Box 2: Stress Testing to Confirm the Resilience of Central Counterparties

Some central banks, financial authorities and international bodies consider central counterparties (CCPs) to be systemically important, and continuity in the provision of their services is regarded as critical to the stability of the financial system. Given their nature, CCPs are counterparties to all their clearing members. The possibility that CCPs do not adequately mitigate the risks they face and those that arise from their role as central counterparties could have a direct impact on their financial health, that of their members and the markets they serve, which could have potential systemic effects. Moreover, in some cases CCPs are highly interconnected through common participants. This can propagate the failures at one CCP throughout the system.

CCPs can increase the resilience of the financial system by simplifying financial interconnections and by ensuring that transactions are safer and more transparent than if they were conducted bilaterally (see Mariño et al., 2020). At the same time, due to their increasingly central role in the financial system and the reliance that members have on them, disruptions in CCPs now have more potential to cause stress in the financial system (Wenqian and Takáts, 2020; Wilkes, 2020; BIS, 2014; Wendt, 2015). A key tool for approximating the resilience of CCPs is the application of stress tests to gauge their ability to withstand extreme market scenarios and multiple member defaults.

According to the Bank of England (2021), while daily stress tests performed by CCPs focus on their own risk management, market clearing and cleared products, supervisory stress tests of CCPs can be used to achieve a system-wide view. Therefore, supervisory stress tests are better suited to capture and assess the connections, dependencies, and shared risk factors between CCPs, their members and their service providers.

In this regard, some financial authorities use stress tests as tools to assess the resilience of CCPs. The purpose of these tests is to measure the individual CCP's ability to withstand stress events caused by its members and the markets, and the resilience of the clearing network and its interaction with the rest of the financial system. Moreover, stress tests promote transparency and help to establish public confidence in the financial system. They also provide information to market participants, and act as a mechanism whereby the authorities can strengthen their tools to ensure financial stability.

This section offers some examples of recommendations issued by international organizations on the subject and summarizes several stress test exercises conducted by the financial authorities in the European Union (EU), the United States of America and England. Stress tests performed by the Central Counterparty of Colombia S. A. (CRCC), the Office of the Superintendent of Financial Institutions in Colombia (SFC) and *Banco de la República* (BanRep) are described for the Colombian case.

1. Payments and Market Infrastructure Committees and the Board of the International Organization of Securities Commissions (CPMI and Iosco).

The CPMI and Iosco published the Principles for Financial Market Infrastructures (PFMIs) in 2012, which strengthened and harmonized the three pre-existing sets of international standards for financial market infrastructures (FMIs) by increasing minimum standards, providing more detailed guidance, and expanding the scope of the standards to cover new areas of risk management. Among other aspects, the PFMIs note that CCPs should have enough financial resources to cover simultaneous default by their two largest clearing members and their subsidiaries, in addition to the need to ensure that these resources are available.

In April 2015, the G20 finance ministers and central bank governors asked the Financial Stability Board (FSB) to work jointly with the CPMI, Iosco and the Basel Committee on Banking Supervision to develop and present reports on a work plan to identify and address the CCP-related weaknesses and potential financial stability risks that are systemic across multiple jurisdictions. Thus, joint plans were put in place to address the priorities related to CCP resilience, recovery, and resolution.

The committees also were asked to assess CCPs' stress testing policies and practices, and to consider the need to establish a consistent and comparable framework for stress testing that seeks to measure the efficiency of CCPs' financial resources (including capital) and liquidity arrangements. In addition, they were asked to explore how stress tests are conducted by supervisory authorities.

As a result, CPMI-Iosco issued a document entitled "Framework for Supervisory Stress Testing of Central Counterparties (CCPs)" in April 2018. It defines a framework for supervisory stress testing (SST), which refers to exercises designed and executed by financial authorities, with or without the direct involvement of CCPs. SST can be designed to achieve specific objectives; for example, to assess the resilience of a given CCP in a specific stress scenario; that is, to assess effects at the micro level. At the macro level, the objective is to assess the potential systemic effects associated with a stress event that impacts multiple CCPs.

Because different authorities with different responsibilities, legal frameworks, expertise, and resources may be involved in each stress test exercise, the framework establishes a flexible, high-level approach to designing and conducting the tests. Given the number of variables at play, this guidance is intended to help authorities consider various approaches and decision points, while recognizing that each option may not be uniformly applicable across all authorities or jurisdictions. Authorities will need to consider each of these situations in view of their particular mandates and must design their tests accordingly.

The general framework for testing sets out the following six components that describe the steps authorities would likely follow in designing and executing these tests: 1) define the objective of each exercise; 2) establish institutional arrangements; 3) develop stress scenarios; 4) collect and protect information; 5) combine results and develop analytical metrics; and 6) determine how the results will be used and circulated.

In November 2020, the chairs of the FSB, CPMI, Iosco and the FSB Resolution Steering Group publicly agreed to collaborate and continue the effort to review CCP financial resources in terms of recovery and resolution. This work will examine the need for international policy on the use, composition and volume of financial resources for recovery and resolution, and develop relevant policy to further strengthen the resilience and resolution of CCPs in scenarios of losses generated by defaults or any other event. The results of this first exercise are expected to be published by the end of the first half of 2022.

Table B2.1
Stress Tests according to risk in several jurisdictions

Jurisdiction	Credit risk	Liquidity risk	Concentration risk	Operational risk
European Union	X	X	X	X
United States	X	X		
England	X	X	X	
Colombia	X	X		

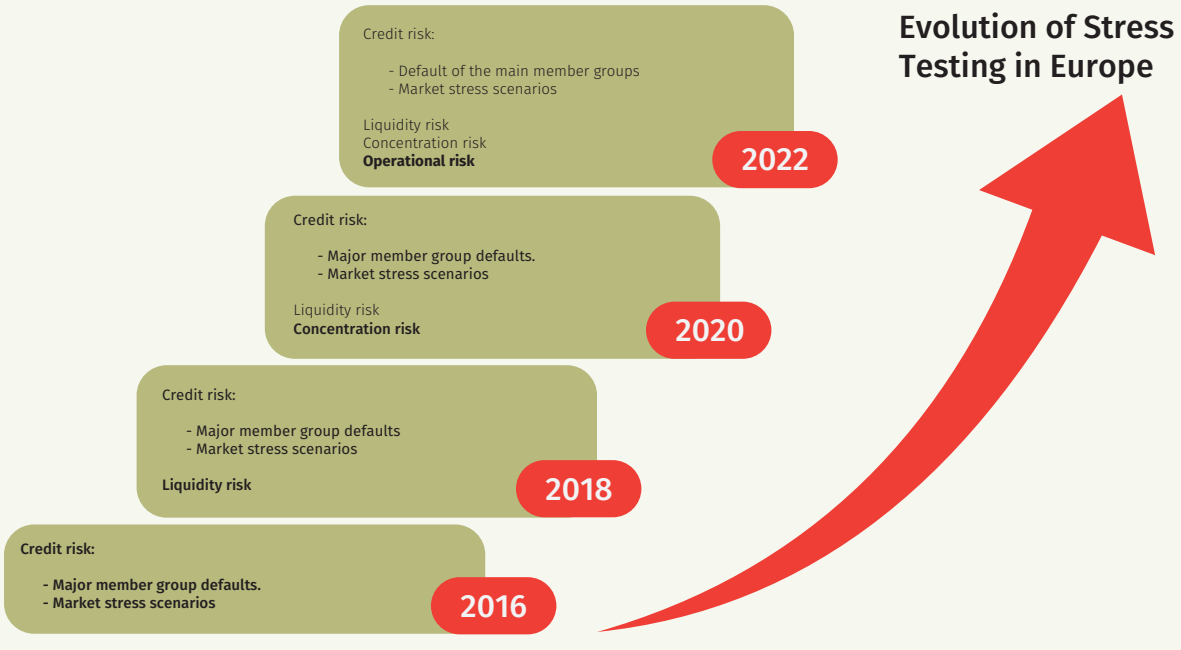
Source: Own calculations based on the sources described in section 2.

In addition to these multilateral initiatives, supervisory authorities in some jurisdictions have conducted stress tests of CCPs. Table B2.1 shows the types of risks assessed through stress tests in the selected jurisdictions.

2. Developments in Stress Testing in the European Union

Regulation EU-No 648/2012 of the European Parliament and Council establishes guidelines on OTC derivatives, central counterparties, and trade repositories. It specifies that each member state shall designate a competent authority to perform the functions required to apply the regulation when it comes to authorization and supervision of the CCPs established in its territory and to report to the European Securities and Markets Authority (ESMA). The latter will play a coordinating role in creating a common supervisory culture and ensuring uniform procedures and consistent approaches. Building on this legal and institutional structure, ESMA has conducted four stress testing exercises for CCPs operating in the EU. Each exercise involved a new test element with respect to the previous one, representing a constant evolution. Diagram B2.1 shows the risks assessed in each exercise.

Diagram B2.1
Evolution of Stress Testing in Europe



Sources: Reports of the ESMA stress test results; diagram prepared by *Banco de la República*.

The first exercise began in 2014 and the final report was published in April 2016.[1] It assessed the resilience of 17 CCPs and focused on the counterparty credit risk that EU CCPs would face because of multiple defaults by major clearing members[2] and simultaneous market price shocks. The exercise was supplemented with an analysis of the concentration of CCP exposure and potential spillover effects on non-defaulting clearing members, assessing the likelihood of additional defaults triggered by the CCP loss absorption mechanism.

1 This stress test on CCPs was the first exercise. There is no evidence of a similar exercise in any other jurisdiction (ESMA, 2016).

2 The financial significance of major groups is determined by the largest exposure they represent for CCPs, including exposure weighted by the probability of default.

The second exercise was launched in 2017 and the report on the results was published in February 2018 (ESMA, 2018). Compared to the first exercise, ESMA broadened the scope to include tests to measure CCPs' resilience to liquidity risk and strengthened the framework for defining scenarios and validating the test results set out in the first exercise. From a liquidity risk perspective, it examined whether CCPs had sufficient tools or sources of liquidity to cover default by their two largest members. The exercise tested the resilience of 16 European CCPs with approximately 900 clearing members across the EU.

The third exercise was begun in 2019 and the report on the results was published in July 2020 (ESMA, 2020). It covered credit and liquidity risks, with specific improvements in the methodology compared to the previous two exercises.[3] In addition, a stress test to assess the impact of the cost of liquidating concentrated positions (concentration risk) was included for the first time.

Concentration risk was assessed on the share of members' contributions to default funds and on the value of credit lines with liquidity providers. The larger the contributions or credit lines provided by a smaller number of members/suppliers, the greater the likelihood that stress at one institution will affect one or more CCPs, which could have systemic consequences.

The fourth exercise was launched in 2021, and the report outlining its methodology and scope was published in June of the same year (ESMA, 2021). According to the work plan, the report on the results is expected to be available by the second quarter of 2022. Klaus Löber, Chairman of the EU CCP Supervisory Committee, noted that the year 2020 showed financial systems are constantly evolving and subject to disruptions, such as those caused by Covid-19 or Brexit. Therefore, CCP stress testing becomes an essential supervisory tool that can contribute to financial stability and supervisory convergence in the EU.

In the fourth reiteration of stress testing, thirteen CCPs approved in Europe and two in the UK will be assessed, the credit and exposure concentration components [4] will be developed in an aggregate way, and an operational risk analysis will be introduced as well. With respect to the latter, CCPs will be provided with a common methodology to identify service providers that support critical activities. Once the common providers have been identified among the CCPs, potential risks will be assessed, and mitigation and monitoring tools will be defined.

In summary, the results of the three completed stress tests in terms of validating the adequacy of prefunded resources to withstand simultaneous default by the two most representative members and extreme market scenarios, show the European CCPs can be considered resilient because their prefunded resources would be sufficient to cover the losses resulting from most of the scenarios evaluated. However, in extreme scenarios where the two largest members are in default in all CCPs where they participate, combined with extreme market scenarios, it would be necessary to call on unfunded resources. Particularly, in the second exercise, one CCP was identified for which it would be necessary to request additional resources, without systemic implications.

On the other hand, the results of those tests measuring the adequacy of liquid resources show that, in most scenarios of extreme market movements, CCPs would have sufficient capacity to meet their liquidity needs. However, one of the CCPs assessed in the second exercise would require unrestricted access to markets and the ability to settle immediately, some CCPs would require access to short-term foreign exchange markets to hedge obligations in several major currencies, and other CCPs would use repo lines provided by central banks. In addition, some CCPs would need to be required to restructure the amounts required of members in each currency to meet their obligations on time.

Finally, the results of the concentration risk tests showed that concentrated positions pose a significant risk for two of the 16 CCPs, for which 80% of the default fund contributions are

3 One of the main changes was the use of information for two specific dates. Previous exercises were limited to one day of information.

4 An additional change in this fourth exercise refers to the granularity of the information. Accordingly, the exercises were applied not only to the clearing members but also to the account structures.

provided by three members. With respect to the concentration of liquid resources, three CCPs were found to be highly concentrated in their main liquidity provider.

3. Experience with Stress Testing the CCPs in England

In recent years, the Bank of England (BE) has been very much involved in the development of an international framework for SST of UK CCPs. Accordingly, it issued a discussion paper to gather the necessary information to develop a public framework for doing supervisory stress testing (BE, 2021). In October 2021, the Bank of England launched its first public supervisory stress test of CCPs.

The 2021-2022 stress test will explore the credit and liquidity resilience of the entire CCP system in the UK. The findings of the stress test will be used, together with comments on the discussion paper, to help develop and refine the SST regime. On the one hand, it will test whether CCP resources withstand a combination of market stress scenarios and clearing member defaults. On the other hand, it will validate the ability of CCPs to meet all liquidity requirements in the face of scenarios involving simultaneous market stress and default by its major clearing members and several service providers.

Both components will include an assessment of the additional costs associated with liquidating concentrated positions in stressed markets and for short periods. In addition, reverse stress tests [5] will be used to analyze the impact of severe scenarios with respect to market stress, concentration costs, and the number of defaulters CCPs would be able to withstand, and to determine under what circumstance CCPs' resources would be depleted.

The Bank of England expects to publish the results of the stress test in mid-2022.

4. The Stress Testing Experience for CCPs in the United States

The Commodity Futures Trading Commission (CFTC) is the financial authority in charge of overseeing CCPs in the United States that clear and settle commodity derivatives. The CFTC has conducted three CCP stress testing exercises to validate the adequacy of prefunded resources available to cover closing out positions in the event of member defaults and market stress scenarios that exceed the CCP's estimates.

The first report was published in November 2016, with results and an analysis of the impact to the system resulting from stressed market conditions and default by some clearing members in several CCPs. The tests focused on simulating default by those members with positions in more than one CCP, and the market stress conditions were based on extreme, but plausible, hypothetical scenarios. Overall, the CCPs were found to have the financial resources to withstand extreme market price movements across a wide range of products for the selected date.

In October 2017, the second stress test was conducted with an additional component to the first; that is, it also tested the capacity of available liquid financial resources. Specifically, it assessed how CCPs would obtain the necessary funds in time to honor obligations resulting from the settlement of positions in the face of simultaneous default by the two largest clearing members, and whether the need would arise for multiple CCPs to generate a demand for the same sources of liquidity, which could have systemic implications. It was found that CCPs used a wide variety of sources to fund their liquidity needs, and that there was no significant concentration in these sources. This mitigates systemic risk concerns.

The report on the results of the third test was released in April 2019. The test included two additional sections to those mentioned in the previous tests. The first involved the addition of a reverse stress test of CCP resources and an analysis of stressed costs because of settling positions. The reverse stress test identified potentially extreme scenarios for exhausting all prefunded resources available to the CCPs. The analysis of costs in settlement was structured to assess whether the CCPs had sufficient resources to meet both the obligations of

5 The process of identifying the point at which a CCP's risk management model or security-ring scheme becomes vulnerable; e.g., identifying the scenario in which available financial resources are exhausted.

a member default and an extreme shift in the market. Additionally, it was assumed that costs in the sale or auction of defaulted members' positions would be higher than the CCPs expected.

The results of the reverse stress tests showed the two CCPs included in the exercise had enough prefunded resources to cover losses in the selected scenarios. In other words, the sum of the shortfalls of all clearing members with exposure arising from these price shifts did not exceed the prefunded resources, including those that are mutualized. Additional resources would be required only in the scenario where price changes were more than 200% of the changes estimated by the CCPs. The results of the stressed settlement cost test showed the CCPs had sufficient liquid prefunded resources to cover the aggregate market and settlement costs for each defaulted member account.

5. Stress Tests Done by the Authorities in Colombia

In Colombia there is a central counterparty, the Cámara de Riesgo Central de Contraparte de Colombia S. A. (CRCC), which is supervised by the SFC. The latter has conducted periodic exercises to measure the CRCC's resilience in terms of credit and liquidity risks. The SFC assesses the capacity of the risk management model to address potential defaults by clearing members in the event of market stress. To do so, it provides the CRCC with six simulated stress scenarios from which the entity estimates the amount of the margin calls for each clearing member. Subsequently, the SFC incorporates these results in the regulatory liquidity metrics of each entity, as a cash flow to assess the sufficiency of the members' liquid resources. Finally, in the event of a hypothetical short-term liquidity mismatch in any member, the CRCC quantifies the impact on its risk model and evaluates its sufficiency to respond to severe market stress scenarios.

On the other hand, *Banco de la República* monitors the financial risks associated with the clearing and settlement of transactions managed by the CRCC, with a focus on identifying events with systemic implications. Accordingly, it conducts bimonthly reverse stress testing exercises to validate the adequacy of the CRCC's prefunded resources in the event of simultaneous default by its two main clearing members. Additionally, using extreme market scenarios superior to those employed by the CRCC, it determines in what situation or circumstance the prefunded resources and the recovery mechanisms available to the CRCC would be depleted. The last exercises done in 2021 showed the CRCC has sufficient prefunded resources to contend with simultaneous default by its two main clearing members, and that additional resources would be necessary only in the scenario where price variations were greater than 150% of the variations estimated by the CRCC.

For its part, the CRCC directly performs stress testing exercises on credit and liquidity risks. On the one hand, it validates the adequacy of prefunded resources in the face of multiple scenarios of market price volatility for each group of cleared products (segments). It also does reverse stress tests to determine the number of members that would have to default simultaneously for the prefunded financial resources to be exhausted. These tests are intended to validate the coverage of the two main members. Moreover, the CRCC assesses its liquidity needs daily by stressing the value of daily movements of cash by the two largest members and contrasting them with available liquid resources and credit lines.

6. Closing Comments

In conclusion, the preponderant role CCPs play in the post-trade activities of financial market operations and their contribution to risk mitigation oblige multilateral organizations that promote initiatives and tools to strengthen the financial stability of countries, as well as the authorities charged with supervising and monitoring financial infrastructures, to validate the resilience of CCPs in the face of extreme market scenarios and default by their main clearing members. Given the experience described above, the design, structure and scope of stress tests will depend largely on factors such as the complexity of the relationships these infrastructures have with each other, the concentration of risks in a few members, and the coincident participation of the same clearing members and related service providers.

Generally speaking, the stress tests done by the authorities emphasize evaluating the structure of the security-ring scheme, the adequacy of prefunded financial resources and the existence of mechanisms for recovering these resources. They also center on the existence of multiple sources of liquidity that allow CCPs to cover potential extreme liquidity needs. Finally, in their most recent tests, the authorities have focused their efforts on assessing the risks associated with exposure being concentrated in a few members and lines of credit being concentrated in a few liquidity providers, in addition to analyzing the potential operational effects of failure on the part of critical service providers. Due to the momentum in the markets and the products that CCPs clear and settle, it is important to regularly adjust the scenarios being assessed and to consider stress tests on additional risks.

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