CLEARINGHOUSES VERSUS CENTRAL COUNTERPARTIES FROM MARGIN CALCULATION POINT OF VIEW

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ABSTRACT

Clearinghouses and central counterparties (CCPs) have a notable role in financial markets, namely facilitating securities trading and derivative transactions on exchanges and over-the-counter markets. They have to clear the transactions and carry out their settlements to decrease costs and settlement risk. To efficiently carry out this activity, they need to collect adequate collateral from the trading parties as guarantees. Two main elements of these guarantees are the margin requirement and default fund contribution. Our paper focuses on the margin calculations and emphasizes their notable difference in the case of clearinghouses and CCPs. Our main result is that clearinghouses' margin requirement is better from a procyclicality point of view; however, CCP margining is more prudent based on our results.

INTRODUCTION

Following the global financial crisis (GFC) of 2007-2009, the attention turned to the over-the-counter (OTC) derivatives markets – trades outside the exchanges – and the risks associated with them. OTC transactions carried a considerable counterparty risk during the GFC, which had transformed easily into a systemic risk throughout large financial institutions' bankruptcy, e.g., the Lehman Brothers. As a result of the GFC, regulators realized the importance of decreasing counterparty risk during trading. Counterparty risk can be managed through clearing bilaterally or centrally (Gregory, 2014). Bilateral clearing means that the two trading partners enter into a master agreement without a CCP covering all of their trades. This agreement has an annex, called the credit support annex (CSA), that requires both parties to provide collateral (Hull, 2018). While central clearing means that every trading partner is trading with the CCP, as shown on the right-hand side of Figure 1, the left-hand side shows the absence of a CCP, representing the bilateral clearing case.

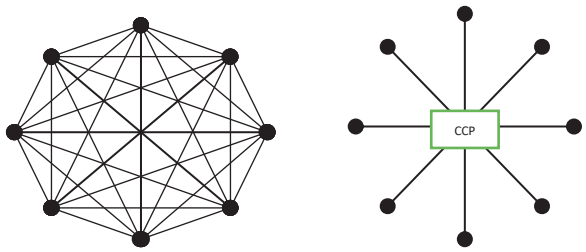

Figure 1: Bilateral versus central clearing on OTC markets (Hull, 2018, pp. 57.)

During the summit in Pittsburgh on 26th September 2009, the participating G20 leaders were in unison that all standardized OTC derivative contracts should be cleared through CCPs by the end of 2012. The other aim of the financial reform was to enhance transparency, as well as to make these contracts reported to trade repositories (EMIR (5), 2012). Finally, the capital requirements should be higher for the non-centrally cleared OTC derivatives (Gregory, 2014). As a result of this agreement, the Dodd-Frank Wall Street Reform and Consumer Protection Act (DFA) enacted in July 2010 in the USA, while in July 2012, the European Market Infrastructure Regulation (EMIR) in the European Union (EU).

In April 2012, the Principles of Financial Market Infrastructures (PFMI, 2012) was issued by the Committee on Payment and Settlement Systems and the International Organization of Securities Commissions (CPSS-IOSCO), which became the global benchmark for the regulatory requirement for CCPs (RTS (2), 2013). As a result, all of the standardized OTC trades between financial institutions must be cleared through a CCP. This regulation's exceptions are the non-financial institutions if their position does not exceed the clearing threshold (Doyle et al. 2016) in the framework of the EU regulation; while in the case of the US regulation, the non-financial firms are exempted if their transaction is entered in order to hedge commercial risk (Gregory, 2014). Finally, the foreign exchange transactions are exceptions, too (Hull, 2018).

Based on the DFA and the EMIR, the CCPs should manage a multilevel guarantee system. The traders have to pay two significant types of guarantees within this guarantee system, the margin requirement and the

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default fund contribution, which is called guaranty fund in the case of the clearinghouses. Our primary focus in this paper is the margin requirement calculation. We will analyze how clearinghouses and CCPs are calculating the value of margin, what the differences are, and what the similarities are. We will also explain the different margin-related notions, like the variation margin, initial margin, maintenance margin, and the margin call.

LITERATURE

The primary role of clearinghouses and central counterparties is the clearing and the settlement of trades. A clearinghouse is operating on exchange markets, while CCPs can operate on exchange markets and also on OTC markets. The main difference between the two institutions is that the CCP takes over the counterparty risk during trading, namely becomes the seller to every buyer, and the buyer to every seller, while a clearinghouse usually does not do this. So in the case of OTC CCPs, the two trading parties are, therefore, no longer exposed to each other, but only to the CCP, which provides insurance against bilateral default risk (Biais et al., 2016). Also, a CCP always nets transactions, while clearinghouses not necessarily. The final difference is that in OTC CCPs, the trades are not necessarily cleared daily (Berlinger et al., 2016). So we can state that every CCP is a clearinghouse, while not every clearinghouse can be regarded to be a CCP (DNB, 2013).

There are several margin notions related to trading: initial margin (IM), maintenance margin (MM), variation margin (VM), and margin call. These notions have a different meaning, depending on which margin we are talking about: securities margin, futures margin, or the CCP margin. Securities margin means a partial downpayment – usually up to 50%, regulated by Regulation T (Reg T, 2021) – of the financial asset's price. The trader has to pay this amount to his broker and borrow the remaining amount also from his broker to buy the financial assets. This is what is called "buying on margin" (CFA, 2017). The notion of securities margin is different from the margin notions we are analyzing in this paper, although it is also related to trading with the financial assets but has nothing to do with the clearing activity.

Futures margin is the margin calculated by clearinghouses only in exchange trading, while the CCP margin is calculated by CCPs and can also be used in exchange- and OTC trading. In both cases, the trader (a.k.a. the clearing member) has to pay both the variation margin and the initial margin.

The initial margin aims to cover the potential closeout cost of the traders' positions to cover potential future costs a CCP or a clearinghouse may face in normal market conditions if the trader defaults. The value of the IM is usually based on a risk measure. For example, in the EMIR framework, the CCP IM on the OTC market should be enough to cover losses on a 99,5% significance level, with a 5-day liquidation period, while for the exchange-traded asset, 99% significance level, and 2-day liquidation period should be applied. The model parameters should be estimated from a 12 months look-back period, which contains a stressed time period (EMIR, 2012, RTS, 2013). The DFA is not as detailed as the EMIR regarding the IM model's parameters, and it just quantifies the application of the 99% significance level (SEC, 2021a). Moreover, another notable difference between the two regulations from the IM point of view is that EMIR emphasizes that IMs should not be procyclical, while DFA does not.

The process of how the IM is handled in the futures margining and the CCP margining is different. Regarding the futures margining, it has to be paid before the trade is entered, so the trader cannot start trading without it (CME Group, 2021a). Meanwhile, in the CCP margining case, the initial margin has to be paid after the first trading day is over, when the transactions are cleared (Hull, 2018).

Meanwhile, the initial margin is not applied to the bilateral clearing in most of the trades. Basel Committee on Banking Supervision IOSCO (BCBS-IOSCO) (2015) states that the total amount of initial margin on bilateral transactions not cleared by a CCP represents only 0.03% of the gross notional exposure in 2012. In 2011 a Working Group on Margin Requirements (WGMR) had been formed by the BCBS, the IOSCO, the CPSS, and the Committee on Global Financial Systems (CGFS) to work out a margining framework on the bilateral trades as well. Based on their work, financial firms and systematically important non-financial institutions should use initial margins above a certain threshold, applying a 99% significance level and a 10-day liquidation period (BCBS-IOSCO, 2015).

Variation margin has to be paid after the mark-to-market valuation of the open positions, so after the losses/gains the trader had on a certain trading day. In the case of CCP margin, if the trader gains on his open position on a particular day, he has access to this amount and could withdraw from his collateral account. Contrary, if the trader loses on his position, he has to pay this loss to the CCP as a variation margin. It is important to note that in bilateral trading without a CCP, this variation margin also has to be paid. So the losses will increase the amount of collateral the trader has to pay, while the gains will decrease is.

In the futures margin case, the clearing of the actual loss/profit works differently. If the trader has a loss/profit when his position is being marked-to-market, this loss/profit is being subtracted/added to his actual margin account balance. In case the loss is so extensive that this balance falls to the level – or below – the so-called maintenance margin level, the trader will get a margin call. A margin call means that the margin balance level has to be increased to the level of the initial margin. In sum, the variation margin is the amount that is needed to increase the margin account balance to the initial margin level (CME Group, 2021a). In the case of the CCP margin, the notion of maintenance margin is not applied.

The notions we have described here are the basics of futures margining and CCP margining on the individual financial assets' level. The actual margin calculation process can be different in the case of clearinghouses and CCPs. For example, the parameters of the IM model can change, or the risk measure they use. Also, the application of the calculated IM value to define the final collateral value may differ. An example of this is the CME Group's Standard Portfolio Analysis of Risk (SPAN) methodology, which defines the margin on a portfolio level (CME Group, 2021b). Several CCPs are using this approach besides CME Group, e.g., KELER CCP Ltd, the CCP of Hungary (KELER CCP, 2021).

Pros and cons of central clearing

Bilateral and central clearing are similar in that both are netting the transactions, and both use margining for the same purposes. However, in several other aspects, they are very different, which we aim to show by highlighting the advantages and disadvantages of CCP clearing from the perspective of the CCP.

The most important advantages of central clearing through CCPs are transparency, offsetting, loss mutualization through the default fund, legal and operational efficiency, liquidity and default management (Gregory, 2014), risk mitigation, and capital efficiency (ICE, 2021). While the main disadvantages include moral hazard; adverse selection; bifurcation; procyclicality; assets are less effective for hedging if they have to be centrally cleared; more costly than bilateral clearing without a CCP; only highly liquid assets can be used as collaterals. At the same time, several factors are undecidable whether they are advantages or disadvantages of central clearing. The most important is the CCPs contribution to systemic risk. Interoperability among CCPs increases risk without enhancing the financial resources of each interoperating CCP (Turing (2012)). Duffie and Zhu (2011), Amini et al. (2016), Lopez and Saeidinezhad (2017), Health et al. (2016), and several others are primarily concerned with the potential for contagion due to their high level of interconnectedness. King et al. (2020) address the problem from a procyclicality point of view: CCP resource demands are inherently procyclical concerning the market, thus threatening the ability of CCPs to fulfill their obligations in stressful periods. Gregory (2014) states that CCPs convert counterparty risk into liquidity, operational and legal risk.

Other vital reasons against central clearing through CCPs on the OTC markets are the assets maturity, liquidity, and complexity. Although the CCPs are efficient in handling counterparty risk on futures and spot markets, where usually the positons are open for only a short period of time (weeks to months), CCPs are not as efficient in case of the OTC market's assets, which are financial assets that usually has a considerable maturity which can even last for decades (Gregory, 2014). For example, a ten-year credit default swap is not uncommon in these markets (Murphy, 2013). Moreover, the exchange-traded assets are standardized, not too complicated, and liquid. So handling counterparty risk on OTC markets, where the assets are complex, traded volumes are not concentrated in highly liquid assets, is inefficient and too expensive to clear through a CCP. For example, in a stressed market condition to close down a position can take some days because of illiquidity. It can also happen that for non-standardized and exotic OTC derivatives, central clearing is just not feasible. However, the most important reason against CCP central clearing is that the OTC markets are the central place of financial innovations and offer cost-effective and well-tailored risk reduction products. Nevertheless, these new, non-standardized, or exotic products cannot be cleared by CCPs (Gregory, 2014).

The most convincing reason for the CCP central clearing is the case of the global financial crisis where the Lehman default on 15th September 2008 was the biggest default in CCP history (Fleming and Sarkar, 2015; Bernstein et al., 2019). LCH.Clearnet's SwapClear service provided nearly half of the world's interest rate swap positions at the time of the default. It could handle the default of Lehman efficiently within hours, by suspending insolvent Lehman entities and by having around USD 2 billion as initial margin account from Lehman already by that time (Gregory, 2014, Norman, 2011). LCH.Clearnet faced massive failures before as well, like the default of Barings in 1995, which it could also handle without any severe problems (Gregory, 2014). These examples show the most critical advantages of CCPs, and how shock resistant they are. The critical nature of their role was endorsed in September 2018, when the default of a clearing member at the Swedish CCP, Nasdaq Clearing, reached losses causing the use of the CCP's prefunded buffer, and surviving members were required to replenish USD 107 million of that buffer within a few days (King et al. 2020). The event did not end with the mass default of the market participants.

Clearing in the USA and the EU

In the USA, the clearing services are provided by a few major actors:

- Subsidiaries of the Depository Trust & Clearing Corporation (DTCC), which are the world's largest clearinghouses (DTCC, 2021), both administered and supervised by the US Securities and Exchange Commission (SEC) (CFI, 2021): 1) National Securities Clearing Corporation (NSCC) and 2) Fixed Income Clearing Corporation (FICC).
- Option Clearing Corporate (OCC): the world's largest equity derivatives clearing organization. It is under the jurisdiction of the SEC and the CFTC (Commodities Futures Trading Commission) because it is also registered as a derivatives clearing organization (DCO) (OCC, 2021).
- CME Clearing: it is a subsidiary of the CME Group Inc. exchange and clears and settles exchange-traded futures and options contracts, and also OTC

derivative contracts (BIS, 2012). Since it is considered a DCO, it is regulated by the CFTC.

- ICE Clear Credit LLC is an ICE subsidiary (Intercontinenal Exchange Inc.) and the world's largest credit default swap clearinghouse. The CFTC and SEC regulate it (ICE Clear Credit, 2021).
- There are other domestic (e.g., MGE Clearing, New York Portfolio Clearing) and foreign clearing which operate as DCOs (e.g., LCH.Clearnet Ltd.).

Besides the already mentioned CCPs, the following belong under the SEC's supervision: ICE Clear Europe Limited and the LCH SA (SEC, 2021b).

There are 19 CCPs in the EU from 15 different countries (EACH, 2021) with the EMIR recognition for providing clearing and settlement services on exchanges and OTC markets in the European Union. The supervisor for all of them is their national supervisor, e.g., the national bank and the European Securities Market Authority (ESMA) on the EU level. It is important to note that not only an EU-based country can get EMIR recognition (ESMA, 2021). The CCP just has to prove that its operation and risk management process is prudent enough. Moreover, the European Commission and the CFTC agreed on a common approach to cross-border processes. The announcement made on 10th February 2016 permits DCOs and CCPs to clear derivatives for counterparties abroad. (Doyle, 2016).

MODEL

In our simulation, our main goal was to show how the margin calculation in the case of the futures- and CCP margining work for a stock position. We used the following assumptions for the simulation:

The logreturn of the stock follows arithmetic Brownian motion (ABM) based on Equation 1.

$$dY = \alpha \cdot dt + \sigma * \sqrt{dt} \cdot N(0,1) \qquad (1)$$

where 'dY' is the change in the logreturn during 'dt' period, $'\alpha'$ is the expected value of the logreturn, $'\sigma'$ is the standard deviation for the logreturn, and 'N(0,1)' is a standard normal random variable. We have estimated the expected value of the logreturn (7.71%) and the standard deviation (22.37%) from the time series data of the DAX index in the period of 12th January 1991 and 11th January 2021.

We simulate also stresses into the simulated logreturn time series. The occurrence of the stress is modeled with a Poisson process with a lambda parameter of 0.005, while the extent of the shock is modeled with a lognormal distribution with a mean of -10 and a standard deviation of 2.25. The decay of the shock is modeled with a 0.97 parameter. Finally, the stock price is determined by Equation 2, where 't' stands for time, and 'S' stands for the asset's price.

$$S_t = S_0 \cdot e^{Y_t} \qquad (2)$$

We simulate the prices for 500 days, from which the first 250 is used to define the initial margins input parameters, and the remaining 250 days will be used to calculate the IM, VM, MM on a daily basis.

We define the initial margin with the model of Béli-Váradi (2017), which model is based on the Value-at-Risk model and applies a 25% procyclicality buffer, which is exhausted if the exponentially weighted moving average (EWMA) standard deviation of the stock's logreturn is greater than its equally weighted standard deviation. This IM value will be the same for both (futures and CCP) margining methods.

We have used the following parameters for the IM calculation: the look-back period is 250 days; the significance level is 99%; the liquidation period is 2 days; the lambda parameter of the EWMA standard deviation is 1%.

The maintenance margin will be 75% of the actual day's initial margin value.

Our assumptions regarding handling the gains and losses of the marked-to-market valuation will be different, based on how it works in practice.

- CCP margining: the variation margin requirement will be paid to the CCP if the trader had a loss on that day, while he will receive money – collateral – back if he had a gain. The only exception is if his overall margin account balance (so the sum of the IM and VM) would go below the IM's value. In that case, the trader can take away only that amount from the gain to have at least the IM value on the margin account.
- Futures margining: if the trader makes a loss, it will be subtracted from the margin account balance till the maintenance margin is lower than this balance. If its MM is higher, the trader will get a margin call, and has to increase the margin account balance to the level of the IM. If the trader makes a gain, it will increase the margin account balance, even if the balance is already greater than the initial margin. This means that he won't take away the gain from the balance.

A 10-day sample of a simulated margin calculation series can be seen in Table 1 and Table 2, which shows the IM, MM, VM, and margin call dynamics.

Table 1: Simulated margin account balances in case of the futures margining

Futures margin							
date	S	initial margin	Daily gain	Margin account balance	Maintenance margin	margin call	Daily CF of the clearing member
251	1134	50,00	19,18	50,00	37,50	0,00	50,00
252	1130	50,00	-3,44	46,56	37,50	0,00	0,00
253	1111	50,00	-18,85	27,71	37,50	22,29	0,00
254	1110	50,00	-1,03	48,97	37,50	0,00	22,29
255	1121	50,00	10,60	59,57	37,50	0,00	0,00
256	1105	50,00	-16,27	43,30	37,50	0,00	0,00
257	1088	50,00	-16,41	26,89	37,50	23,11	0,00
258	1096	50,00	7,82	57,82	37,50	0,00	23,11
259	1117	50,00	21,41	79,23	37,50	0,00	0,00
260	1104	50,00	-13,37	65,86	37,50	0,00	0,00

Table 2: Simulated margin account balances in case of the CCP margining

CCP margin					
date	S	initial margin	variation margin	Margin account balance	Daily CF of the clearing member
251	1134	50,00	19,18		
252	1130	50,00	-3,44	50,00	50,00
253	1111	50,00	-18,85	53,44	3,44
254	1110	50,00	-1,03	72,29	18,85
255	1121	50,00	10,60	73,32	1,03
256	1105	50,00	-16,27	62,72	-10,60
257	1088	50,00	-16,41	78,99	16,27
258	1096	50,00	7,82	95,40	16,41
259	1117	50,00	21,41	87,59	-7,82
260	1104	50,00	-13,37	66,18	-21,41

RESULTS

We have run the simulations 11 000 times. One of the realizations can be seen in Figure 2 and Figure 3. In Figure 2, the cash flows can be seen in both of the margining methodologies.

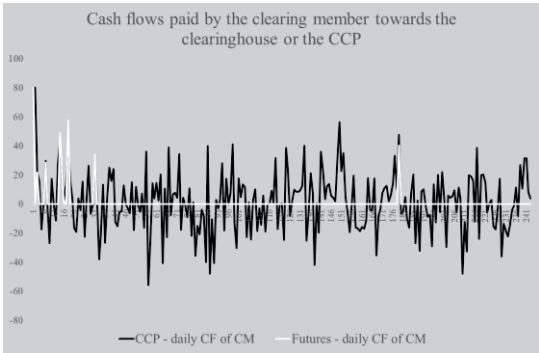

Figure 2: Cash-flows towards the clearing member from the CCP or clearinghouse point of view

It is important to see that there was less cash-flow in the futures margining since the losses did not have a cash-flow effect unless the trader has received a margin call (white line). In contrast, in the CCP margining case, there was a cash-flow every day because of the variation margin or because the initial margin changes.

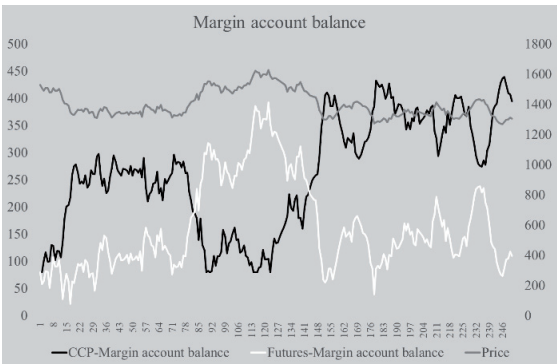

Figure 3: Margin account balances

In Figure 3, the margin account balances can be seen in both cases. The most interesting about the simulation result is that the margin account balance moves exactly the opposite direction in the futures- and CCP margining case. The two methods are capturing the same risk during the calculation of the initial margin with the same method – same VaR model, with the same parameters – but how the marked-to-market valuation is being handled is much different, which causes the balances to change differently. Comparing the margin account balance to the stock's price evolution, we can see that the futures margin account balance decreases/increases when the prices do, while CCP margining behaves the opposite way.

It is important from a procyclicality point of view since when prices are falling, it usually happens when a shock hits the market. If the margin requirements increase when there is a shock, and prices are falling, it is not as efficient from the traders' point of view and can easily cause liquidity problems to finance the increasing collateral requirements. Interestingly, in the case of the CCP margin, the notable point is to handle procyclicality throughout defining the IM in the EMIR framework; meanwhile, futures margining does not focus on this phenomenon. At the same time, futures margin moves together with the cycle and asks for less collateral when prices are falling and require more when the prices increase, so handle procyclicality much better. To confirm this relationship, we have calculated from the 11 000 simulations the average correlation between the logchanges of the prices, CCP margins, and futures margins. There is a strong correlation between the prices and futures margin with a value of 0,784, and a very low correlation between the prices and the CCP margin, -0,004, and also very low between the futures- and CCP margin, with a value of 0,064.

Besides procyclicality, there are other essential characteristics of the margin balance, which are more critical than procyclicality, namely how good and prudent the model is. This can be quantified by the backtest, which compares a certain day's price change to the margin account balance: whether the margin was enough to cover the price change.

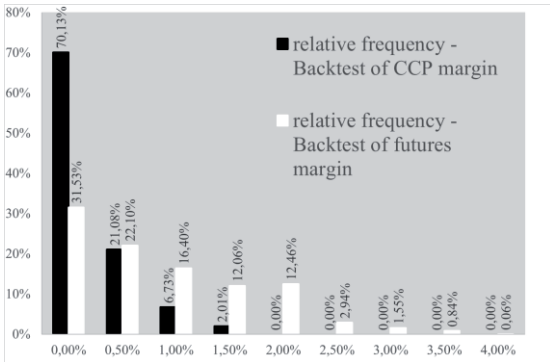

Figure 4: Backtest results

Figure 4 and Figure 5 show the result of the backtest. Figure 4 shows the relative frequency of the backtest result, which does not contain the results of the 1% of the simulated data, which we handled as outliers.

Results show that in case of the CCP margin in more than 70% of the cases the margin was enough to cover losses every day throughout the 250 days, for which the margin was simulated.
Moreover, none of the simulated time series resulted in a worse backtest outcome than 1,5%. In contrast, the futures margins' backtest did not perform as well. Only 31,53% of the cases were the margin adequate to cover every day's price change, and for comparison, only 82,14% of the cases were the backtest's result 1,5% or better. This difference is significant and notable from a risk management point of view.

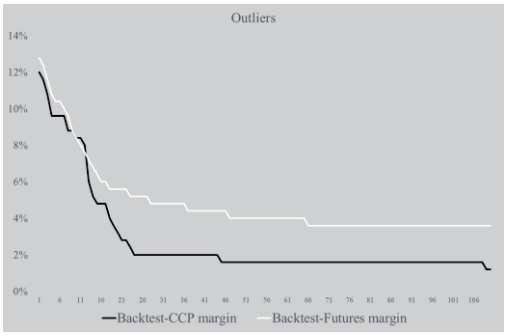

Figure 5: Backtest result in case of the outlier data

Regarding the outlier data of Figure 5, we can conclude the same result as the previous. In this figure, we see the exact values of the worst 110 backtest result in the case of both margining methods. We can see that there were some extreme values in both of the cases, but the CCP margin's most of the "outlier" data was around 2%, while the futures margin's worst values were around 4-5%. This difference is also notable.

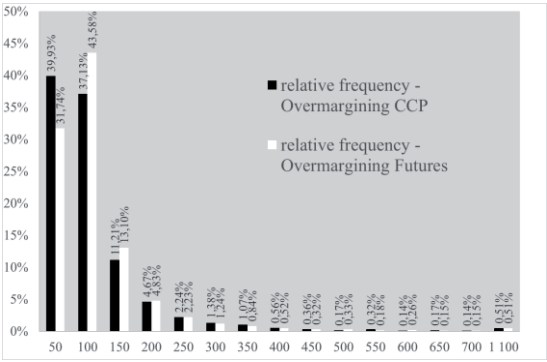

Figure 6: Overmargining

Although CCP margin performed much better than the futures margin from a backtesting point of view, it is also important that which margining method is stricter from the overmargining point of view. If the margin is always unreasonably too high, it is easy to have a good backtest result, which is good from a risk management point of view, but not necessarily good from the clearing members' since it takes away too much liquidity from them. Also, the CCP may have a competitive disadvantage if it is too expensive, requires too much collateral. We define overmargining as the ratio of the margin account a certain day and the actual price change, so how many times did the margin cover the possible losses. We calculated this ratio for all of the 250 days, and we took the average of these values in every simulation. Figure 6 contains the relative frequency of these average overmargining values. Here also we analyzed the worst 1% separately. On the x-axis, we can see how many times the margin value exceeded the price changes, while on the y-axis, we see the relative frequency of this possible outcomes. There is no notable difference above the level of the 200-times overmargining. On lower levels – till 50-times overmargining – it can be seen that the CCP margin was more frequent, while between 50- and 150-times overmargining, the futures margin was.
Figure 7 shows the outlier data results, although it contains only the ten most extreme values. In the remaining 100 outlier cases, the same can be observed as in Figure 6 in the interval of the 200-1000x.

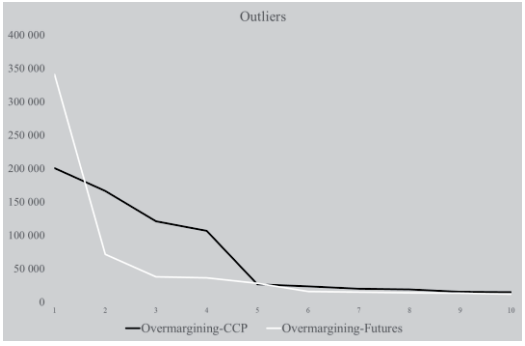

Figure 7: Overmargining in case of the outlier data

The most extreme value was in the case of the futures margining method, although the 2-4th largest values were greater in the CCP margining case.

CONCLUSION

Our results show that calculating the margin balance with the futures margining or the CCP margining can lead to a much different margin account balance, although the initial margin requirements were calculated the same way. We run our simulation 11 000 times. The main result was that the futures margin followed the stock price movements much better, which is more efficient from a trader's liquidity position point of view and from a procyclicality aspect, but the CCP margin was better from the model adequacy perspective. Namely, it performed much better on the backtest, while also it was less strict from an overmargining point of view.
Potential future research can be to change the assumptions regarding the handling of losses/gains throughout the marked-to-market process. Namely, to allow the futures margining case to take away the gains if the margin account balance is above the initial margin or the other way around, prohibiting the CCP margining from taking away the gain.

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