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CCP initial margin models in Europe

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Contents

Abstract

In this paper we aim to provide a holistic understanding of the Initial Margin (IM) models used by Central Counterparties (CCPs) in Europe. In addition to discussing their relevance in terms of CCP risk management and their importance for the functioning of financial markets, we provide an overview of the main modelling frameworks used, including Standard Portfolio Analysis of Risk (SPAN) and Value at Risk (VaR) models.

By leveraging on publicly available data, we provide an up-to-date picture of current modelling practices for specific cleared product classes, as well as various trends in IM modelling practices in Europe. We show how IM model frameworks vary materially, depending on the CCP's past choices and the products it clears. Despite a propensity to switch to VaR models, idiosyncrasies and differences across CCPs are likely to persist.

We conclude by highlighting current and upcoming challenges and risks to CCP IM model frameworks and linking the current status quo with ongoing and upcoming regulatory work at European and international level.

Key words: Central Counterparties, initial margin models, risk management, model governance and validation.

JEL Codes: G15, G18, G19, G23, G28, G32.

Non-technical summary

The global financial crisis (GFC) of 2007-09 exposed the need for further regulation of derivatives markets causing Central Counterparties (CCPs) to grow in relevance, as regulators required steadily more types of derivatives to be centrally cleared, and market participants moved rapidly to minimise risks.

To function properly and to be able to quantify and assess risks, CCPs rely on complex analytical frameworks, the most prominent of which are perhaps the frameworks used to compute potential future exposure. These models are used to calculate initial margin (IM) requirements, i.e. the collateral amounts required by CCPs to protect themselves against potential future exposure in the event of default by a clearing member.

Given the role of CCPs as systemic risk managers, CCP IM requirements – and the models they rely on – play a central role in reflecting risk levels. This was evidenced in particular by the developments in IM calls during recent episodes of market turmoil such as COVID-19 in early 2020 and the stress observed in the energy markets between the first and third quarter of 2022, which led to liquidity concerns for certain market segments and participants.

This paper provides a holistic understanding of the complex, multi-layered regulatory environment for IM models in Europe, as well as an overview of the numerous modelling choices and variables that can influence IM model outputs, which may explain differences in margining practices and output.

We focus on the two main types of IM model frameworks, namely SPAN[1] and Value at Risk (VaR) models and investigate their respective strengths and weaknesses. While SPAN models require the calculation of intra and inter-product offsets, VaR models calculate margin requirements at portfolio level, already implicitly considering hedging-, diversification- and cross-correlation effects. We review their conceptual structures and risk management characteristics, as well as touching on intrinsic features such as reactiveness to economic cycles. We also shed light on the ongoing trend among CCPs to shift their model frameworks from SPAN to VaR, based on computational and risk management considerations.

To complement theoretical discussions with actual CCP data, we review CCP IM modelling practices in Europe at CCP and clearing service level using publicly available information. Despite some methodological constraints, we have identified a variety of practices, mainly depending on the derivative instrument cleared. While commodities are currently overwhelmingly cleared using SPAN models, interest rate swaps are often cleared via VaR models. For other types of derivatives, modelling practices often depend on the fundamental model framework

[1] Standard Portfolio Analysis of Risk.

choices made at CCP level, i.e. no specific instrument-related considerations are observable.

Modelling choices (in terms of parameters) differ markedly across CCPs, even across CCPs that choose the same IM model framework type. While further alignment could occur over time as market transparency increases, this suggests that despite a general shift towards VaR models, significant diversity in modelling choices and output is likely to persist.

We conclude by elaborating on the aspects needed to safeguard and maintain sound IM modelling practices, also taking into account upcoming challenges.

A **sound understanding of modelling frameworks** (including their respective strengths and weaknesses) not only by the modelling department, but also by the CCPs' Senior Management, is deemed to be crucial for sound risk management.

Considered, prudent modelling choices and internal consistency in this respect are also highly relevant, as this will enable CCPs to optimise and deepen their organisational expertise and reap economies of scale. Furthermore, it reduces the risk, perceived or real, of CCPs engaging in regulatory arbitrage, thereby starting a race to the bottom to compete via required margins.

Strong governance and validation arrangements will become increasingly important as the complexity of cleared products and expectations of market participants, regulators and supervisors increase over time. Finding the right balance between safeguarding CCPs' internal investments in their models and guaranteeing a sufficient degree of transparency to optimise market functioning will be key.

Finally, liquidity strains and difficulties in sourcing sufficient collateral to address increased margin calls, as experienced in practice by counterparties when confronted with large exogenous events (such as COVID-19 or turmoil related to the energy supply and related derivatives), underscore the importance for financial stability of achieving additional transparency and an understanding of CCPs' IM models by clearing members and their clients.

1 Introduction

The GFC of 2007-09 made manifest the interconnectedness of financial institutions and systems across jurisdictions, revealing the need to further enhance coordination, regulation and additional prudential safeguards. In addition to triggering concrete reforms aimed at strengthening and streamlining risk management and governance practices for banks, a considerable effort was made to reduce the opacity and, consequently, the contagion risks stemming from over-the-counter (OTC) derivatives markets in particular.[2] Such measures included the obligation to clear a gradually expanding range of standardised derivatives contracts, increased capital and minimum margin requirements for non-centrally cleared contracts, as well as the mandatory reporting of certain contract types to trade repositories.

Consequently, the role and relevance of CCPs has increased over the past decade, as they have expanded their services to include a growing number of products and trades.[3] While their risks and business/operating models differ fundamentally from those of banks, CCPs have been found to be similarly systemically critical for the performance and functioning of financial markets as well as overall financial stability because of their interlinkages with other crucial financial market players.

This relevance and the need for an effective regulatory framework has been explicitly recognised in all major jurisdictions – in Europe via the European Markets Infrastructure Regulation (EMIR). This led to the implementation of a harmonised set of (minimum) requirements for clearing services providers. In parallel, a wide array of second-line regulatory products (in the form of regulatory technical standards (RTS) and guidelines (GL)) were introduced, as well as a regulation establishing the framework for CCP recovery and resolution, the CCP Recovery and Resolution Regulation (CCPRRR).[4]

Box 1
Further background on CCPs

CCPs are financial market infrastructures which intermediate between counterparties to (derivatives) contracts, becoming the buyer to every seller and the seller to every buyer (thereby "clearing" the respective contract).[5] Consequently, CCPs are instrumental in increasing market

2 See Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories (Text with EEA relevance).

3 See Domanski, Dietrich, Gambacorta, Leonardo and Picillo, Cristina (2015), "Central clearing: trends and current issues" *BIS Quarterly Review*, Bank for International Settlements, December.

4 See Regulation (EU) 2021/23 of the European Parliament and of the Council of 16 December 2020 on a framework for the recovery and resolution of central counterparties and amending Regulations (EU) No 1095/2010, (EU) No 648/2012, (EU) No 600/2014, (EU) No 806/2014 and (EU) 2015/2365 and Directives 2002/47/EC, 2004/25/EC, 2007/36/EC, 2014/59/EU and (EU) 2017/1132 (Text with EEA relevance).

5 See Rehlon, Amandeep and Nixon, Dan (2013), "Central counterparties: What are they, why do they matter and how does the Bank supervise them?", *Bank of England Quarterly Bulletin*, June.

efficiency and decreasing counterparty risks, as if one of the counterparties fails, the other is protected via the default management procedures and resources of the CCP.

Besides reducing counterparty risk, CCPs allow for multilateral netting,[6] which reduces the liquidity needs of market participants and allows liquidity to be allocated more efficiently. More generally, the initial margining of CCPs has become an important determinant of system-wide demand for (and the availability of) safe collateral, in particular high-quality liquid assets (HQLAs).[7]

In the post-GFC reform process, collateral became a core instrument for mitigating counterparty risk, as the GFC had been exacerbated by high bilateral exposures which were not sufficiently collateralised. The list of eligible collateral for posting at CCPs is very restricted (mostly cash and HQLAs), and this, coupled with the increase in cleared transactions, has made collateral requirements a significant determinant of collateral supply and demand.[8]

CCPs clear several types of instruments such as securities, derivatives and secured financial transactions, in addition to exchange-traded instruments (e.g. futures and options) and OTC-traded instruments (e.g. swaps). It is important to mention that EU law establishes the obligation for major financial and non-financial counterparties to clear certain derivatives (e.g. single-currency interest rate swaps (IRSs)[9] in certain denominations) and depending on the amount of transaction traded (the "clearing threshold").

While not directly exposed to market risk via their matched book principle, the CCP operating model is by no means risk free. CCPs are exposed to market risk for the replacement of a position in the event that a member defaults, as well as to other risks such as operational and liquidity risk (Manning and Hughes, 2016).[10] CCPs have always been able to successfully fulfil their role. However, there have been isolated cases in which CCPs and their clearing members have experienced significant losses, (e.g. following the default event at Nasdaq Clearing in September 2018). Similarly, CCPs have on rare occasion failed or defaulted in the past, as reviewed by Bignon and Vuillemey (2020).

In order to ensure their proper functioning and thus the stability of the financial markets, CCPs and regulators have developed a range of tools and minimum requirements to properly manage risks. These risk management tools include margin and collateral requirements, (strict) membership criteria, appropriate governance, risk appetite and stress-testing frameworks, efficient default management processes and pre-funded/committed financial resources (including

6 A CCP's multilateral netting across its clearing members needs to be distinguished from bilateral netting (where a dealer nets with one counterparty across many assets).

7 For a more in-depth discussion of the liquidity implications of initial margins, see ESRB (2020), "Liquidity risks arising from margin calls", June.

8 It remains to be said that traders engaging in bilateral, uncleared transactions are now also more prone to exchange collateral and minimise counterparty credit risk.

9 Further discussion of the interest rate swap market can be found in Babbi et al (2023), "The euro interest rate swap market: Recent trends in trading activity and liquidity", SUERF Policy Brief No 552, March.

10 By contrast, Tucker (2019) argues that a CCP resembles a securities dealer: "A CCP is akin to a securities dealer with a completely matched book that hedges itself against counterparty risk --- the market-risk exposures opened up by a counterparty's default --- via collateral requirements of various kinds."

own resources), such as the default fund, which together would allow a CCP to withstand extreme but plausible events.

CCPs are also inherently reliant on risk models to properly gauge and manage underlying risks. Areas in which CCPs are dependent on models notably include the calculation of margin requirements, default fund contributions and collateral eligibility criteria as well models used to stress test and challenge assumptions.[11] Due to this reliance on models, appropriate CCP model governance frameworks, risk management practices and a sufficient level of transparency are crucial.

In light of the renewed more intense episodes of market volatility observed in recent years,[12] the subset of models subject to further scrutiny includes IM models.[13] Unlike Variation Margin (VM) models, which are applied to evaluate the value of contracts and collect and redistribute VM flows to offset current exposures (which are largely uncontroversial), IM models vary considerably across CCPs and may harbour a considerable amount of model risk.[14]

Box 2
Margining in high volatility episodes: March 2020 and 2022

Since the launch of EMIR, Europe has witnessed two distinct high-stress periods which impacted CCP margining:

- **the volatility period of March 2020** at the onset of COVID-19;[15]
- **the 2022 market stress** caused by Russia's war in Ukraine, which triggered a surge in major commodity prices and caused significant price volatility and subsequent increases in margin requirements.[16]

Both episodes were characterised by:

- **marked asset price movements and increased volatility** causing a flight to safety and dash for cash[17], impacting most prominently equity, credit and interest rate portfolios during the 2020 period, as well as energy and power derivatives markets in the 2022 market stress period;

11 See LCH (2015), "On the Margin – Portfolio Managing at a CCP", August.

12 Initial margins have been subject to material volatility and increases, e.g. IM requirements at ECC, a major European CCP, increased from EUR 5 billion to EUR 50 billion within the time span of 18 months (kindly refer to the CCP's public quantitative disclosures). This prompted material discussions about the drivers of IM models: i.e. market prices ("fundamentals"), modelling aspects or even increased trading positions.

13 See ECB (2021), "Lessons learned from initial margin calls during the March 2020 market turmoil", *Financial Stability Review*, November.

14 While the VM is usually cash, the IM can take other forms, such as HQLAs.

15 For further discussion and analysis of the impact of the uncertainty caused by COVID-19, see European Central Bank, (2021), "Lessons learned from initial margin calls during the March 2020 market turmoil", Financial Stability Review, Frankfurt am Main, November.

16 For further discussion and analysis of the price dynamics and financial stability risks from energy derivatives markets, see European Central Bank, (2022), "Financial stability risks from energy derivatives markets", Financial Stability Review, Frankfurt am Main, November.

17 See the Financial Stability Board's Holistic Review of the March Market Turmoil (2020) for further details.

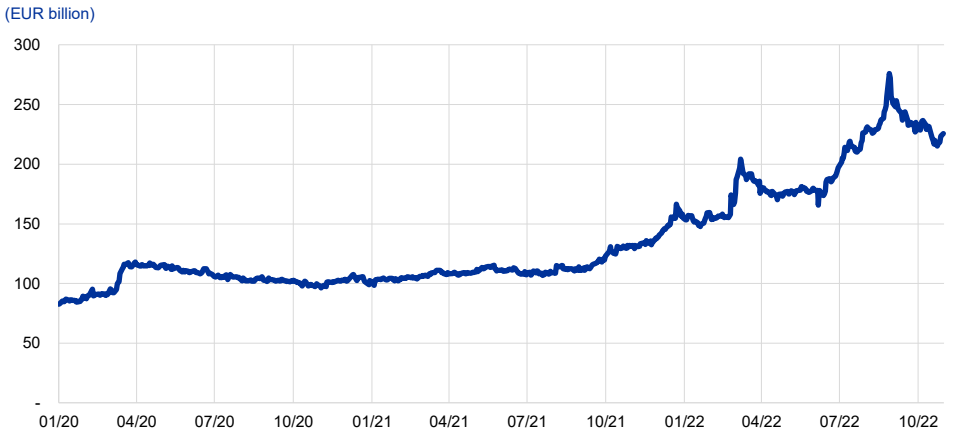
- **massive margin calls by CCPs** as a consequence of the increased volatility and heightened energy prices in the 2022 market stress period;
- **liquidity stress,** especially for non-financial counterparties, as they needed to raise cash rapidly for VM calls and other HQLAs for IM calls.

While these episodes were distinct and affected different market segments, both of them had significant market repercussions and brought the CCPs' (IM) models into the spotlight. Nevertheless, in light of the low incidence of defaults, one can say that CCP risk management frameworks and models have generally worked well, (even though they have been accompanied by fiscal measures and assurances).

Chart 1 clearly shows how IMs posted to CCPs by euro area (EA) clearing members have evolved over time. Since the start of the COVID-19 pandemic and during the summer of 2022, IMs increased by a factor of 5 (see Box 2 below for further details).

Chart 1

IM posted by EU clearing members to CCPs clearing derivatives contracts



Source: EMIR data.

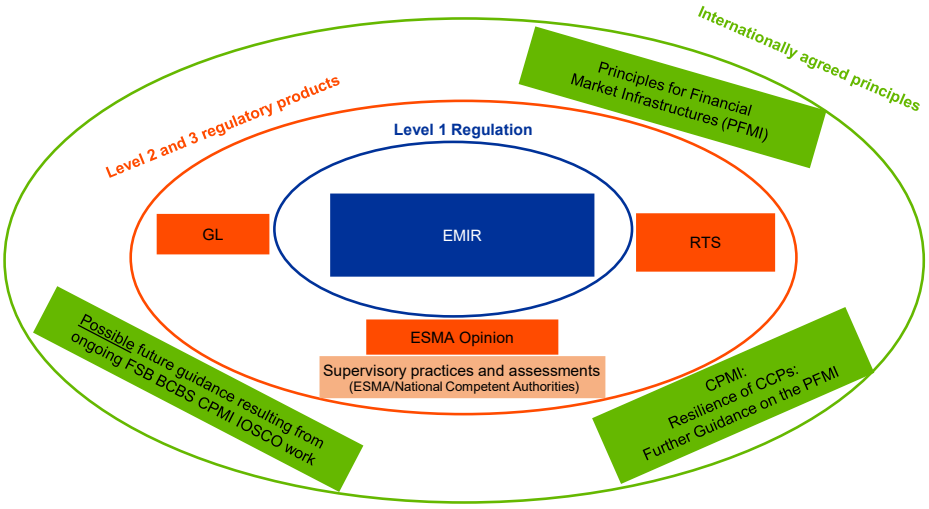
In the remainder of this paper we provide an overview of the IM model landscape of large European CCPs, providing benchmarks, pointing out trends in the evolution of these models and identifying areas where further understanding and work is needed.

2 The European landscape of IM models

IM models are employed by CCPs to derive the appropriate amount of collateral necessary to protect themselves and their members against potential future exposure arising from the default of a clearing member between the moment of the last (VM) margin collection and the moment when the defaulter's positions are liquidated.[18]

The relevance of IM models for proper risk management by CCPs is recognised implicitly and explicitly in EMIR (Article 41 "Margin requirements" of Chapter 3 Prudential Requirements), the corresponding Regulatory Technical Standard (RTS), a Guideline (GL) and an ESMA opinion further specifying the requirements and expectations pertaining to IM models. Additionally, expectations with respect to margin models have been published by the Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (IOSCO).[19] Further work and discussions on margin models are currently ongoing at global and European level[20] to reap the benefits of the lessons learned in past years.

Figure 1
Schematic overview of the European regulatory framework for IM models



Source: Authors' illustration.

In Europe, various CCPs provide clearing services for a wide range of financial products. An overview of the CCPs in which the Eurosystem, as the central bank of

18 Intuitively, the interdependence/co-relationship between IM models on the one hand and VM models and collateral haircut models, for instance, can be clearly gauged.

19 For instance, the Principles for Financial Market Infrastructures (PFMI).

20 These are naturally interrelated. On the one hand, the European regulatory landscape is (also) implementing international agreements and principles. On the other hand, international discussions/principles are also influenced by European experiences.

issue for the euro,[21] is involved in Supervisory Colleges, as well as the respective financial instruments and markets served (including EU CCPs and non-EU CCPs which have systemic relevance for the euro) is provided below.[22]

Table 1

List of Central Counterparties

Country	CCP name	Classes of financial instruments cleared (*) (Over-the-counter = OTC; Regulated markets = RM)	Total margin posted (EUR billion) Q3 2022 (**)
DE	European Commodity Clearing AG	Derivatives: Commodities (OTC and RM), Emission/Climate (OTC and RM), Freight (OTC and RM)	61.01
DE	Eurex Clearing AG	Securities: Equity (OTC and RM), Debt (OTC and RM); Derivatives: Equity (RM), Debt (OTC and RM), Interest Rate (OTC and RM), Inflation Rate (OTC), Currencies (OTC and RM), Commodities (RM), Emission/Climate (RM); Repo: Equity Debt (OTC)	132.53
GR	Athens Exchange Clearing House (ATHEXClear)	Securities: Equity (RM), Debt (RM); Derivatives: Equity (RM), Currencies (RM), Commodities (RM); Securities Lending: Equity Debt (OTC)	0.25
ES	BME Clearing	Securities: Equity (OTC and RM), Debt (OTC and RM); Derivatives: Equity (RM), Debt (RM), Interest Rate (OTC), Currencies (RM), Commodities (OTC and RM); Repo: Equity Debt (OTC and RM)	4.2
FR	LCH SA	Securities: Equity (OTC and RM), Debt (OTC and RM); Derivatives: Equity (RM), Credit (OTC), Currencies (RM), Commodities (RM); Repo: Equity Debt (OTC)	57.98
IT	Cassa di Compensazione e Garanzia S.p.A. (CC&G)[23]	Securities: Equity (OTC and RM), Debt (OTC and RM); Derivatives: Equity (RM), Commodities (RM); Repo: Equity Debt (OTC and RM)	8.39
NL	European Central Counterparty N.V.	Securities: Equity (OTC and RM) Derivatives: Equity (OTC and RM)	1.18
NL	ICE Clear Netherlands B.V	Derivatives: Equity (OTC and RM)	0.00
AT	CCP Austria Abwicklungsstelle für Börsengeschäfte GmbH (CCP.A)	Securities: Equity (RM), Debt (RM)	0.21
PT	OMIClear – C.C., SA	Derivatives: Commodities (OTC and RM)	1.92
SE	Nasdaq Clearing AB	Derivatives: Equity (OTC and RM), Debt (OTC and RM), Interest Rate (OTC and RM), Commodities (OTC and RM), Emission/Climate (OTC and RM); Repo: Equity Debt (OTC)	16.81
UK	ICE Clear Europe Limited (ICE Clear Europe)	Derivatives: Equity (OTC), Debt (OTC), Interest Rate (OTC), Credit (OTC), Currencies (OTC), Commodities (OTC and RM), Emission/Climate (OTC and RM), Freight (OTC)	186.15
UK	LCH Ltd	Securities: Equity (OTC and RM), Debt (OTC and TV); Derivatives: Equity (OTC and RM), Interest Rate (OTC and RM), Inflation Rate (OTC), Currencies (OTC), Repo: Equity Debt (OTC and TV)	274.05

Note: The table is in line with Table 3 of the ECB Eurosystem Oversight Report 2020.
(*) As per ESMA's list of authorised CCPs (excluding non-MiFID assets) and third country CCPs recognised under EMIR.
(**) Total, post haircut IM held at the CCP as per point 6.2.15 of the CPMI-IOSCO – Public quantitative disclosure standards for central counterparties – February 2015.

21 For a detailed overview on the role of the Eurosystem in EMIR and Global Supervisory colleges, see ECB (2021), "Payments and market infrastructure two decades after the start of the European Central Bank".

22 For further information and understanding on the Eurosystem/ECB's involvement in CCP oversight, see European Central Bank (2021), "Eurosystem oversight report 2020", Frankfurt am Main, April.

23 Now called Euronext Clearing.

IM models vary significantly across CCPs. This is a direct consequence of the decision to opt for principles-based requirements[24] **(complemented by a set of specific minimum requirements) instead of opting for a more prescriptive approach.** The underlying rationale here is that CCPs are likely to be in a better position to understand and gauge the risks of the specific products and portfolios that are cleared at their respective venue.

This principles-based approach went hand in hand with the practices employed by CCPs, which implemented similar simple, modelling approaches (such as the SPAN approach which is further discussed and reviewed below) and cleared a relatively limited (and less complex) range of products and financial contracts. Over time, CCPs have started to expand the range of products they clear (moving into fish, timber or crypto-currency derivatives, for instance) and have developed additional modelling approaches, which has raised the need for regulators to provide additional specifications.

Against this backdrop, the recent episodes of financial turmoil, coupled with the existence of differing modelling practices, has raised further awareness of the divergence in outcomes and the performance of the models currently used by CCPs to derive their IM requirements.[25] In Europe, ESMA – as the EU's securities and markets regulator – has launched a consultation on CCP anti-procyclicality measures, mirroring similar efforts at international level.

As mentioned above, IM models currently applied by CCPs can be broadly subdivided into two categories: SPAN and VaR models. While this dichotomy is not absolute and delimitations have weakened over time, it is useful to consider these frameworks separately to fully gauge and understand their impact on IM outcomes across various dimensions. As VaR models have only recently become more popular among CCPs for managing their default risks, we will start with a review of SPAN models, before moving on to these.

Box 3
Variables that matter, and may differ across CCPs

EMIR and related level 2 legislation provide the main requirements that margin models are expected to comply with. Article 41 of EMIR as well as Articles 24 to 28 of the EMIR RTS are relevant as they provide minimum standards and further guidance for CCPs when developing, maintaining and validating their models.

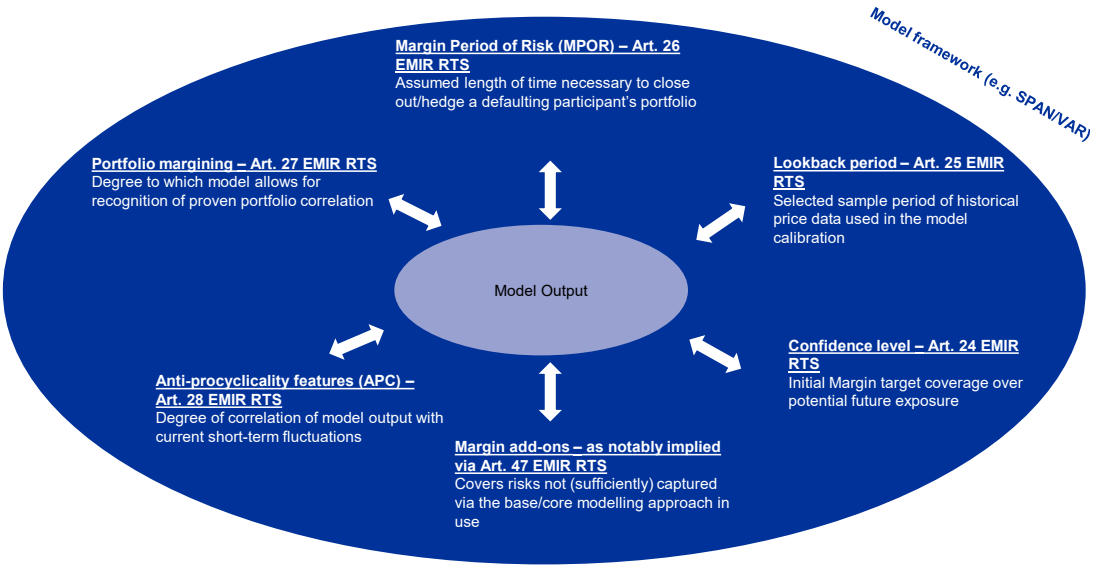
[24] See Carter, Louise and Cole, Duke (2017), "Central Counterparty Margin Frameworks", *RBA Bulletin*, Reserve Bank of Australia, pages 84-94, December.

[25] See Committee on Payments and Market Infrastructures and Board of the International Organization of Securities Commissions (2021), "Consultative Report: Review of Margin Practices", *Bank for International Settlements*, Basel, October.

Aside from the modelling framework itself (SPAN, historical VaR-based frameworks), the parameters establishing the output of the IM requirement calculations are well-known and covered by EMIR and the respective RTS[26].

Figure A

Schematic overview of IM model output determinants



Source: Authors' illustration.

2.1 A conceptual review of SPAN models

SPAN models were first developed in 1988 by the Chicago Mercantile Exchange (CME) to assess risk on an overall portfolio basis.[27] They quickly gained popularity, as they enable easy margin derivations by establishing the maximum potential loss for a portfolio over a predefined close-out horizon. SPAN frameworks simulate how the portfolio's theoretical value would be affected by a limited set (originally 16) of predefined market scenarios. As of today, many CCPs continue to apply the SPAN model framework licensed by CME (or a slightly adapted form of the SPAN framework (i.e. "SPAN-like" models, in light of their conceptual comparability)) to derive margins, especially for exchange-traded (ETD) derivatives.

SPAN frameworks share a range of common features and core methodology, although details differ across CCPs.

1. **SPAN margin models rely on a set of product-specific risk parameters and factors** – most prominently volatility and price level ranges which reflect the underlying products and contracts, and which are set by the CCP risk manager.

[26] Indeed, looking across international practices, CCPs in Europe are subject to more specific requirements through provisions in EMIR and the relevant technical regulatory standards as compared to their peers in other jurisdictions. Nevertheless, CCPs in Europe still retain a large degree of freedom and choice.

[27] See CME Group (2019), "CME SPAN Standard Portfolio Analysis of Risk".

Nowadays, these parameters are often derived via historical VaR models, whose calibration varies depending on the product class and CCP.

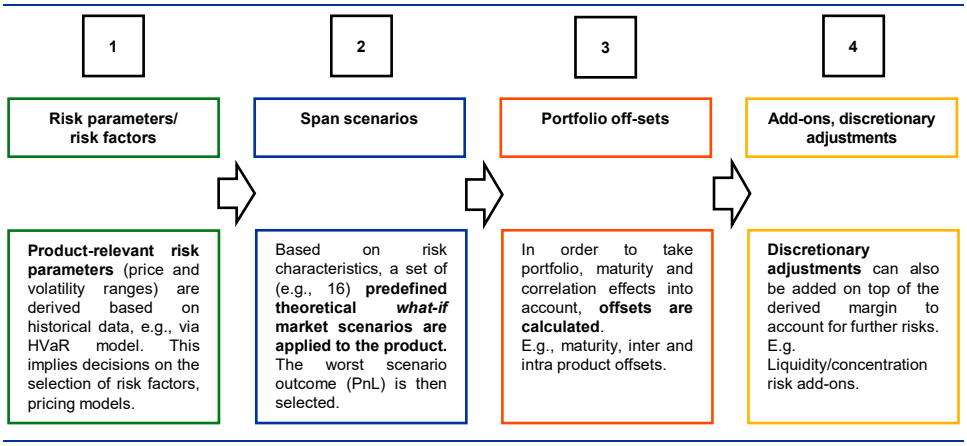
2. **Once risk parameters have been derived and set, a range of predefined "what if" profit and loss scenarios are run.** The outcome of the worst-case scenario is usually then selected to establish the margin[28].

3. **In order to compute margins at portfolio level, product correlations, maturity and other portfolio effects need to be taken into account.**[29] CCPs thus derive inter and intra-product offsets,[30] which lead to increased computational complexity and operational burden as cleared products and portfolios become more complex.

4. **Finally, further discretionary adjustments and add-ons for liquidity or concentration risks,** for instance, that are not captured by the SPAN model, are added to derive the final margin.

Figure 2

A schematic overview of SPAN model frameworks



Source: Authors' illustration, based on publicly available CCP information.

Based on the above, it is easy to discern and appreciate the benefits of the SPAN framework when calculating IMs. Having served as the market standard for a considerable amount of time, the framework is well understood and easily implemented.[31] Conceptually, SPAN models are sound and are able to accommodate a high level of flexibility (e.g. a different number of scenarios, risk parameters, add-ons, etc.). Additionally, the computational complexity of SPAN models is moderate, as the amount of data and simulations applied are limited (CCPs are also free to update parameters at their discretion and calculations may not necessarily be carried out on a daily basis). Were it not for discretionary

28 The scenario selected is the one leading to the worst profit and loss (PnL) figure taking into account the portfolio of relevant contracts.

29 It is important to acknowledge that the consideration of portfolio/correlation effects are capped by EMIR, the EMIR RTS and further discussed in a dedicated opinion.

30 To take correlations into account, they need to be statistically significant and robust(or highly reliable) also under extreme market stress. This is usually done using meta models that are run on a similar lookback period to the one used for the risk parameter derivations.

31 See Mourselas, Costas (2019), "The great migration: CCPs ponder life after Span", August.

measures and add-ons which render the overall picture more complex, SPAN models would also be easily replicable and hence contribute to a more transparent and efficient initial margin landscape in Europe. **Finally, SPAN models are widely recognised and accepted, since they are inherently conservative and seem to lead to more conservative estimates when compared with VaR models for instance.** Given the systemic role of CCPs, the impact and benefit of this conservativeness should not be downplayed.

Despite these benefits, SPAN models come with considerable weaknesses, which have led multiple CCPs, including the inventor of the framework (CME)[32], to gradually shift towards other models. SPAN models rapidly reach their limits for large, more complex portfolios. For instance, the calculation of correlation parameters or intra and inter-product offsets can become highly complex and difficult, and harbour a significant level of model and operational risk, especially when dozens of different products are involved. Furthermore, the discretion available to CCP risk managers is prone to the same weaknesses and could lead to untimely updates.

SPAN model frameworks are further criticised for only considering a limited set of scenarios, which could unduly exclude unforeseen tail events. Naturally, these concerns and criticisms are not new, and CME and other CCPs employing SPAN models have implemented frameworks which can be described as hybrid SPAN models, as they continue to use a limited set of SPAN scenarios but employ different model types (such as VaR models) to derive risk parameters on a daily basis or employ shadow and/or alternative models to challenge and oversee their SPAN model outputs.

Nevertheless, these adjustments are, to a certain extent, piecemeal solutions, which do not entirely address the criticism to which SPAN models are subject (such as the need to derive correlations or offsets in separate, additional steps). This leads us to the other category of IM models frameworks widely used by CCPs.

2.2 A conceptual review of VaR models

Like SPAN models, VaR models have been around since the 1980s and have similarly undergone significant methodological improvements, notably with the introduction of filtered historical VaR models[33] at the end of the 1990s.[34]

VaR can be defined as the loss level that will not be exceeded with a certain confidence level during a certain period of time. Similarly, Expected Shortfall (ES), also called conditional VaR, is a conservative extension of VaR, as it is a

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32 Kindly also refer to CME's announcement on its website: "Launching SPAN 2 Initial Margin Framework in Q3 2023".

33 When replacing SPAN frameworks with other models, CCPs seem to converge towards the use of filtered historical simulation VaR models, which rely on historical returns/sensitivities, but attribute a higher weight to more recent returns, as these are deemed to be more relevant.

34 See Gurrola-Perez, Pedro and Murphy, David (2015), "Working Paper No. 525 Filtered historical simulation Value-at-Risk models and their competitors", *Bank of England*, February.

measure that gives equal weighting to losses at and beyond the VaR point in a distribution (by contrast VaR gives 100% weighting to the VaR point).

VaR is typically calculated by first modelling the entire return distribution for a position or a portfolio, then calculating the value at the percentile corresponding to the desired confidence level. VaR models are not limited by predefined scenarios, but often include a very large number of scenarios and simulations. There are a variety of methodologies to derive the return distribution, which depends on underlying risk factors. Most prominent among these are historical simulations (derived from past history), which are most commonly used by CCPs, parametric simulations (assumed distributions) and Monte Carlo simulations.

VaR is the most widely used metric for market risk and it has been hard-wired in banking regulation[35] since the 1990s. It has recently been extended by ES.

In historical IM VaR models, the margin requirement is calculated by valuing the participant's entire portfolio (as opposed to single products) using historical price movements. The portfolio is valued for each day over a given historical time series, as if the participant's current portfolio had undergone the same price movements that occurred in each period in the past. The IM requirement is set to cover losses up to a certain level implied by the resulting distribution of historical valuations.

As the margin requirement is calculated at portfolio level (rather than for each product individually) and the VaR calculations already allow hedging, diversification and cross-correlation effects, among others, to be accounted for, explicit adjustments to recognise offsets are not required. It is also important to recognise that CCPs may make certain adjustments to the "basic" HVaR model to better capture current market conditions and ensure regulatory compliance.[36]

VaR/ES models therefore have a range of advantageous features which can be best summarised as follows:

- **VaR models rely on minimal expert or management intervention and (potentially) have an intrinsic "auto-updating"** feature based on market volatility which leads to lower operational risk in this respect;
- **A further benefit of (non-parametric) VaR/ES models used by CCPs is that they are not reliant on assumptions,** such as price and volatility distributions, as these are derived from the portfolio's own history;
- **VaR models can be easily understood and communicated to insiders and the market**, as these frameworks are widely used (notably by banks) for risk management purposes;

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35 See the Basel market risk amendment in 1997.

36 Article 27 of the EMIR RTS caps the level of correlation offsets that can be considered for the final portfolio margin output. In order to comply with this regulatory constraint, CCPs might include add-ons or workarounds that provide assurance that the VaR model does not overestimate offsetting benefits.

- **VaR frameworks allow for a direct incorporation of portfolio effects, as VaR simulations allow for integrated portfolio evaluation approaches:** there is no need to separately calculate correlations/relationships between products and maturities, for instance;

- **VaR frameworks allow for significantly more flexibility as there are fewer restrictions on the quantity and quality of scenario simulations.**

Nevertheless, it is important to highlight that while VaR/ES frameworks have a range of benefits, they also come with a set of challenges[37] and deficiencies that need to be considered and addressed:

First, VaR frameworks remain sensitive to their calibration (e.g. lookback period, margin period of risk (MPOR), confidence level, simulation method, ES or VaR model) and hence they need to be accompanied by strong governance frameworks (including a first, second and, possibly, third line of defence). The flexibility and large range of choices are a material (model) risk.

In relation to this, VaR frameworks, which are more "efficient" in that they capture market movements more accurately for a given portfolio, tend to be more risk sensitive and hence reactive to volatility, i.e. prone to procyclical tendencies (see Box 5, which looks into the procyclical features of IM models).

The risk sensitive features mean that VaR frameworks tend to yield lower margin levels in times of stable economic conditions. When CCPs transition to VaR/ES models, a number of add-ons/safeguards are commonly implemented to ensure that IM outputs do not drop excessively. To some extent, this recourse to add-ons or model stabilisers counteracts the theoretical efficiency and transparency brought about by VaR frameworks in the first place.

Box 4
ISDA's Standard Initial Margin Model (SIMM)

In the context of IM models, we also touch briefly on ISDA's SIMM, which has been developed to calculate IMs for non-cleared derivatives contracts. While conceived primarily for non-cleared contracts, the SIMM has also established itself as a benchmark, especially in terms of specific features of margin models such as procyclicality, model governance and transparency.

Although the SIMM derives margins based on a VaR framework/concept, it differs significantly from simulations based on the VaR models commonly applied by CCPs. The SIMM applies a parametric VaR methodology (commonly termed the sensitivities-based approach or delta-gamma-normal approach), which leans considerably on the model applied for the derivation of risk capital in the Fundamental Review of the Trading Book[38].

In simple terms, the SIMM, which assumes a normal distribution of market returns, only requires market participants to input the sensitivities (delta, vega and curvature, also known as "Greeks") of

[37] See Gurrola-Perez, Pedro and Murphy, David (2015), "Filtered historical simulation Value-at-Risk models and their competitors", Bank of England staff working paper 525, February.

[38] See ISDA (2016), "ISDA SIMM: From Principles to Model Specification", March.

predetermined risk factors into a predefined formula provided by ISDA (with differing parameters according to the product category). The model output relies on ISDA centrally providing and publishing correlations and risk weights for various risk factors and product categories.

The advantages and disadvantages of SIMM methodology can be easily identified. On the one hand, the SIMM provides an easily understandable way to derive initial margins, which can also be quickly computed for small market players (the Greeks are the "only" inputs required, no revaluation of the entire portfolio is necessary). Additionally, the SIMM assumptions and methodology are publicly available and largely in line with the methodology applied by banks to derive capital for uncleared OTC derivatives. Furthermore, the SIMM relies on assumptions and simplifications, which have proven to be reliable and sound, especially under normal conditions. Finally, as the SIMM is based on pre-set assumptions, which under normal conditions are updated by ISDA on a yearly/quarterly basis, its output does not exhibit any inherently procyclical features.

On the other hand, the SIMM output is dependent on proper governance and monitoring by ISDA. As many aspects of the methodology are not controlled and monitored by market participants, this could raise governance concerns, especially for larger market players, where more understanding and control over model methodologies is expected. It is also important to reiterate that the SIMM is based on a set of assumptions and approximations that might well be considered an acceptable compromise for uncleared products and smaller market players but might not be optimal for CCPs, where systemic considerations are more prominent.

2.3 Connecting the dots and comparing the frameworks

Our review of the most commonly recurring frameworks in use by CCPs to calculate IMs raises the question of whether a certain type of model framework would be superior and thus preferable. Unsurprisingly, the answer to this question is ambiguous and not clear-cut.

SPAN frameworks have been established for a significant length of time and have performed adequately. Data and computational requirements are limited so long as the products and portfolios cleared are simple. From a systemic and prudential perspective, in times of heightened volatility SPAN frameworks may prove to be an anchor of stability with less reactive, more conservative features, and hence they do not feed into potential procyclical feedback loops to the same extent.

VaR/ES frameworks have a similarly long history in modelling (market risk), as well as a strong track record. Their methodological features are a major benefit when computational constraints are no longer an issue (due to advances in information technology). VaR/ES models provide more direct/risk sensitive outputs for complex products or portfolios, rendering VaR models preferrable in this aspect to certain CCPs.

However, VaR/ES frameworks require proper modelling justifications and governance, as risk sensitivity should not come at the expense of systemic stability and overly low IM model output/procyclical tendencies. Consequently, in addition to

proper model governance, VaR/ES models usually require the use of add-ons and a (more) elaborate anti-procyclicality (APC) policy in order to stabilise the model.

In summary and as observed in the European CCP IM model landscape, the following considerations should be raised.

- **Going forward, SPAN models may be used less frequently but are likely to subsist for simple products at smaller CCPs, which may not see the need or have the resources to transition to VaR/ES frameworks.** The remaining SPAN models in use are likely to undergo further changes and more divergence between CCPs will be observed as they develop their own product-specific (sub) models.
- **VaR/ES models are likely to become the framework of choice for larger CCPs, especially when complex product portfolios are ubiquitous.** Nevertheless, a VaR/ES model monoculture is unlikely to emerge, as model frameworks are likely to differ materially from one CCP to another depending on the products cleared and the respective risks/add-ons and the calibration methodology chosen.

Box 5

Deliberations on APC features for IM models

Having introduced and discussed the main IM model framework from a conceptual standpoint, we now look at a core topic for CCP IM models, which has been under growing scrutiny over the past few years: procyclicality.

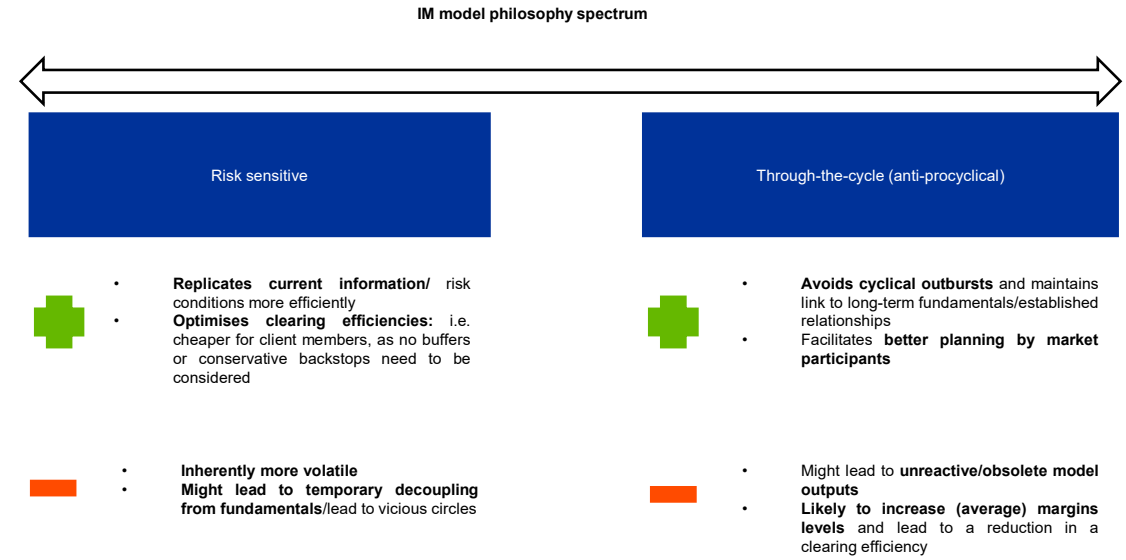
As previously highlighted, IM models are employed by CCPs to derive the appropriate amount of collateral necessary to protect themselves and their members against potential future exposure arising from the default of a clearing member. Consequently, IM models need to gauge market conditions and signals as precisely as possible.

In other words, IM models are expected to be risk sensitive in order to measure potential losses robustly and safeguard the CCP and its members from undue risk. Consequently, IM models often rely on (market/price) volatility as a key input for calculating initial margins. When markets are more volatile (i.e. risks are higher), model variables will react and margins will increase. Similarly, when markets are less volatile and perceived risks are low, the behaviour of margin model variables will trigger decreased margins.

This co-movement between margin model variables/outputs and market movements is commonly known as procyclicality and is of concern when mutually reinforcing dependencies exist and extreme market behaviour is observed. Depending on the parametrisation of the IM model, there is a risk that IM model outputs could lead to excessive margin calls, with systemic repercussions, where already constrained market participants would be required to post large amounts of collateral, making their situation worse. This could result in negative feedback loops and threaten financial stability (see ESRB 2020). Similarly, when markets display long periods of low volatility, there is a risk that the CCPs' IM models will produce excessively low margin requirements, exposing them to undue risks in event of sudden changes in the risk environment.

Figure A

IM model philosophy spectrum



Source: Authors' illustrations.

Ultimately, when deciding on which IM model to apply, there is an unavoidable trade-off between risk sensitivity and anti-procyclical features in order to safeguard the CCPs' collateralisation and systemic stability. This trade-off, which also features in banks' credit risk models, has been formally recognised by EMIR and level 2 regulatory products.

Article 41 of EMIR clearly states that the IM *"shall capture the risk characteristics of the products cleared"*, i.e. it must be risk sensitive.

Furthermore, Article 28 of the EMIR RTS states that CCPs "shall limit procyclicality to the extent that the soundness and financial security of the CCP is not negatively affected. This shall include avoiding when possible disruptive or big step changes in margin requirements and establishing transparent and predictable procedures for adjusting margin requirements in response to changing market conditions".

EMIR puts forward three options for CCPs to reduce the procyclicality of their IM models:

- charging a 25% margin buffer on top of the IM computed by the CCP, which can be exhausted to absorb unexpected increases in the computed IMs;
- assigning a 25% weight to stressed observations in the lookback period;
- ensuring a floor on the margins using a ten-year lookback period.

Similar to the general approach selected for IM models, CCPs are not currently restricted and may opt for any of the three options above. Minimum conditions are provided by the regulatory framework and CCPs are free to optimise their model according to their preferences. Critics have pointed out that this could lead to suboptimal results, as the various options could produce significantly different outcomes. The lack of constraints in the APC tool adds a further source of opacity to CCPs' IM models, in addition to the lack of comparability that already exists given the

various modelling options. This could potentially lead to a situation in which CCPs would opt for the least conservative APC tool, in addition to engaging in regulatory arbitrage and a race to the bottom.

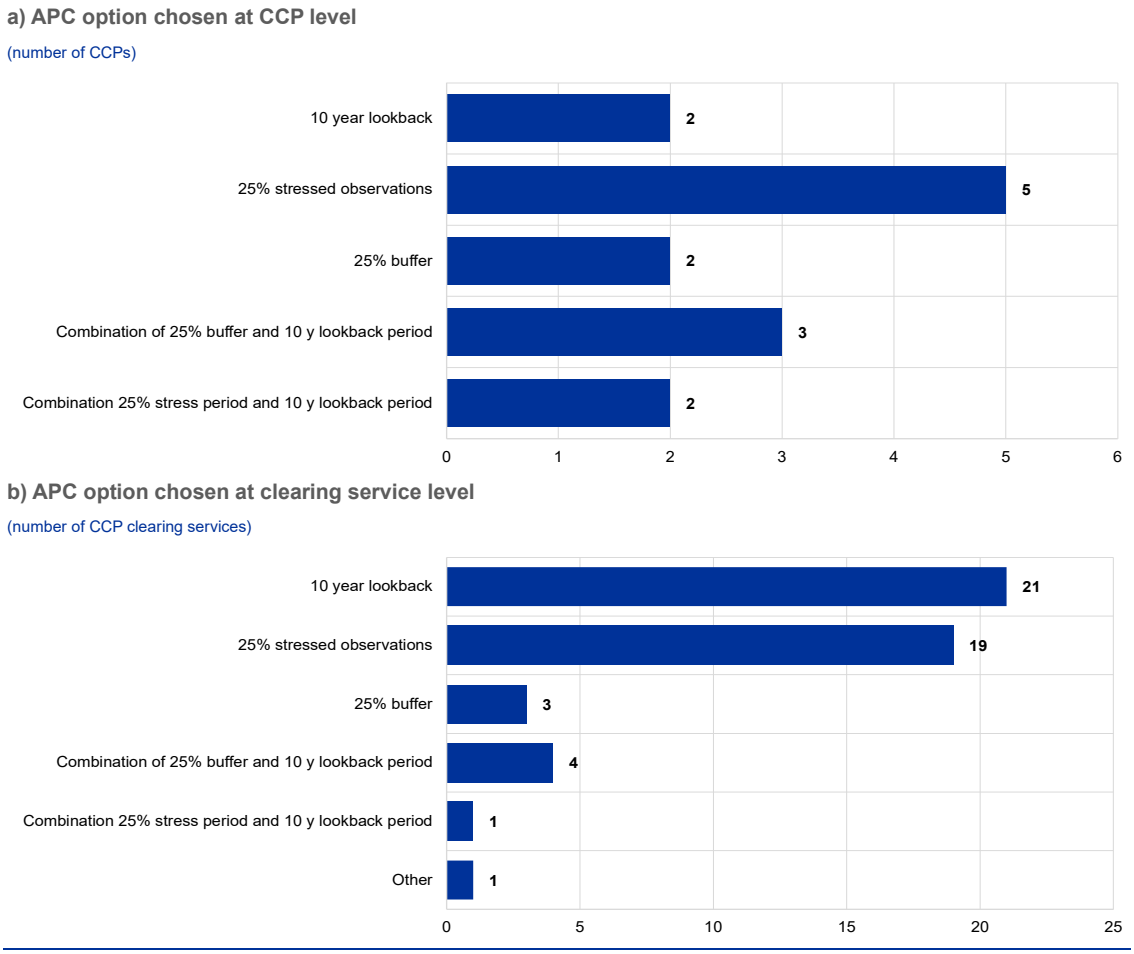
Chart A provides an overview on the distribution of the APC option chosen by the 14 CCPs covered in this paper.

The upper panel of Chart A provides the distribution at CCP level, showing that no single option dominates, as the various CCPs have selected different APC options. 9 CCPs have decided to opt for a general APC option which applies across all clearing services/asset class cleared (for instance, 5 CCPs selected to use assigning a 25% weight to stressed observations in the lookback period). At the same time, 5 CCPs have selected several APC options, depending on the clearing service/asset class – hence opting for one option for one clearing service, whilst opting for another option for another clearing service.

When looking at the lower panel of Chart A, one can see the distribution of the APC options selected at the level of the clearing service/asset class, confirming that no single option dominates.

Chart A

APC option chosen by European CCPs



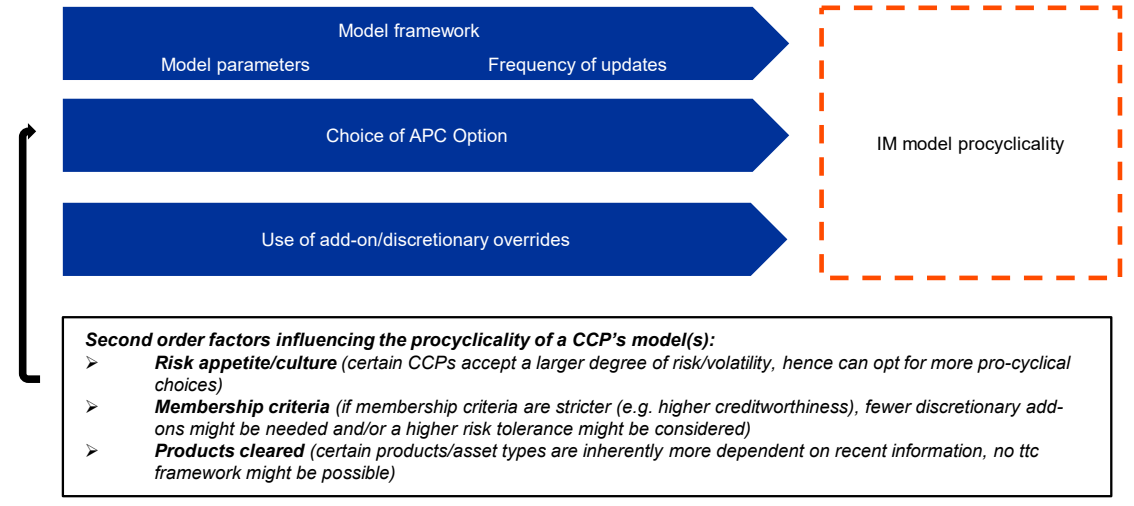
Sources: CCP CPMI-IOSCO Public Quantitative Disclosures, CCP self-assessments against CPMI-IOSCO Principles for Financial Market Infrastructures and other publicly available CCP disclosures.

The systemic relevance of the APC tools has also been recognised over the few past years, as high volatility events have led to considerable increases in margins, straining the resources of market participants and banks. Regulators at both European and global level are currently attempting to derive more concrete guidance and frameworks to ensure that results are more consistent and robust. However, regulators face a difficult task, as procyclicality is not solely dependent on the CCPs' choice of a specific EMIR APC option, but also depends on other factors such as the model type, selected variables or the extent to which the CCP implements add-ons and discretionary overrides.

For instance, VaR/ES-driven models tend to be more prone to procyclicality when compared with SPAN models (or ISDA's SIMM), as they auto-update and thus tend to factor in more new information. This could be particularly apparent when compared with SPAN frameworks, where parameters and scenarios are only updated after concrete intervals (typically on a monthly basis). Similarly, add-ons to a base model to redress model risk and discretionary aspects can lead to additional procyclicality. If a CCP decides to levy a discretionary idiosyncratic margin during a volatile period, this could exacerbate the situation for affected counterparties, clearing members or clients.[39]

Figure B

Schematic overview of factors impacting IM model procyclicality



Source: ECB and authors.

[39] On a related note, since VaR/ES models tend to be more progressive and efficient, they tend to require more add-ons when compared with SPAN-like model frameworks, which are conservative by construction. This could imply that VaR frameworks not only exhibit procyclical tendencies due to their continuous auto-updating features, but also through the use of a range of add-ons to counter model risk due to their calibrations.

2.4 The current IM model landscape for large (European) CCPs

Having introduced and discussed common IM model frameworks, we now delve further into concrete IM modelling practices at large European CCPs.[40] It is crucial to keep in mind here that any such exercise can only deliver a point-in-time picture of the CCP model landscape as this is continuously being updated (in fact, various CCPs are currently transitioning from SPAN to VaR-based models).

As shown in Table 1, a variety of CCPs serve the European financial markets. Some of these CCPs provide clearing services for a larger range of products, while others are more (geographically) specialised. Looking at the broader picture, the largest CCPs in Europe are LCH Limited (dominant in interest rate swaps (IRS)), ICE EU (dominant in credit default swaps (CDS)[41]), LCH SA (dominant in euro-denominated repos) and Eurex (dominant in EA financial futures).[42]

Table 2

Overview of the European model landscape – selected metrics

CCP	Service/Segment/ Products	Model Type	Confidence interval	MPOR	Lookback
Athex Clear	Derivatives	SPAN/SPAN-like	99% for equity derivatives 99.2% for energy derivatives	2 to 4 days	1 year
	Transferable securities	Other	99%	2 to 3 days	1 year
BME Clear	Equity derivatives & IBEX35	SPAN/SPAN-like	99%	2 days	Max (Brexit/10y)
	FX derivatives	VaR/ES	99%	2 days	10 years
	Electricity	SPAN/SPAN-like	99%	2 days	From Jan -17
	Gas	SPAN/SPAN-like	99.50%	5 days	From May-18
	Fixed income securities	SPAN/SPAN-like	99.90%	2 days	10 years
	Swaps segment (IRS)	VaR/ES	99.65%	5 days (prop. account) / 7 days (client)	13 years
	Equities	SPAN/SPAN-like	99%	2 days	Max (Brexit/10y)
CBOE Clear (EuroCCP)	Equity derivatives	VaR/ES	99%	3 days	700 days
	Cash equity instruments	VaR/ES	99%	3 days	700 days
CCPA	Cash market products (essentially equity)	Other	99%	3 days	Between 1 year and 600 days
	Electricity	Other	99%	3 days	1 year
ECC	Derivatives	SPAN/SPAN-like	99%	2 days for most instruments 3 days for freight products	1 year (255 days)

40 When constructing the CCP sample to be analysed, it seemed appropriate to select the 14 CCPs that are currently in scope for Eurosystem oversight.

41 For single-name CDSs, there is a higher rate of central clearing than mandated (cf. Pelizzon et al, 2018).

42 See Murphy (2020) for an analysis of the distribution of IMs in an ETD clearing CCP.

CCP	Service/Segment/ Products	Model Type	Confidence interval	MPOR	Lookback
	Spot	Other	99%	N.a.	1 year (255 days)
Eurex	OTC IRS	VaR/ES	99.50%	5 days	3 years, 252 days Stress Periods
	Commodity & precious metal derivatives	VaR/ES	99.00%	3 days	
	Listed equity derivatives	VaR/ES	99.00%	3 days	
	Listed fixed income derivatives	VaR/ES	99.00%	2 days	
	FX derivatives	VaR/ES	99.00%	2 days	
	Corporate bonds	VaR/ES	99.00%	2 days	
	Indices, Crypto derivative, OTC Non-deliverables	VaR/ES	ETD: 99%, OTC: 99.5%	between 2 days - 5 days	1 year EWMA volatility, 10 year minimum margin parameter
	Other instruments (e.g. Equities, Bonds & Repos)	SPAN/SPAN-like	99.00%	2 days	
Euronext (CC&G)	Equity derivatives products & equity cash	SPAN/SPAN-like	99.50%	Equity cash: 1 to 2 days Equity derivatives: 1-3 days	1 year or longer *where available since 1991
	Bonds (for MTS traded sovereign bonds)	VaR/ES	99.5% - 99.8%	5 days	From 2004
	Energy derivatives	SPAN/SPAN-like	99.00%	2 days	1 year
	Wheat derivatives	SPAN/SPAN-like	99.00%	1-3 days	1 year or longer where available
ICEEU	CDS	Other	99.50%	5 days (prop account) / 7 days (client)	250 days/ from Q2:2007
	Energy derivatives	SPAN/SPAN-like	99.00%	1 or 2 days	500 days
	Commodities/softs	SPAN/SPAN-like	99.00%	1 or 2 days	500 days
	Equity derivatives	SPAN/SPAN-like	99.00%	2 days	Maximum of 60, 250 and 525 days
	Interest rates (OIS, bonds)	SPAN/SPAN-like	99.00%	2 days	Maximum of 60, 250 and 525 days
ICENL	Equity derivatives	SPAN/SPAN-like	99.00%	2 days	Maximum of 60, 250 and 525 days
LCH Ltd	Swap clear	VaR/ES	99.70%	5 days for house accounts (7 for client accounts)	10 years
	Listed rates	VaR/ES	99.70%	2 days	5 years
	Forex clear	VaR/ES	99.70%	5 days for house accounts (7 for client accounts)	10 years
	Repo clear	VaR/ES	99.70%	5 days	10 years
	Equity clear	VaR/ES	99.70%	2 to 7 days	4 years
LCH SA	CDS clear	VaR/ES	99.70%	5 days	10 years
	Repo clear	VaR/ES	99.70%	5 days	
	Cash equity (equity clear)	VaR/ES	99.70%	3days	
	Listed derivatives	SPAN/SPAN-like	99.70%	2 days	
	€GC+ (triparty repo)	SPAN/ SPAN-like	99.70%	7 days	

CCP	Service/Segment/ Products	Model Type	Confidence interval	MPOR	Lookback
LME	Commodity (metal) Derivatives	SPAN/SPAN-like	99.00%	2 days	Maximum of 2 and 10 years
Nasdaq Clearing	Equities- OMS-II	SPAN/SPAN-like	99.20%	Between 2 and 5 days	375 days (1.5 days)
	Fixed income - CFM	Other	ETD: 99.2% and OTC:99.5%	Between 2 and 5 days	500 days (2 years)
	Commodities - SPAN	SPAN/SPAN-like	99.20%	Between 2 and 5 days	500 days for vola and 5 years for margin curve shape
OMI Clear	Power	SPAN/SPAN-like	99.00%	2 days	Mix between 1 year and available history
	Natural Gas	SPAN/SPAN-like	99.00%	2 days	

Sources: CCP CPMI-IOSCO Public Quantitative Disclosures, CCP self-assessments against CPMI-IOSCO Principles for Financial Market Infrastructures and other publicly available CCP disclosures.

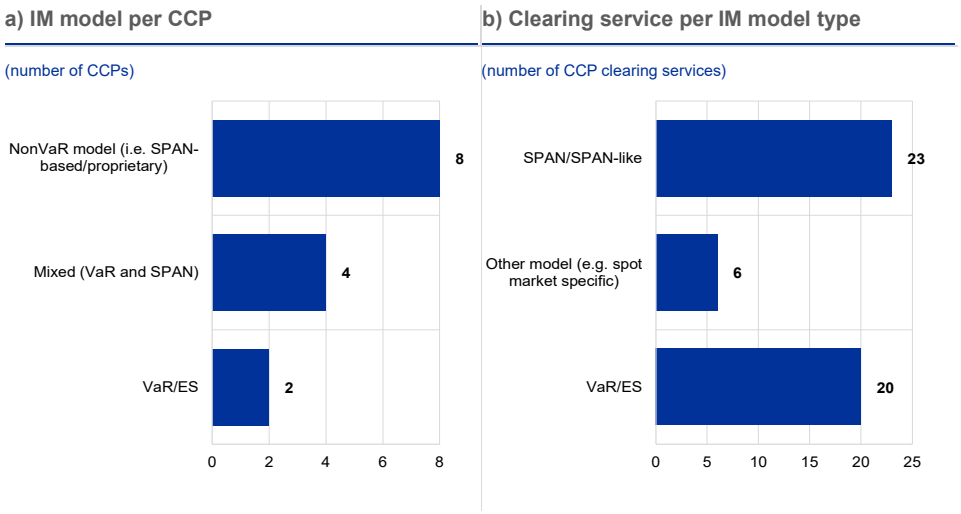
With respect to the IM model frameworks currently in use by CCPs, more than half of the sample employ SPAN methodology or SPAN-linked models (as well as other non-SPAN, proprietary models) in order to compute internal margins across all their clearing services. By contrast, two CCPs rely solely on VaR/ES models to derive their internal margins, while the remaining three CCPs employ both types of models (which vary according to the clearing service or products cleared).

At clearing service level,[43] the picture is more balanced as roughly half of clearing services (23 out of 49) are margined via SPAN/SPAN-linked models, a similar number (20 out of 49) are margined using VaR/ES model frameworks and the remaining six models are margined using other models. This picture can be expected to change going forward, as a range of CCPs have concrete plans to switch their model framework from SPAN to VaR/ES for various clearing services. Chart 2 provides an illustrative picture of the current situation.

[43] Where the term clearing service is in line with Table 2. It is important to mention that clearing services are to some extent a highly imperfect metric, as their definition varies from one CCP to the other. While certain CCPs define their clearing services at sub-product level (gas, gasoline, etc.) other CCPs barely distinguish across asset classes (clearing services encompassing several products). It is important to keep this caveat and source of bias in mind. However, as a minimum level of granularity is provided by every CCP in the sample, we believe that valuable information can still be derived at clearing service level.

Chart 2

IM model distribution according to CCP and clearing service



Sources: CCP CPMI-IOSCO Public Quantitative Disclosures, CCP self-assessments against CPMI-IOSCO Principles for Financial Market Infrastructures and other publicly available CCP disclosures.

In light of the variety of approaches in use across CCPs and clearing services, we have attempted to determine whether the use of a specific model framework depends on the product type cleared. Despite the well-known caveats (model landscapes in transition from SPAN to VaR and variations in the definition of a clearing service across CCPs), we were able to identify different modelling practices in the various product categories.

- **Commodities are generally modelled using SPAN model frameworks, as modelling assumptions do not seem to go beyond what is mandated by EMIR:** frequently, the confidence interval chosen stands at 99% and the MPOR is set to two days[44] with lookback periods mostly on the shorter side[45]. In terms of APC option chosen, there is considerable diversity, with all three options being applied depending on the CCP. Whenever Option C (the ten-year lookback floor) is applied, the effective lookback period for the calibration of margin parameters is considerably longer.

- **By contrast, interest rate derivatives are mostly modelled via VaR/ES model frameworks, although some CCPs still resort to SPAN-like models.** In terms of model parameters, CCPs often go beyond what is mandated by EMIR: confidence intervals applied are often higher (at times exceeding the 99.5% required for OTC). The MPOR applied is highly variable, depending on the CCP. Finally, an application of longer lookbacks and the selection of Option C or B as the preferred APC tool is being observed.

- **Equities are modelled using both SPAN-like frameworks and VaR models, although SPAN-like models predominate** (around two thirds currently use

44 Also depending on product or market-specific liquidity characteristics.

45 It is important to highlight that differences in model parameters are also determined by the derivative/product type, e.g. for OTC products assumptions are likely to be stricter than for ETD products.

SPAN-like models). Compared with commodities, model parameters appear to be more conservative: the MPOR tends to be between two and four days (depending on the CCP and the concrete product), the lookback periods applied seem to be longer and the confidence interval is sometimes higher than the 99% minimum mandated by EMIR. The choice of APC option correlates materially with the lookback period, *i.e.* when longer lookbacks are applied, Option C is generally selected.

- **Repo and FX products are commonly modelled via VaR/ES model frameworks.** For repos, assumptions are in general very conservative, with high confidence intervals, an MPOR of five days and long lookback periods, combined with APC Option C.

- **Finally, certain products such as CDSs or transferable securities are also cleared at European CCPs**. However, besides a tendency towards more conservative parameters, no clear trend could be identified, as a variety of methodologies coexist.

In addition to the similarities and differences in modelling approaches described above, model add-ons are a further area of interest, whereby CCPs resort to a range of add-ons to address model risks and potential areas which are not covered by their base models, irrespective of whether they apply VaR or SPAN-like model frameworks. The most common model add-ons include add-ons for wrong-way risk, add-ons for reduced market liquidity and add-ons for concentrated positions.

It is noticeable that the number and structure of add-ons varies across cleared product categories, and also across CCPs. CCPs diverge in terms of the number and type of add-ons that are deemed to be required to redress model weaknesses. This could be the result of the modelling approach chosen (more conservative parametrisation might well require fewer/lower add-ons), or, alternatively, lower risk awareness. Furthermore, it is apparent that CCPs address certain risks, such as low-liquidity or concentrated positions in different ways. While some deal with these risks by increasing the MPOR, others calculate an additional explicit IM add-on.

It is important to state that the existence of add-ons is not a concern in itself and can be welcome if used to address a shortcoming that cannot be otherwise remedied. However, the existence of add-ons and the inconsistency of their application across CCPs reduces the comparability and transparency of modelling outputs and may be used to hide modelling weaknesses. Additionally, it opens the door to subjectivity if the add-ons are not properly governed and based on expert and managerial judgement.

3 Strong model governance and enhanced transparency as key aspects for sound IM model-related practices

IM model frameworks used in Europe are highly diverse. Despite a shift away from SPAN towards VaR/ES models, full standardisation/comparability of modelling output is unlikely to be the result of this transitory period. As previously highlighted, this is the consequence of the conscious decision to entrust CCPs with a large amount of flexibility, relying on their track record and awareness of risks. Further specifications and regulatory efforts relating to APC tools are unlikely to change this overall flexible approach.

Notwithstanding, a push for stronger industry practices (including governance and validation practices), increased transparency on modelling choices and understandable decision-making pertaining to modelling practices will rank high on the regulatory agenda. While EMIR and the EMIR RTS specify a range of requirements pertaining to organisational,[46] governance and model validation aspects,[47] the level of detail provided is (intentionally) relatively low to allow for sufficient flexibility. While not wishing to paraphrase EMIR or the EMIR RTS, in line with the transition to more refined modelling practices, the points that follow are crucial for safeguarding model output and risk management (see Figure 3 below for a schematic overview).

First and foremost, CCPs are expected to understand the IM models employed, i.e. their respective strengths and weaknesses, notably with respect to underlying model risk. As CCPs update their model frameworks, it will be important to have updated documentation on modelling choices, have the capabilities to perform ongoing monitoring of modelling outputs and engage in comprehensive deliberations on upcoming changes and required modifications. Model risk, especially when stemming from areas which are not covered by currently employed "baseline" [48] models, are likely to be a focal point.

Similarly, CCPs will have to update their modelling techniques, as best practices change and/or they become aware of deficiencies. CCPs are expected to apply a significant degree of conservativeness, when necessary and if there is uncertainty which cannot be otherwise addressed. It is fundamental for CCPs to be able to correctly price and prudently collect margins. Overall, CCPs are expected to anticipate structural breaks and have a playbook/decision-making matrix in place (e.g. via extra add-ons) to enhance their readiness in crisis situations.

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46 Title IV of Chapter 5 of EMIR and Chapter III of the EMIR RTS which discuss organisational requirements.

47 See Article 49 of EMIR and Chapter XII of the EMIR RTS for specifications on the review of models, stress testing and backtesting.

48 In this case, "baseline" refers to models (output) without adjustments or add-ons.

Although CCPs have a degree of freedom when choosing models and parameters, they shall substantiate their modelling choices and be internally consistent. Specifically, this means that wherever feasible, CCPs will opt for a specific methodological approach and apply it across their model landscape (add-on type, risk management approach, etc.). This responds to the need to simplify and align decision-making and reduce the risk of regulatory arbitrage and excessive discretionary decisions.

Consistency is key also to establishing clear decision-making procedures, thus facilitating the implementation of proper governance. When opting for a certain methodological choice, CCPs will ideally implement a cost-benefit analysis of the various available methodological choices and provide reasoning and evidence for their choice (e.g. via an initial validation). A degree of discretion (e.g. discretionary margin increases for single counterparties based on emergency situations/*ad hoc* assessments) may be allowed but should be substantiated and documented, and such action should always be an exception.

In addition to sufficient model risk awareness and consistency with respect to modelling choices, CCPs shall maintain solid and rigorous governance and validation mechanisms, which are ideally risk-based and go beyond the regulatory minimum. Areas of relevance are model ownership, senior management involvement and awareness. As CCP model frameworks are updated, ascertaining proper staffing and available internal expertise are key points worth mentioning.

It is important that CCPs maintain systemic rigorous validation follow-up mechanisms for both comprehensive and risk-based validation mandates (to a certain extent involving the Internal Audit function) to empower the validation function. This function shall not report to the model development function but have direct access to senior management (e.g. the CRO). In addition to being comprehensive, CCP validations shall be risk-based, in order to build up expertise and maintain organisational relevance. For instance, if a CCP decides to outsource the validation of its IM model, it must remain closely involved in the process.

The CCP, which is responsible for proper validation and model performance, must review and challenge the quality of the validation performed by the external validator. To do this, it is important that the CCP maintains and continues to work on a model validation concept with clear and predefined expectations (including a holistic list of the minimum quantitative and qualitative tests to be performed) and sufficient internal expertise to discuss, review and implement validation results and follow-up actions.

It has become clear that additional efforts are needed to provide further transparency to market participants (clearing members and clients) about CCPs' IM models[49]**.** The need to acknowledge and protect CCPs' investments in their proprietary IM model methodology needs to be carefully counterbalanced by considerations pertaining to market functioning and financial stability.

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[49] See BCBS-IOSCO (2022), "Review of margining practices- Thematic summary of feedback", September.

For the sake of clarity, it is necessary to further distinguish between (i) clearing members, who have wider access to CCPs' methodologies and often are involved in their governance and therefore their respective modelling choices, **and (ii) the clients of these clearing members**, who may not have access to the same level of information and foresight.

Certain counterparties seem to have been insufficiently prepared for sudden margin spikes and have struggled to source sufficient collateral in the required time, which also raises liquidity concerns for some sectors. This was especially true during the recent turmoil affecting the energy derivative markets, where fiscal and regulatory measures had to be taken to support large energy companies which struggled to source sufficient collateral.

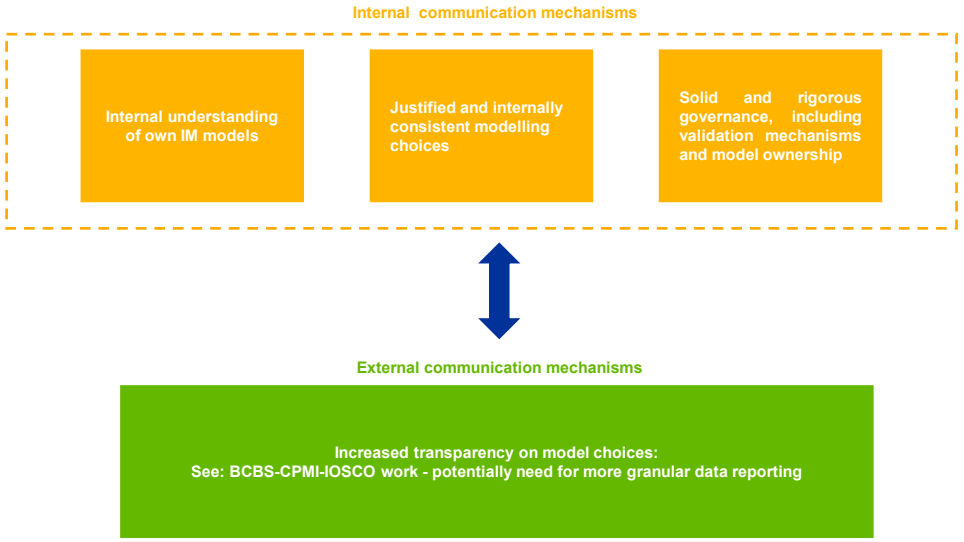
While the recent volatility episodes were driven by largely exogenous and unforeseeable events, less procyclical models and, most importantly, a better understanding of margin models by market participants could have smoothed over the situation and muted the liquidity strain, thus alleviating concerns over the difficulties facing energy derivatives traders being passed on to financial institutions, which finance such companies.

It is important to highlight that a range of international work streams (BCBS-CPMI-IOSCO, 2021) are currently ongoing with the aim of providing further guidance and clarity by establish greater transparency moving forward (e.g. through the publication of additional material, data and validation reporting). Additionally, ESMA has held a public consultation on its review of the EMIR RTS with respect to procyclicality of margin[50]. The outcome of this work will be crucial to establish further clarity for IM models and thus the financial markets.

[50] See ESMA (2022), "Consultation Paper Review of RTS No 153/2013 with respect to procyclicality of margin", January.

Figure 3

A schematic overview of focus areas for sound IM modelling practices



Source: Authors' illustration.

4 Conclusion

In this paper we have endeavoured to provide a comprehensive overview of the relevance and main driving factors of the IM models used by CCPs in Europe. More concretely, we would like to put forward the following key conclusions.

Current CCP IM model frameworks vary substantially, depending on the CCP's past choices and the products which it clears. Nevertheless, and given the large amount of freedom that CCPs enjoy to choose their framework independently according to their risk appetite policy, certain trends can be observed such as the clear movement across multiple CCPs to transition from SPAN modelling frameworks to more flexible VaR frameworks.

We also observe that CCPs are continuously updating and improving their modelling frameworks based on the lessons they have learned and supervisory/regulatory requests in this area. Nevertheless, models are likely to retain significant idiosyncratic components.

Aside from changes pertaining to model design and model development, it is clear that questions related to model governance, internal risk management frameworks and communication with market participants will play a prominent role in the future.

In regard to upcoming international work and potential future research, we consider market transparency to be a key issue. In light of industry complaints that CCPs' models are not sufficiently understood, especially by smaller banks accessing clearing platforms through larger clearing members, we consider that it is important to carry out further research and analysis.

To conclude on a related note, further work on the role of increasing concentration risk in CCPs' models would be warranted, in light of the trend observed in Europe where often only large financial institutions are allowed to clear directly through CCPs. This further questions whether CCPs have sufficient understanding of who the ultimate clients are and whether risk management mechanisms may have to adapt, as they ultimately have a range of implications for the clearing universe.

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