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EMIR Anti-Procyclicality Margin Measures for Central Counterparties

Rita Barley Paes de Sande e Castro

MSc in Mathematical Finance - 2022

Dissertation supervised by: Professora Doutora Diana Mendes

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Resumo

Contrapartes Centrais - CCP's- têm estado no centro do Sistema Financeiro há vários anos. As Contrapartes Centrais são parte do Sistema de Infraestrutura dos Mercados Financeiros. O seu papel principal é garantir que contrapartes possam trocar dinheiro e títulos financeiros. *"Estes Sistemas de Infraestrutura de Mercados Financeiros são um conjunto de regras, processos e organização operacional, reduzindo e alocando os riscos inerentes às transações financeiras entre participantes do mercado."* [**3**]

O principal objetivo das Contrapartes Centrais, também chamado CCP's, é manter a eficiência e credibilidade do mercado. As Contrapartes Centrais são compostas por um conjunto de Membros. Estes Membros têm os seus clientes com quem há intermediação de transações. As CCP's distinguem-nas por diferentes tipos de contas (contas de Casa ou Cliente). Não só as contas são diferentes, mas também as suas responsabilidades. As CCP's enfrentam o risco dos Membros, mas não dos seus clientes, portanto, os contratos são definidos entre Membros e a Contraparte Central.

As Contrapartes Centrais regem-se por um conjunto de regras, que todos os participantes devem cumprir. Há depósitos de dinheiro mínimos, Margens Iniciais, Margens Variáveis, Margens adicionais e contribuições para o fundo de incumprimento. Estas contribuições feitas em dinheiro protegem a da Contraparte Central. Este esquema implica que todas as partes têm uma parcela dos seus ativos em risco. Este é o melhor incentivo para que todos os participantes cumpram as regras estabelecidas.

Para que as Contrapartes Centrais estejam protegidas de possíveis falências as contribuições acimas mencionadas são requeridas. Estas contribuições são estabelecidas num *"Rule Book"*, documentos relativos à metodologia de margens, *"Principles for Financial Market Infrastructure Disclosure"* (PFMI) e por fim *"Quantitative Disclosure"* é requerido pelo *European Securities and Markets Authority"* (ESMA). As contribuições seguem certas metodologias e parâmetros.

As metodologias das margens utilizadas por diferentes Contrapartes Centrais podem ser diferentes consoante o tipo de produtos e a sofisticação e pre-disposição para investir em gestão de risco. Para que haja alguma estandardização das Contrapartes Centrais,

há valores mínimos de Value-at-Risk para cada produto determinados pela ESMA. Adicionalmente, diretrizes de anti-prociclicalidade estão definidas.

O objetivo desta dissertação é analisar a importância de diferentes metodologias de margens usadas pelas Contrapartes Centrais e verificar a sua eficácia para evitar prociclicalidade.

Palavras-chave: Contrapartes Centrais, Membros de Contrapartes Centrais, Margem Inicial, Margem Variável, Margem Adicional, Fundo de Incumprimento, ativos em risco, Rule Book, "Principles for Financial Market Infrastructure Disclosure (PFMI)", Relatório Quantitativo, European Securities and Markets Authority (ESMA), prociclicalidade.

Abstract

Central Counterparties - CCP's - have been at the the heart of Financial system for several years. The CCP's are part of the Market Infrastructure system. Their core role is to ensure that counterparties can exchange cash and securities. *"These market infrastructures are sets of rules, processes and operational arrangements managing, reducing and allocating the inherent risks arising from transactions between market participants."* [**3**]

The focus of the Central Counterparties, also known as CCP's is to maintain market efficiency and credibility. The Central Counterparties are composed by a group of Clearing Members. These Clearing Members then have their own clients to intermediate the transactions with. CCP's distinguish them by different account type (House account and Client account). Not only the accounts are different but so are the responsibilities. The CCP only faces its Clearing Members risk and not their Clearing Members clients, hence a contract is only established with the Clearing Member.

Central Counterparties have a set of rules that must be followed by every participants. There are minimum cash deposits, Initial Margins, Variation Margins, Additional Margins and Default Fund contributions. These contributions are layers of cash in order to protect the Central Counterparty system. This means that all parties have a skin-in-the-game, a share at stake. This is the best incentive for all participants to play by the rules.

In order for Central Counterparties to be protected from possible defaults the above contributions are requested. These contributions are established by a "Rule book", Margin Methodology documents, Principles for Financial Market Infrastructure Disclosure (PFMI) and at least a quarterly Quantitative Disclosure is required by European Securities and Markets Authority (ESMA). The contributions follow specific margin methodologies and parameters.

The margin methodologies used by different CCP's might differ according to the type of products and the CCP's sophistication and willingness to invest in risk management. Aiming to achieve some standardisation within the Clearing Counterparties, there is a minimum Value-at-Risk for each product determined by ESMA. In addition, guidelines on anti-procyclicality measures are defined.

The purpose of this dissertation is to assess the importance of different margin methodologies used by Clearing Counterparties concerning anti-procyclicality measures and their effectiveness.

Keywords: Central Counterparties, Clearing Members, Initial Margin, Variation Margin, Additional Margin, Default Fund, skin-in-the-game, Rule Book, Principles for Financial Market Infrastructure Disclosure (PFMI), Quantitative Disclosure, European Securities and Markets Authority (ESMA), procyclicality.

Contents

List of Figures

CHAPTER 1

Introduction

\ Central Counterparties - CCP's - have been at the center of the Financial system for several years. The CCP's are part of the Market Infrastructure system. Their core role is to ensure that counterparties can exchange between themselves cash and securities. *"These market infrastructures are sets of rules, processes and operational arrangements managing, reducing and allocating the inherent risks arising from transactions between market participants."* [**3**]

European Securities and Markets Authority - ESMA - is an independent European Union (EU) Authority that contributes to the stability of the Financial System by enhancing the protection of investors and promoting stable and orderly financial markets.

The purpose of this dissertation is to assess the importance of different margin methodologies used by the Clearing Counterparties in the anti-procyclicality measures and their effectiveness.

There are three anti-procyclical measures presented by European Market Infrastructure regulation- EMIR for Central Counterparties, article 28(1).

- Option a) 25% buffer on top of the Margin Requirements;
- Option b) Incorporating stress observations in the Margin Requirements;
- Option c) 10 year lookback period as a Floor Margin.

For this analysis a Procedure of the Methodology calculation available on BME - Bolsas y Mercados Espanoles - Clearing Circulars have been used. This Spanish Clearing House has five segments for which the margin methodologies are described: Derivatives, Energy, Fixed Income, Swaps and Cash Equities.

In this dissertation the three anti-procyclicality measures will be used for two types of margin methodology computation: Historical Value-at-Risk and a Filtered Historical Simulation.

The dissertation is divided into three parts. The first part is an introduction to the Central Counterparties and existing regulators: their roles and guidelines as far as procyclicality is concerned.

The second part, a detailed explanation of the anti-procyclicality guidelines, possible interpretations and space for improvement as well as an explanation of both margin methodologies: Historical Value-at-Risk and Filtered Historical Simulation with a Exponentially Weighting Moving Average (EWMA) component.

The third part is a practical scheme where a combination of margin methodologies and anti-procyclicality measures are presented.

Lastly, the main conclusions and takeaway of this dissertation are presented.

CHAPTER 2

Central Counterparties and Regulators

2.1. Central Counterparties - CCP's

According to the European Securities and Markets Authority - ESMA, a Central Counterparty interposes itself between counterparties to contracts traded, becoming the buyer to every seller and the seller to every buyer.

The importance of the Central Counterparties in maintaining the stability of financial markets is known. From the regulators point of view it also eases the number of counterparties under their scope, as more trading activity is concentrated in a single counterparty.

According to CFA Institute [**4**] a Clearing Counterparty is responsible for *"settling trading accounts, clearing trades, collecting and maintaining margin monies, regulating delivery, and reporting trading data."*

The Central Counterparty takes the opposite side of the transactions to all trades. In case a Clearing Member wants to buy an option, the counterpart it is facing is the Central Counterparty. Meaning, that the Clearing Member is not directly facing the risk of default of the seller of the option.

For protection of the Central Counterparty, some margins will be requested to all Clearing Members. These margins could be the following:

- Initial Margin: Aims to forecast possible market moves for a certain holding period. These margins can be calculated using a Historical Value-at-Risk, Parametric Value-at-Risk, Filtered Historical Simulation, Expected Shortfall, Monte-Carlo or in-house models. [**2**]
- Variation Margin: Aims to capture the mark-to-market differences, either losses or gains. In case of market losses, the Central Counterparty will request the Clearing Member to pay these losses. In case of gains, the Central Counterparty might pay them back to the Clearing Member or keep them until the maturity of the financial instrument and use them to offset other margin requirements. [**2**]
- Additional Margins: Aim to cover other risks that might not be captured by the Initial Margin. These risks can be:

  - **Credit Risk**, in case a Clearing Member has a poor Rating (either internal or external) the Central Counterparty can decide to charge an extra margin. [**10**]
  - **Sovereign Risk** intends to cover the Clearing Member risk of default being correlated with the Sovereign risk of the country it belongs. [**10**]
  - **Concentration Risk**, which is usually portfolio dependent. In case a Clearing Member has several contracts of the same product the Central Counterparty can decide to charge an extra margin to account for the difficulty in liquidating that position in case of market stress. It is usually dependent on the Open Interest or Average Daily Volume. [**10**]
  - **Liquidity Risk**, is portfolio and market dependent. This margin will cover the bid-ask spread widening. It aims to cover the increase of the liquidation period assumed by the Initial Margin in case of market stress as the bid-ask spread is increasing. There is usually a re-computation of the Initial Margin and the add-on is computed by the difference between these two. As the liquidity and concentration margin are related, meaning the bigger the position usually the longer it takes to liquidate it and the higher the bid-ask spread will be, these margins may be requested together. [**10**]
  - **Wrong-Way Risk Margin** covers the correlation between collateral posted by the Clearing Members and their activity. The Central Counterparty needs to ensure that if a Clearing Member enters in Default the collateral posted does not lose its value. Usually it is forbidden to post collateral issued by the Clearing Members or their subsidiaries.[**10**]
  - **Default Fund (DFAM) or Stress Risk Additional Margin** is used to ensure that the Default Fund size established by the Central Counterparty is respected and the CCP is protected against uncovered losses. Usually this size is determined based on a Cover 1 or Cover 2 approach recommended by regulators, meaning, it should cover the biggest (Cover 1) or two biggest (Cover 2) exposures of the Central Counterparty under stress market conditions. These stress market conditions can be related to the amount of Initial Margin posted by the Clearing Members or the type of portfolio cleared. The reason behind it is that the amount of Initial Margin does not mean that the portfolio under stress conditions will lead to the greatest losses. [**10**]
- Default Fund: This is a mutualised pool of contributions among all Clearing Members and the CCP. If the CCP has several segments or services, these contributions might be segregated by segment. The aim of this Default Fund is to protect the non-defaulting Clearing Members and the Central Counterparty from defaulting. From a Risk perspective it will force all participants to integrate and

supervise an orderly Risk Management, as all participants have a stake at risk. Usually the Default Fund mechanism has three main areas of interest:

- **Size of the Default Fund**, which can be either a Cover 1 or Cover 2 approach. It is translated as the amount of financial resources that the CCP will have available in case a Clearing Member defaults. It can be either the biggest or the two biggest Clearing Members exposure, accounting for a simultaneous default.
- The **allocation key** considers the size of the total default fund and will determine which part will be allocated to each Clearing Member. This can be either a direct proportion of the posted Initial Margin, so the contribution of the Clearing Member over the total contributions of all Clearing Members or based on a Stress Loss over Initial Margin. The Stress Loss over Initial Margin will allocate more resources to the Clearing Member with the greatest losses under stress conditions. Lastly, the CCP can use a combination of these two methods. Allocating a certain percentage on the proportion of Initial Margin and another on the Stress component.
- The **Waterfall mechanism** is established for all CCP's and determines the order in which financial resources will be consumed by the CCP in case of losses from a Defaulting Clearing Member. The structure of the Waterfall scheme usually starts with the consumption of all the collateral posted by the Defaulting Participant. The second layer should be the contribution of the Central Counterparty itself, which is named Skin-in-the-game, only after the contribution of non-defaulting participants. The non-defaulting participants may have to replenish their initial contribution of the Default Fund to secure and ensure the continuity of the Clearing Counterparty. If the resources and replenishment are no longer available, the survival of the Central Counterparty will be at stake.

In case a Clearing Member of a Central Counterparty enters in default or the Central Counterparty itself, there might be substantial destabilizing effects. Not only on the other Clearing Members but also on their clients and might lead to a "domino effect" of financial losses. As most Clearing Members are part of several CCP's.

From a regulator point of view the soundness and robustness of CCPs are, therefore, at the heart of ESMA mission to safeguard financial stability and promote stable and orderly financial markets.

2.2. Regulators

2.2.1. ESMA and EMIR

ESMA stands for European Securities and Markets Authority, which is an independent European Union (EU) Authority that contributes to stability of the Financial System by enhancing the protection of investors and promoting stable and orderly financial markets.[**6**]

The European Markets Infrastructure Regulation (EMIR) has established a set of standardised recommendations to be followed by Central Counterparties. In addition, considering the Covid crisis a CCP Recovery and Resolution Plan (CCP RRR) have been implemented in order to ensure business continuity for clearing services.[**6**]

According to EMIR Paper no.2 [**9**] in order to prevent and control possible procyclical effects, *"margin requirements shall be forward looking, stable and prudent. Furthermore, CCP's shall avoid possible disruptive or big step changes and establish transparent and predictable procedures for adjusting margin requirements in response to changing market conditions."*

One of the main points regulators have been lobbying for is the increase of transparency from the Central Counterparties. This increased transparency allows Clearing Members to, not only, understand when possible sharp moves in the Margin Requirement might arise as well as forecast these moves alongside the Clearing Counterparty. Another beneficial point arising from this transparency is that as the Clearing Members have their skin-in-the-game stake as well will push for Clearing Counterparties to have good Risk measures in place, hence Clearing Members will have the interest to ensuring the Margin Methodologies are well calibrated.

EMIR have established guidelines to ensure that exposures are fully collateralised on a daily basis. The exposures are assessed almost in real time and margins are collected in case pre-defined thresholds are exceeded. In addition, the Regulatory Technical Standards specify that the minimum lookback period to be used shall be at least twelve months and that stressed periods are captured. The coverage level needs to be at least 99.5% for OTC derivatives and 99% for other financial instruments.[**9**]

The chosen lookback period of at least twelve months aims to ensure that seasonality effects are captured and avoids being over-responsive to temporary volatility, as this could amplify the procyclicality effects. The inclusion of stress periods alongside the high confidence level should guarantee that the model will be prepared for future stress events.[**9**]

CHAPTER 3

Anti-procyclicality and Margin Methodologies

3.1. Anti-Procyclicality

Anti-procyclicality measures have been at the heart of Regulators discussions following Covid Financial Crisis.

Procyclicality relates to the high increases and decreases of margin requirements during either high or low volatility in the market. Meaning there is a tendency of margin increase during market stress. It is an issue for Clearing Member to suddenly have a big margin call, as it brings liquidity stress; Especially if the Clearing Member has clients to request these margin calls. Procyclicality relates not only to margin requirements but also to collateral haircuts.[**7**]

In order to avoid these market constraints when volatility strikes and to increase transparency and reduce market risks EMIR published some anti-procyclicality recommendations.[**7**]

- Option a) 25% buffer on top of the Margin Requirements;
- Option b) Incorporating stress observations in the Margin Requirements;
- Option c) 10 year lookback period as a floor.

According to the Guidelines on EMIR Anti-Procyclicality Margin Measures for CCP's the following measures should be taken and specified:

- *The risk appetite for procyclicality of its margins e.g., tolerance threshold for big-stepped margin increases;*
- *The quantitative metrics it uses to assess the procyclicality of its margins;*
- *The frequency at which it conducts the assessment;*
- *The potential actions it could take to address the outcomes of metrics;*
- *The governance arrangements surrounding the reporting of the outcomes of the metrics and approval of actions it proposes to take in relation to the outcomes.*

According to the same Guidelines for each Anti-procyclicality recommendation there should be some measures to be followed by each Clearing Counterparty for each option.

In case the CCP decides to use the 25% buffer for options products, this buffer should be applied to risk factors and not directly to the final Margin requirement.

These three recommendations allow Clearing Counterparties to have a common ground in the anti-procyclicality measures. However, their implementation might diverge significantly.

3.1.1. Option a) Buffer

Adding a 25% buffer on top of core Margin requirements is a common approach. Nevertheless it is not disclosed by EMIR how this buffer should be exhausted during volatile periods. Also, it is not straightforward for a CCP to know when a period can be considered volatile, as such, the implementation of this measure can differ.

It is mentioned in the ESMA Guidelines for Anti-procyclicality [**8**] that, in case there is more than one relevant risk factor, the 25% buffer should be applied at Risk Factor level instead of product level.

3.1.2. Option b) Incorporation of stressed observations

Incorporating stress observations in the margin requirements means that in the historical lookback period used in the Core Initial Margin computation the CCP should choose a certain number of observations representing a stressed period.[**8**] However, not all Clearing Counterparties use the same lookback period, nor the products are the same. In fact the CCP can either choose a fixed period of a certain number of observations and add it to a dynamic window of a lookback period; Let us assume, 50 observations belonging to the 2008 Crisis. Or only use the last 750 observations because a stressed period is already included. Due to these combinations of several options it is most likely that Clearing Counterparties will not apply the recommendation in the same way. Hence obtain different results, meaning different margin charges.

According to EMIR Paper no.2 [**9**] *"no binding rules are provided on how to identify and weight the stress observations to be included in the historical look-back period, especially as this requirement is not directly linked to the provisions detailing the methodology to be used to identify the worst historical events for the stress testing framework. Moreover, if margins are calibrated using longer (than the minimum) historical look-back periods, stress events can be averaged-out."* Supporting the above statement, that the guidelines are subject to interpretation and its applicability may differ from CCP to CCP.

3.1.3. Option c) Margin Floor

The use of a 10 year lookback period as a floor implies the use of both a Core and Floor Initial Margin. There will probably exist two margin methodologies; One of which will have a longer lookback period- Floor- to include more stressed observations and with the same weight, as a Historical Value-at-Risk. The other - Core- will have a shorter lookback period and a more reactive behavior, most likely not all the periods will have the same weight, as a Filtered Historical Simulation for example. The Clearing Counterparty will choose to charge the maximum between the two. In order to ensure a prudent approach.[**8**]

The idea is for the Clearing Counterparty to charge an Initial Margin equal to the Floor during low volatile periods, even if the current market scenario is below this value, to avoid decreasing into too low amounts of Margin Requirements. While the Core Initial Margin should be charged during high volatile periods due to its re-activeness. However, the transition between these two margins will be smooth, as the Floor will never reach minimum levels and the Core will provide more weight to the most recent observations in a smoothly manner, however, this smoothness will depend on the decay factor used.[**8**]

The decay factor or lambda, is one of the parameters used in an Exponentially Weighted Moving Average (EWMA) which is used in a Filtered Historical Simulation methodology. The aim of using the Exponentially Weighted Moving Average is to give

different weights to different observations; Where the most recent ones have a higher weight in case the decay factor is lower than one. The closer to zero, the higher the weight will be given to the recent observations. Hence, a decay factor equal to one will be the same as using an Historical Value-at-Risk, as all periods have the same weight.

3.1.4. Combination of recommendations

As a forth option, which is not detailed as such, there could exist a combination of the above measures. *"In applying the APC margin measures at risk factor level, a CCP may use different APC margin measures for different risk factors or apply the same APC margin measure across all risk factors. If a CCP chooses to use the same APC margin measure across all risk factors, it may do so by applying the measure independently to each risk factor or by using internally consistent scenarios across risk factors."* [**8**]

For the purpose of this dissertation some of these procyclicality recommendations will be tested and evaluated.

3.2. Margin Methodologies

"Margin requirements are calculated to cover at a given confidence level the exposure of the CCP's arising from a default of a clearing participant and include variation margin (current exposure), the initial margin (potential future exposure) and other purpose specific (e.g. credit risk) margin add-ons. Variation margin requirements can be a source of procyclical effects, but will cover the current exposure of the CCP on the basis of realised (mark to market) or theoretical (mark to model) prices and will therefore reduce procyclicality effects on initial margins, as losses in an adverse market environment will be covered gradually over time reducing the potential future exposure and the necessity of excessive initial margin calls."[**9**]

The proposed Margin Methodologies to be discussed and tested in this dissertation are a Historical Value-at-Risk and a Filtered Historical Simulation with an Exponential Weighted Moving Average (EWMA) component.

For both Margin methodologies a certain confidence level and Margin Period of Risk (MPOR) will be assumed, and for the Filtered Historical Simulation with a EWMA component the decay factor is another parameter used. The confidence level will detail, with this certainty level, what is the maximum amount expected to be lost in a given portfolio. The MPOR will dictate the time period in which the expected loss will not be surpassed. Meaning, for the same confidence level, a lower MPOR will most likely represent a lower possible loss.

3.2.1. Historical Value-at-Risk

Value-at-Risk (VaR) is a financial metric that estimates the risk of an investment. VaR is a statistical technique used to measure the amount of potential loss that could happen in an investment portfolio over a specified period of time. A Clearing Counterparty that uses this metric to calculate the Margin Requirement of its Clearing Members aims to cover a possible loss on the portfolio they are clearing on their behalf.

The process to compute the Historical Value-at-Risk used in the next chapter is the following:

(1) Obtain a number of historical observations which are the prices of an underlying financial instrument.
(2) The returns are calculated based on these historical observations. These returns will depend on the chosen Margin Period of Risk and will ignore the same number of observations. The returns are calculated for all periods from t + MPOR until the most recent one.

$$Return = (Price_{t+MPOR} - Price_t)/Price_t \tag{3.1}$$

(3) Once all the Returns are calculated they are ordered.
(4) Depending on the confidence level and whether a two-sided or one-sided tail distribution is chosen the Value-at-Risk is selected.

Most financial instruments will follow a Normal distribution or very similar to it. Where the curve represents the possible Profit and Loss probability density function. The fatter the tails of this distribution, the higher the probability of loss of a certain portfolio.

According to the Corporate Finance Institute - CFI [**5**] the main advantages of this methodology is that it is easy to understand, hence implement and compute; Its applicability, not only can be used for different types of instruments such as equity, debt, derivatives and forex. It can also be used by different entities; and it is accepted by most financial institutions and regulators as a reliable statistical metric, that assumes history will repeat itself. There are, however, some limitations, such as: for large portfolios it will require the calculation of a correlation metric between underlying, the simplicity of its calculation might leave aside possible losses, by using only historical data some outcomes might be being disregarded by the methodology; Lacks re-activeness, as all observations weight the same, stress periods might be diluted in the distribution and lack the necessary weight in the final VaR.

3.2.2. Filtered Historical Simulation

If portfolio volatility were constant over time it could be estimated efficiently with the historical volatility estimator.[**11**] However this is not the case. Volatility is market dependent, it might have some seasonality or history cycles, nevertheless it is not constant.

The Filtered Historical Simulation using an Exponentially Weighted Moving Average - EWMA, could be seen as an upgrade from the simple Historical Value-at-Risk. The main difference here is that there is a scaling parameter given to the returns. This aspect is quite interesting when the objective of the model is to react as soon as market volatility strikes.

The Exponentially Weighted Moving Average introduces the concept of λ or decay factor. This parameter needs to be between zero and one and dictates the intensity or weight that is given to the most recent observations. A decay factor equal to one is the same as having a Historical Simulation. However, a decay factor of 0.94, for example, means that the recent market events will have more weight in the final computation of the Value-at-Risk.

The process to compute this scaling volatility has been adapted from BME Clearing for Interest Rate Swap products [**1**], as follows:

(1) Obtain a number of historical observations which are the prices of an underlying financial instrument.

(2) The returns are calculated based on these historical observations. These returns will depend on the chosen Margin Period of Risk and will ignore the same number of observations. The returns are calculated for all periods from t + MPOR until the most recent one.

$$Return = (Price_{t+MPOR} - Price_t)/Price_t \tag{3.2}$$

(3) Using the returns calculated, the average of these returns is computed.

(4) The difference between the returns of each period and the average is calculated.

(5) For each period, the distance between the return and the average, is squared.

(6) At time 0, the seed is generally defined as the standard deviation using the oldest returns. Usually a burning period is used to compute the EWMA 0, the seed. In the practical case, 60 days have been used.

$$\sigma_{t_0}^{EWMA} = \sqrt{\frac{1}{(n-1)} \sum_{i=1}^{-n} (r_{t_i} - \overline{r})^2} \tag{3.3}$$

(7) The EWMA iterative process is given by:

$$\sigma_{t_i}^{EWMA} = \sqrt{\lambda \sigma_{t_{i-1}}^{EWMA^2} + (1-\lambda)\, r_{t_i}^2} \tag{3.4}$$

The EWMA at time 1 will use the seed, so EWMA 0 from time 0. The return is from that period and λ or decay factor will be chosen from 0 to 1. Where a decay factor of 1 means that all periods have the same weight, and a lower decay factor means more re-activeness from the model.

(8) The unscaled return is calculated based on the ratio between the return of each period and the EWMA Volatility computed as well for each period.

(9) The scaling function is given by the average of the EWMA Volatility of period i and the last EWMA Volatility. The scaled returns are given by multiplying the scaling function by the unscaled returns.

$$\text{Scaled Return} = \frac{(\text{EWMA Volatility}_i + \text{EWMA Volatility}_T)}{2} \times \text{Unscaled Return}_i \tag{3.5}$$

(10) The present value for each period is computed based on the last known price:

$$PV = \text{Price}_T \times (1 + \text{Scaled Return}) \tag{3.6}$$

(11) The differences between the present value and the last known price are calculated for all periods.

(12) Once these differences are calculated, they are ordered.

(13) Depending on the confidence level and whether a two-sided or one sided tail distribution is chosen, the Value-at-Risk is selected.

CHAPTER 4

Practical Case

The data used for these calculations was taken from Bloomberg terminal. Two products were selected for this exercise, COPUSD rate and EUR Overnight Interest Rate Swap.

Considering there are three anti-procyclical measures presented by European Market Infrastructure regulation- EMIR for Central Counterparties.

- 25% buffer on top of the Margin Requirements;
- Incorporating stress observations in the Margin Requirements;
- 10 year lookback period as a floor.

For this dissertation, the three methods will be studied separately at the first stage for Historical Value-at-Risk and Filtered Historical Simulation. Secondly, the last two options of anti-procyclicality will be analysed together: Incorporation of stressed observations and a 10 year lookback period. In order to simplify and leverage from the available data, the stressed observations that will be considered are 2008 crisis for both products, Forex and Overnight Interest Swap.

In addition, an analysis on the impact of the lambda or decay factor of the Exponentially Weighted Moving Average will also be analysed. This analysis will support the argument for minimum standardisation of metrics across Clearing Counterparties and their final impact.

4.1. Returns

The figures 1 and 2 are the plot of the Returns of the two products that will be analysed hereafter: COPUSD Forex Rate and Overnight Interest Swap. COPUSD Forex Rate represents the most volatile product, as its returns can vary between -0.075 and 0.125, while Overnight Interest Swap from -0.004 to 0.004. This value of 0.004 represents an outlier coming from 2020, hence Covid Crisis.

For simplicity purposes the shown results will be for COPUSD Forex rate as for Overnight Interest Rate Swaps the results and hence conclusions are similar.

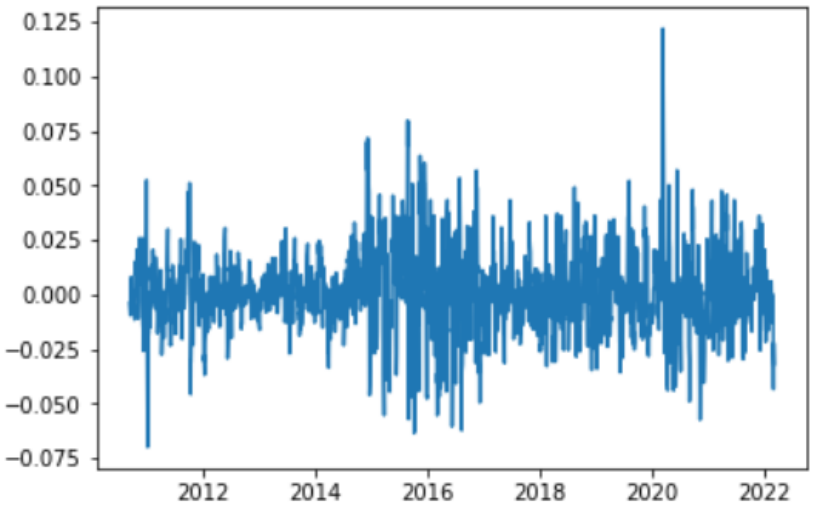

FIGURE 1. Product of COPUSD Forex - Returns calculated for the full length of data available

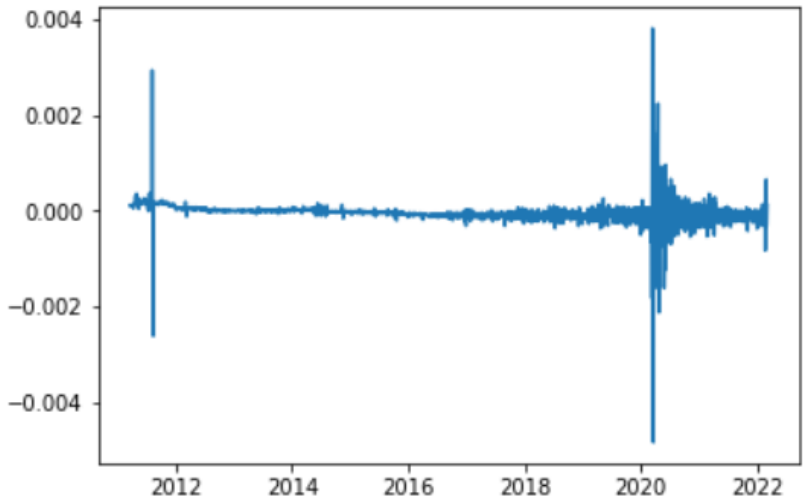

FIGURE 2. Product of Overnight Interest Swap - Returns calculated for the full length of data available

4.2. 25% buffer on top of Margin Requirements

The figure 3 and 4 were obtained by using both a Historical Value-at-Risk and a Filtered Historical Simulation for COPUSD product. For both margin methodologies analysis the lookback periods used are the same. Also, the Model parameters are identical. A confidence level of 99% was used and a Margin Period of Risk of 5 days. The decay factor or lambda of the Filtered Historical Simulation is 0.97.

It can be observed that the measure imposed by European Market Infrastructure Regulation, by itself will not avoid procyclicality unless there is some scheme of exhaustion of the 25% buffer. In other words, if a Clearing Counterparty would only rely on using the 25% buffer on top of the margin requirement there would still be procyclicality, as

the buffer is following the same pattern as the margin itself.

To conclude the analysis of this EMIR option, it is necessary to have concrete measures on how the decrease and increase of the buffer should be done during volatile and non-volatile periods in order to make it effective, independently of the Margin Methodology being used.

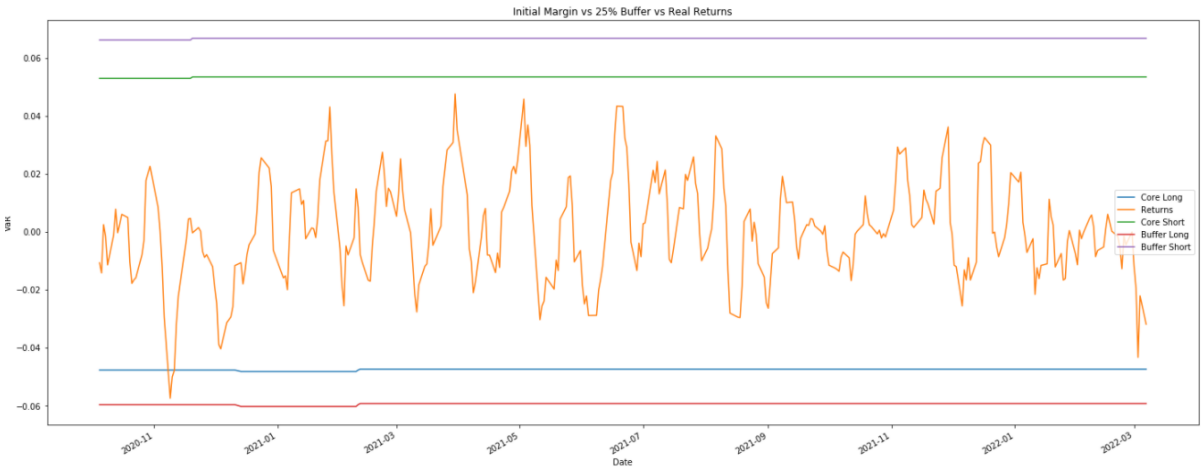

FIGURE 3. COPUSD Forex - Buffer on top of Initial Margin calculated through a Historical VaR

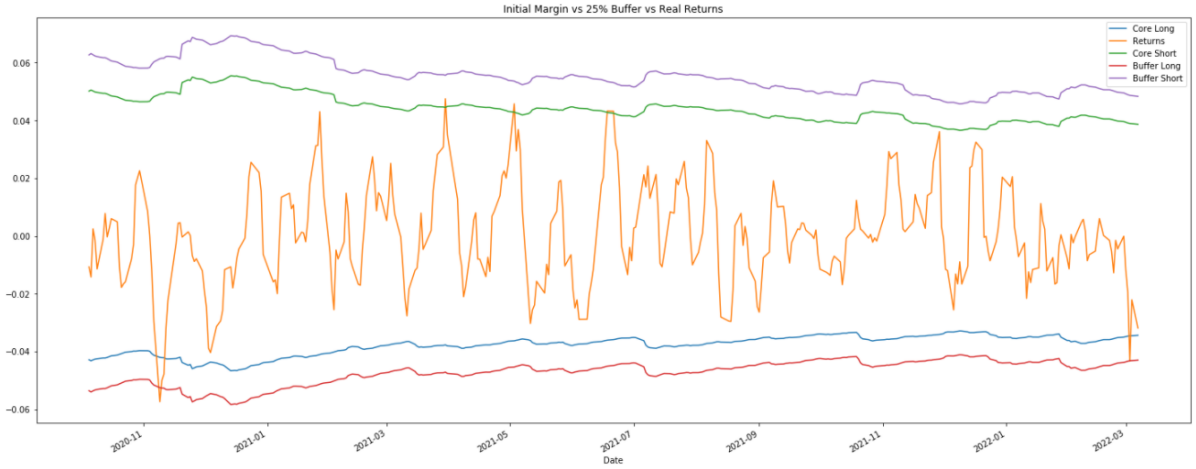

FIGURE 4. COPUSD Forex - Buffer on top of Initial Margin calculated through a Filtered Historical Simulation

4.3. Incorporation of stress observations

To perform the below analysis both Historical Value-at-Risk and Filtered Historical Simulations were used. The chosen stressed observations were the 2008 Financial Crisis. This was a crisis that affected most sectors, especially financial ones. For both margin methodologies analyses the lookback periods used are the same. Also, the Model parameters are identical. A confidence level of 99% was used and a Margin Period of Risk of 5 days. The decay factor or lambda of the Filtered Historical Simulation is 0.97.

4.3.1. Historical Value-at-Risk

The main characteristic of a Historical Value-at-Risk is the lack of re-activeness. The figure 5 below shows the returns of COPUSD product and the backtesting results using a HVaR both in Core and Core 2008. Being the only difference between these two is the

inclusion of stress observations. The Core2008 Short margin is higher at the begging of the backtesting and tens to decrease and accompany Core Short. As the Core2008 has more observations in its distribution, and the volatility is decreasing compared with 2008, these stress observations tend to lose its weight as we go in time. They become diluted and tend to the same pattern as the Core one. On the other hand, as the number of observations is larger, the time it will take to react when volatility strikes again will be lower.

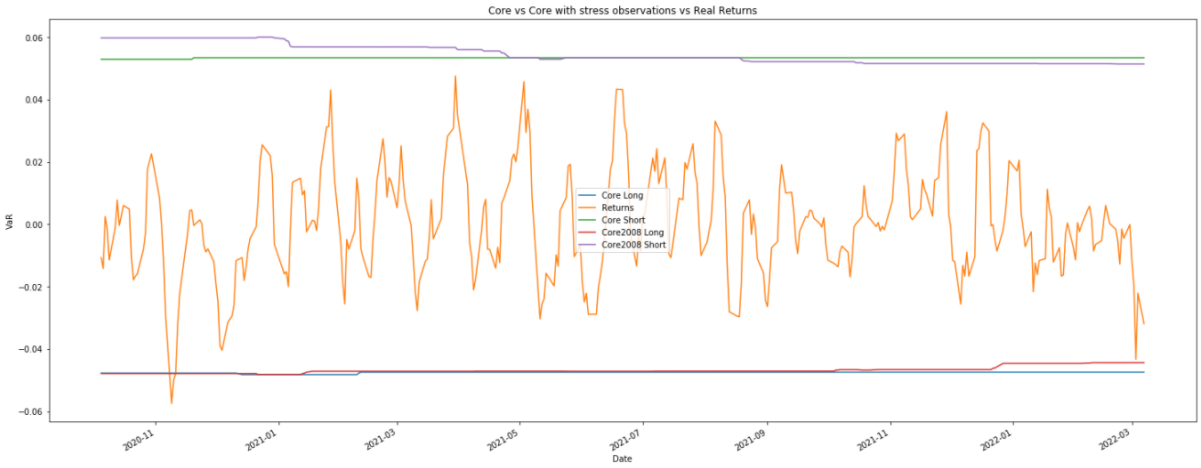

FIGURE 5. COPUSD Forex - Stressed observations included in the Initial Margin calculated through a Historical Simulation

4.3.2. Filtered Historical Simulation

The figure 6 shows the Returns of COPUSD product and the backtesting results using a Filtered Historical Simulation both in Core as in Core2008. The main difference is that the Core2008 has included stress observations from the 2008 crisis, while Core has a shorter lookback period with no stress observations. One can see that the inclusion of these stress observations allowed the model to be less procyclical hence more stable. Due to past events the model was better prepared for volatility. While the Core Margin was extremely unstable and more procyclical. During some periods it surpassed the Core2008, yet, either increasing or decreasing, depending on the returns of the time.

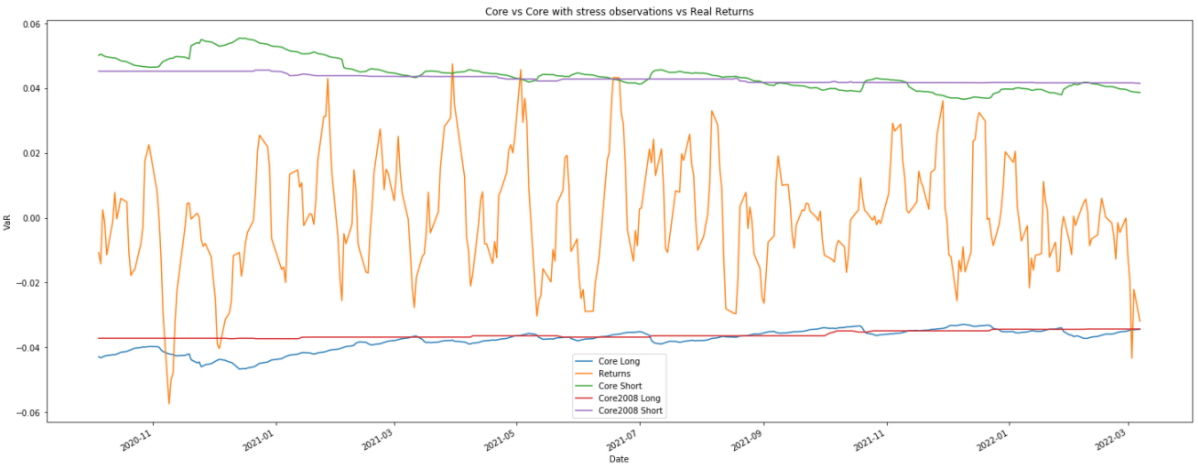

FIGURE 6. COPUSD Forex - Stressed observations included in the Initial Margin calculated through a Filtered Historical Simulation

4.4. Floor

The Floor approach presented by the European Market Infrastructure regulation bases itself on the assumption that the Clearing Counterparties will rely on two margin methodologies. Being the Floor a Historical Value-at-Risk with a longer lookback period and, for example, a Filtered Historical Simulation with a lower lookback period. For the dissertation purpose a lookback period with stressed observations and without stressed observations was used for the Floor, and both are compared. While for the Core approach a Filtered Historical Simulation with 99% confidence level and 5 days of Margin Period of Risk was chosen.

The figure 7 shows a Core that is always below the Floor, meaning that the Clearing Counterparty will be charging the Floor as Initial Margin. The floor is less procyclical, and at the same time provides a "buffer" when compared with the Core. Additionally, by charging this Floor as Initial Margin, the Clearing Counterparty avoids breaches, as the Returns only surpass the margin charged in November of 2020.

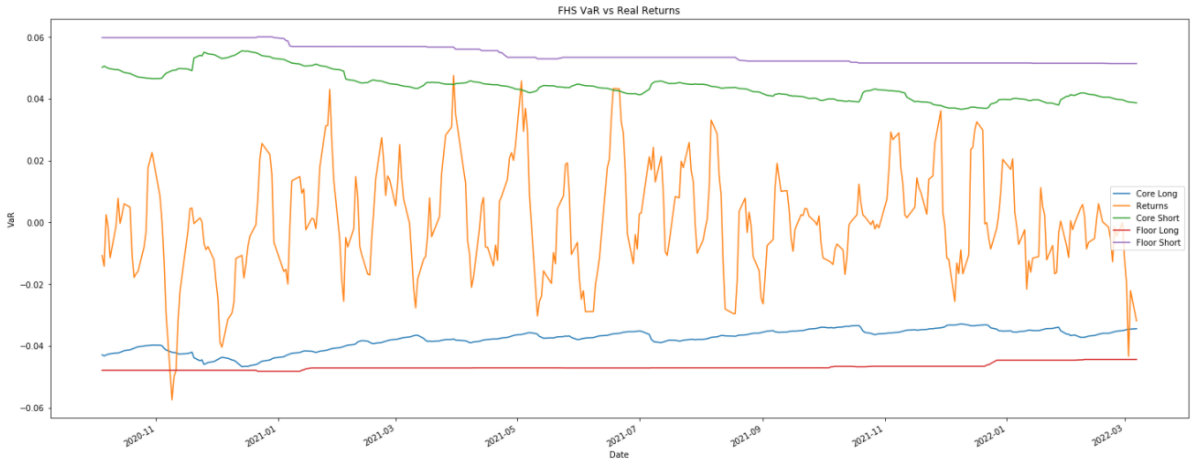

FIGURE 7. COPUSD Forex - Floor and Core Initial Margin calculated through a Filtered Historical Simulation, decay factor 0.97

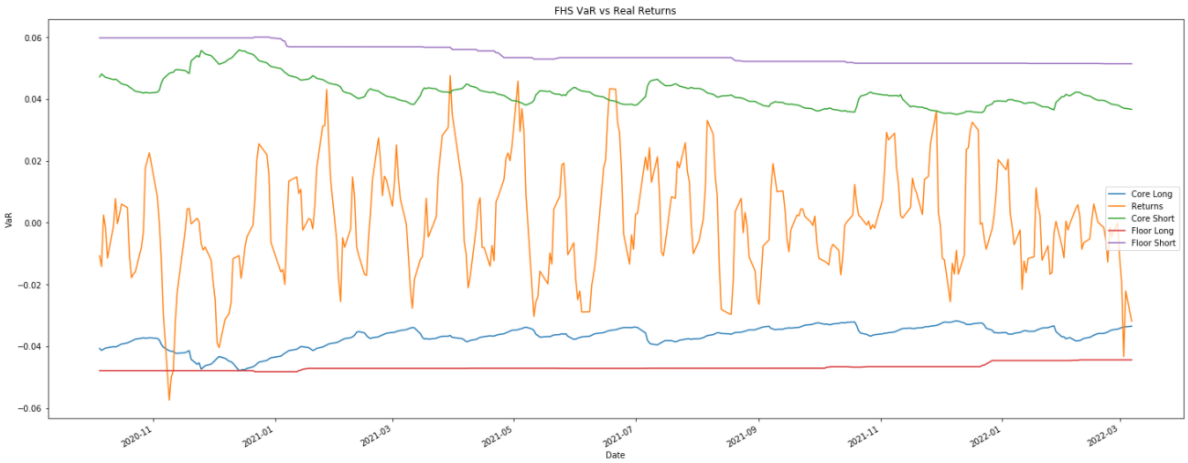

FIGURE 8. COPUSD Forex - Floor and Core Initial Margin calculated through a Filtered Historical Simulation, decay factor 0.95

As another exercise, the decay factor was set at a lower value, from 0.97 to 0.95, to understand if the aggressiveness of the EWMA Volatility component prevents the breaches from occurring. However this was not the case as shown in figure 8. The Core became more procyclical as it is accompanying the Returns better and the breaches occurred regardless of this parameter.

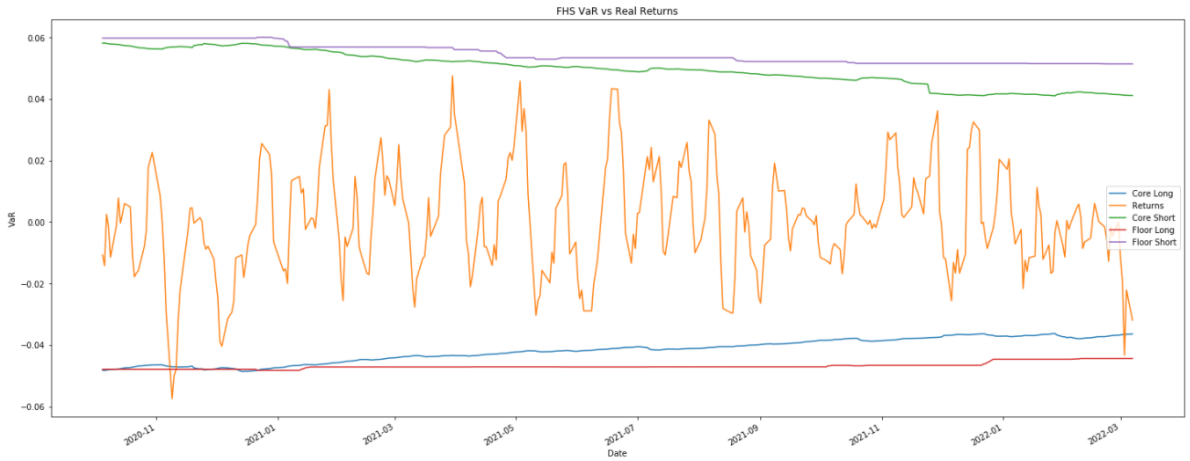

FIGURE 9. COPUSD Forex - Floor and Core Initial Margin calculated through a Filtered Historical Simulation, decay factor 0.99

Regarding figure 9 the decay factor or lambda of the Exponentially Weighting Moving Average Volatility has been increased to 0.99, meaning closer to 1, which is also closer to a Historical Value-at-Risk with a shorter lookback period than the floor.

One can conclude that the Core is less reactive, but also closer to the Floor. However, one important point to highlight, is that the lack of stress observations led to a breach at the end of the backtesting, March 2022, that the Floor is able to avoid, due to its longer lookback.

CHAPTER 5

Conclusions

Central Counterparty context has been presented as well as some regulators and their role in ensuring the efficiency and security of CCP's. In this context, the three anti-procyclicality measures imposed by the European Market Infrastructure regulation- EMIR for Central Counterparties have been at the heart of this thesis.

In order to analyse the anti-procyclicality measures the BME Clearing initial margin process has been used to implement a python code. By using two margin methodologies: Historical Value-at-Risk and a Filtered Historical Simulation with an Exponentially Weighted Moving Average to scale volatility.

It has been demonstrated through these two margins for two distinct products: CO-PUSD Forex and Overnight Interest Swaps, the impact of these measures on the final Margin charged to Clearing Members to avoid procyclicality.

Bearing in mind that these anti-procyclicality measures were tested for these two margin methodologies, some criticism is raised about the lack of standardisation and detailed information that is provided by the European Market Infrastructure Regulation- EMIR. For the first guideline, an implementation of a 25% buffer seems only to be fit for the purpose in case an exhaustion method of this buffer is disclosed. As this is not the case, not much can be said about the buffer being anti-procyclical. As it is just an increase of the initial margin charged by the Clearing Counterparty that does not avoid big increases or decreases, these are still product and methodology dependent.

Regarding the second measure of the inclusion of a stressed period in the lookback period of the model, this is only fit for purpose in case the lookback period is not such that the observations get diluted. However, this is a measure that, in principle, will avoid big jumps in the margin charged, meaning the procyclicality is reduced. As the stress observations are going to the tail of the distribution, the Value-at-Risk is always kept at higher levels than if these observations were not included. This conclusion is true for both Historical Value-at-Risk and Filtered Historical Simulation.

As a third option, there is the inclusion of a Floor. This approach assumes that two margins will be calculated: a floor and a core, where the floor will have a higher lookback period, hence more probability of capturing stressed observations. When using a Filtered

Historical Simulation with an Exponentially Moving Weighted Average this measure is indeed less procyclical, independently of the decay factor used. As for COPUSD Forex product the Floor is always higher than the Core, this will most likely be the margin charged by the Central Counterparty. The stressed observations make the model more conservative and in case there is a sudden volatile moment, the Core will be able to surpass the Floor, but this increase in margin will be smoother.

To conclude, it seems that the most effective margin approach is the use of a Floor and Core. As this is leading to less breaches for COPUSD product. However, this is subject to interpretation as it is applied for these specific products in the context of these two margin methodologies. If one were to choose other products with different margins models, such as a Monte-Carlo, the results could be very different. One thing is certain, the anti-procyclicality measures imposed by EMIR should clearly define standard rules and methodologies. As there are many parameters to change, such as decay factor, lookback period, confidence level, Margin Period of Risk and so on that could lead to weak models. This type of regulation should not be left to Central Counterparties to decide.

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