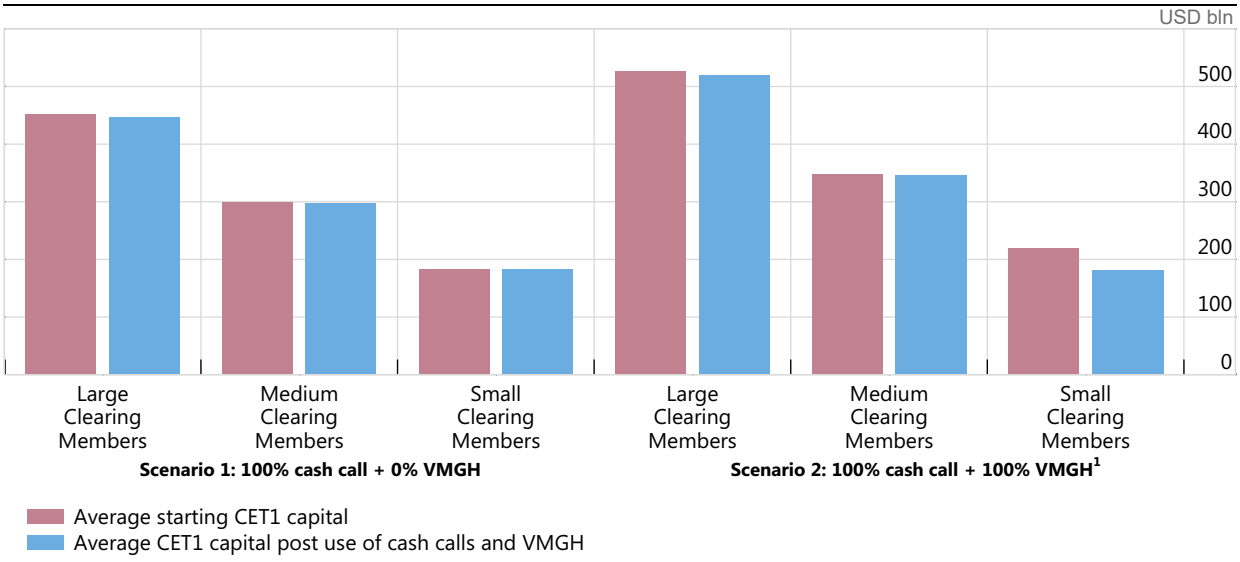
In most cases, each clearing member bucket absorbed the most extreme scenario (combined impact of the largest HQLA haircut and maximum tool use) with limited impacts on LCR (less than three percent reduction in LCR). In the case of the small clearing member bucket of one CCP, the average LCR reduction was approximately five percent. The number of clearing members experiencing liquidity stress did not vary substantially across the various tool use scenarios at each HQLA haircut level in any of the CCPs.

However, some clearing members did breach their regulatory minimum LCRs under the more extreme liquidity stress scenarios. In the cases where a breach did occur, members were typically near or already below regulatory minimums even before the application of CCP recovery or resolution tools, as a result of the modelled liquidity stress. This suggests that in all or almost all cases, the primary driver of a breach when it occurred was the assumed HQLA haircut and not the additional liquidity demands from tool use.

Solvency impact

Each clearing member bucket also absorbed the most extreme scenario with limited impacts on the value of CET1 capital (at most, an approximately four percent reduction in CET1 values). As in the case of the liquidity analysis, the impact of the use of cash calls and VMGH on clearing members' CET1 was limited compared to their starting solvency position (see Graph 4).

Average impact of cash calls and VMGH on clearing members' CET1 **Graph 4**



[1] One CCP is excluded from Scenario 2 analysis, as it does not operate variation margin.

Source: Jurisdictions' data

1.2.2. Qualitative review

Methodology

Alongside the quantitative assessment of the potential liquidity and solvency impact of cash calls and VMGH, a qualitative, judgment-based review of financial stability implications was undertaken. The qualitative review did not take into account the results of the quantitative analysis. The qualitative review covered all the recovery and resolution tools discussed in the relevant CPMI-IOSCO and FSB guidance, irrespective of whether they are currently available for use by CCPs or resolution authorities. The tools assessed were cash calls, VMGH, IMH, forced allocation, tear-ups and write-down of liabilities in resolution. The implications considered were:

- *Knock-on effects:* The risk that the use of available recovery or resolution tools in stressed market conditions may increase the level of market stress across the wider financial system.
- *Performance risk*: The risk that funds available via the use of the tool may fail to materialise in the expected amount or timeframe.
- *Disruption of CCP links*: The risk that the use of tools may disrupt the regular operations between the CCP and other linked financial market infrastructures (FMIs).
- *Interruption of access to securities or cash collateral*: The risk that participant access to otherwise available securities or cash collateral posted to and held by the CCP may be interrupted.
- *Impacts on central clearing*: The risk that the actual or potential use of tools may be perceived to increase the cost of clearing and/or negatively impact central clearing incentives.

- *Incentivisation*: The risk that the current level of loss distribution directly implied by the default/non-default waterfalls or indirectly implied by reputational or related risk of CCP failure may result in ineffective incentives for the CCP or members to adequately risk manage and participate in recovery/resolution.

- *Market and public confidence in CCPs*: The risk that the use of recovery tools might diminish market and public confidence in the CCP.

Observations

The reviewed tools may have effects in three areas: (i) effects during business-as-usual (BAU) from the availability of the tool (e.g., a disincentive to clear with a CCP or under a regime where the tool is available), (ii) effects from the use of the tool, and (iii) effects that are a function of the extent to which the tool is used (e.g., the liquidity impact may be proportionate to the size of the cash call/gains haircut).

Among the implications considered, the knock-on effects, the performance risk and the impact on market and public confidence in the CCP were considered to vary across the tools, while the other impacts were perceived as being more consistent. A CCP's ability to use recovery tools is likely to incentivise more active participation in the CCP's default management process, including through bidding in auctions. Where CCPs have cross-margin or interoperability arrangements, the use of all other tools except cash calls may, depending on design, affect the linked CCP if it is not explicitly excluded from such loss allocation, serving as a potential channel to propagate risk. Generally, the use of recovery and resolution tools does not affect access to securities or cash collateral.

The remainder of this section discusses the varying potential impacts of the other risks referred to above for each recovery and resolution tool covered in the CPMI-IOSCO and FSB guidance (see Annex 1).

Recovery and resolution cash calls

Cash calls are expected to have relatively low performance risk because the maximum amount of cash calls is generally defined in advance and therefore predictable. In addition, clearing members' willingness to meet these obligations is strengthened by including them in the CCP's rulebook, and the potential larger losses to the clearing members in case they do not meet the call.[30] While the maximum amount of cash calls will be known ex ante, they still draw on clearing members' liquidity resources and could have knock-on effects, particularly in an already stressed environment. The impact of drawing on an individual clearing member's liquidity resources would depend on the amount of the cash call, its size relative to the clearing member's balance sheet, the cumulative effects of other default management and recovery actions already taken by the CCP or other CCPs, and conditions in the broader market. In a resolution scenario that is likely to involve especially stressed market conditions, the use of a cash call may have a broader market impact. In assessing potential knock-on effects, it is important to take into account how

[30] e.g., by giving the CCP the right to place the clearing member into default and use its collateral to meet the cash call.

clearing members are treating potential cash calls in managing their capital and liquidity buffer or in considering adjustments to their positions.

VMGH

Performance risk from VMGH is negligible as the CCP controls its execution. Since the CCP retains cash that it already received from variation margin calls (if they were met), a clearing member has no possibility to circumvent a haircut. However, a participant's positive position within a particular CCP may not be a perfect indicator of its relative ability to absorb a credit loss or liquidity shortfall. In particular, participants with directional portfolios would be more likely to face proportionally larger haircuts relative to their liquid resources. In assessing how significant potential knock-on effects could be, it is important to take into account, among other things, the amount of the loss and how clearing members and, where relevant, clients are treating potential VMGH in managing their capital and liquidity buffer. Market confidence might be damaged if VMGH is used, particularly if it was applied over several days.

IMH

The biggest risks with IMH are the impact on market and public confidence in the CCP and its potential knock-on effects. The inclusion of the tool in the toolkit is likely to have a negative impact during business-as-usual, as the possibility of haircutting participant collateral would undercut trust in the CCP. Many clients would be unwilling, and others would be legally unable, to continue to clear at a CCP where IMH was possible. The use of IMH would also contradict the contractual and statutory protections, where they exist, that provide that client collateral is bankruptcy remote.[31] CPMI-IOSCO Recovery Guidance recognises that if initial margin is not bankruptcy remote, it will attract additional capital charges.[32] FSB 2017 Resolution Guidance states that "[i]n considering including [IMH] in their legal framework, jurisdictions should take into due account the impact on financial stability and on incentives to centrally clear."[33] The potential knock-on risks of IMH would also be significant while the performance risk would be negligible because it is a pre-funded resource.[34] However, IMH requires participants to immediately replace the initial margin that had been haircut or liquidate their positions, likely exacerbating market stress, and adding to concerns on knock-on effects.

Forced allocation and tear-ups

Partial and complete tear-ups, and forced allocation, are tools to restore a matched book, rather than allocate a loss. Therefore, their relevance to this analysis is indirect. The use of these tools has the potential for knock-on effects on the participants, and ultimately clients, that would become subject to the tear-ups or forced allocation. The knock-on effects from a partial tear-up would be a function of the extent of the positions torn-up. Similarly, the knock-on effects from

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31 Many types of participants with fiduciary duties cannot take the risk of write-down of initial margin. This would require such participants to withdraw from central clearing or to have contractual arrangements that require initial margin liability to fall on their clearing member. In cases where they withdraw, they would likely try to move to bilateral markets or potentially not hedge their exposures.

32 Section 4.2.26.

33 Section 2.11.

34 In many jurisdictions, IMH is prohibited under legal and/or regulatory frameworks (whether jurisdiction is home or host). In other jurisdictions, if there is lack of clarity as to whether the resolution authority may use the tool, other authorities or courts may take actions to prevent its use, in which case there would be significant performance risk.

forced allocation would be a function of the extent of the positions forcibly allocated. A full tear-up, by contrast, is expected to lead to market-wide and systemically disruptive knock-on effects, given the systemic importance of CCPs.

In the case of both forced allocation and partial tear-ups, depending on the allocation or tear-up scheme, the affected participants might end up with more directional portfolios and thus higher initial margin and variation margin calls. Indeed, in the case of forced allocation, depending on the allocation scheme, a participant may be assigned positions in products or durations in which it does not regularly trade and which therefore are not yet within its risk management structure. A partial tear-up, by reducing or, depending on the extent, removing one of the legs in a participant's hedging strategy, might lead to a participant's existing position becoming less effectively hedged or, at the extreme, unhedged.

The resulting positions might, until and unless liquidated in the market, exceed the participants' risk tolerances and netting capacity and their ability to effectively risk manage their positions. Moreover, in forced allocation risk exposures would be concentrated in a subset of clearing participants, which could have negative impacts in the event of further defaults. The performance risk in the use of forced allocation and tear-ups is low and relates to the CCP's ability to assign positions appropriately (including in terms of price) to non-defaulting clearing members.

Writing down of liabilities

A power enabling the resolution authority to write down a CCP's unsecured liabilities might provide the resolution authority with a readily available source of loss absorbency.[35] It avoids the ex-ante costs of liquidity inefficiencies of requiring CCPs to hold pre-funded resources ring-fenced for availability in resolution but is limited in loss absorbency by the quantum of liabilities available for write-down. The performance risk for the write-down tool is negligible, given that no action is required from parties whose liabilities against the CCP are being written down.

The potential knock-on effects will depend on the timing, quantum and scope of the write down. As with all resolution tools, use of the write-down tool will be subject to the NCWO safeguard. The impact on market and public confidence in the CCP would seem to depend on public perceptions of the extent to which the occurrence of the loss reflects a significant flaw in the design of the CCP and its internal controls.

2. Conclusions and next steps

Based on the results and challenges of the evidence gathering and analysis undertaken, there is merit to continuing work on CCP financial resources for recovery and resolution. While all of the sampled CCPs would have had sufficient prefunded and recovery resources and tools to cover losses in the applied default loss scenarios, the analysis was subject to a number of limitations and assumptions that suggest that the results are to be interpreted cautiously. Moreover, one of the non-default loss scenarios applied would have resulted in the need to use

[35] Depending on the formulation of the write-down power in the jurisdiction's legal framework, a CCP's unsecured liabilities could include clearing members' accrued but not yet realised profit on their cleared positions, other settlement amounts and the CCP's other unsecured liabilities. Some jurisdictions may exclude liabilities to providers of critical services to the CCP from the scope of the write-down power. In most jurisdictions, initial margin is explicitly excluded from the scope of any write-down power.

resolution powers in the majority of the CCPs. Ensuring an adequate set of resolution tools to cover both default and non-default losses in case of a need continues to be important.

The assessment presented in this report could not consider system-wide, aggregate effects due to constraints arising from data availability and confidentiality. On average, the analysis identified only limited impacts on bank clearing members' liquidity and solvency. However, the level of understanding of the impact of the use of recovery and resolution tools on non-bank clearing members, clients and the financial system as a whole remains limited. Therefore, it would be beneficial to enhance as much as possible the understanding of the potential complex system-wide effects of the use of recovery and resolution tools.

Informed by the evidence gathering and analysis presented in this report, the FSB has decided to:

- continue to review the sufficiency of the existing toolkit for CCP resolution, focusing in particular on non-default loss scenarios. Further work will consider the need for, and costs and benefits (including effectiveness and impact on incentives) of, potential alternative financial resources and tools for CCP resolution. This further work, to be undertaken in cooperation with CPMI-IOSCO, will be initiated in Q2/2022. The FSB would welcome stakeholder views as input to this work by 29 April. The comments received will be published unless requested otherwise.

- continue to monitor that resolution authorities have access to an adequate set of resolution tools.[36] This will be undertaken through continued efforts to conduct and enhance implementation monitoring.

Separately, CPMI-IOSCO is carrying out work on CCP non-default losses in resilience and recovery, in particular to identify current and effective practices and potential gaps. CPMI-IOSCO remain committed to full, timely and consistent implementation of the PFMI standards on CCP financial resources and tools for resilience and recovery, supplemented by the CPMI-IOSCO guidance on recovery.

[36] See FSB 2021 Resolution Report (p. 18) for an example of the monitoring currently undertaken by the FSB.

Annex 1: Scope of recovery and resolution tools

The following is a summary of the recovery and resolution tools covered under the existing CPMI-IOSCO and FSB guidance. It does not provide information on the extent to which these tools are implemented.

Tools available under CPMI-IOSCO guidance[37]

- CCPs should have (i) tools to allocate uncovered losses caused by participant default (including cash calls, gains based haircutting, use of initial margin, or other tools involving collateral and capital); (ii) tools to address uncovered liquidity shortfalls (including obtaining liquidity from third-party institutions or obtaining liquidity from participants); (iii) tools to replenish financial resources (including cash calls or recapitalisations); (iv) tools to re-establish a matched book following participant default (including forced allocation of contracts or contract termination: tear-up (complete, partial, or voluntary)); and (v) tools to allocate losses not caused by participant default (including capital and recapitalisation, insurance or indemnity agreements, or other tools).

- The list of tools set forth in the CPMI-IOSCO guidance is not intended to be exhaustive.

- The appropriateness of a given recovery tool or set of tools will vary based on particular CCPs and their individual circumstances. The set of tools in a CCP's recovery plan should be (i) comprehensive; (ii) effective; (iii) transparent, measurable, manageable and controllable; (iv) create appropriate incentives; and (v) minimise negative impact on direct and indirect participants and the financial system more broadly.

Tools available under FSB guidance[38]

- Resolution authorities should have powers to ensure the maintenance and continuity of the CCP's critical functions or ensure continued performance of those functions by another entity or arrangement (including a bridge entity established by the resolution authority) coupled with the orderly wind-down of the residual CCP in resolution.

- Resolution authorities should have all the powers that are necessary to carry out an orderly resolution of a CCP, in particular, powers and tools to: (i) enforce any outstanding contractual obligations, including under the CCP's rules and arrangements; (ii) continue to operate the CCP; (iii) return the CCP to a matched book; (iv) address any outstanding default losses; (v) replenish financial resources within an appropriate time frame to a level sufficient to maintain regulatory approval; (vi) write down (fully or partially) the equity of the CCP and, where appropriate, unsecured liabilities; and, if appropriate, convert unsecured liabilities into equity or other instruments of ownership of the CCP or of a successor entity ('bail-in'); (vii) transfer critical functions to a solvent

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37 See Recovery of financial market infrastructures (BIS website and IOSCO website).

38 See *Guidance on Central Counterparty Resolution and Resolution Planning*.

third party or bridge CCP; and (viii) wind down operations not judged to be critical functions.

- Resolution considerations for default losses

  - Resolution authorities should have access to the resources available via the CCP's rulebook (including cash calls and gains-based haircutting (GBH) powers where present). Resolution authorities may also have access to a statutory GBH power (which allows the resolution authority to conduct GBH beyond the time and size limits set out in the CCP's rulebook). There may also be an optional statutory resolution cash call.

- Resolution considerations for non-default losses

  - Resolution authorities should have access to any resources available via the CCP's rulebook, the CCP's capital, and other tools available to the CCP. Resolution authorities should have the power to write down CCP equity and liabilities and may have access to a statutory cash call power.

Annex 2: Default loss scenario: total stress losses and resources

			Service line A	Service line B	Service line C	Service line D
Name of scenario						
Product type cleared						
Stage	**Order of use**		**Amount in million *[insert currency]***			
		Total stress loss at cover 4 with 1.4 scaling ("Total Stress Loss")				
Resilience (BAU)	*Please specify order of use with a numerical ranking. Where resources/tools can be applied alternatively or in parallel, they should be shown as having the same rank.*	Required available collateral (initial margin) of defaulting clearing members for use in the scenario (1) available (2) used				
		Default fund contribution of defaulting clearing members (1) available (2) used				

		Other prefunded resources of defaulting clearing members ***please specify in notes, but exclude excess initial margin*** (1) available (2) used				
		Total amount of defaulting clearing members' prefunded resources (1) available (2) used				
		Total stress loss after using defaulting clearing members' resources				
Resilience (BAU)		Skin-in-the-game ("SITG") (1) available (2) used				
		Default fund contributions of non-defaulting				

		clearing members (per service line) (1) available (2) used				
		Second skin-in-the-game ("SSITG") (1) available (2) used				
		[Other prefunded resources, CCP or mutualised, ***please specify in notes,*** *(1) available (2) used]*				
		Total amount of CCP and mutualised waterfall resources (1) available (2) used				
Recovery		Recovery cash calls by the CCP (1) available (2) used				
		VMGH by the CCP (1)				

		available (2) used				
		Use of IM (other than defaulters' IM) by the CCP (1) available (2) used				
		CCP equity directly available for default losses in excess of minimum reg. requirements (1) available (2) used				
		Other non-waterfall resources; ***please specify in notes*** *(e.g. legal commitment or obligation by parent to provide further resources / comfort letters / insurances) (1) available (2) used*				
		Total CCP and non-defaulting				

		clearing members' recovery resources (1) available (2) used				
Resolution		Resolution cash calls by the resolution authority (1) available (2) used				
		VMGH by the resolution authority (1) available (2) used				
		CCP equity held to satisfy regulatory requirements (1) available (2) used				
		Write-down of IM (other than defaulters' IM) by the resolution authority (1) available (2) used				
		Write-down / bail-in of				

		unsecured liabilities (1) available (2) used				
		*Other available resolution resources **please specify in notes** (1) available (2) used*				
		Total resolution resources (1) available (2) used				

Additional remarks

1. Include specific notes on each type of “other available resources” included above.

2. Initial margin should in no case include excess collateral. Only margin components related to the elements of the stress test (e.g. market risk-related components) should be included in the available resources. All values should be stated prior- and post-haircut and be provided at the aggregate level as well as a break-down per collateral type.

3. Include resources required/available under the CCP’s rules and the home country’s legislation as in force or finalised as of the date of the stock take. Information regarding intended future amendments or amendments in discussion, but not yet decided, should not be considered in the stock take, but may be disclosed here.

4. Amount of the available/required resources should be shown in the currency in which these are available, owed or committed. Where the currency between these resources varies, they should be converted into one single currency for purposes of arriving at a total sum in one currency. This fact and the applied conversion rates should be disclosed here.

5. Where a CCP's business model comprises several clearing service lines with separate dedicated default funds, data should be calculated and indicated separately for each clearing service line of the given CCP, unless the rules of the CCP provide for a cross-service line use of these resources. Where cross-service line use is permitted, provide specific notes, including regarding amounts available and used.

6. Include any constraints in the use or timely availability of prefunded resources for loss absorption. Please also indicate any cases where there are constraints in the use of resources by a relevant body (e.g. resources available to the resolution authority but not to the CCP).

7. For each resource type, the applicable reference size, frequency, cap or other limitations / constraints should be identified in the respective columns of the template. Where a certain resource type can be applied multiple times (e.g. cash calls) or up to a certain cap (e.g. VMGH by the CCP), the amount shown in the column "amount" should indicate the maximum amount available if the instrument was applied to its fullest extent, as well as, where applicable, what this amount represents; e.g. "3x EUR 150 mn" or "EUR 450 mn" which represents 3x current default fund. Where the use of a tool is unlimited, this should be clearly specified under "amount".

Annex 3: Liquidity risk from the loss of access to the institution holding assets on behalf of the CCP

This hypothetical scenario has been constructed to help analyse the resources available at the CCP to address liquidity risk due to loss of access to an institution holding assets (securities and/or cash) on behalf of the CCP in conjunction with payment defaults ('Institution'). The scenario assumes that the incident would prevent the Institution (and all affiliates) from performing their obligations to the CCP in any capacity (e.g., custodian, member, liquidity provider).

Authorities and CCPs should assume that:

- The CCP loses access to assets held at the Institution[39] that would cause the largest liquidity risk[40] to the CCP. This scenario is intended to result in a circumstance where the CCP's liquidity needs in the immediate term exceed its available liquidity resources. Therefore, CCPs should identify the peak liquidity exposure during the period starting 1/1/2020 and ending on 30/9/2021 as well as considering the days of extraordinary volatility over the past five years.

- Loss of access to the assets held at the Institution is for reasons unrelated to the CCP's actions or its own financial position (e.g., insolvency of the Institution). This loss of access is assumed to last for a prolonged period.

    - In most cases, the largest liquidity risk to the CCP would arise if the CCP loses access to the margin and other CCP (proprietary) accounts at the Institution that holds the highest value of the CCP's assets.[41] However, if the loss of access to a different Institution is likely to cause a greater liquidity risk to the CCP, this other Institution should be chosen for purposes of this exercise.

- The CCP will not be able to access any accounts held at the Institution and therefore will not be able to make corresponding required payments using funds held at that Institution.

- The CCP's clearing members would similarly be unable to access any of their assets held at that Institution.

- If the Institution (or any of its affiliates) is/are member(s) of the CCP or participate(s) in a consortium for a liquidity line, then neither the Institution nor its affiliates will be making any of their payment obligations as a member to the CCP or as a liquidity provider.

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39 If the institution that would generate the largest liquidity risk is the central bank, CCPs should use the institution that would generate the second largest liquidity risk. If the institution that would generate the largest liquidity risk would be subject to resolution under the authority's resolution framework, it should still be analysed.

40 The CCP's largest liquidity exposure may consist of non-cash assets and collateral, cash, or a combination.

41 Normalising to whichever currency is most relevant at that CCP.

Perform the analysis in Steps 2 to 5 of the *FSB Guidance on financial resources to support CCP resolution and on the treatment of CCP equity in resolution* with respect to liquidity risk only. Identify data and assumptions used as well as any stresses applied to the CCP data. In particular, identify the factors that may lead to the CCP not being able to access BAU liquidity sources and the resilience and sufficiency of such resources in resolution, as well as the potential for adverse effect on financial stability that may render the resource or tool unusable or unavailable in resolution.

First complicating assumption: Now assume that a payment default to the CCP by the two clearing members (and their affiliates) that would generate the largest aggregate payment obligations to the CCP in extreme but plausible market conditions occurs during the period that the CCP does not have access to assets held at the Institution.[42] Therefore, the CCP would need additional liquidity for default management because all or a portion of its guarantee/default fund assets are not available because of the loss of access to the Institution. CCPs should assume that assets held at the Institution would not be available for the entire period that it takes to manage the default.

Second complicating assumption: In addition to the additional defaults in the first complicating assumption, also assume that that the loss of access happens while variation margin settlement funds are "in flight." That is, assume that the loss of access to assets at the Institution takes place at a point in time in the middle of the CCP's settlement cycle, such that the CCP has received at its settlement bank(s) all settlement payments due from clearing members with losses for that cycle, but has not yet made any settlement payments to clearing members with gains.

[42] For consistency across CCPs, if the clearing member/affiliates that generates the largest payment obligation are the same as (or affiliated with) the institution identified above, include the clearing member/affiliates that generates the *second* largest payment obligation.

Annex 4: Cyber theft scenario (theft of cash held by the CCP)

This hypothetical scenario was constructed to help analyse the resources available to cover operational losses, incurred by the CCP, that exceed the CCP's available resources and that the CCP would not be able to allocate to third parties (such as clearing members) or receive support from its parent to cover. The scenario is intended to enable the evaluation of the adequacy of resources available to the CCP and resolution authority to manage NDLs. It makes certain assumptions and simplifications to increase consistency and comparability between CCPs.

Authorities and CCPs should assume that:

- The CCP has suffered a theft of a significant quantum of cash following an external actor illegally gaining access to the CCP's systems to make unauthorised transfers. Funds were redirected to a third-party's bank account (and then onward from there) instead of being transferred from the CCP's bank account to its investment agent or depositary.

- The quantum of cash stolen is equal to the highest daily value of the sum of all cash transferred by the CCP from any single investment agent or depositary on one day, during the period starting 1/1/2020 and ending on 30/9/2021 as well as considering the days of extraordinary volatility over the past five years. Intraday and end-of-day transfers should be included in the analysis.

- The CCP will not receive any uncommitted funds or other voluntary support from any third-party, including its parent company or other owners, to remedy the theft.

- The theft was the result of a failure of the CCP's cyber defences. Therefore, it is highly unlikely that the CCP would be in a position to invoke the liability of any third party in order to recover, from any other potentially responsible party, compensation for losses arising from the theft.

- To the extent the CCP has applicable insurance coverage, this coverage will not be available in the immediate term.

- There is no realistic prospect of the CCP being able to trace and recover the sums lost.

- Subsequent to the theft, the CCP has discovered and remedied the weakness in its cyber defences and its IT access management procedures that enabled the theft to occur.

- No FX risk arises subsequent to the theft: authorities should use a quantum calculated in a single currency equivalent (choosing the currency most relevant for that CCP) for the quantum of cash stolen.

Perform the analysis in Steps 2 to 5 of the *FSB Guidance on financial resources to support CCP resolution and on the treatment of CCP equity in resolution* with respect to solvency and liquidity risk. Identify data and assumptions used as well as any stresses applied to the CCP data. CCPs should identify losses associated with the management of the entire theft and not focus solely on the first day. In addition, CCPs should identify funds necessary for replenishment and ongoing operational requirements.

Annex 5: Template for the stock-take of resources for non-default losses

NDLs: *Mitigants* as of the date used in the relevant stress test scenario

Stage & Order	Type	Amount in million *[insert currency]*			
		Service line A	Service line B	Service line C	Service line D
? Resilience	Rule-based direct absorption of non-default losses by clearing members, e.g., based on exclusion of the CCP's liability *[please specify under "additional remarks"]*				

Additional remarks

NDLs: *Prefunded* resources as of the date used in the relevant stress test scenario

Stage & Order	Type	Amount in million *[insert currency]*			
		Service line A	Service line B	Service line C	Service line D
? Resilience (BAU)	Dedicated own CCP capital for NDLs				
?	*[Other prefunded resources in BAU, please specify]*				
--	**1st total amount of prefunded resources**				
? Recovery	*[Prefunded resources in recovery, e.g., recovery capital, please specify]*				
?	CCP equity directly available for non-default losses in excess of minimum regulatory requirements				
--	**2nd total amount of prefunded resources**				
? Res.	Remaining equity of the CCP				
--	**3rd total amount of prefunded resources**				

Additional remarks

NDLs: *Non-prefunded* resources as of the date used in the relevant stress test scenario

Stage & Order		Type	Reference size	Frequency / Cap / Limitations	Amount in million *[insert currency]*			
					Service line A	Service line B	Service line C	Service line D
?	Recovery	Non-default loss allocation to clearing members where CCP is liable in the first instance, please specify (e.g., rule-based commitments by clearing members to contribute for certain NDL events, general NDL allocation tool, etc.)						
?		Other non-prefunded resources; please specify (e.g., legal commitment or obligation by parent to provide further resources / comfort letters / insurances)	*[e.g., committed or available amount]*	*[e.g., limitations or constraints on their use (e.g., uncommitted resources not to be considered) / timeliness (e.g., insurance not to be considered)]*				
--		**1st total amount of non- prefunded resources**						
?	Resolution	Resolution cash calls by the resolution authority	*[e.g., default funds across all service lines]*	*[e.g., 2x]*				
?		Write-down / bail-in of unsecured liabilities	*[e.g., unsecured liabilities minus initial margin]*	*[specify degree to which the remainder exists of those towards clearing members]*				
?		Other available resolution resources [please specify]	*[e.g., available amount]*	*[e.g., limitations on use]*				
--		**2nd total amount of non-prefunded resources**						

Additional remarks

Annex 6: Template for the stock-take of resources for liquidity needs

NDLs: Liquidity resources as of the date used in the relevant stress test scenario

Order Used	Type	Description	Relevant Collateral Type	Amount in million *[insert currency in relevant cell/s]*			
				Service line A	Service line B	Service line C	Service line D
1	Committed	Committed repo lines	Sovereigns in Super-Major Currencies				
2		Committed Euro lines	Euro cash collateral				
3		Liquidity facility	Fixed-income securities, including sovereigns and corporate bonds				
4		Loan facilities *[please specify]*	Cash, cash against collateral				
5		Rule-based loss assumption by third parties resulting in liquidity need mitigation	*[please specify]*				
6		Equity of the CCP	*[please specify]*				
?	Uncommitted	Additional repo lines					
?		Regularly used FX broker/dealers	Super-Major Currencies				
?		Other CCP-specific arrangements *[please specify]*	*[please specify]*				
?		Market transactions for highly liquid collateral	Corporate bonds, equities				

Additional remarks

Annex 7: Methodology for assessing the potential financial stability implications from the use of VMGH and cash calls

The following sets out the methodology for assessing the potential liquidity and solvency impact from the use of cash calls and VMGH.

Step 1: Selecting a representative sample of clearing members

- The same sample of financial institutions was used to estimate both the liquidity and solvency impact that may arise from the use of CCP recovery and resolution tools during stressed market conditions.

- The sample of clearing members was selected based on the membership of the CCP's largest clearing service (as measured by the sum of the total value of initial margin and default fund contributions).

- Given limitations stemming from data availability and confidentiality, the sample used was limited to clearing members that are banks. Non-bank clearing members and clients were not considered.

- Each sample of clearing members consisted only of clearing members for which participating authorities had or could gain access to the relevant data. Where this led to having to omit foreign clearing members, it was verified that such omissions did not significantly affect the results of the analysis.

- The clearing member population was then split into three buckets: small clearing members, medium-sized clearing members and large clearing members. The buckets were formed via a choice of two methods. The first method was based on clearing members' default fund contributions (as of end-Q1 2020). Clearing members were placed in order of their default fund contributions to produce a default fund contribution distribution. The sample was split into those clearing members which accounted for (i) the 67-100 percentile (large clearing members); (ii) the 34-66 percentile (medium-sized clearing members); and (iii) the 0-33 percentile of the distribution (small clearing members). For example, if a population of 90 clearing members is considered, the resulting buckets may have consisted of 5 large clearing members (67-100 percentile), 15 medium-sized clearing members (34-66 percentile) and 70 small clearing members (0-33 percentile). The second method for forming the buckets was also based on clearing members' default fund contributions. However, the difference was that the clearing member population was split into three equal groups with the same number of clearing members in each group. For example, if a population of 90 clearing members is considered, the resulting buckets would have consisted of 30 large clearing members, 30 medium-sized clearing members and 30 small clearing members. Authorities adopted the method that made their buckets the most representative.

- Once the clearing member buckets were formed, the required number of clearing members was selected from each sub-group. The sample size used in the analysis was at least five clearing members for each sub-group, provided five or more members fell

into the respective bucket for a given CCP. Depending on the overall size of CCP membership, participating authorities could optionally use a maximum sample size of ten clearing members for each sub-group. For each CCP, the overall clearing member sample had to reflect at least 25% of the CCP's total default fund size.

- For the medium-sized clearing member and large clearing member buckets the top five (or max ten) clearing members in terms of default fund contributions were selected. A similar approach was adopted for the small clearing member bucket. However, the difference was that there was also a secondary check to ensure that the clearing members included in this subset had a small balance sheet size. Clearing members that did not have a small balance sheet size (i.e., large clearing members that only conduct a small amount of business at a CCP) were excluded from the sample. Where a clearing member was a separate legal entity from its banking group, the group was treated as one clearing member (with combined default fund contributions).

Step 2: Compiling the liquidity and solvency data for the clearing members

- The liquidity and solvency impact of VMGH and cash calls was assessed at a group level for each clearing member included in the sample, based on consolidated liquidity and solvency data.

- For estimating the liquidity impact of recovery and resolution tools, data on those clearing members' end-Q4 2019 liquidity coverage ratio (LCR), high quality liquid assets (HQLA) and net outflows was collected.

- For estimating the solvency impact of recovery and resolution tools, data on those clearing members' Tier 1 common equity (CET1) was collected.

Step 3: Calculating the maximum exposures from variation margin gains haircutting

- This part of the analysis considered the maximum amount of VMGH that each clearing member could have been subject to on the business day during the COVID-19 stress / dash-for-cash episode (March 2020) which generated the maximum total variation margin paid to the CCP.[43] For each CCP, data was then collected on the amount of variation margin that each clearing member received or paid on that date.

- Then the maximum amount of VMGH that a clearing member could have been exposed to at different stages from the rulebook up to resolution was calculated. To ensure that the variation margin gain could be determined for all clearing members covered by the analysis, the inverse variation margin was used for those clearing members with variation margin pays on the relevant date.

[43] This approach was informed by the view that resolution authorities would seek to minimise their use of VMGH, seeking to only deploy one round of VMGH at most (unless more prolonged use of VMGH is unavoidable).

- To understand how a clearing member would have been treated under the no-creditor-worse-off (NCWO) counterfactual, all VMGH measures (those which the CCP may call upon on its own accord and those which might be reserved for the resolution authority) had to be taken into account. This required modelling the maximum loss distribution per clearing member that would have been achieved under the CCP's rulebook (i.e., under CCP recovery) and using that result to inform the maximum quantum of loss the clearing member could have borne in resolution.

- Where VMGH is not within a jurisdiction's current resolution powers, the relevant authority also assessed the loss absorbency that would have been available if it were and reported the results of the assessment of the jurisdiction's current regime and a fully FSB compliant regime separately.

Step 4: Calculating the maximum exposures from cash calls for default losses

- Consistent with the VMGH analysis, the maximum cash call a CCP could have hypothetically called during the COVID-19 stress / dash-for-cash episode (March 2020) was determined.

- For most CCPs, the size of a potential cash call (or cash calls) is determined as a multiple of clearing members' existing default fund contributions. Therefore, for each CCP, data on clearing members' default fund contributions to the CCP's largest clearing service was compiled. For each clearing member, the day during March 2020 where its default fund contributions were the highest was determined.

- The individual pre-funded default fund contribution on that day for each sample clearing member was multiplied by the applicable factor, to produce the maximum resolution cash call available (without generating a NCWO compensation risk) under the FSB guidance. This factor was determined by examining the CCP's rulebook to understand the NCWO counterfactual.

- Thus, all cash calls (those which the CCP may call upon on its own accord and those which might be reserved for the resolution authority) were taken into account, including the obligation to replenish the default fund, to the extent this applies in addition and is not already covered by the cash calls.

Data collection

- The data used for each of the above assessment steps and the source and date of that data is summarised in the following table:

Assessment step	Data required	Data source	Date of data
Selection of clearing member sample	Default fund contribution (per clearing member)	CCPs / CCP supervision	End-Q1 2020
	Balance sheet size (per clearing member), for "small" clearing members only	Public / supervision	End-Q1 2020
Estimating the liquidity impact of recovery and resolution tools	HQLA (per clearing member)	Partly public / supervision	End-Q4 2019
	Net liquidity outflows (per clearing member)	Supervision	End-Q4 2019
	Max value of cash call contribution (per clearing member)	CCPs / CCP supervision	March 2020
	Max value of VMGH (per clearing member)	CCPs / CCP supervision	March 2020
Estimating the solvency impact of recovery and resolution tools	CET1 capital (per clearing member)	Public	End-Q4 2019
	Max value of cash call (per clearing member), same as above	CCPs / CCP supervision	March 2020
	Max value of VMGH (per clearing member), same as above	CCPs / CCP supervision	March 2020