

2023 CCP Supervisory Stress Test: results report

Results of the Bank of England's 2023 Supervisory Stress Test
of Central Counterparties

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1: Foreword

The publication of the Bank's second public UK Central Counterparty (CCP) Supervisory Stress Test marks another important step forward in the Bank's supervision and regulation of CCPs.

CCPs sit at the centre of the UK and global financial system. Their resilience is important to financial stability in the UK and overseas. And supervisory stress tests like these have a key role to play in assessing that resilience, providing transparency, and promoting confidence.

This is the second exercise of this nature that the Bank has undertaken. It incorporates several new innovations relative to the previous exercise, including an assessment of CCP resilience against more idiosyncratic shocks. From a wider perspective, it also includes an assessment of the potential Initial Margin and Variation Margin calls that CCPs' members might face in a stress – something that the Bank's system-wide exploratory scenario (SWES) exercise will examine in further detail.

The results confirm the continued resilience of UK CCPs to market stress scenarios that are of equal and greater severity than the worst-ever historical market stresses. CCPs' results have improved across each of the components of the stress test relative to our previous exercise. Notably, CCPs are able to more comfortably absorb default losses and maintain higher liquidity balances through the exercise. And they are also able to survive more extreme combinations of assumptions, which intentionally go beyond historical precedents and regulatory requirements.

This reflects CCPs' financial resources as well as levels of collateralisation that have increased after the periods of market volatility in energy, metals, and UK rates markets in 2022. While this dynamic of higher market volatility leading to higher margins is expected and an integral part of CCPs' risk models and risk management, the Bank has also deployed in-house models to understand how the results might look as Initial Margin levels have reduced following a period of lower volatility, supporting our assessment of UK CCPs' resilience.

This ability to adjust assumptions and increase severity across multiple dimensions independently and in combination enhances the Bank's understanding of a wide range of risks to UK CCPs. In conjunction with the Bank's past and future CCP stress-test exercises, it further supports the Bank's supervision and regulation of UK CCPs, contributing to financial stability at home and abroad.

A handwritten signature in black ink that reads "Sarah Breeden". The signature is written in a cursive style with a long, sweeping underline.

Sarah Breeden, Deputy Governor Financial Stability

2: Executive summary

Purpose and design

UK central counterparties (CCPs) lie at the heart of the global financial system and are supervised by the Bank of England (the Bank) because of their importance to the smooth functioning of financial markets and the wider economy. As part of this supervision, the Bank conducts regular stress testing of UK CCPs. This report sets out the results of the Bank's second public supervisory stress test of UK CCPs (the 2023 CCP SST).

The 2023 CCP SST explores the credit and liquidity resilience of the three UK CCPs (ICE Clear Europe Limited (ICEU), LCH Limited (LCH), and LME Clear Limited (LMEC)), and their interconnectedness with the rest of the financial system. It is not a pass-fail exercise. Nor is it aimed at checking compliance with regulations or assessing the quality of CCPs' internal stress testing. Rather, it aims to identify any potential vulnerabilities and gaps in CCPs' financial resilience, with the findings used to support and inform the Bank's supervisory and regulatory activities.

The 2023 CCP SST has four analytical components: the Credit Stress Test, the Credit Reverse Stress Test, the Liquidity Stress Test, and the Clearing Member and Client Analysis. It includes several extensions relative to the Bank's previous CCP SST exercise. Each component is based on a hypothetical Baseline Market Stress Scenario, which represents a global economic downturn combined with a negative supply shock in commodities markets. The scenario consists of shocks to a wide range of products cleared by UK CCPs. The Bank has calibrated the scenario to a level of severity broadly equivalent to the worst historical stress experienced by each CCP, while ensuring historically plausible correlations between different risk factors. Overall, the Baseline Market Stress Scenario is also more severe than the corresponding scenario in the Bank's previous CCP SST exercise, as the calibration methodology incorporates the large shocks that occurred in energy, metals, and UK rates markets in 2022.

Results and findings

Overall, the exercise demonstrates that UK CCPs are resilient to the Baseline Market Stress Scenario and default of the Cover-2 population,[1] from both a credit and liquidity perspective.

In the Credit Stress Test, all UK CCP Clearing Services have sufficient prefunded resources[2] to comfortably absorb default losses following a Cover-2 default, even when accounting for the cost of liquidating concentrated positions. Only two CCP Clearing Services (ICEU F&O and LME Base) experience any depletion of mutualised Default Fund contributions. Defaulters' own resources and CCPs' own capital[3] are sufficient to cover default losses at the other CCP Clearing Services.

Further, each UK CCP Clearing Service sees less depletion of mutualised Default Fund contributions than in the Bank's previous CCP SST exercise. This is despite the more severe Baseline Market Stress Scenario. This confirms the UK clearing system responded as it was expected to following the periods of market volatility in 2022. That volatility fed through CCPs' risk models and risk management into increases in Initial Margin requirements and Default Fund sizing ahead of the 2023 CCP SST launch date. This means a greater share of total stressed losses are covered by defaulters' own resources, reducing the depletion of mutualised Default Fund contributions at each CCP Clearing Service.[4]

Initial Margin requirements have fallen at some CCP Clearing Services since the 2023 CCP SST reference date, consistent with normalising market conditions and a reduction in volatility. Nonetheless, internal analysis suggests CCPs would continue to be resilient to the Baseline Market Stress Scenario and simultaneous Cover-2 default, despite increased depletion of prefunded resources.

In the Credit Reverse Stress Test – which tests CCPs against increasingly challenging assumptions that go beyond historical precedent and regulatory requirements – all three CCPs perform better relative to the Bank's previous CCP SST exercise. This is despite the Credit Reverse Stress Test also applying more severe market stress scenarios than in the Bank's previous CCP SST exercise. Under the most severe combination of assumptions examined – a more severe market stress scenario, a higher number of defaulting Clearing Members, and

reduced ability to liquidate concentrated positions – only one CCP Clearing Service (LME Base) experiences full depletion of both prefunded and non-prefunded resources.[5]

When extending this analysis to test CCPs against idiosyncratic shocks deliberately outside historical experience, the results provide evidence of CCPs' ability to withstand targeted shocks more extreme than the historical worst for individual product groups. This new and exploratory analysis assesses the size of shocks required in different product groups (such as Brent Crude Oil products, or GBP interest rate swaps) to deplete CCP Clearing Services' Default Funds under a Cover-2 default. This analysis is not as accurate as the Credit Stress Test and Credit Reverse Stress Test, which are based on full scenario revaluations undertaken by CCPs.[6] The Bank intends to follow up with CCPs to discuss the analysis in more detail and subsequently develop and improve this modelling capacity further to support ongoing supervision.

The Liquidity Stress Test shows that all three CCPs can meet liquidity requirements under the combination of the Baseline Market Stress Scenario and the simultaneous default and failure of the Cover-2 population. Each CCP maintains a positive liquidity balance in aggregate, and in key individual currencies (EUR, GBP and USD) when additionally assuming no access to foreign exchange markets. When subjected to more extreme assumptions regarding their ability to mobilise liquid resources – to examine CCPs' reliance on different liquidity management tools – results are generally improved relative to the Bank's previous CCP SST exercise.

The provision of key services that CCPs rely on for liquidity risk management remain concentrated. This concentration reflects Clearing Member preferences and market-related factors, but continues to illustrate the importance of CCPs ensuring their arrangements with service providers are appropriately robust.

The largest liquidity demands from CCPs' margin calls generally fall on the Clearing Members who are the largest financial groups and are better able to manage them. Consistent with the Bank's previous CCP SST exercise, non-bank Clearing Members face liquidity demands which, while smaller, can still be significant.

Overall, the liquidity demands from Variation Margin calls are more material than those from increased in Initial Margin requirements, but relative increases in Initial Margin requirements can still be material for some Clearing Members. The Bank is working with other international regulators to improve the transparency of Initial Margining practices, and intends to explore liquidity demands from margin calls further as part of the Bank's **system-wide exploratory scenario** exercise.

The Bank will use the findings from the 2023 CCP SST to support and inform its ongoing supervision and regulation of UK CCPs.

3: Introduction

UK central counterparties (CCPs) lie at the heart of the financial system, playing a crucial role in the functioning of financial markets in the UK and globally. The Bank of England (the Bank) supervises UK CCPs because of their importance to the smooth functioning of the financial system and wider economy.

As part of the Bank's ongoing supervision of UK CCPs, the Bank conducts regular supervisory stress testing. The Bank concluded its first public CCP supervisory stress test (the [2021–22 CCP SST](#)) in October 2022. In March 2023, the Bank **[launched its second public supervisory stress test of UK CCPs](#)** (the 2023 CCP SST). This report sets out the results of the 2023 CCP SST exercise.

Like the previous exercise, the 2023 CCP SST explores the individual and cross-CCP credit and liquidity resilience of the UK CCPs (listed in Table A), and their interconnectedness with the rest of the financial system. It aims to identify any potential vulnerabilities and gaps in CCPs' financial resilience, with the findings used to support and inform the Bank's supervisory and regulatory activities. It is not a pass-fail exercise, nor is it aimed at checking compliance with regulations or assessing the quality of CCPs' internal stress testing.

Table A: CCPs in scope of the 2023 CCP SST

CCP	Default Fund/Clearing Service	Key products cleared
ICE Clear Europe Limited (ICEU) ^(a)	Futures and Options (F&O)	Commodities, equity derivatives, fixed Income
LCH Limited (LCH)	SwapClear ^(b)	Interest rate swaps
	RepoClear	Repos (UK Gilts collateral)
	EquityClear	Equities
	ForexClear	Non-deliverable and deliverable FX
LME Clear Limited (LMEC)	LME Base	Commodities (base metals)

(a) The ICEU CDS Clearing Service – which was in scope of the 2021–22 CCP SST – is out of scope of the 2023 CCP SST due to its closure and consolidation into ICEU Clear Credit LLC. ICE Clear Credit LLC is a Derivatives Clearing Organisation (DCO) regulated by the Commodity Futures Trading Commission (CFTC) and Securities and Exchange Commission (SEC) in the United States.

(b) The LCH Listed Rates Clearing Service uses the same Default Fund as the LCH SwapClear Clearing Service.

Like the 2021–22 CCP SST, the 2023 CCP SST comprises four overarching analytical components (summarised in Figure 1):

- **The Credit Stress Test.** An assessment of CCPs' resilience to the default of their Clearing Members in a severe market stress scenario, focusing on the sufficiency of financial resources under CCPs' default waterfalls.^[7] Further details of the Credit Stress Test component are provided in Section 5.
- **The Credit Reverse Stress Test.** An assessment of CCPs' resilience to increasingly severe assumptions to identify what combination of assumptions might fully deplete CCPs' prefunded^[8] and non-prefunded^[9] resources. These assumptions – regarding market stress severity, number of defaulting Clearing Members, and the cost of liquidating defaulters' positions – deliberately go beyond historical precedents and regulatory requirements.^[10] In combination they are extremely severe. Further details of the Credit Reverse Stress Test component are provided in Section 6.
- **The Liquidity Stress Test.** An assessment of CCPs' ability to service all relevant liquidity requirements under a severe market stress and the simultaneous default

and failure of selected Clearing Members and service providers. This component also includes an analysis of the provision of key services that CCPs rely on for liquidity risk management. Further details of the Liquidity Stress Test component are provided in Section 7.

- **Clearing Member and Client Analysis.** An assessment of the potential liquidity demands from CCPs’ margin calls on UK CCPs’ Clearing Members and their clients in a severe market stress. Further details of the Clearing Member and Client Analysis component are provided in Section 8.

Figure 1: Summary of the 2023 CCP SST analytical components (a)



(a) Sub-components and elements with an asterisk are new or extended relative to the Bank’s previous CCP SST exercise.

4: Market stress scenarios

Each of the components in the 2023 CCP SST applies a hypothetical market stress scenario developed by the Bank (the Baseline Market Stress Scenario). The Baseline Market Stress Scenario is based on a global economic downturn and negative supply shock in commodities markets. Interest rates and government bond yields increase across most currencies and maturities, while equity prices and equity indices decline, and emerging market currencies depreciate against the US dollar. In commodities markets, the prices of most gas, oil, power and metals commodities increase, while the prices of agricultural commodities and carbon emissions allowances decline.

Overall, the Baseline Market Stress Scenario is calibrated to achieve a target level of severity for each CCP Clearing Service, rather than being concentrated in certain markets, while maintaining historically plausible correlations between different market prices and rates ('risk factors'). In particular, the risk factor shocks were calibrated such that in combination they were broadly equivalent in severity to the worst historical stress experienced for each UK CCP Clearing Service, given the volume and mix of products cleared. To ensure historically plausible correlations between risk factors, the direction of and relationship between shocks were grounded in historically observed shocks consistent with the overall scenario narrative. As such, the design of the Baseline Market Stress Scenario incorporates the most severe historical stresses, but without replicating any specific event.

Overall, the 2023 CCP SST Baseline Market Stress Scenario is more severe than the corresponding scenario in the Bank's previous CCP SST exercise. This reflects the calibration methodology incorporating the large ahistorical shocks that occurred in energy, metals, and UK rates markets in 2022. Each of these shocks occurred after the reference date for the Bank's previous CCP SST exercise,^[11] but before the 10 February 2023 reference date for the 2023 CCP SST.

In total, the Bank specified the two-day and five-day shocks for over 850 market prices and rates ('risk factors') in the Baseline Market Stress Scenario. This full set of risk factor shocks was published at the launch of the 2023 CCP SST ([2023 CCP SST Market Stress Scenarios](#)). To ensure a complete and accurate reflection of

the Baseline Market Stress Scenario on UK CCPs, each CCP was required to extrapolate these 850+ individual risk factor shocks to all products and exposures within their respective clearing businesses. This extrapolation was undertaken in a manner consistent with the overall scenario narrative and intended severity of the Baseline Market Stress Scenario. The Bank reviewed each CCP's approach to extrapolation.

The 2023 CCP SST also includes three additional 'multiplier' scenarios. These are constructed by applying linear multipliers (of -1.0x, 1.5x and 2.0x respectively) to each of the individual risk factor shocks in the Baseline Market Stress Scenario. The inclusion of a -1.0x multiplier scenario – in which the direction of shocks in the Baseline Market Stress Scenario are reversed^[12] – is new relative to the Bank's previous CCP SST exercise and supports exploratory analysis in the Credit Stress Test. The 1.5x and 2.0x multiplier scenarios – which are more severe than the multiplier scenarios applied in the Bank's previous CCP SST exercise^[13] – are used for the Credit Reverse Stress Test component. In addition, the Credit Reverse Stress Test component includes exploratory analysis of CCP resilience to more targeted product-specific stress scenarios (refer to Box B for more information).

Each of the Baseline Market Stress Scenario and additional multiplier scenarios are applied on the 10 February 2023 reference date for the 2023 CCP SST. This reference date was selected to be generally representative of the period since the conclusion of the Bank's previous CCP SST exercise.^[14] It determines the market prices and rates to which the risk factor shocks are applied, as well as the size of CCP exposures and resources in the 2023 CCP SST. Clearing Member defaults are assumed to occur after the end of day on the reference date, but before markets open the following working day. At this point, the Bank assumes that: (i) no payments are exchanged between CCPs and defaulting Clearing Members; (ii) no position changes are accepted; and (iii) no further payments or margin contributions are made to CCPs.

5: Credit Stress Test

Purpose and objectives

The Credit Stress Test assesses whether CCPs' financial resources are sufficient to absorb default losses in a severe market stress scenario. These losses include those resulting from changes in the value of defaulters' positions due to the market stress scenario, and the additional costs that CCPs may face when they liquidate – through hedging or auction – a large or concentrated positions of defaulters (referred to as 'concentration costs').

The Credit Stress Test is organised into four sub-components:

- **Standard Credit Stress Test:** assesses the sufficiency of CCPs' resources to absorb losses under the market price shocks specified in the Baseline Market Stress Scenario and simultaneous default of the Cover-2 population. The Cover-2 population consists of the two Clearing Member groups whose default generates the largest exposure at each CCP Clearing Service under the applicable market stress scenario. Concentration costs are not included in this analysis.
- **Credit & Concentration Stress Test:** as in the Standard Credit Stress Test, but additionally includes conservative estimates of concentration costs.
- **Cover-X Analysis:** as in the Credit & Concentration Stress Test, but under the simultaneous default of a customised selection of Clearing Member groups (rather than the Cover-2 population). The purpose of this analysis is to examine whether resources sized against the Cover-2 standard are sufficient to cover the default of other combinations of Clearing Members. It is also intended to identify whether there are combinations of Clearing Member groups whose default leads to losses greater than for the Cover-2 population.
- **Opposite Direction Scenario Analysis:** as in the Credit & Concentration Stress Test, but under the -1.0x multiplier of the Baseline Market Stress Scenario. This exploratory analysis is intended to assess CCP resilience against shocks which move in the opposite direction to those in the Baseline Market Stress Scenario.

Methodology

The Credit Stress Test methodology aims to reflect the processes and mechanics of a Clearing Member default scenario, based as closely as possible on the applicable regulations and CCPs' rulebooks.

The Bank collects data from CCPs on financial resources held (including margin requirements and margin collateral, Default Fund contributions, and CCPs' own capital),^[15] Clearing Member and client positions, and on the impact of each of the market stress scenarios on Clearing Members' and clients' profit and losses. The Bank relies on CCPs' models to revalue collateral and positions given the complexity of some of the products cleared by UK CCPs. The Bank validates the data submitted by CCPs against other information sources available.

Using this input data, the Bank assesses the impact on individual CCP Clearing Services' financial resources under the applicable market stress scenario and default assumptions, following the steps below. Where additional modelling assumptions are required – for example in the estimation of concentration costs – the Bank applies its own bespoke and conservative models.

Step 1 – Calculation of surplus or deficit of resources at the individual account level.

The Bank first calculates the surplus or deficit of resources for each individual Clearing Member house account and client account. This is determined by comparing the profit-and-loss (PNL) impact of the relevant market stress scenario, estimated concentration costs where applicable (refer to Box A for further detail), and the applicable account-level prefunded resources. These calculations are based on margin requirements, rather than total margin collateral, to reflect the possibility that Clearing Members may withdraw excess collateral from CCPs in the run-up to a default event.

Step 2 – Calculation of surplus or deficit of resources at the Clearing Member level

Next, the overall impact for each individual Clearing Member is determined based on the surplus or deficit of resources at each of its accounts, and the relevant account segregation rules. Surpluses and deficits on house accounts are generally

aggregated, as CCP rules allow any surplus on Clearing Members' house accounts to be used to offset any deficits on their client accounts. Balances at client accounts are only aggregated where (i) those accounts have a deficit, and (ii) those accounts are not assumed to be ported (ie transferred) to other (non-defaulting) Clearing Members. This reflects CCP rules which stipulate that any surplus on clients' accounts must be returned to those respective clients and cannot be used to offset deficits elsewhere.

The Bank considers alternative assumptions regarding CCPs' ability to successfully port client accounts (detailed in Table B) to assess the impact of successful porting on CCPs' resilience. Where porting of client accounts is assumed, ported accounts would be moved across to a new Clearing Member with all their positions and resources and so are excluded from the rest of the calculation process.

Table B: Credit Stress Test alternative porting assumptions

Porting assumption	Description
No porting	No client accounts port from defaulting Clearing Members to non-defaulting Clearing Members. This is the most conservative porting assumption in the Credit Stress Test.
Segregated client accounts port	Client accounts that are individually segregated (ISEG) or legally segregated operationally comingled (LSOC) are assumed to successfully port from defaulting Clearing Members to non-defaulting Clearing Members. Omnibus accounts do not port from defaulting Clearing Members to non-defaulting Clearing Members.
All client accounts port	All client accounts are assumed to successfully port from defaulting Clearing Members, including ISEG, LSOC, and omnibus accounts.

Step 3 – Calculation of surplus or deficit of resources at the Clearing Member group level

Clearing Members are then grouped together into Clearing Member groups when they are under the same corporate/legal structure and/or have particularly close economic relationships. This reflects the likelihood that all Clearing Members within a Clearing Member group would default together when a default occurs.

The surplus or deficit of resources for each Clearing Member group is then calculated based on the net surplus/deficit of each individual Clearing Member within that Clearing Member group. Under CCPs' rules, defaulting Clearing Members are resolved separately, even if they are part of the same corporate group. For Clearing Members with a surplus, this surplus therefore cannot be used to offset losses elsewhere in the Clearing Member group. For Clearing Members with a deficit over their margin resources, this deficit is compared against their own Default Fund resources and then aggregated to calculate stressed losses over defaulting members' resources (SLOMR) at the Clearing Member group level.[16]

Step 4 – Default of selected Clearing Member groups

The Credit Stress Test methodology can test any combination of defaulting Clearing Member groups. The initial focus is on the default of the Cover-2 population, which is determined algorithmically for each CCP clearing service by calculating losses for every potential pair of defaulting Clearing Member groups.[17]

This is complemented by the Cover-X Analysis, which considers the default of customised populations of Clearing Member groups. This includes an analysis of the system-wide Cover-2 population, defined as the two Clearing Member groups whose default leads to the greatest aggregate SLOMR across all CCP Clearing Services. It also includes populations of Clearing Member groups based on common characteristics, such as entity type or industry, and based on Clearing Members' probability of default.

Step 5 – Calculation of depletion of financial resources held under CCPs' default waterfalls

After selecting the defaulting Clearing Member groups, the resulting SLOMR are compared to the other resources available to each CCP Clearing Service under their default waterfalls. These resources are drawn upon in the following order:

- **Skin in the Game (SITG):** CCPs' own capital set aside to absorb default losses beyond defaulters' own resources in the first instance.
- **The mutualised Default Fund:** Contributions of non-defaulting Clearing Members that can be used to absorb default event losses beyond SITG and would require replenishing by non-defaulting Clearing Members.

- **Powers of Assessment:** Additional non-prefunded resources that can be called by the CCP from non-defaulting Clearing Members in a given CCP Clearing Service to cover default event losses, where these losses exceed the mutualised Default Fund.[18]

Box A: Concentration cost methodology

Concentration costs are the costs over and above the impact of the market stress that CCPs would face when liquidating (through auction or hedging) concentrated positions of defaulting Clearing Members. Where these positions are material, it is likely that CCPs would need to take a discount on their market value in order to liquidate them.

By including concentration costs, the Credit Stress Test methodology provides a more realistic view of the impact of the combined market stress scenario and default of Clearing Members on CCPs. Given concentration costs necessarily require estimation, the Credit Stress Test focuses on the high-level impact of the inclusion of concentration costs on the resilience of CCP Clearing Services, rather than a granular analysis of resources collected by CCPs specifically to cover concentration costs (which are subject to separate regulatory scrutiny).

The methodology for estimating concentration costs is the same as in the Bank's previous CCP SST exercise and incorporates conservative assumptions and calibration choices. To calculate concentration costs, the Bank follows the following steps:

1. **Position aggregation.** Positions on all non-ported accounts within the defaulting Clearing Member population are first aggregated (netted) at a granular product level. This ensures that the calculation of concentration costs is based on the actual aggregated positions in every product that a CCP would have to liquidate in the event of a default of a given Clearing Member population.^[19]
2. **Calculation of potential market risk losses.** These losses are implied by considering the additional market risk CCPs would face if they had to liquidate these positions gradually in order to avoid a material change in market prices. Specifically, the Bank conservatively assumes that CCPs could only liquidate exposures equivalent to 25% of the daily average volumes traded for each product each day before impacting market prices.

[20]

3. Allocation of concentration costs to accounts. Estimated concentration costs for each product are allocated back to the accounts of defaulting Clearing Members, proportionally to the relevant positions held in each account. This allows the Bank to calculate the impact of concentration costs within the account segregation rules detailed in the Credit Stress Test methodology above.

Calculation of concentration costs at a granular product level is a conservative approach. In practice, auction portfolios would likely benefit from diversification and could attract lower concentration premiums. Market participants may also have an interest in taking on positions at a more favourable price to the CCP, for example when those positions could be used to hedge other positions in a stress.

Results

Standard Credit Stress Test

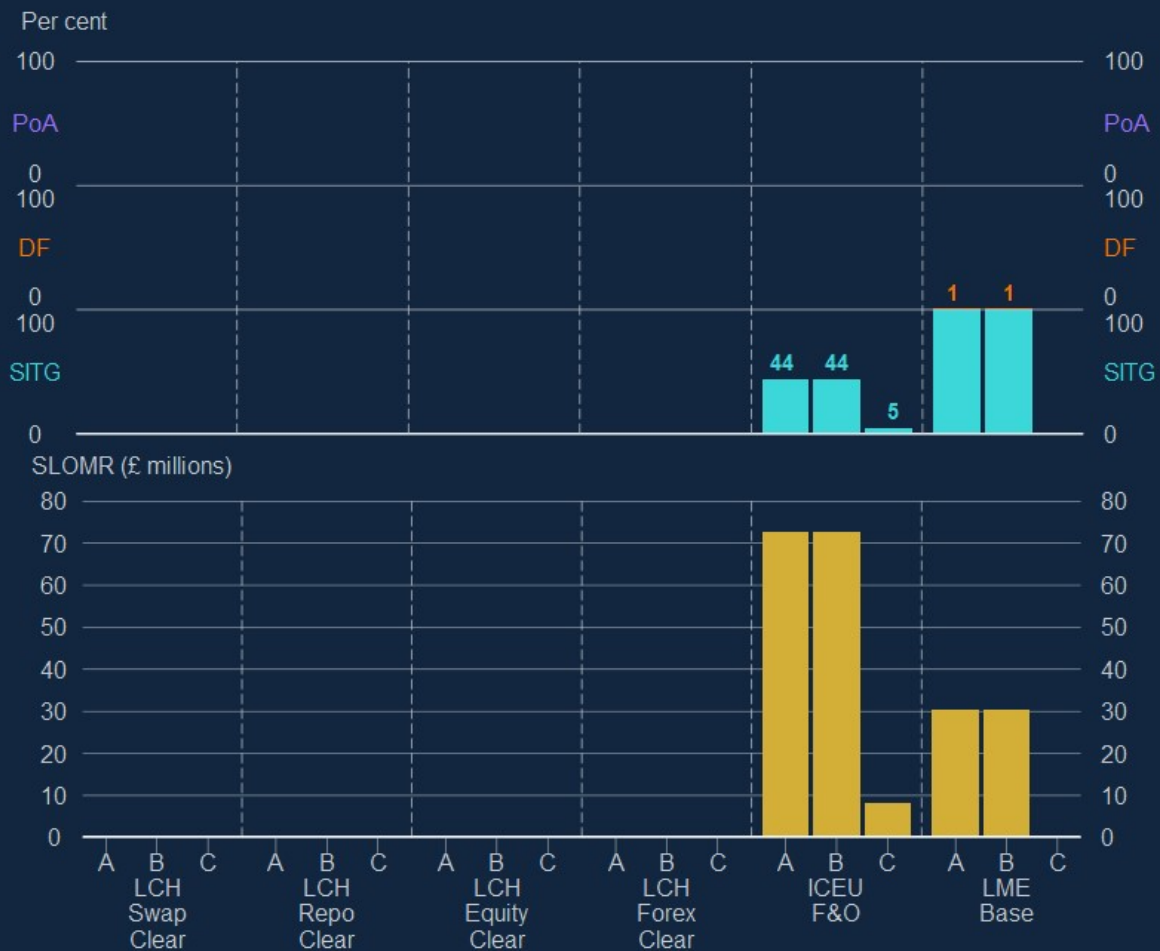
Chart 1 shows the results of the Standard Credit Stress Test. The lower panel of the chart shows SLOMR, while the upper panel shows how this translates into relative depletion of CCPs' default waterfalls. Results are shown for all three porting assumptions in Table B.

Only two CCP Clearing Services (ICEU F&O and LME Base) experience any SLOMR under a Cover-2 default. However, both CCP Clearing Services have adequate prefunded resources to cover these default losses, and only LME Base experiences any depletion of mutualised Default Fund contributions. Defaulters' own resources (Initial Margin and Default Fund contributions) are sufficient to cover losses in the Baseline Market Stress Scenario at all other CCP Clearing Services.

Consistent with the Bank's previous CCP SST exercise, a relaxation of porting assumptions (Table B) can have a material impact on results, where client clearing represents a relatively greater share of clearing activity. Across ICEU F&O and LME Base, SLOMR are almost completely eliminated when all client accounts are assumed to successfully port to non-defaulting Clearing Members.

Chart 1: Standard Credit Stress Test results (a) (b) (c) (d)

Baseline Market Stress Scenario, CCP Clearing Service Cover-2, all porting assumptions (e)



- (a) Stressed losses over defaulting members’ resources (SLOMR) is the absolute amount (£ millions) by which losses exceed defaulters’ resources (Initial Margin and Default Fund contributions).
- (b) Percentage usage of dedicated CCP resources (SITG).
- (c) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters’ Default Fund contributions.
- (d) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-prefunded resources that CCPs can call from non-defaulters.
- (e) A = ‘No porting’, B = ‘Segregated client accounts port’, and C = ‘All client accounts port’.

All CCP Clearing Services experience less depletion of mutualised Default Fund contributions compared to the Bank’s previous CCP SST exercise. This is despite a more severe Baseline Market Stress Scenario in the 2023 CCP SST. This

predominantly reflects an increase in financial resources at most CCP Clearing Services, as the market volatility of 2022 fed through CCPs' risk models and risk management into increases in Initial Margin requirements and Default Fund sizing between the conclusion of the Bank's previous CCP SST exercise and the 2023 CCP SST reference date.[21]

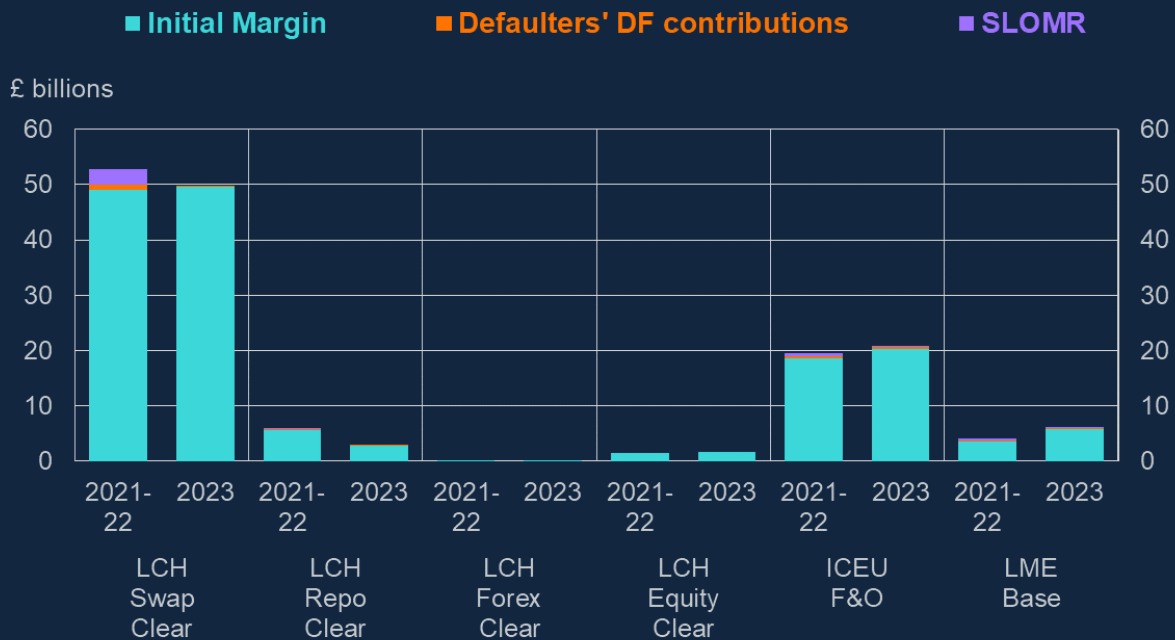
Initial Margin is sized to cover defaulters' losses at a certain level of confidence. As risk fundamentals in a market increase it is therefore a feature of CCPs' models that Initial Margin requirements will increase to ensure collateralisation keeps pace with the changing risks. Likewise, Default Fund sizing can also increase as new stress events enter the stress scenario libraries. The increase in CCPs' financial resources in the 2023 CCP SST and resulting improvement in results in the 2023 CCP SST therefore confirms the UK clearing system responded as it was expected to following the periods of market volatility in 2022.

While CCPs' Initial Margin models have an unavoidable procyclical element – in that they reflect changes in the risk fundamentals in markets – it is important that this necessary pro-cyclicality does not add unnecessarily to a system stress and that positions remain collateralised efficiently. In this context, the Clearing Member and Client Analysis component of the 2023 CCP SST (Section 8) considers the potential liquidity demands that Clearing Members and clients would face through Initial Margin calls in the Baseline Market Stress Scenario. The Bank is also working with other international regulators to evaluate the responsiveness of CCPs' Initial Margin models to volatility and market stresses, and to explore appropriate ways to analyse and compare Initial Margin procyclicality in different settings.

Chart 2 shows the Bank's estimates of the total stressed losses of all Clearing Members in the 2023 CCP SST, compared to the Bank's previous CCP SST exercise. Overall, the scale of total losses was broadly unchanged, as the increase in scenario severity was partially offset by some de-risking in Clearing Member's positions. However, the increase in both Initial Margin requirements and Default Fund sizing since the Bank's previous CCP SST exercise has meant a greater share of these total stressed losses are covered by defaulters' own resources in the 2023 CCP SST. In turn, this has reduced the relative size of SLOMR for each Clearing Member, and therefore the depletion of the mutualised Default Fund at each CCP Clearing Service.

Chart 2: Standard Credit Stress Test results

Aggregate stressed losses, Baseline Market Stress Scenario (a) (b) (c) (d)



(a) Stressed losses are aggregated across all Clearing Members in the 2021–22 CCP SST and 2023 CCP SST respectively. The Bank’s measure of aggregate stressed losses is an estimate calculated under simplifying assumptions.

(b) Initial Margin represents stressed losses absorbed by Clearing Members’ own Initial Margin.

(c) Defaulters’ Default Fund (DF) contributions represents stressed losses absorbed by Clearing Members’ own mutualised Default Fund contributions.

(d) Stressed losses over defaulting members’ resources (SLOMR) represents aggregate stressed losses beyond Clearing Members’ Initial Margin and mutualised Default Fund contributions. In the event of a default, these losses would need to be covered by (in order of application): CCP SITG, non-defaulters’ Default Fund contributions, and Powers of Assessment.

Credit & Concentration Stress Test

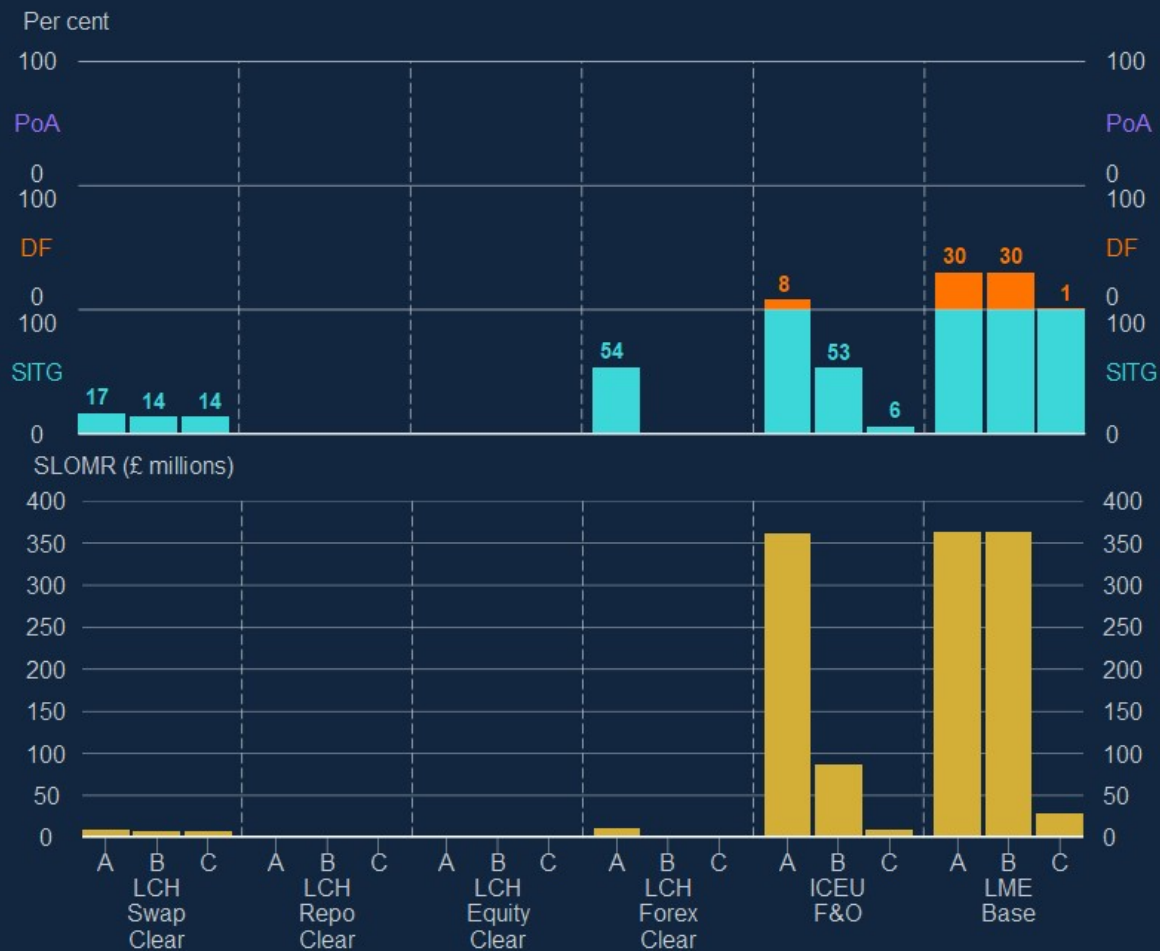
Chart 3 shows the results of the Credit & Concentration Stress Test, in which the Bank’s conservative estimates of concentration costs are additionally included. Inclusion of concentration costs can have a material impact on resource depletion, increasing SLOMR of the Cover-2 population by many multiples for some CCP Clearing Services relative to the Standard Credit Stress Test.

Two CCP Clearing Services (ICEU F&O and LME Base) experience partial depletion of mutualised Default Fund contributions when concentration costs are included. Again, both maintain adequate prefunded resources against a Cover-2 default. CCP SITG is sufficient to cover SLOMR at both LCH SwapClear and LCH ForexClear, while defaulters' own resources remain sufficient to cover losses at all other CCP Clearing Services. Porting continues to have a material effect on results where client clearing represents a relatively greater share of clearing activity.

As in the Credit Stress Test, all CCP Clearing Services experience smaller overall depletion of the mutualised Default Fund relative to the Bank's previous CCP SST exercise (Annex A), despite the more severe Baseline Market Stress Scenario. Again, this is predominantly driven by an increase in CCPs' financial resources but also reflects lower concentrations of exposures in the Cover-2 population.

Chart 3: Credit & Concentration Stress Test results (a) (b) (c) (d)

Baseline Market Stress Scenario, CCP Clearing Service Cover-2, all porting assumptions (e)



- (a) Stressed losses over defaulting members’ resources (SLOMR) is the absolute amount (£ millions) by which losses exceed defaulters’ resources (Initial Margin and Default Fund contributions).
- (b) Percentage usage of dedicated CCP resources (SITG).
- (c) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters’ Default Fund contributions.
- (d) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-prefunded resources that CCPs can call from non-defaulters.
- (e) A = ‘No porting’, B = ‘Segregated client accounts port’, and C = ‘All client accounts port’.

While an increase in Initial Margin requirements has led to improved results for each CCP Clearing Service in both the Standard Credit Stress Test and Credit & Concentration Stress Test, this increase in Initial Margin has partially unwound at

some CCP Clearing Services since the 2023 CCP SST reference date. This is consistent with a subsequent normalisation of market conditions and reduction in volatility.

To understand how this might affect the results in the Credit Stress Test, the Bank has carried out sensitivity testing against changes in the size of Initial Margin requirements, Default Fund contributions and positions since the 2023 CCP SST reference date.^[22] This analysis suggests that, while they would experience an increased depletion of prefunded resources, CCPs would continue to be resilient to the Baseline Market Stress Scenario if the 2023 CCP SST was re-run on an updated reference date.

Cover-X Analysis

To complement the analysis of results under a Cover-2 default, the Bank uses 'Cover-X' analysis to explore the impact of a wider range of defaulter combinations. Chart 4 illustrates the results of Credit Stress Test in the Baseline Market Stress Scenario under four alternative defaulter combinations – when also including concentration costs – in addition to results under a Cover-2 default:^[23]

- **System-wide Cover-2:** default of the two Clearing Member groups whose default generates the largest SLOMR across all CCP Clearing Services in aggregate under the Baseline Market Stress Scenario.
- **Non-financial Cover-X:** default of all Clearing Members groups defined as non-financial entities.
- **Non-bank Cover-X:** default of all Clearing Member groups defined as non-bank entities.
- **Probability of Default Cover-X:** default of all Clearing Member groups with a one-year probability of default greater than 0.2%.

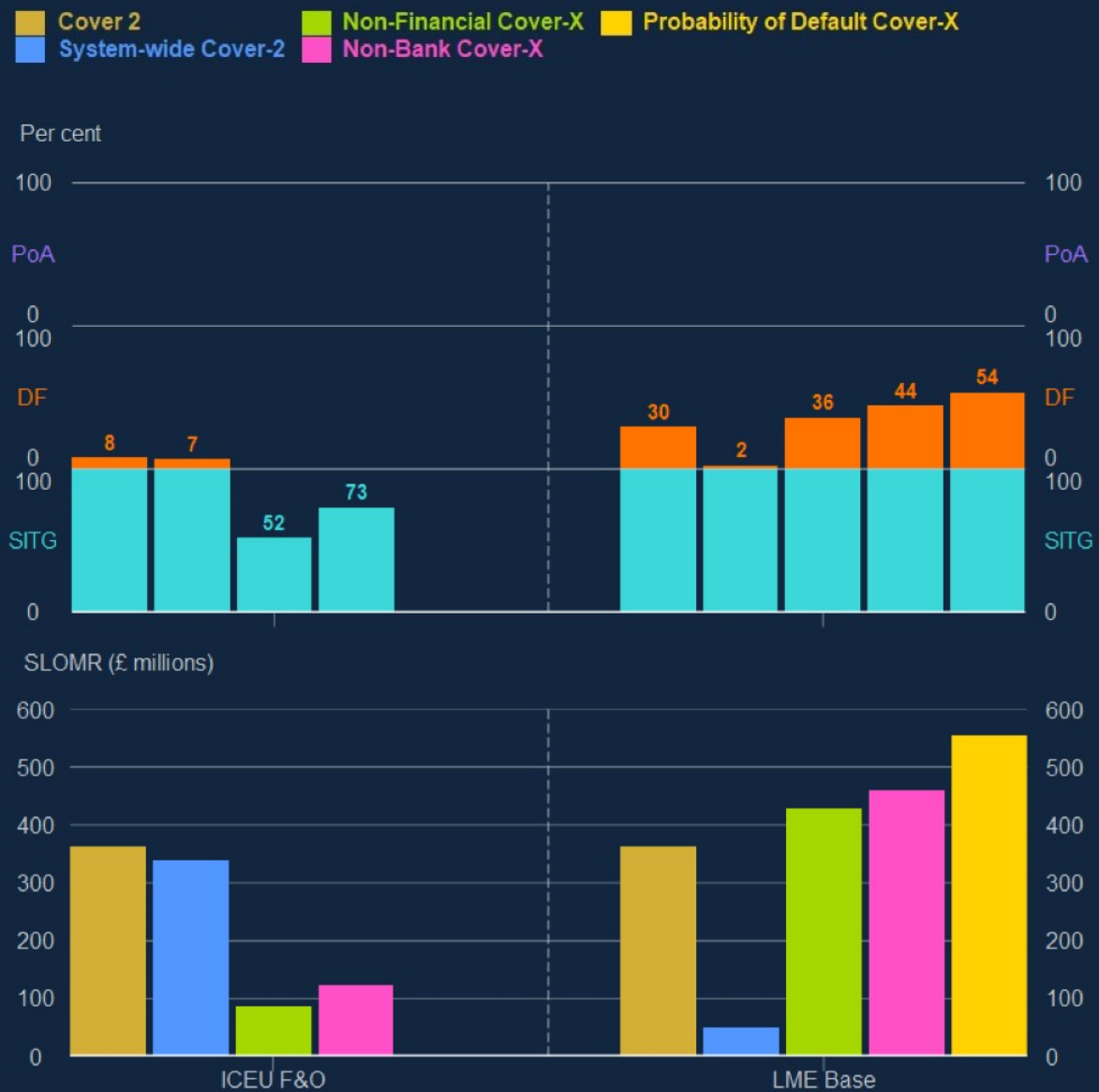
All CCP Clearing Services have sufficient prefunded resources to cover default losses under each of these Cover-X default assumptions. No LCH Clearing Service experiences losses over defaulter resources, and so these results are excluded from Chart 4. ICEU F&O experiences default losses that are lower than under a Cover-2 default in each of the Cover-X assumptions. Losses at LME Base are greater than under a Cover-2 default when assuming the default of all non-financial

Clearing Member groups, of all non-bank Clearing Member groups, or of all Clearing Member groups with a one-year probability of default greater than 0.2%, but only result in moderate depletion of mutualised Default Fund contributions.

These results predominantly reflect differences in membership at each CCP Clearing Service, rather than any particular issues with risk management. Specifically, both ICEU F&O and LME Base membership consists of a greater number or proportion of non-bank and non-financial entities compared to LCH's Clearing Services.

Chart 4: Credit & Concentration Stress Test results (a) (b) (c) (d)

Baseline Market Stress Scenario, Cover-X combinations, No porting



- (a) Stressed losses over defaulting members' resources (SLOMR) is the absolute amount (£ millions) by which losses exceed defaulters' resources (Initial Margin and Default Fund contributions).
- (b) Percentage usage of dedicated CCP resources (SITG).
- (c) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters' Default Fund contributions.
- (d) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-prefunded resources that CCPs can call from non-defaulters.

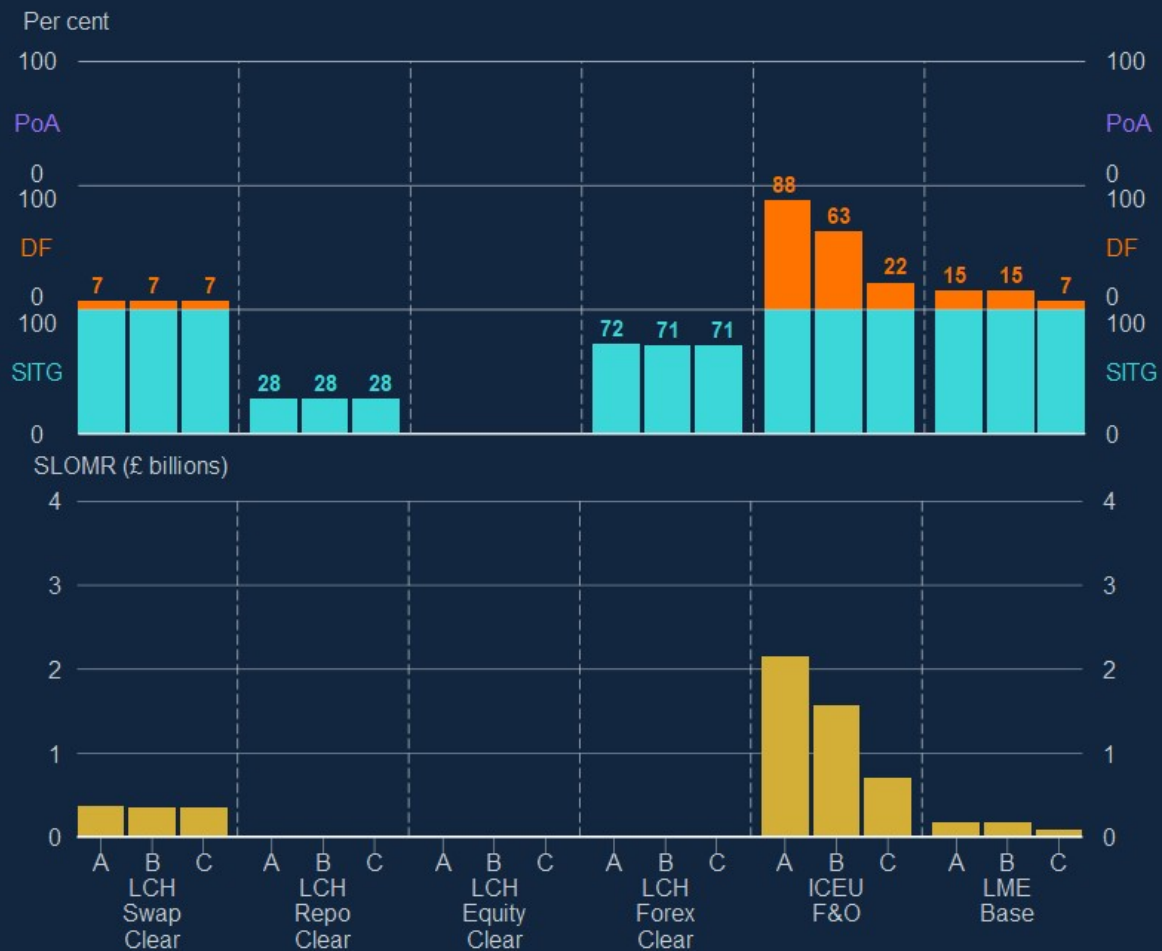
Opposite Direction Scenario Analysis

The Opposite Direction Scenario Analysis subjects CCPs to an ‘opposite direction’ market stress scenario, in which the direction of all shocks (except volatility shocks) in the Baseline Market Stress Scenario are reversed. This analysis can identify whether CCPs face particular directional risks and assess whether they are resilient to shocks very different in nature from recent market experience. The Bank estimates that this scenario is more severe overall than the Baseline Market Stress Scenario for each CCP Clearing Service and goes beyond historical precedents. While each shock has the same absolute magnitude as in the Baseline Market Stress Scenario, the shocks for most products sit further into, or beyond, the historical distribution than is the case for the corresponding shocks in Baseline Market Stress Scenario.

As illustrated in Chart 5 each CCP Clearing Service (except LME Base) experiences greater losses in this scenario but maintains sufficient prefunded resources against a Cover-2 default. ICEU F&O experiences a material increase in SLOMR in this scenario relative to the Baseline Market Stress Scenario, and comes close to full depletion of the mutualised Default Fund. These results for ICEU F&O are driven by a concentration of short positions in the Cover-2 population, which are exposed to material price increases examined in the Opposite Direction Scenario and attract significant concentration costs under the Bank’s methodology. The Bank intends to explore these results further with CCPs.

Chart 5: Credit & Concentration Stress Test (a) (b) (c) (d)

-1.0x Baseline Market Stress Scenario multiplier, CCP Clearing Service Cover-2, all porting assumptions (e)



(a) Stressed losses over defaulting members' resources (SLOMR) is the absolute amount (£ billions) by which losses exceed defaulters' resources (Initial Margin and Default Fund contributions).

(b) Percentage usage of dedicated CCP resources (SITG).

(c) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters' Default Fund contributions.

(d) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-prefunded resources that CCPs can call from non-defaulters.

(e) A = 'No porting', B = 'Segregated client accounts port', and C = 'All client accounts port'.

Conclusions and next steps

Overall, all the UK CCP Clearing Services can comfortably absorb default losses within their prefunded financial resources under the Baseline Market Stress Scenario and simultaneous Cover-2 default. This is true even when including conservatively estimated concentration costs. Only two CCP Clearing Services (ICEU F&O and LME Base) experience any depletion of mutualised Default Fund contributions when concentration costs are included. Defaulters' own resources and CCPs' SITG are sufficient to cover default losses at the other CCP Clearing Services.

Each CCP Clearing Service also sees less depletion of prefunded resources than in the Bank's previous CCP SST exercise, despite the more severe Baseline Market Stress Scenario in the 2023 CCP SST. This improvement in results confirms the UK clearing system responded as it was expected to following the periods of market volatility in 2022, with this market volatility feeding through CCPs' risk models and risk management into increases in Initial Margin requirements and Default Fund sizing ahead of the 2023 CCP SST launch date.

While the scale of total stressed losses in the 2023 CCP SST is broadly unchanged relative to the Bank's previous CCP SST exercise, the increase in CCPs' Initial Margin requirements means a greater share of these total stressed losses are covered by defaulters' own resources in the 2023 CCP SST. In turn, this has reduced the relative depletion of the mutualised Default Fund at each CCP Clearing Service.

This increase in Initial Margin requirements has partially unwound at some CCP Clearing Services since the 2023 CCP SST reference date, consistent with normalising market conditions and a reduction in volatility. Nonetheless, analysis of a reduction in margin requirements of a similar scale suggests CCPs would continue to be resilient to the Baseline Market Stress Scenario and simultaneous Cover-2, despite an increased depletion of prefunded resources.

While all CCP Clearing Services (except LME Base) experience greater losses under the Opposite Direction Scenario, each maintains adequate prefunded resources against a Cover-2 default. This is despite the Bank estimating that this scenario is more severe overall than the Baseline Market Stress Scenario and the historical worst stress for each UK CCP Clearing Service.

6: Credit Reverse Stress Test

Purpose and objectives

The Credit Reverse Stress Test assesses CCPs' resilience to combinations of increasingly severe assumptions. In contrast to the Credit Stress Test component, the aim of the Credit Reverse Stress Test is to deliberately identify combinations of input assumptions that might fully deplete CCPs' prefunded and non-prefunded resources.

The Credit Reverse Stress Test assesses CCP resilience to increasingly severe and conservative combinations of three key inputs: the market stress severity; the number of defaulting Clearing Members; and the cost of liquidating defaulters' positions. Each of these assumptions is adjusted to levels of severity that intentionally go well beyond historical precedents and regulatory requirements and in combination are extremely severe.

As a new extension to the Credit Reverse Stress Test, the 2023 CCP SST also includes an analysis of CCP resilience to more targeted idiosyncratic stress scenarios (referred to as the 'Single Product Reverse Stress Test'). This exploratory analysis is motivated by the large shocks observed in some specific markets in 2022. Box B sets out further details and the high-level findings from this analysis.

Methodology

The Credit Reverse Stress Test uses the same calculation methodology as the Credit Stress Test (Section 5), with adjustments to the following input assumptions:

[24]

- **Market stress scenario severity:** application of 1.5x and 2.0x multipliers of the Baseline Market Stress Scenario detailed in Section 4.
- **Number of defaulting Clearing Member groups:** application of increasing numbers of defaulting Clearing Members groups (the 'Cover-N' population) from one to five.[25]
- **Concentration cost calculation:** application of increasingly severe assumptions used to model concentration costs. Specifically, the volume of defaulting Clearing

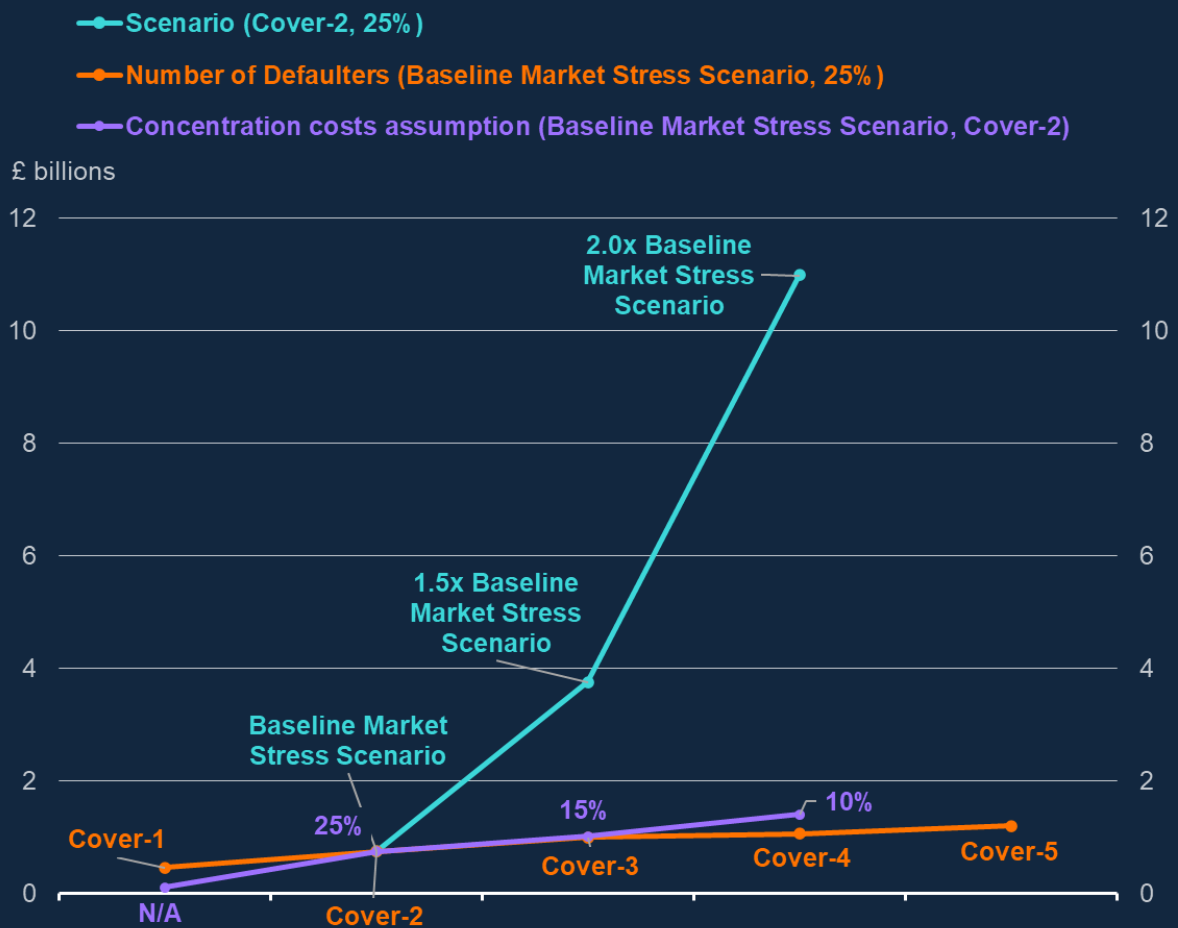
Members' positions assumed can be liquidated each day before giving rise to concentration premiums is limited from 25% down to 15% and 10% of daily average volumes traded (refer to Box A for further details on the concentration cost methodology). It also includes results without concentration costs included.

Results

Chart 6 presents aggregate SLOMR across all CCP Clearing Services as the severity of each Credit Reverse Stress Test assumption is adjusted individually. In isolation, increasing the severity of the market stress scenario has the greatest impact on SLOMR, compared to increasing the number of defaulting Clearing Member groups or increasing the severity of the Bank's concentration cost assumptions.

Chart 6: Credit Reverse Stress Test results (a) (b) (c)

Aggregate SLOMR across all CCP Clearing Services



- (a) Each line illustrates the impact of increasing the severity of one assumption while holding all other assumptions constant. Where the number of defaulting Clearing Member groups is held constant, the identity of the Clearing Member groups can change according to the dynamic Cover-2 methodology.
- (b) Stressed losses over members’ resources (SLOMR) is the absolute amount (£ billions) by which losses exceed defaulters’ resources (Initial Margin and Default Fund contributions).
- (c) ‘25%’, ‘15%’, and ‘10%’ represent the percentage of daily average volume traded for each product assumed can be liquidated daily without a price impact. A lower liquidation rate implies a reduction in the market’s ability to absorb CCP positions before giving rise to concentration costs. N/A represents exclusion of concentration costs.

Chart 7 presents the results of the Credit Reverse Stress Test when combining changes in multiple input assumptions simultaneously, which can have more complex effects. The chart illustrates which layers of each CCP Clearing Service’s

default waterfall experience depletion under each combination of assumptions. Shading indicates the proportion of each layer depleted. Losses beyond Powers of Assessment are scaled relative to the size of CCPs' Powers of Assessment.[26]

When concentration costs are excluded, no CCP Clearing Service experiences full depletion of both prefunded and non-prefunded resources. Further, it requires a combination of the 2.0x Baseline Market Stress Scenario multiplier and more than two defaults for any CCP Clearing Service to fully deplete its prefunded resources; assumptions that go beyond historical precedents and regulatory requirements. In particular, when concentration costs are excluded:

- ICEU F&O and LME Base only experience full depletion of mutualised Default Fund contributions under the simultaneous default of at least three Clearing Member groups in the 2.0x Baseline Market Stress Scenario multiplier.
- LCH SwapClear only experiences full depletion of mutualised Default Fund contributions under the simultaneous default of at least four Clearing Member groups in the 2.0x Baseline Market Stress Scenario multiplier.
- For all other Clearing Services, prefunded resources are sufficient to cover stressed losses in all market stress scenarios and defaulter combinations examined.

When including – and then scaling up the severity of – concentration costs, the impact on CCPs increases materially:

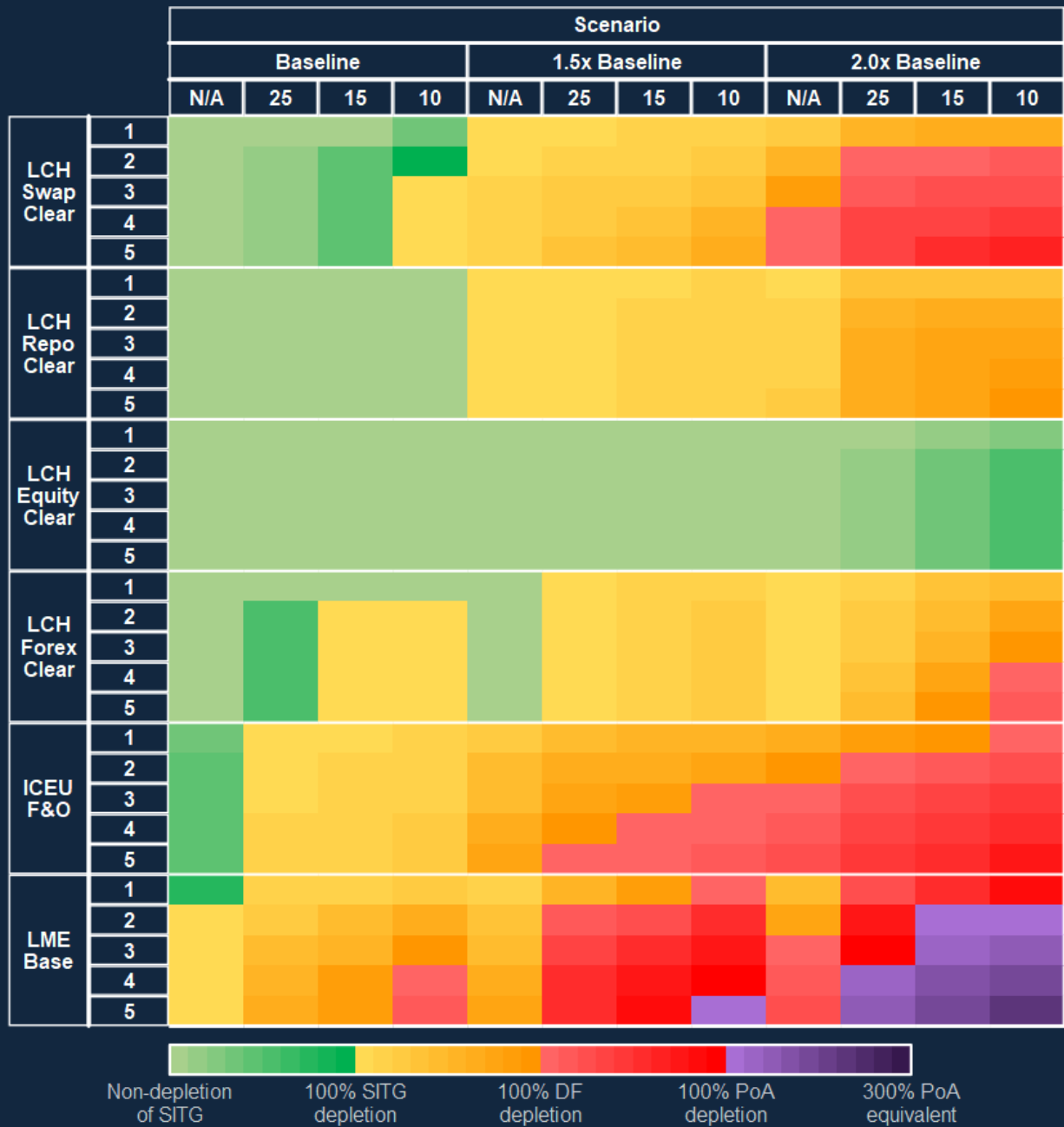
- Only one CCP Clearing Service (LME Base) experiences full depletion of both prefunded and non-prefunded resources. Relative to the Credit Stress Test, this occurs only under: (i) the most severe concentration cost assumption and default of five Clearing Member groups in the 1.5x Baseline Market Stress Scenario multiplier; (ii) the default of at least four Clearing Member groups under the 2.0x Baseline Market Stress Scenario multiplier; or (iii) an increase in the severity of concentration cost assumptions under the 2.0x Baseline Market Stress Scenario multiplier.
- Three CCP Clearing Services (LCH SwapClear, LCH ForexClear and ICEU F&O) experience some depletion of non-prefunded resources:
 - For LCH SwapClear, this only occurs under the most extreme market stress scenario.

- For LCH ForexClear, this only occurs under the most extreme market stress scenario and concentration cost assumptions, and the default of at least four Clearing Member groups.
- For ICEU F&O, this only occurs under the 2.0x Baseline Market Stress Scenario multiplier, or under the 1.5x Baseline Market Stress Scenario multiplier when combined with either more severe concentration or defaulter assumptions than in the Credit Stress Test. In all cases, the combination of these assumptions are beyond historical precedents and regulatory requirements.
- Neither of the other CCP Clearing Services (LCH RepoClear and LCH EquityClear) experience full depletion of prefunded resources under any combination of assumptions in the Credit Reverse Stress Test.

Overall, each CCP Clearing Service is resilient to more severe combinations of assumptions than in the Bank's previous CCP SST exercise. This is despite the more severe Baseline Market Stress Scenario and multiplier scenarios. Consistent with the Credit Stress Test, this predominantly reflects the increase in CCP financial resources between the two exercises. While there are differences between CCP Clearing Services results, this may reflect several factors. For example, using linear multiplier scenarios of the Baseline Market Stress Scenario may subject some CCP Clearing Services to shocks that go further into, or beyond, the tail of the historical distribution than is the case for others. Box B explores further the resilience of CCPs to more targeted shock scenarios, including those that go increasingly beyond the historical distribution.

Chart 7: Credit Reverse Stress Test results (a) (b) (c) (d) (e) (f)

CCP Clearing Service Cover-N, No porting



- (a) Percentage usage of dedicated CCP resources (SITG).
- (b) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters' Default Fund contributions.
- (c) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-pledged resources that CCPs can call from non-defaulters. PoA are assumed to be equal to the minimum of non-defaulting Clearing Member groups' Default Fund contributions multiplied by three, or the non-defaulting Clearing Member groups' Default Fund contributions multiplied by the number of individual defaulting Clearing Members.

(d) Losses beyond PoA, presented with reference to the size of PoA. For example, 100% PoA equivalent where losses beyond PoA are of the same magnitude as PoA.

(e) '25', '15', and '10' represent the percentage of daily average volume traded for each product assumed can be liquidated daily without a price impact. A lower liquidation rate implies a reduction in the market's ability to absorb CCP positions before giving rise to concentration costs. N/A represents exclusion of concentration costs.

(f) Numbers on the y-axis represent the number of Clearing Member groups assumed to default.

Box B: Single Product Reverse Stress Test

As an extension to its CCP SST toolkit, the Bank has developed in-house capability to assess CCP resilience under bespoke market stress scenarios. This analysis is exploratory, complementing the analysis undertaken under the Baseline Market Stress Scenario.

The Baseline Market Stress Scenario applies shocks to the broad range of products cleared at UK CCPs and is calibrated to reflect historically plausible correlations between different risk factors. However, CCPs may also be exposed to more asset-specific shocks or decorrelation scenarios. In the context of the large idiosyncratic shocks that occurred in energy, metals, and UK rates markets in 2022, the results report from [the Bank's previous CCP SST exercise](#) noted the benefits to examining hypothetical market stress scenarios and reverse stress testing on single products or groups of products.

The Bank has therefore extended its analysis to examine CCP resilience to more targeted idiosyncratic stress scenarios in the 2023 CCP SST. This exploratory analysis (referred to as the 'Single Product Reverse Stress Test') identifies product-specific stress scenarios that might fully deplete CCPs' prefunded resources under the default of the Cover-2 population. For example, this analysis can provide an indication of how much the price of Brent Crude Oil (or any other product) would need to change such that the default of the two Clearing Members most exposed to this price shock would result in a full depletion of a CCP's default waterfall.

The analysis uses Clearing Members' account positions data submitted by CCPs and measures of first-order sensitivity to risk factors to estimate account-level PNL under different stress scenarios. For modelling simplicity, the Bank groups relevant products together into distinct product groups (eg Brent Crude Oil products) and applies the same shock across all products and maturities within these groups, while assuming no shocks to any other products. This simplifying assumption is deliberately intended to create product-specific decorrelation scenarios.

After estimating account PNL, the Bank applies the same methodology detailed in Section 5 to calculate the impact on CCPs' default waterfalls.^[27] For each product group, this calculation is repeated under increasing shock severity to identify the minimum shocks (both positive and negative) that would result in a depletion of CCPs' prefunded resources under a Cover-2 default.

This modelled approach has the advantage of enabling the Bank to assess a wider range of stress scenarios without requiring CCPs to undertake additional scenario revaluations or submit additional data. However, the results are based on model estimates and therefore do not have the same level of accuracy as results in the Baseline Market Stress Scenario, where PNL impacts are computed by CCPs. For example, the model does not capture non-linear impacts of risk factor shocks, or how the value of options products might vary with volatility. As such, the results of this exploratory analysis are indicative in nature and therefore not presented in full.

Overall, this exploratory analysis provides evidence of CCPs' ability to withstand targeted shocks more extreme than the historical worst for most individual products groups. Chart A plots the distribution of the idiosyncratic shocks required to deplete the relevant CCP Clearing Service's Default Fund under a Cover-2 default, calculated as a ratio relative to the worst historical shock for each product. For most products groups, the shock required to deplete CCPs' Default Funds is greater than the historical worst, illustrated by a value greater than one. This finding is in line with expectations, given CCPs are required to conduct reverse stress testing beyond plausible market conditions in order to inform calibration of their own 'extreme but plausible' stress-testing scenarios.^[28] Initial Margin requirements and Default Fund contributions are also typically calculated based on each clearing member's portfolio of trades, rather than at a product level, which helps provide coverage against idiosyncratic shocks.

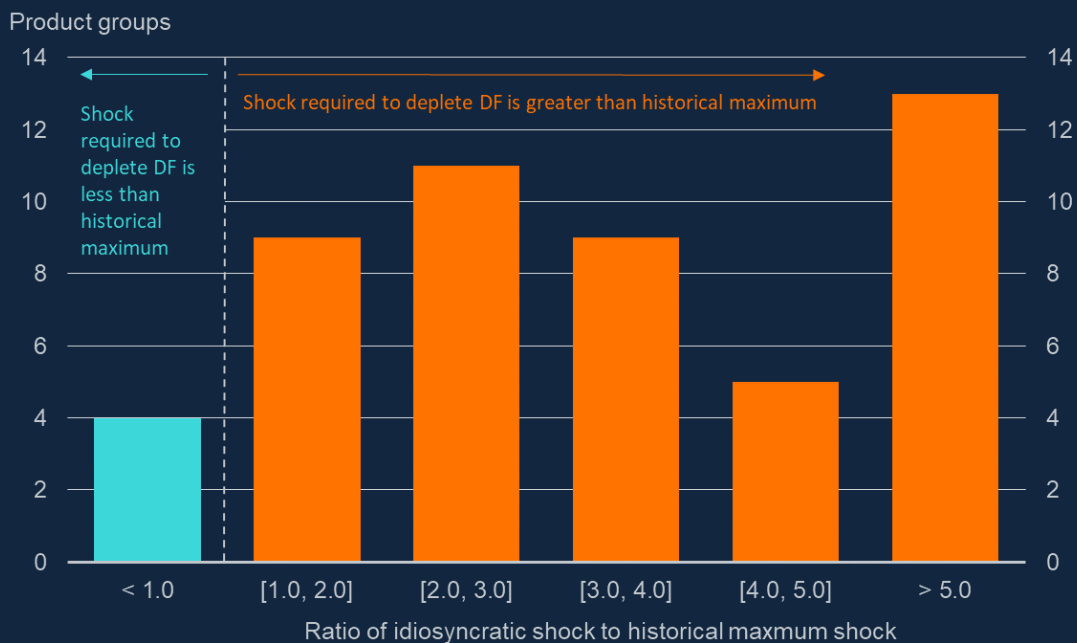
The Bank replicated this analysis using the CCP financial resources and Clearing Member positions data from the Bank's previous CCP SST exercise. Overall, the results from this retrospective analysis suggest CCPs have increased their resilience to targeted hypothetical shocks. In particular, the shocks required to deplete CCPs' Default Funds under a Cover-2 default

have increased for most product groups in the 2023 CCP SST, relative to the Bank’s previous CCP SST exercise. Consistent with the findings of the Credit Stress Test (Section 5), this generally reflects an increase in margin requirements between the two CCP SST exercises, as well as some reduction in the concentration of positions.

The Bank will follow up with CCPs to discuss the analysis in more detail and intends to develop and improve this modelling capacity further to support its ongoing supervision.

Chart A: Single Product Reverse Stress Test results

Distribution of shocks required to deplete Default Fund relative to historical worst, per product group (a) (b)



(a) Product groups are bucketed according to the ratio of the shocks required to deplete the relevant CCP Clearing Service’s Default Fund (DF) under a Cover-2 default (‘idiosyncratic shock’) to the maximum historical shock observed for that product group. The maximum historical shock is calculated across all relevant products and maturities within each product group.

(b) The y-axis records the number of product groups within each bucket. The product groups presented only include those for which the shock required to deplete the relevant CCP Clearing Service’s Default Fund under a Cover-2 default is within a -500bps to +500bps or -100% to +200% range.

Conclusions and next steps

The Credit Reverse Stress Test tests CCPs against increasingly challenging combinations of assumptions to identify what might fully deplete their prefunded and non-prefunded resources. These assumptions are intentionally well beyond historical precedents and regulatory requirements, and in combination are extremely severe.

When excluding concentration costs, no CCP Clearing Service experiences a full depletion of both prefunded and non-prefunded resources when subjected to market stress scenarios well beyond the worst historical stress together with the default of up to five Clearing Member groups. Only under extreme assumptions – the 2.0x Baseline Market Stress Scenario and the default of at least three Clearing Member groups – do three CCP Clearing Services (LCH SwapClear, ICEU F&O and LME Base) experience full depletion of prefunded resources.

When including concentration costs, only one CCP Clearing Service (LME Base) experiences full depletion of both prefunded and non-prefunded resources under the most extreme combination of assumptions examined, which go beyond historical precedents and regulatory requirements.

Relative to the Bank's previous CCP SST exercise, all CCP Clearing Services perform better in the Credit Reverse Stress Test, considering the increase in severity of the market stress scenarios. This is in line with the findings of the Credit Stress Test and similarly reflects an increase in CCPs' financial resources since the Bank's previous CCP SST exercise.

Motivated by the large decorrelation shocks observed in energy, metals and UK rates markets in 2022, the Credit Reverse Stress Test also includes an exploratory analysis to identify product-specific market stress scenarios that might fully deplete CCPs' prefunded resources under given defaulter assumptions. Overall, this analysis provides evidence of CCPs' ability to withstand targeted shocks more extreme than the historical worst for individual product groups under a Cover-2 default. The Bank intends to develop and improve this modelling capacity further to support ongoing supervision. The Bank will also follow up with CCPs to discuss the analysis in more detail.

7: Liquidity Stress Test

Purpose and objectives

The Liquidity Stress Test assesses CCPs' liquidity resilience and ability to service all relevant liquidity requirements under a severe market stress scenario and the default and failure of selected Clearing Members and service providers.

The analysis in the Liquidity Stress Test focuses on CCP liquidity resilience under the Baseline Market Stress Scenario and simultaneous default of the Cover-2 population. The Cover-2 population in the Liquidity Stress Test consists of the two Clearing Member groups whose failure in all relevant capacities (eg including provision of payment bank, investment agent, and custodial services) generates the worst cumulative liquidity balance under the market stress scenario. This includes the default and failure of service providers that are not members of a given CCP but are part of the same group as defaulting Clearing Members.

The analysis in the Liquidity Stress Test component is organised into three sub-components:

- **Liquidity Stress Test:** The Liquidity Stress Test examines CCPs' liquidity resilience at the aggregate level and in key individual currencies (EUR, GBP, USD) under the Baseline Market Stress Scenario and simultaneous default/failure of the Cover-2 population at each CCP.
- **Liquidity Sensitivity Testing:** Liquidity Sensitivity Testing examines CCPs' reliance on different liquidity management tools, by sensitivity testing CCPs' liquidity resilience against more extreme disruptions to their ability to mobilise liquidity resources.
- **Service Provider Concentration Analysis:** The Service Provider Concentration Analysis (Box C) examines the concentration of the provision of key services that CCPs rely on for liquidity risk management.

Methodology

Liquidity Stress Test

The Liquidity Stress Test aims to simulate and test, with conservative assumptions, CCPs' ability to service all relevant cash requirements resulting from the default of the Cover-2 population under the Baseline Market Stress Scenario.

The Bank collects data from CCPs on their liquid resources and liquidity requirements in the Baseline Market Stress Scenario. For precision, the Bank relies on CCPs' models to calculate the impact of the Baseline Market Stress Scenario on CCPs and Clearing Members (for example, on Variation Margin flows, trade settlement requirements, and revaluation of assets). However, the Bank has reconciled, sense-checked and validated the data submitted by CCPs.

Using the input data provided by CCPs, the Bank calculates the liquid resources available to each CCP and the liquidity requirements each CCP would be exposed to under the default of each combination of two Clearing Member groups and for each day of the five-day stress-test window. For each day, the Bank then calculates the net surplus or deficit of liquidity on a cumulative basis. As such, the Bank can identify the pair of Clearing Member groups whose default generates the worst cumulative liquidity balance for any given input assumptions.

This analysis is undertaken at the aggregate currency level (presented in GBP equivalent), covering resources and requirements in all currencies, under the assumption of unlimited access to foreign exchange markets. It is also undertaken separately at the individual currency level for key currencies (EUR, GBP, USD) when additionally assuming no access to foreign exchange markets.

When calculating available liquid resources and liquidity requirements, the Bank has applied conservative assumptions and modelling regarding: (i) how Clearing Member group defaults affect CCPs' ability to access their liquid resources; and (ii) how Clearing Members' behaviour in a stress might affect CCPs' liquidity requirements (for example, through withdrawal of excess collateral, and a reduction in Initial Margin posted where non-defaulters act to hedge their exposures).

Table C provides a summary of the liquidity resources assumed to be available to CCPs in the Liquidity Stress Test, while Table D provides a summary of the liquidity requirements that CCPs would have to meet.

Table C: Available liquid resources (a)

Cash	Cash held on account with central banks	Assumed to always be available (no modelling of central bank defaults or disruption).
	Cash held on account with commercial banks	Available where the commercial bank is not defaulting.
	Cash from maturing CCP investments (reverse repo, maturing bonds held outright)	Available where: <ul style="list-style-type: none"> • cash flows occur in the stress-test period; • applicable counterparties are not defaulting; and • the custodian of the asset is not defaulting.
	Cash from maturing assets of defaulters (maturing bonds received as collateral or through reverse repo)	Available where: <ul style="list-style-type: none"> • bonds posted as collateral do not relate to an account subject to porting; • bonds received through reverse repo have been received from the defaulter; • cash flows occur in the stress-test period; and • the custodian of the asset is not defaulting.
Committed facilities with commercial banks (b)	Committed unsecured facilities with commercial banks	Available where the facility is not provided by a defaulting commercial bank.
	Committed secured facilities with commercial banks	Available where: <ul style="list-style-type: none"> • the facility is not provided by a defaulting commercial bank; and • the CCP has allowable, non-encumbered, collateral to post against the facility.

Cash from liquidation of non-cash assets (c)	Securities held by CCPs as investments	Available where the custodian of the asset is not defaulting.
	Securities posted by defaulters as collateral	Available where: <ul style="list-style-type: none"> • securities are not tied to a client account being ported; and • the custodian of the asset is not defaulting.
	Collateral from reverse-repo investments	Available where the custodian of the asset is not defaulting.
	Collateral from defaulters' physically settled 'buy' trades	Available where: <ul style="list-style-type: none"> • the collateral posted relates to physically settled trades of defaulters with non-defaulters; • settlement is within the stress-test period; and • the collateral posted is not tied to client accounts being ported.

(a) For the purposes of the Liquidity Stress Test, the Bank assumes that CCPs are still able to access resources under management of defaulting Investment agents, but this assumption is subject to further sensitivity testing (refer to Liquidity Sensitivity Test below). As a conservative assumption, the Bank also assumes no porting of client accounts occurs.

(b) Committed facilities with central banks are excluded from liquidity resources in the Liquidity Stress Test to show the results and resilience of CCPs assuming no recourse to central banks.

(c) Limited to high-quality liquid securities, issued or explicitly guaranteed by central banks, governments or supranational entities.

Table D: Liquidity requirements (a)

Default-related requirements	Defaulters' Variation Margin requirements	Cash outflows generated by CCPs' need to post cash Variation Margin to non-defaulting Clearing Members on positions held by defaulted Clearing Members.
	Cash payments on servicing defaulters' physically settled 'buy' trades	This relates to defaulters' trades that require them to pay cash against a receipt of a non-cash asset within the stress test period. CCPs are required to pay this cash in order to service the relevant trades.
	Net costs of sourcing assets to service defaulters' sell trades	This relates to defaulters' trades that require them to provide a specific non-cash asset in exchange for receipt of cash. CCPs are assumed to go into the market to buy the required asset and settle the original trade.
	Cash settlements	Cash settlements due to/from defaulters within the stress-test period.
Operational requirements	Excess cash collateral repayments	Modelled excess cash collateral withdrawals by non-defaulting Clearing Members.
	Substitution of cash collateral	Modelled requests for substitution of cash with non-cash collateral from non-defaulting Clearing Members.
	Potential reduction in Initial Margin	Modelled potential repayment of Initial Margin to non-defaulting Clearing Members.
	Provision of liquidity to facilitate settlements/payments intraday	Requirements to hold cash intraday with payment/settlements providers in order to facilitate intraday performance.
	Other operational requirements	Other realistic operational requirements reported by CCPs.

(a) For the purposes of the Liquidity Stress Test, the Bank assumes that non-defaulters with Variation Margin outflows to CCPs find alternative arrangements to pay CCPs where payments were due to go through defaulting payment banks. However, this assumption is subject to further sensitivity testing (refer to Liquidity Sensitivity Test below).

Liquidity Sensitivity Test

The Liquidity Sensitivity Test examines CCPs' reliance on different liquidity management tools, by sensitivity testing CCPs' liquidity resilience against more extreme disruptions to their ability to mobilise liquidity resources. Sensitivity testing is conducted both at the aggregate currency level, and individually for key currencies (EUR, GBP, USD).

The Bank undertakes four sensitivity tests, which apply the following assumptions:

- **Payment bank sensitivity test:** non-defaulting Clearing Members affected by the failure of payment banks are unable to make payments to CCPs on the day of default, and instead pay CCPs the following day, while CCPs still service all Variation Margin payments to all non-defaulting Clearing Members. Cash held with disrupted payments banks is therefore recognised as a liquidity requirement (Table D).
- **Investment agent sensitivity test:** CCPs are unable to access any resources under management of defaulting investment agents. Cash from maturing CCP investments, cash from maturing assets of defaulters, cash from liquidation of securities held by CCPs as investments, and cash from liquidation of collateral from reverse-repo investments (Table C) are therefore not recognised as liquid resources if held with defaulting investment agents.
- **Asset liquidation sensitivity test:** CCPs are not able to liquidate any non-cash collateral. Cash from liquidation of non-cash assets (Table C) is therefore not recognised as a liquid resource.
- **Combined sensitivity test:** each of the payment bank, investment agent and asset liquidation sensitivity tests above are applied simultaneously.

These sensitivity tests are deliberately extreme. They do not consider legal and operational protections available to CCPs, and tools and procedures CCPs have at their disposal to avoid these assumptions transpiring. For example:

- CCPs are protected from payment bank failures through (regularly tested) Extended Member Liability arrangements, requiring non-defaulting Clearing Members to find alternative routes to pay CCPs on the same day (if they do not, they can be put into default). In practice, CCPs would also not pay out any

Variation Margin gains to Clearing Members that were not meeting Variation Margin payments towards the CCP.

- Investment agents operate on accounts owned by CCPs through Power of Attorney, and as such CCPs could revoke the Power of Attorney and access the funds via alternative arrangements (which are also tested by CCPs).
- CCPs hold highly liquid assets with a large market size, and have access to the Bank's Discount Window Facility,^[29] and so the assumption that CCPs cannot liquidate high-quality bonds is particularly conservative.

Results

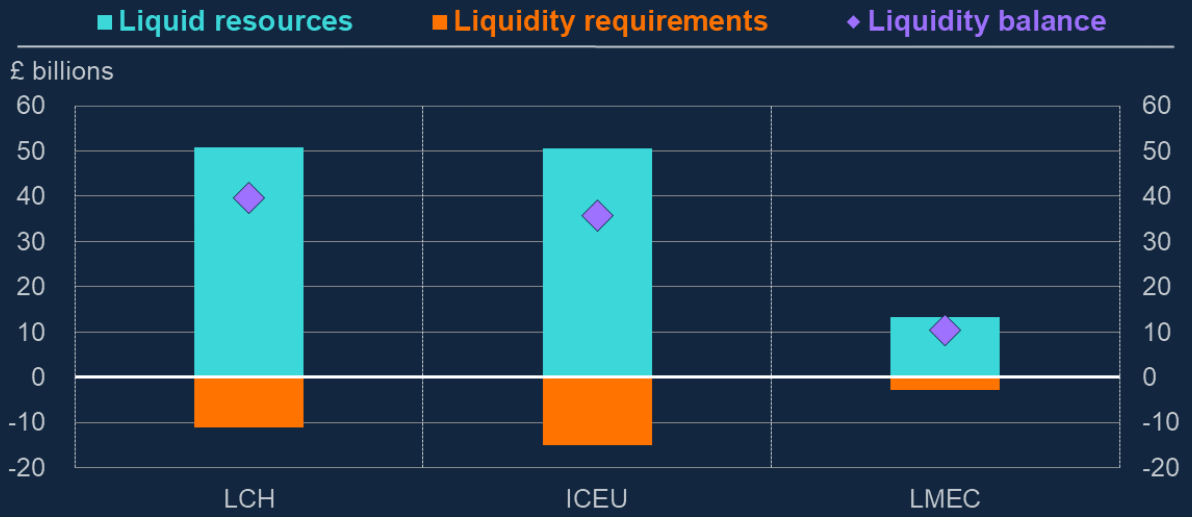
Liquidity Stress Test

Charts 8 and 9 illustrate the Liquidity Stress Test results, at the aggregate currency level and individual currency level for key currencies (EUR, GBP, USD) respectively. Each chart illustrates the cumulative liquid resources, liquidity requirements and liquidity balance for each CCP, on the day in the stress-test window in which each CCP's cumulative liquidity balance is lowest.

All of the UK CCPs maintain a positive liquidity balance at an aggregate currency level over the stress-test window, so can meet all liquidity requirements in all currencies in aggregate. Relative to the Bank's previous CCP SST exercise, all CCPs maintain a similar or improved worst day cumulative liquidity balance, despite the more severe Baseline Market Stress Scenario in the 2023 CCP SST.

Chart 8: Liquidity Stress Test results (a)

Baseline Market Stress Scenario, aggregate currency level (GBP equivalent)

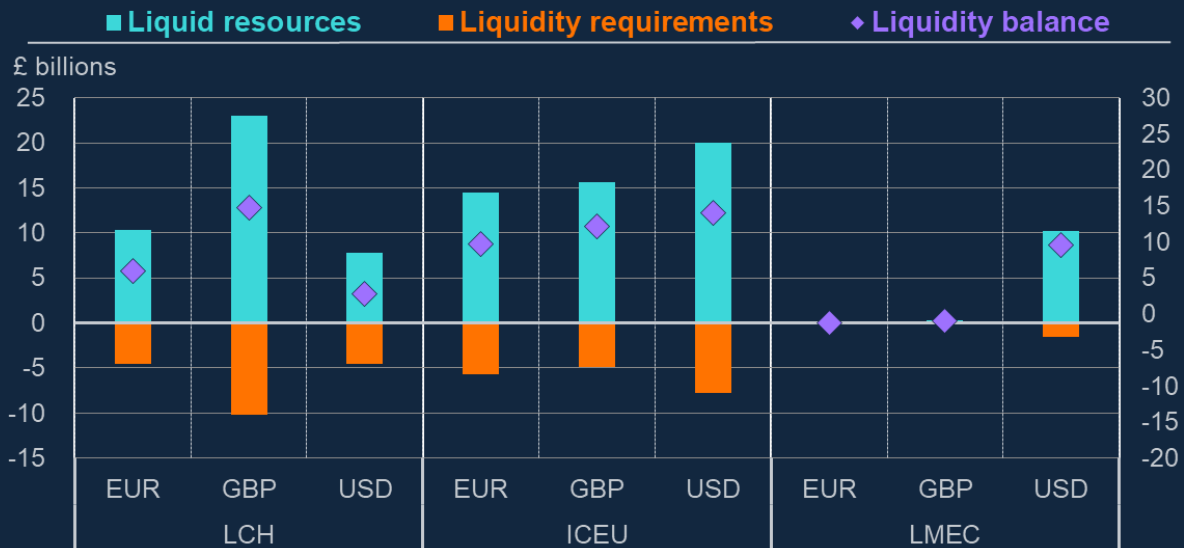


(a) Liquid resources, liquidity requirements, and the liquidity balance are presented for the day in the stress-test window on which the liquidity balance was lowest for each CCP.

In addition, all three CCPs maintain a positive liquidity balance in each of EUR, GBP, and USD under the additional assumption that they are unable to access foreign exchange markets. These results are also generally improved relative to the Bank’s previous CCP SST exercise.

Chart 9: Liquidity Stress Test results (a)

Baseline Market Stress Scenario, individual currency level (GBP equivalent)



(a) Liquid resources, liquidity requirements, and the liquidity balance are presented for the day in the stress-test window on which the liquidity balance is lowest for each individual currency for each CCP.

Liquidity Sensitivity Testing

Chart 10 shows that each CCP maintains a positive liquidity balance at the aggregate level in most cases. This is despite making very extreme assumptions about disruption to CCPs' ability to mobilise their liquidity resources. As noted above, in practice CCPs have a range of tools and measures available to them to prevent and manage such disruptions, which are tested regularly. These results are mostly improved relative to the Bank's previous CCP SST exercise. Overall, the Liquidity Sensitivity Test therefore indicates a high level of liquidity resilience at each UK CCP.

Chart 10 also illustrates the varying degree of reliance that each CCP has on different liquidity management tools:

- Each CCP maintains a positive liquidity balance in the payment bank sensitivity test, under which Clearing Members affected by payment bank disruptions are unable to process payments to CCPs on the day of default, thus limiting CCPs'

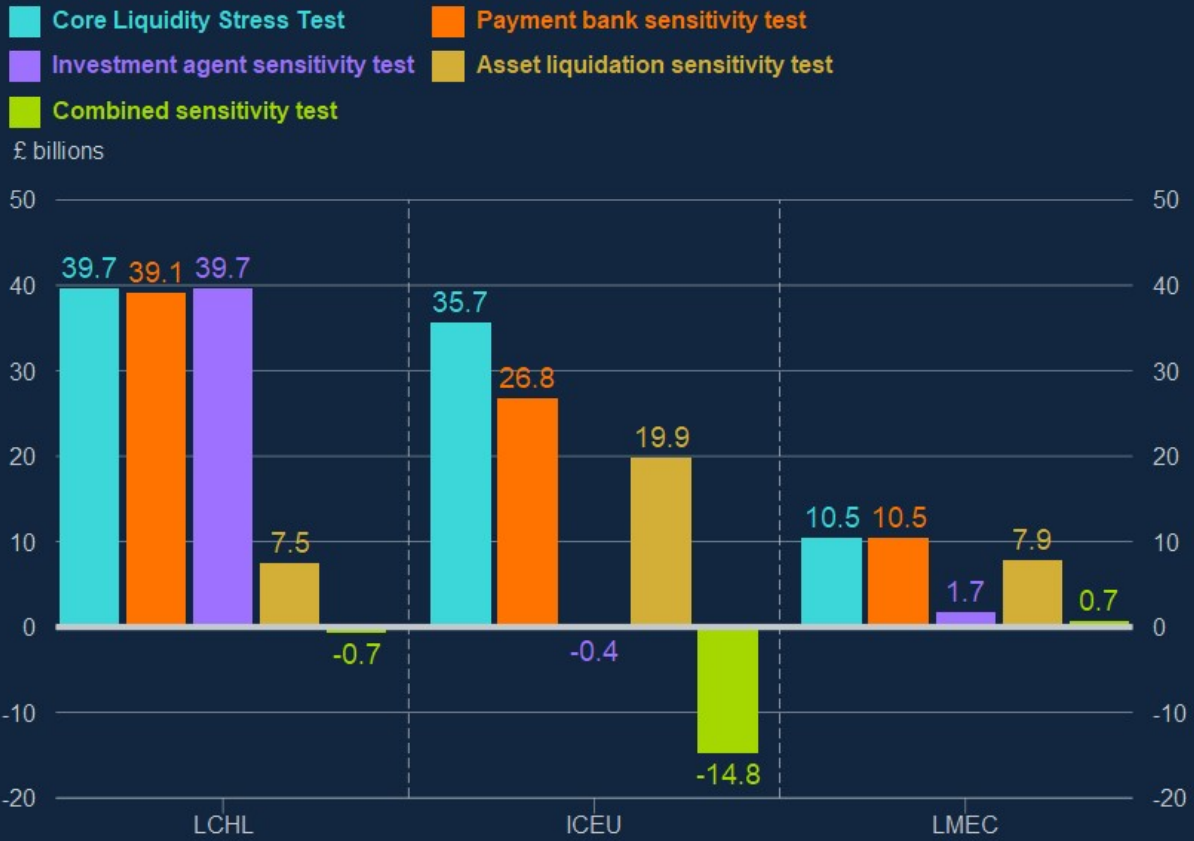
ability to mobilise these resources. Only ICEU has a materially lower liquidity balance under this sensitivity test.

- ICEU's and LMEC's liquidity balances deteriorate in the investment agent sensitivity test, in which CCPs are unable to access any resources under management of defaulting investment agents. Under this extreme assumption, ICEU experiences a negative worst day liquidity balance, reflecting a change in ICEU's investment profile towards reverse-repo via investment agents and away from non-renumerated central bank cash deposits since the Bank's previous CCP SST exercise. In practice investment agents operate through Power of Attorney, meaning CCPs can revoke the Power of Attorney and mobilise these resources via alternative arrangements; these alternative arrangements are tested regularly.
- LCH is relatively more exposed to an inability to liquidate non-cash collateral in the asset liquidation sensitivity test, but maintains a liquidity balance that is positive and higher than in the Bank's previous CCP SST exercise. While each CCP is materially affected, this is a conservative assumption given the overall liquidity and market size for the quality of assets CCPs hold, and UK CCPs' access to the Bank's Discount Window Facility.

Liquidity Sensitivity Testing results at the individual currency level for EUR, GBP and USD are included in Annex D, and are broadly consistent with those at the aggregate currency level.

Chart 10: Liquidity Sensitivity Testing results (a)

Baseline Market Stress Scenario, aggregate currency level (GBP equivalent)



(a) The liquidity balance is presented for the day in the stress-test window on which the liquidity balance is lowest for each individual CCP, and under each individual sensitivity test. Results are based on a dynamic Cover-2 population which can change as each sensitivity test is applied.

Box C: Service Provider Concentration Analysis

As illustrated in the Liquidity Stress Test, service providers can play a crucial role in CCPs' liquidity risk management. Their failure or non-performance can have potentially significant impacts on CCPs, including compromising their ability to service cash requirements, transfer collateral or fulfil securities obligations.

Using data submitted for the Liquidity Stress Test, the analysis in this box examines the concentration of CCPs' activity across three types of service provider:

- **Payment banks:** payment banks (also referred to as Assured Payment Systems) are banks that offer cash settlement services to CCPs. They process cash collateral flows between CCPs and their members, while also assisting in processing the movement of funds and securities for cash market funds. To facilitate this, each CCP will have an account with the same payment bank, in each settlement currency.
- **Custodians:** custodians safeguard prefunded financial resources (Initial Margin and Default Fund contributions) that have been provided to CCPs by their Clearing Members and their clients. For the purposes of the 2023 CCP SST, the definition of custodians includes banking groups offering custodian services as well as international Central Securities Depositories (CSDs).
- **Investment agents:** investment agents manage CCPs' total investment portfolios, including investments of cash and/or other collateral as well as the CCPs' own cash resources. For the purposes of the 2023 CCP SST, the definition of investment agents includes investment counterparties as well as third-party investment managers facilitating CCPs' investments.

In contrast to the Liquidity Stress Test, the analysis in this box considers the concentration of CCPs' exposures to both service providers that are part of Clearing Member groups, and service providers that are not Clearing Member entities.

Charts A, B and C illustrate the concentration of CCPs' activity across these three types of service provider.^[30] Consistent with the findings of the Bank's previous CCP SST exercise, the provision of these key services remains concentrated individually for each CCP, and collectively across all three UK CCPs in aggregate. Further, each of these services are often provided to UK CCPs by entities belonging to the same Clearing Member groups.

As noted in the Bank's previous CCP SST exercise, these concentration levels reflect Clearing Member preferences and market-related factors:

- For payment banks, Clearing Members are likely to use the same payment bank for all their Variation Margin payments across all currencies and CCPs. Given UK CCPs have services and cash flows in many currencies and so require payment banks with multicurrency services, this also limits the number of appropriate service providers available (and excludes central banks). Clearing Members offering payment services themselves also tend to process their own payments in-house rather than relying on a different entity.
- For custodians, this concentration is related to dominant CSDs. These are market utilities that ensure the existence of securities and check the right number of securities are in issuance and that the issuer is legitimate. They also facilitate the settlement of an exchange when a security is bought and sold. CSDs account for half of the number of custodians available to CCPs.
- For investment agents, the high level of concentration reflects the viability of the service being reliant on large volumes of investment under management, limiting the number of available investment agents. Consistent with the findings of the Liquidity Sensitivity Testing, ICEU's investment agent concentration has increased relative to the Bank's previous CCP SST exercise. This reflects a change in ICEU's investment profile away from non-remunerated central bank cash accounts.

These high levels of concentration continue to demonstrate the importance of CCPs ensuring their arrangements with service providers are appropriately robust. For payment banks, CCPs maintain and test back-up payment bank arrangements (including with central banks). CCPs also protect against

bankruptcy or insolvency of custodians through segregation of the assets held on clients’ behalf from those of the Clearing Member, and maintain other operational tools to address non-performance of service providers. The Bank will continue to keep concentration levels, and CCPs’ arrangements to manage the associated risks, under regular review.

Chart A: Payment bank concentration (a)

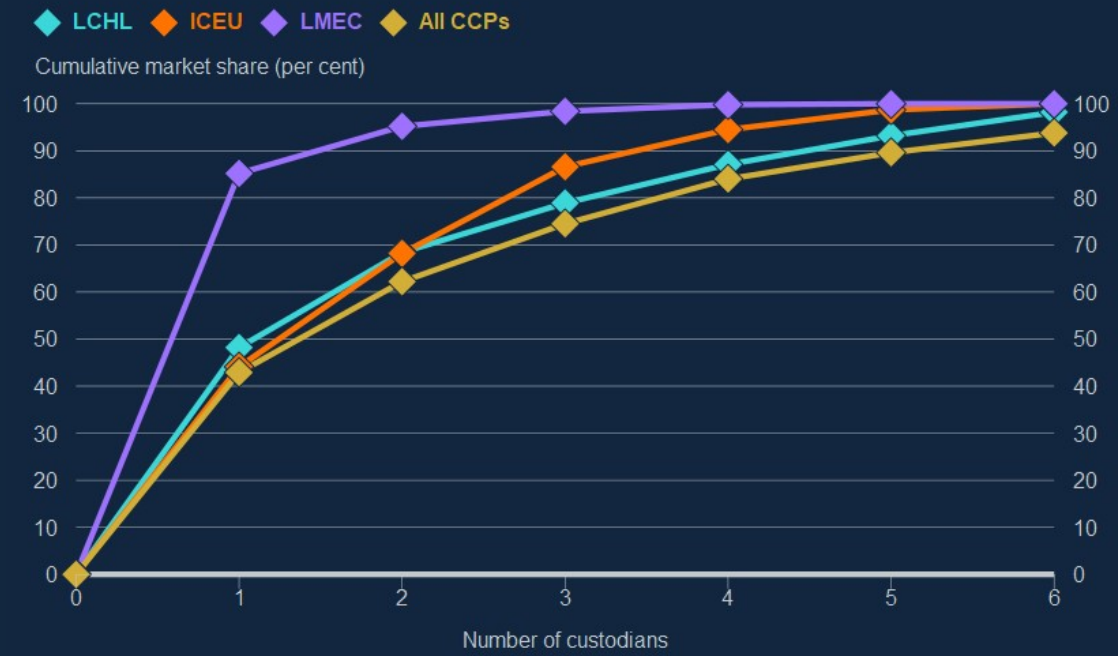
Cumulative market share of Variation Margin payments processed, GBP equivalent (per cent)



(a) The number of payment banks increases according to order ranking of market share. For any given number of payment banks, the identity of payments banks is not necessarily the same for each CCP.

Chart B: Custodial services concentration (a)

Cumulative market share of CCP securities held by custodians, GBP equivalent (per cent)



(a) The number of custodians increases according to order ranking of market share. For any given number of custodians, the identity of custodians is not necessarily the same for each CCP.

Chart C: Investment agent services concentration (a) (b)

Cumulative market share of CCP investments under management by investment agents, GBP equivalent (per cent)



(a) The number of investment agents increases according to order ranking of market share. For any given number of investment agents, the identity of investment agents is not necessarily the same for each CCP.

(b) LCH is not shown as it invests collateral directly rather than through investment agents.

Conclusions and next steps

Overall, the results of the Liquidity Stress Test illustrate that the UK CCPs are resilient to the Baseline Market Stress Scenario and simultaneous default of the Cover-2 population. Each CCP maintains a positive liquidity balance throughout the stress-test window at an aggregate currency level, and also in key individual currencies (EUR, GBP, USD) when assuming no access to foreign exchange markets.

Under more extreme disruptions to CCPs' ability to mobilise their liquidity resources, CCPs maintain a positive liquidity balance in most cases. Both LCH and LMEC maintain a positive aggregate liquidity balance in all sensitivity tests, while

ICEU only experience a small negative aggregate liquidity balance under the assumption that they are unable to access any resources under the management of defaulting investment agents. While CCPs have specific tools and measures available to manage these risks, the results highlight the importance of CCPs maintaining and testing these tools.

The provision of key services that CCPs rely on for liquidity risk management remains concentrated for each CCP and collectively. This reflects Clearing Member preferences and other market-related factors. This continues to illustrate the importance of CCPs ensuring their arrangements with service providers are appropriately robust.

8: Clearing Member and Client Analysis

Purpose and objectives

The Clearing Member and Client Analysis considers the wider impacts of the 2023 CCP SST from the perspective of the Clearing Member and client population at UK CCPs. This analysis focuses on the potential liquidity demands that Clearing Members and their clients could face from CCP Initial and Variation Margin calls under the Baseline Market Stress Scenario.

The inclusion of liquidity demands from CCPs' Initial Margin calls is an extension relative to the Bank's previous CCP SST exercise and is intended to reflect potential liquidity demands more fully.

Methodology

The Clearing Member and Client Analysis uses data submitted by CCPs on Variation Margin and Initial Margin calls to estimate the potential liquidity impact on Clearing Members. For the purposes of this analysis, all Initial and Variation Margin flows are assumed to occur within one margin cycle.^[31] In practice, the precise liquidity positions of Clearing Members in the Baseline Market Stress Scenario would depend on the exact timings of liquidity draws across accounts and currencies on each day of the five-day stress scenario. This analysis therefore provides an estimate and reasonable upper bound of potential liquidity demands.

As part of the Liquidity Stress Test (Section 7), CCPs calculated the Variation Margin and Initial Margin payments that result from the Baseline Market Stress Scenario for each house and client account at each Clearing Member, and in each currency. Variation Margin calls directly reflect changes in the market value of Clearing Member and clients' positions. In contrast, CCPs use bespoke models to calculate Initial Margin requirements, which tend to increase following unprecedented changes in market prices and volatility. As such, CCPs provided the Bank with modelled estimates of the change in Initial Margin requirements that would result from the Baseline Market Stress Scenario.

Using this data, the Bank calculates CCPs' Initial Margin and Variation Margin calls at the Clearing Member group level. These are broken down into gross and net flows,^[32] as well as into the impact on house accounts and client accounts. This reflects CCPs' requirements that: (i) Clearing Members must service all payments to CCPs before receiving payments due from them; and (ii) Clearing Members must meet margin calls on behalf of their clients (though do not require their clients to pay until the following day or later). The analysis does not consider any discretion that Clearing Members have to increase or implement buffers on the margin calls they pass onto their clients. Neither does the analysis capture the margin calls that Clearing Members and their clients might face on uncleared positions.

For ease of interpretation, all values are presented in GBP equivalent, using the stressed foreign exchange rates in the Baseline Market Stress Scenario.

Results

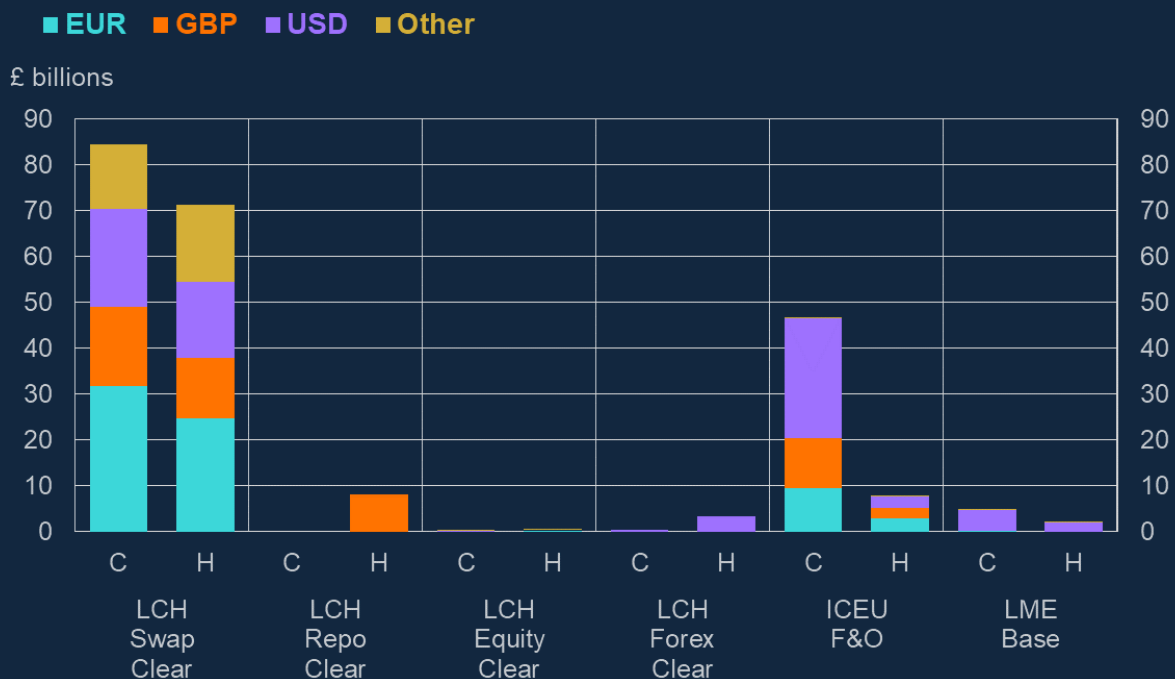
Chart 11 shows the largest UK CCP Clearing Services account for the greatest share of overall Variation Margin flows in the Baseline Market Stress Scenario. In total, LCH SwapClear accounts for 68% of Variation Margin flows, while ICEU F&O accounts for 24%. More than 86% of Variation Margin flows in the Baseline Market Stress Scenario are in EUR, GBP or USD.

Across CCP Clearing Services, the share of Variation Margin flows in these different currencies varies considerably. Reflecting their business lines, Variation Margin calls at LCH ForexClear and LME Base are predominantly in USD, while those at LCH RepoClear are solely in GBP. There is a greater mix of currencies in which Variation Margin is called at LCH SwapClear and LCH EquityClear.

Chart 11 also illustrates the significance of client clearing activity at each CCP Clearing Service. At ICEU F&O and LME Base a greater share of Variation Margin flows fall on client accounts, while client clearing accounts for a smaller share of activity at LCH's RepoClear, ForexClear and EquityClear Clearing Services.

**Chart 11: Gross Variation Margin payments by currency and account type (a)
(b)**

Gross Variation Margin payments for each CCP Clearing Service (GBP equivalent)



(a) The relative share of gross Variation Margin payments in both client and house accounts, and for individual currencies, is calculated at the CCP Clearing Service level.

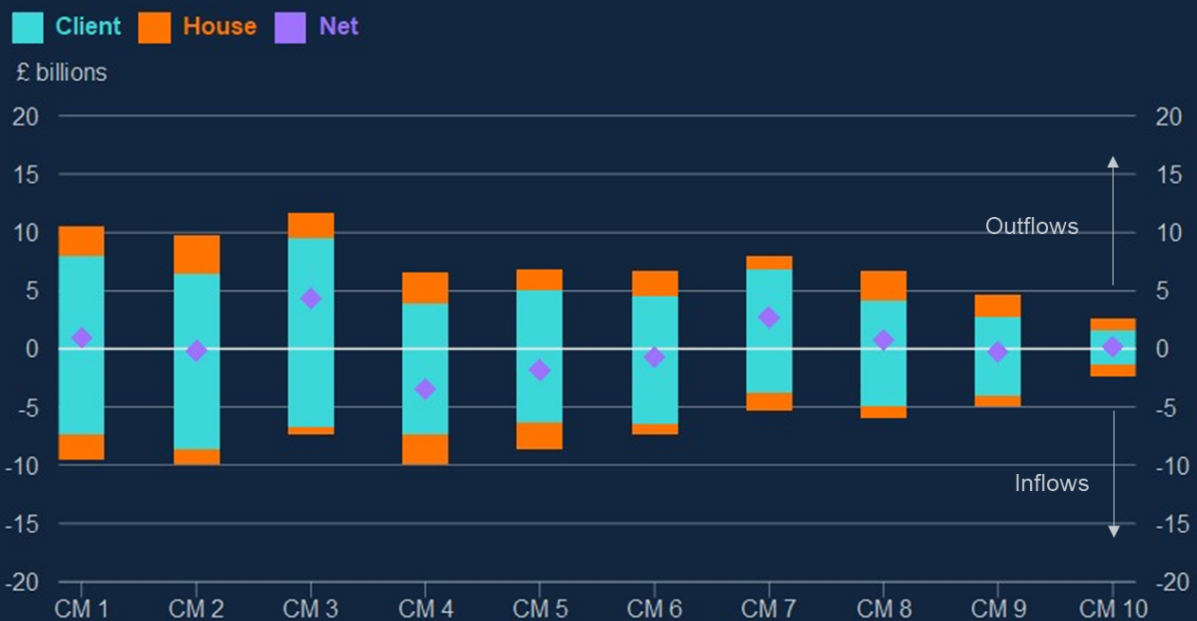
(b) C = client accounts, H = house accounts.

Chart 12 shows the gross and net Variation Margin calls for the 10 Clearing Member groups that face the greatest absolute calls in the Baseline Market Stress Scenario. While many Clearing Members face net Variation Margin inflows – or only small net outflows – gross Variation Margin outflows are often much larger. Further, client accounts are responsible for the majority of these outflows, despite there often being net inflows on client accounts. This highlights the importance of Clearing Members’ liquidity preparedness, given their requirements to: (i) service all payments to CCPs before receiving payments due to them; and (ii) meet margin calls on behalf of clients (but not require their clients to pay until the following day or later).

However, the 10 Clearing Member groups facing the greatest absolute Variation Margin flows are all large financial institutions and global systemically important banks (G-SIBS),^[33] which maintain large reserves to meet unexpected liquidity flows. For each of these Clearing Members, gross Variation Margin outflows represent less than 5% of their high-quality liquid asset (HQLA) holdings.^[34] This suggests that these liquidity demands should not represent a severe liquidity stress for these firms in isolation.

Chart 12: Variation Margin inflows and outflows for the top 10 Clearing Member Groups (a) (b)

Gross Variation Margin in/outflows on client and house accounts, and net in/outflows across all accounts (£ billions)



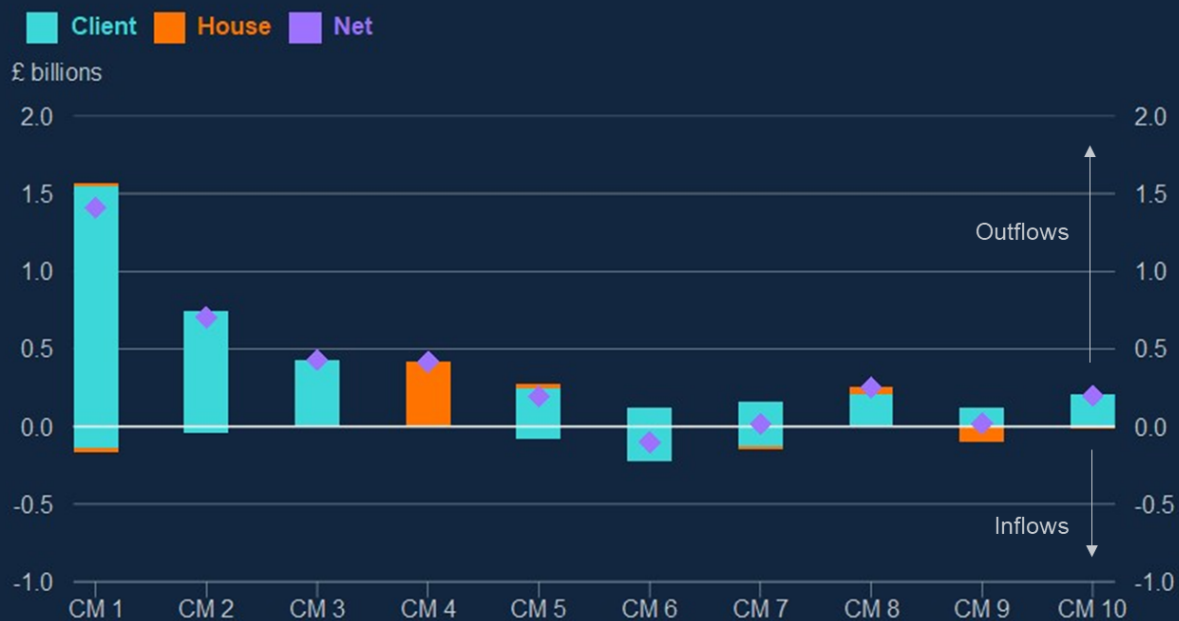
- (a) The top 10 Clearing Member (CM) groups are those with the greatest Variation Margin flows.
- (b) Clearing Member group identities are scrambled across Section 8, so a given Clearing Member group numbering does not correspond to a given Clearing Member group more than once.

In contrast, Chart 13 shows the gross and net Variation Margin calls for the 10 non-bank Clearing Members^[35] with the largest absolute Variation Margin flows. Gross and net calls for these non-bank Clearing Members are more closely aligned, indicating more directional exposures than for larger Clearing Members. Clients

also account for a greater share of Variation Margin flows for these non-bank Clearing Members. For one Clearing Member, gross Variation Margin outflows on client accounts amount to around £1.5 billion, with very little corresponding inflows. This could create large liquidity exposures if these clients were unable to pay Variation Margin, even if only temporarily. These findings illustrate the importance that CCPs are fully assured of their Clearing Members’ ability to meet potential liquidity needs in a stress, including via due diligence and membership criteria.

Chart 13: Gross Variation Margin inflows and outflows for the top 10 non-bank Clearing Member groups (a) (b)

Gross Variation Margin in/outflows on client and house accounts, and net in/outflows across all accounts (£ billions)



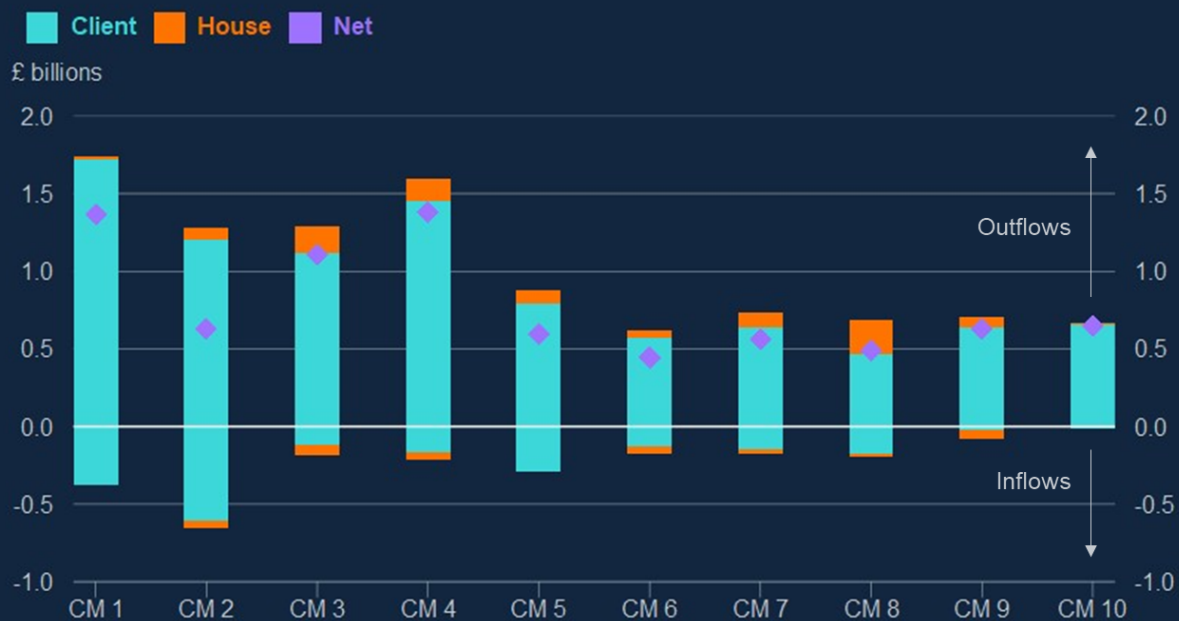
(a) The top 10 non-bank Clearing Member (CM) groups are non-banks with the greatest Variation Margin flows. (b) Clearing Member group identities are scrambled across Section 8, so a given Clearing Member group numbering does not correspond to a given Clearing Member group more than once.

Chart 14 shows gross Initial Margin calls for the 10 Clearing Member groups with the largest absolute change in Initial Margin requirements. Comparing with Chart 12, liquidity demands from gross Initial Margin calls are smaller than those from gross Variation Margin calls. However, on a net basis the two are more comparable

for some Clearing Member groups. Further, from a system-wide perspective, Variation Margin calls generally represent a redistribution of liquidity between Clearing Members, while Initial Margin calls represent a net liquidity drain on Clearing Members.[36]

Chart 14: Initial Margin inflows and outflows for the top 10 Clearing Member groups (a) (b)

Gross Initial Margin in/outflows on client and house accounts, and net in/outflows across all accounts (£ billions)



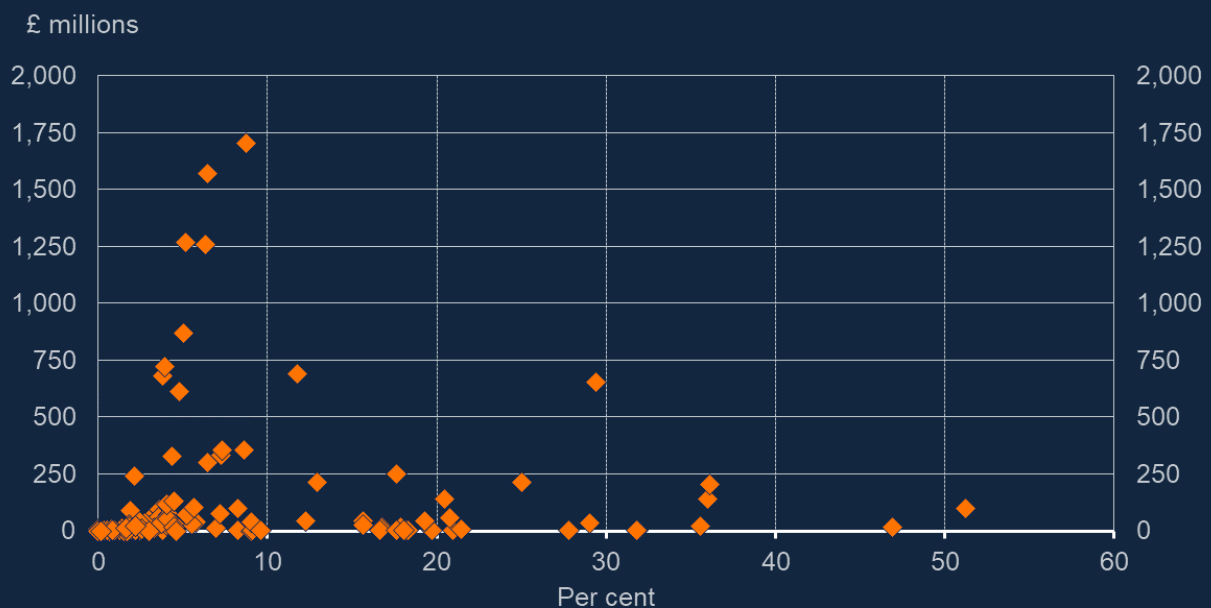
- (a) The top 10 Clearing Member (CM) groups are those with the greatest Initial Margin flows.
- (b) Clearing Member group identities are scrambled across Section 8, so a given Clearing Member group numbering does not correspond to a given Clearing Member group more than once.

Chart 15 shows that some Clearing Members groups may face Initial Margin calls that are smaller in absolute terms, but large relative to their pre-stress Initial Margin requirements and so represent a significant liquidity demand. The Bank is working with other international regulators via the BCBS, CPMI and IOSCO[37] to improve the transparency of Initial Margining practices and evaluate the responsiveness of Initial Margin models. Policy proposals emerging from the international work on Initial Margin transparency and responsiveness are expected to be published in a

consultative report by the end of 2023. The Bank will also explore liquidity demands from both Initial Margin and Variation Margin calls further as part of the recently launched system-wide exploratory scenario exercise.

Chart 15: Change in Initial Margin requirements (a)

Absolute change in Initial Margin (£ millions) versus relative change in Initial Margin requirements (Per cent) (b)



(a) Each diamond represents a single Clearing Member group.

(b) The percentage change in Initial Margin requirements is calculated as the change in Initial Margin divided by Initial Margin requirements, at a Clearing Member group level.

Conclusions and next steps

The Clearing Member and Client Analysis shows that the Baseline Market Stress Scenario has a significant impact on Clearing Members via Variation Margin and Initial Margin calls. Overall, the largest liquidity demands generally fall on the largest financial groups, but in isolation appear manageable in the context of these financial groups' liquidity resources.

However, some non-bank Clearing Members face liquidity demands which, while smaller, can still be significant. These non-bank Clearing Members often have more directional positions than the largest Clearing Members, and client clearing accounts for a greater share of their clearing activity. This highlights the importance of CCPs being fully assured of Clearing Members' ability to meet potential liquidity needs in a stress, including via due diligence and membership criteria.

The Bank is working with other international regulators to improve the transparency of CCP Initial Margining practices, and intends to explore liquidity demands from margin calls further as part of the Bank's **system-wide exploratory scenario** exercise. Policy proposals emerging from the international work on Initial Margin transparency are expected to be published in a consultative report by the end of 2023.

9: Overall conclusions and next steps

Overall, the results of the Credit Stress Test show that all UK CCP Clearing Services are resilient to the default of their Cover-2 population under the Baseline Market Stress Scenario. Under this scenario, all UK CCP Clearing Services can comfortably absorb default losses within their prefunded resources, even when accounting for the cost of liquidating concentrated positions. Further, each UK CCP Clearing Service sees less depletion of mutualised Default Fund contributions than in the Bank's previous CCP SST exercise, despite the more severe Baseline Market Stress Scenario (calibrated to be broadly equivalent in overall severity to the worst historical stress for each UK CCP Clearing Service).

This confirms that the UK clearing system responded as it was expected to following the periods of market volatility in 2022. This market volatility fed through CCPs' risk models and risk management into increased Initial Margin requirements and Default Fund sizing ahead of the 2023 CCP SST reference date. These increases in prefunded resources have since partially unwound at some CCP Clearing Services, consistent with normalising market conditions and a reduction in volatility. Nonetheless, sensitivity testing suggests CCPs would continue to be resilient to the Baseline Market Stress Scenario and simultaneous default of the Cover-2 population, despite an increased depletion of prefunded resources. CCPs are also resilient to the Opposite Direction Scenario in which the direction of shocks in the Baseline Market Stress Scenario are reversed.

In the Credit Reverse Stress Test, CCPs are tested against increasingly challenging combinations of assumptions to identify what might fully deplete their prefunded and non-prefunded resources. Only one CCP Clearing Service (LME Base) experiences full depletion of both prefunded and non-prefunded resources under the most severe combination of assumptions examined. Relative to the Bank's previous CCP SST exercise, all CCP Clearing Services have improved performance in the Credit Reverse Stress Test, considering the increase in the severity of the Baseline Market Stress Scenario and additional multiplier scenarios.

Exploratory analysis also provides evidence of CCPs' ability to withstand targeted shocks more extreme than the historical worst for individual product groups, under the default of the Cover-2 population. The Bank intends to follow up with CCPs to discuss this analysis in more detail and subsequently develop and improve this modelling capacity further to support ongoing supervision.

The results of the Liquidity Stress Test component show that all three UK CCPs are also resilient to the default and non-performance of their Cover-2 population under the Baseline Market Stress Scenario. No CCP experiences a negative liquidity balance at any point in the stress-test window, either at an aggregate currency level or in each of EUR, GBP and USD. When subjected to more extreme assumptions regarding their ability to mobilise liquid resources – in order to examine CCPs' reliance on different liquidity management tools – LCH and LMEC maintain a positive aggregate liquidity balance. Under the extreme assumption that CCPs are unable to access any resources under the management of defaulting investment agents, ICEU experiences a small negative aggregate liquidity balance. In practice, CCPs have other arrangements in place to ensure access to these funds. The results highlight the importance of CCPs maintaining and testing those alternative arrangements.

From a liquidity management perspective, the results show that the provision of key services that CCPs rely on for liquidity risk management remain concentrated across a small number of payment banks, investment agents and custodians. This reflects Clearing Member preferences and market-related factors, but illustrates the importance of CCPs ensuring their arrangements with service providers are appropriately robust.

From the perspective of Clearing Members, the results show that the largest liquidity demands from CCPs' margin calls generally fall on the largest financial groups, but appear manageable in the context of those groups' liquidity resources. However, non-bank Clearing Members can face liquidity demands which, while smaller, can still be significant. Further, while liquidity demands from Variation Margin calls are greatest, Initial Margin calls are still material relative to Initial Margin requirements for some Clearing Members. The Bank's **system-wide exploratory scenario** exercise will explore liquidity demands from margin calls further.

The Bank is also working with other international regulators to improve the transparency of Initial Margining practices and evaluate the responsiveness of Initial Margin models to volatility and other market stresses. Policy proposals from the international work on Initial Margin transparency and responsiveness are expected to be published in a consultative report by the end of 2023.

Consistent with the objectives of the exercise, the Bank will use the findings from the 2023 CCP SST to support and inform its ongoing supervision and regulation of UK CCPs.

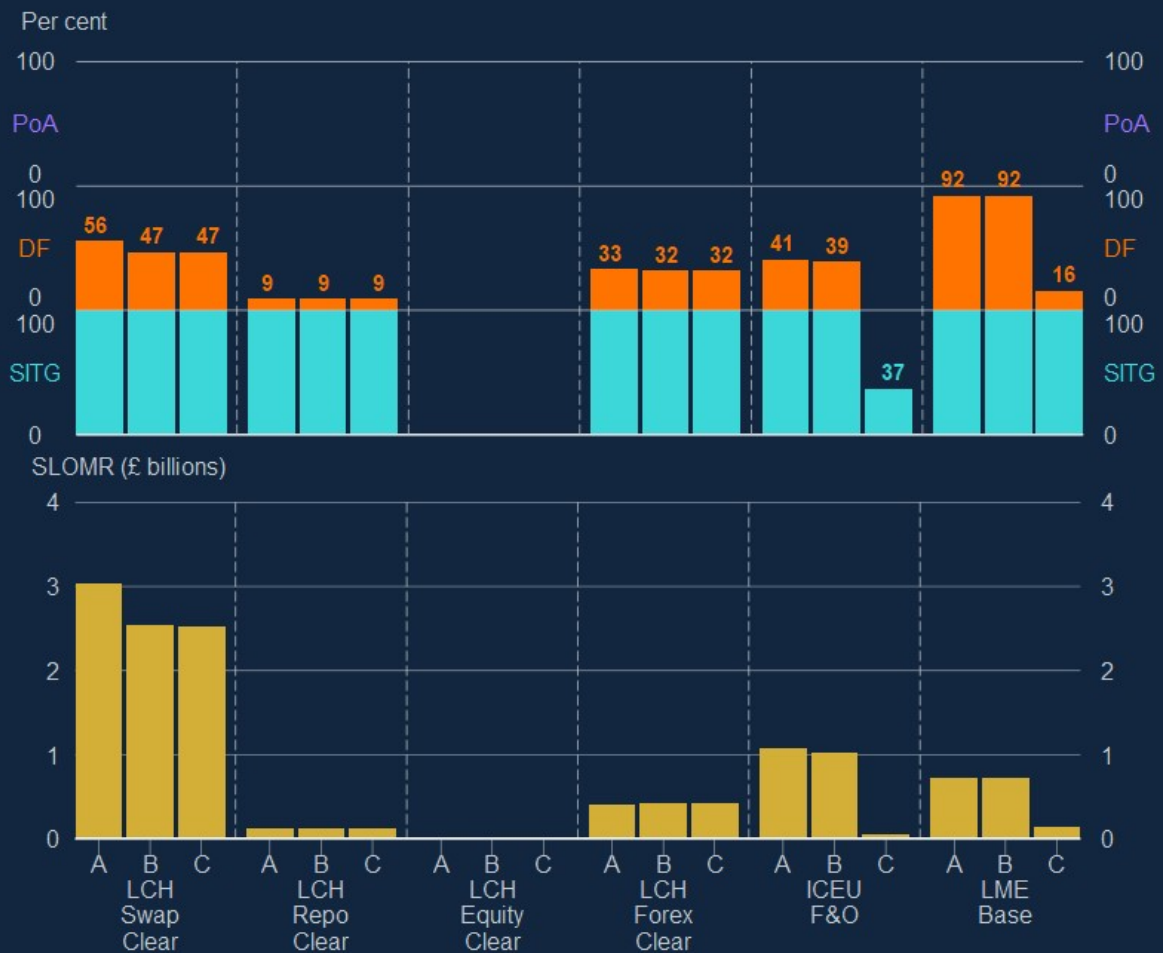
Annexes

Annex A: Credit Stress Test results (2021–22 CCP SST)

Chart A1: Credit & Concentration Stress Test results (2021–22 CCP SST) (a)

(b) (c) (d)

Baseline Market Stress Scenario, CCP Clearing Service Cover-2, all porting assumptions (e)



(a) Stressed losses over defaulting members’ resources (SLOMR) is the absolute amount (£ billions) by which losses exceed defaulters’ resources (Initial Margin and Default Fund contributions).

(b) Percentage usage of dedicated CCP resources (SITG).

(c) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters’ Default Fund contributions.

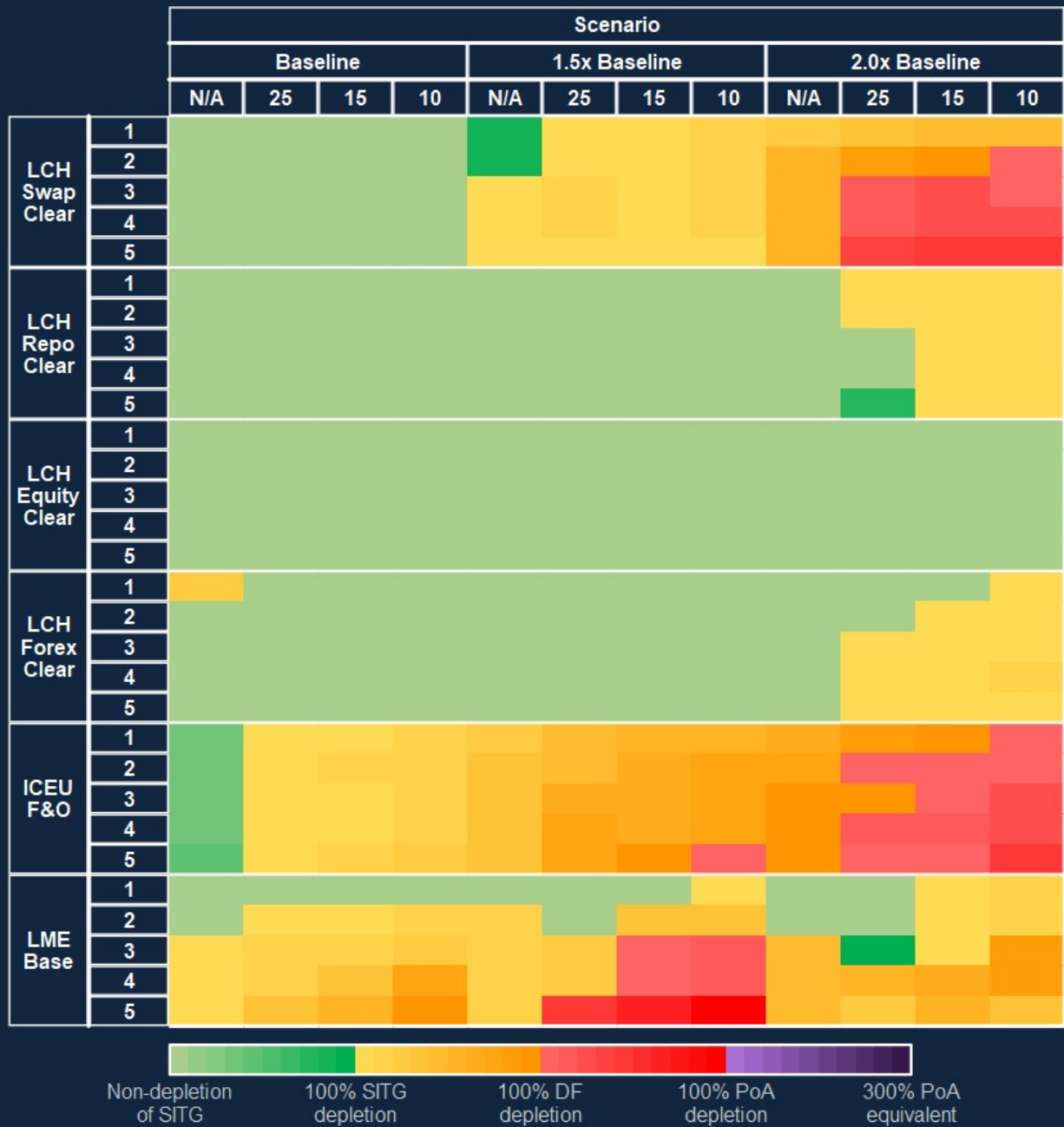
(d) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-prefunded resources that CCPs can call from non-defaulters.

(e) A = ‘No porting’, B = ‘Segregated client accounts port’, and C = ‘All client accounts port’.

Annex B: Credit Reverse Stress Test results (system-wide Cover-N)

Chart B1: Credit Reverse Stress Test results (a) (b) (c) (d) (e) (f)

System-wide Cover-N, No porting



- (a) Percentage usage of dedicated CCP resources (SITG).
- (b) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters' Default Fund contributions.
- (c) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-prefunded resources that CCPs can call from non-defaulters. PoA are assumed to be equal to the minimum of non-defaulting Clearing Member groups' Default Fund contributions multiplied by three, or the non-defaulting

Clearing Member groups' Default Fund contributions multiplied by the number of individual defaulting Clearing Members.

(d) Losses beyond PoA, presented with reference to the size of PoA. For example, 100% PoA equivalent where losses beyond PoA are of the same magnitude as PoA.

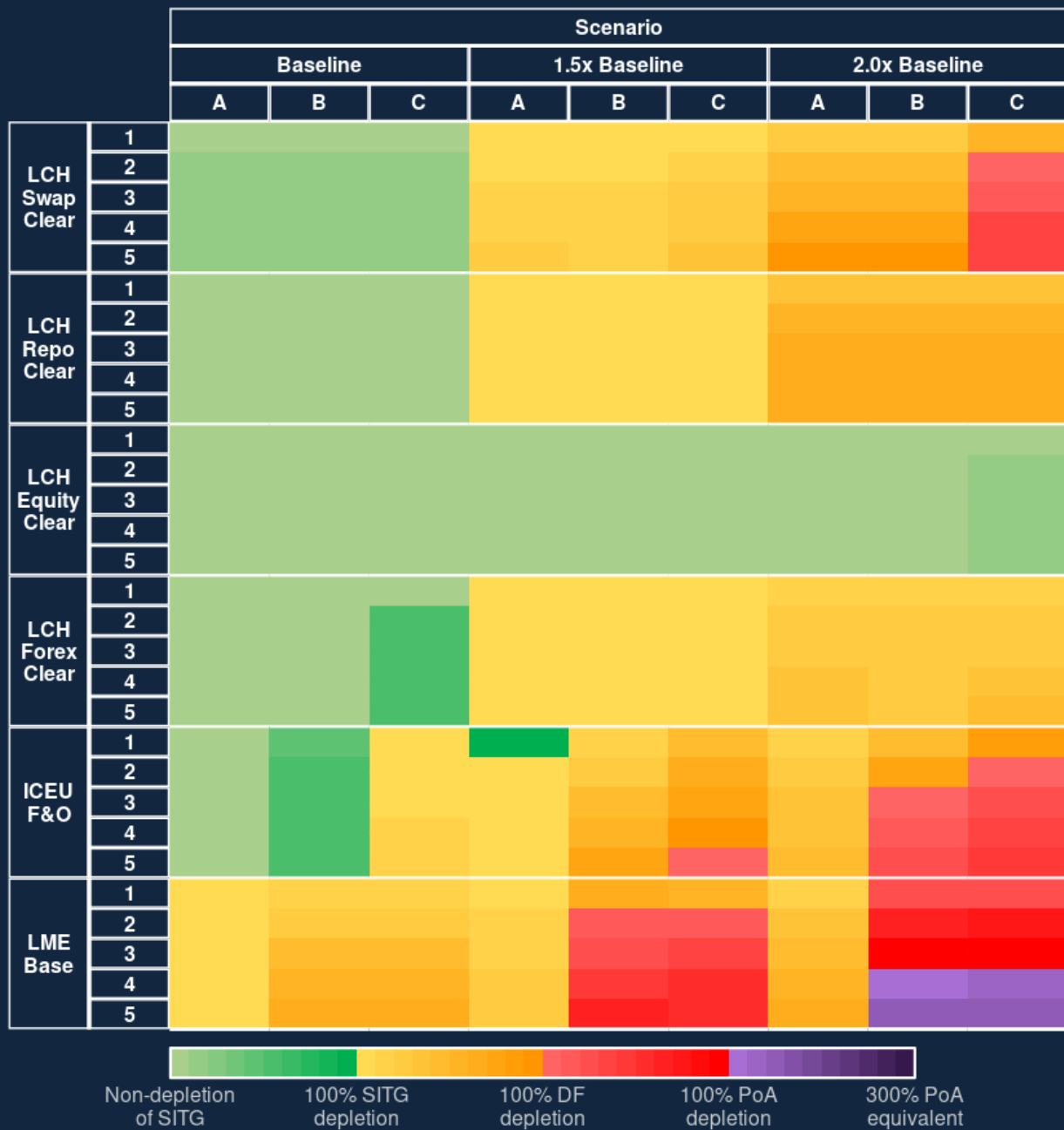
(e) '25', '15', '10' represent the percentage of daily average volume traded for each product assumed can be liquidated daily without a price impact. A lower liquidation rate implies a reduction in the market's ability to absorb CCP positions before giving rise to concentration costs. N/A represents non-inclusion of concentration costs.

(f) Numbers on the y-axis represent the number of Clearing Member groups assumed to default.

Annex C: Credit Reverse Stress Test results (alternative porting assumptions)

Chart C1: Credit Reverse Stress Test results (a) (b) (c) (d) (e)

System-wide Cover-N, 25% of daily average liquidation rate, all porting assumptions (f)



- (a) Percentage usage of dedicated CCP resources (SITG).
- (b) Percentage usage of mutualised Default Fund (DF), consisting of non-defaulters' Default Fund contributions.
- (c) Percentage usage of Powers of Assessment (PoA). PoA represents the total amount of non-prefunded resources that CCPs can call from non-defaulters. PoA are assumed to be equal to the minimum of non-defaulting Clearing Member groups' Default Fund contributions multiplied by three, or the non-defaulting

Clearing Member groups' Default Fund contributions multiplied by the number of individual defaulting Clearing Members.

(d) Losses beyond PoA, presented with reference to the size of PoA. For example, 100% PoA equivalent where losses beyond PoA are of the same magnitude as PoA.

(e) Numbers on the y-axis represent the number of Clearing Member groups assumed to default.

(f) A = 'All client accounts port', B = 'Segregated client accounts port', and C = 'No porting'.

Annex D: Currency-level Liquidity Sensitivity Testing results (EUR, GBP, USD)

Chart D1: Liquidity Sensitivity Testing results (EUR) (a) (b)

Baseline Market Stress Scenario, individual currency level



(a) The liquidity balance is presented for the day in the stress-test window on which the EUR liquidity balance is lowest for each individual CCP, and under each individual sensitivity test.

(b) EUR-level results are not included for LMEC due to an immaterial EUR liquidity balance.

Chart D2: Liquidity Sensitivity Testing results (GBP) (a) (b)

Baseline Market Stress Scenario, individual currency level

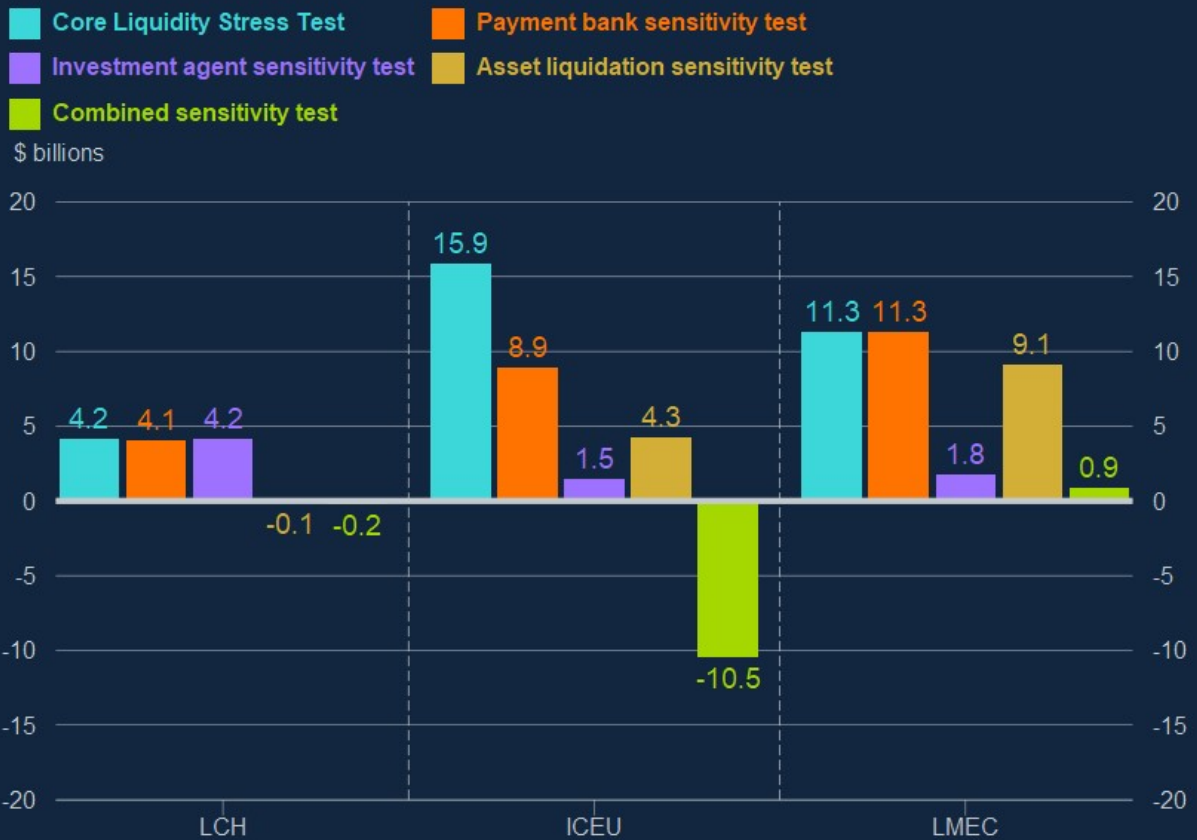


(a) The liquidity balance is presented for the day in the stress-test window on which the GBP liquidity balance is lowest for each individual CCP, and under each individual sensitivity test.

(b) GBP-level results are not included for LMEC due to an immaterial GBP liquidity balance.

Chart D3: Liquidity Sensitivity Testing results (USD) (a)

Baseline Market Stress Scenario, individual currency level



(a) The liquidity balance is presented for the day in the stress-test window on which the USD liquidity balance is lowest for each individual CCP, and under each individual sensitivity test.

Annex E: Glossary

Baseline Market Stress Scenario – A hypothetical market stress scenario designed by the Bank of England. It represents a global economic downturn combined with a negative supply shock in commodities markets. It is modelled to shock CCP Clearing Services to a level of severity equivalent to the worst historical stress scenario.

CCP (Central Counterparties) – Financial Market Infrastructures sitting between the buyer and seller of a trade, guaranteeing the obligations under the contract agreed between the two counterparties. If one counterparty fails, the other is protected via the default management procedures and resources of the CCP.

CCP Clearing Service – A distinct part of a CCP offering clearing for certain financial markets and types of products. Typically, each CCP Clearing Service maps directly to a single Default Fund.

CCP Skin in the Game – A tranche of the CCP's own capital that is utilised directly after the defaulter's resources have been used to cover losses, but before any resources from non-defaulted members can be utilised.

Clearing Member – A direct member of the CCP that submits trades either on their own behalf or on behalf of clients. The Clearing Member is financially responsible for the trade's obligations, such as posting initial margin and variation margin, including on behalf of its clients.

Clearing Member group – A group of entities, at least one of which is a Clearing Member, that form part of a legal entity or are closely economically integrated.

Client – Counterparties that clear trades indirectly via a Clearing Member. These entities do not make contributions to CCPs' Default Funds.

Concentration costs – Additional costs that CCPs may face when they liquidate (through hedging or auction) large or concentrated positions of defaulters.

Cover-2 – The two Clearing Member groups whose default generates the largest impact on resources/worst liquidity balance at each CCP Clearing Service/CCP under the relevant market stress scenario.

Cover-X – An alternative (ie not Cover-2) defaulter population at each CCP Clearing Service.

Custodian – A financial institution that holds cash and collateral on behalf of CCPs and clearing members.

Default Fund – CCPs' prefunded mutualised resources contributed by Clearing Members. These resources are called upon after the defaulters' own resources and the CCP's own capital have been depleted.

Defaulters' own resources – The prefunded resources, consisting of Initial Margin and Default Fund contributions, which a defaulting Clearing Member has posted to the CCP as collateral. These form the first layer of each CCP's default waterfall.

Default waterfall – The resources that a CCP can access to satisfy defaulting Clearing Members' obligations, drawn in the following order: (i) defaulting Clearing Members' prefunded resources (Initial Margin and Default Fund contributions), (ii) CCP Skin in the Game (CCPs' own capital set aside to absorb default losses), (iii) mutualised Default Fund contributions (prefunded contributions of non-defaulting Clearing Members), (iv) Powers of Assessment (non-prefunded resources CCPs can call from non-defaulting Clearing Members).

Initial Margin – Resources posted by a Clearing Member to cover the potential losses that could arise from that Clearing Member's positions in the event of a default. A CCP will call upon the defaulting Clearing Member's Initial Margin contributions before other resources within the default waterfall sequence to meet the obligations of a defaulting Clearing Member.

Investment agents – Specialised financial institutions tasked with identifying and executing investments on behalf of CCPs. Using investment agents allows CCPs to utilise institutional expertise, technology, market position and contacts that it may not otherwise have access to. In case of arrangements with UK CCPs, investment agents operate through Power of Attorney, ie accounts used are in CCPs' names.

Losses beyond Powers of Assessment – Outstanding losses remaining after all previous layers of the default waterfall have been depleted, including Powers of Assessment. CCPs may use tools such as cash calls, Variation Margin gains

haircutting and contract tear-ups where they experience losses beyond Powers of Assessment.

Mutualised Default Fund contributions – Clearing Members' contributions to a CCP's Default Fund which can be used to absorb default losses beyond defaulters' own resources and CCPs' SITG. Utilised contributions require replenishing by non-defaulting Clearing Members.

Non-bank Clearing Member group – Group that is not classified as a bank entity or another CCP.

Non-prefunded resources – Additional financial resources that CCPs have the power to call from non-defaulting Clearing Members via Powers of Assessment.

Omnibus client account – An account maintained by a Clearing Member at a CCP that contains more than one customer of the Clearing Member.

Opposite Direction Scenario – A market stress scenario in which the direction of all shocks (except volatility shocks) is reversed relative to the Baseline Market Stress Scenario.

Payment bank – Service providers that offer cash settlement services to CCPs by processing cash collateral flows between CCPs and their members. In addition, payment banks assist in processing the movement of funds and securities for cash market funds. To facilitate this, CCPs will have an account at the same payment bank, in each settlement currency.

Porting – Refers to the ability of CCPs to successfully transfer client accounts at defaulting Clearing Members to non-defaulting Clearing Members.

Powers of Assessment – The non-prefunded resources a CCP can request from its Clearing Members in the event of a Clearing Member default. This can occur after the depletion of the Defaulter's prefunded resources, the CCP's Skin in the Game and the Default Fund.

Prefunded resources – The total of all collateral held by CCPs that is available at the time of a potential default. This includes Initial Margin and Default Fund contributions of any defaulted Clearing Members, and Default Fund contributions of non-defaulting Clearing Members.

Probability of default – The modelled probability that a chosen entity will default on its obligations over a specified period.

PNL (profit-and-loss) – The observed increase/decrease in the value of a portfolio when this is priced at current market prices.

Reference date – The start date for the CCP supervisory stress test. The reference date determines the market prices to which shocks are applied, as well as CCP exposures and resources.

Risk factors – The individual market prices and rates to which shocks are applied in the Bank's market stress scenarios.

Segregated client accounts (ISEG, LSOC) – A type of account that only holds positions and collateral associated with a single client in individually segregated accounts (ISEG), or multiple clients in legally segregated, operationally commingled accounts (LSOC). These types of accounts are assumed to be easier to port than non-segregated (omnibus) accounts.

Sensitivity testing – The process of individually and jointly changing core assumptions underlying the stress test. Combining multiple sensitivities often represents a more severe test that goes beyond regulatory requirements and historical precedents.

Service provider – Firm that provides CCPs with services such as settlement, payment and investment management. Service providers play an integral role in CCPs managing their liquidity risk.

SWES (system-wide exploratory scenario) – a Bank of England exercise aimed at improving the Bank's understanding of the behaviours of banks and non-bank financial institutions during stressed financial market conditions, and how those behaviours might interact to amplify shocks in UK financial markets that are core to UK financial stability.

Variation Margin – A daily cash amount that is exchanged between members and the CCP that reflects changes in the market value of members' positions.

1. The Cover-2 population for the Credit Stress Test component is defined as the two Clearing Member groups whose default generates the largest exposures at each CCP Clearing Service under the relevant market stress scenario. The Cover-2 Clearing Member population for the Liquidity Stress Test component is defined as the two Clearing Member groups whose failure in all capacities (ie including provision of services such as Assured Payment Systems (APS) or payment banks, investment agents, investment counterparties and custodians) generates the worst aggregated liquidity balance under the relevant market stress scenario.
2. Prefunded resources consist of CCPs' own capital (Skin in the Game) and mutualised Default Fund contributions.
3. CCPs' own capital (Skin in the Game) set aside to absorb default losses beyond defaulters' own resources in the first instance.
4. This analysis is undertaken on the assumption that excess collateral posted to CCPs is not available. This conservative assumption reflects the possibility that Clearing Members may withdraw excess collateral from CCPs in the run-up to a default event.
5. Non-prefunded resources are additional resources CCPs can call from non-defaulting Clearing Members via Powers of Assessment.
6. While the Credit Stress Test and Credit Reverse Stress Test results are calculated utilising full scenario revaluations undertaken by CCPs, this exploratory analysis is undertaken using measures of first-order sensitivity to risk factor shocks, rather than the full revaluation of more granular product specifications undertaken by CCPs.
7. A CCP's default waterfall stipulates the sequence of financial resources that a CCP can draw upon to cover stressed losses over defaulting Clearing Member resources. Beyond defaulting Clearing Member's Initial Margin and Default Fund contributions, the default waterfall includes CCP Skin in the Game (SITG) (the CCP's own capital which can be used to cover credit losses), non-defaulter's Default Fund contributions, and Powers of Assessment (additional non-prefunded resources that CCPs can call from non-defaulting Clearing Members).
8. Prefunded resources consist of CCPs' own capital (Skin in the Game) and mutualised Default Fund contributions.
9. Non-prefunded resources are additional resources CCPs can call from non-defaulting Clearing Members via Powers of Assessment.
10. For example, market stress scenarios beyond the 'extreme but plausible' definition, and the default a greater number of defaults than the two Clearing Member groups whose default generates the largest exposures (Cover-2 population).
11. 17 September 2021.
12. Except for volatility shocks.
13. The 2021–22 CCP SST exercise applied 0.8x, 1.2x and 1.6x multipliers of the Baseline Market Stress Scenario.

14. The 10 February 2023 reference date was selected as CCP resources, CCP exposures and market prices on this date were generally representative of those over the period since the conclusion of the Bank's previous CCP SST exercise. The 10 February 2023 reference date also means that settlement dates and expiries for particular contracts are captured within the five-day stress period of the 2023 CCP SST.
15. CCPs provide both pre-stress and stressed collateral values for each market stress scenario.
16. Where CCPs have rules in place that allow a surplus of a given Clearing Member in one Clearing Service to offset a deficit of that same Clearing Member in another Clearing Service, these offsets are applied in the calculation.
17. The Cover-2 population is defined at the CCP Clearing Service level as UK CCPs maintain segregated Default Funds for different asset classes.
18. Powers of Assessment are calculated to be equal to the minimum of non-defaulting Clearing Member groups' Default Fund contributions multiplied by three, or the non-defaulting Clearing Member groups' Default Fund contributions multiplied by the number of individual defaulting Clearing Members. This reflects UK CCPs' rulebooks allowing a maximum of three Powers of Assessment calls in a six-month period.
19. For selected products that are specifically related to each other, the Bank recognises a conservatively modelled reduction in CCPs' exposures where the respective long and short positions are offsetting. Typically, these offsets relate to calendar spreads or basis exposures in related products for which there are high levels of historically observed correlation during periods of stress.
20. For example, the concentration costs on a position the same size as the daily average volume traded would be estimated to be equivalent to the cost of liquidating that position over four days while market prices continue to evolve.
21. While Initial Margin requirements were higher on the 2023 CCP SST reference date than in the Bank's previous CCP SST exercise, Initial Margin requirements on this date were broadly representative of the period since the conclusion of the Bank's previous CCP SST and do not represent a particular peak or outlier.
22. To undertake sensitivity testing the Bank has re-run the Baseline Market Stress Scenario using an in-house model that applies reductions in the overall size of margin requirements, Default Fund contributions and Clearing Member positions at each CCP Clearing Service. For simplicity, the Bank has not updated the proportional composition of margin requirements, Default Fund contributions and position sizes among CCP Clearing Members.
23. These results assume no porting of client accounts. The classifications for 'Non-financial Cover-X' and 'Non-bank Cover-X' are applied using sector and industry mapping from Bloomberg. The classifications for 'Probability of Default Cover-X' are applied using Bloomberg's one-year probability of default measure.
24. While not a focus of the analysis, the Credit Reverse Stress Test can also be undertaken under different porting assumptions (Table B). Results of the Credit Reverse Stress Test under alternative porting assumptions are shown in Annex C.
25. As in the Credit Stress Test, the defaulting Cover-N population is defined as the combination of Clearing Members whose simultaneous default generates the greatest loss at the CCP Clearing Service level, under the relevant market stress scenario. For $N \leq 2$, this population is determined dynamically ie considering the estimated concentration costs related to the combined positions of defaulting Clearing Members. For $N > 2$,

technical limitations mean the defaulting population is determined using a ranking of the impact of individual (rather than combined) Clearing Member group defaults. Consistent with the Credit Stress Test, the Cover-N population is determined at the CCP Clearing Service level. Results considering the default of the Clearing Member population which generates that greatest aggregate losses across all CCP Clearing Services are presented in Annex B.

26. For example, losses over Powers of Assessment (PoA) of 100% PoA equivalent means that losses over Default Fund contributions are twice the size of CCP's available Powers of Assessment. While not considered in this analysis, it is important to note that CCPs do have other tools that can be deployed where losses exceed PoA (such as cash calls, variation margin gains haircutting and contract tear-ups).
27. Excluding the impact of concentration costs.
28. Refer to [Article 57 of the UK Technical Standards](#) for further information.
29. The Discount Window Facility (DWF) is a bilateral facility, where firms can borrow highly liquid assets (gilts or, in certain circumstances, cash) in return for other assets (collateral). In the case of UK CCPs, sterling cash will be lent as standard, because CCPs generally hold high-quality collateral, so most are likely to turn to the DWF if repo markets were not functioning properly. Refer to [Bank of England Market Operations Guide: Our tools](#) for further information.
30. Payment banks concentration is measured by the share of Variation Margin payments processed. For custodians and investment agents, concentration is measured by the share of CCPs' securities held and share of CCPs' investments under management, respectively.
31. This is a conservative assumption, given the Baseline Market Stress Scenario has a five-day time horizon.
32. Net flows are measured as the final margin increase or decrease experienced by each Clearing Member group once all accounts have been settled.
33. Refer to [Global systemically important banks: assessment methodology and the additional loss absorbency requirement](#) for details.
34. Based on publicly available data.
35. Non-bank Clearing Members refers to Clearing Members with an ultimate parent which is not a banking group, nor another CCP.
36. Though CCPs do reverse-repo some Initial Margin posted as cash collateral.
37. The Basel Committee on Banking Supervision, The Committee on Payments and Market Infrastructure, and The International Organization of Securities Commissions.