THE NECESSARY SIZE OF THE SKIN-IN-THE-GAME TO STAY IN THE GAME

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ABSTRACT

The role of central counterparties (CCPs) is to manage counterparty risk during trading on exchanges. In order to assure resilience, CCPs are required to operate a multilevel guarantee system, the default waterfall (DW). Our paper focuses on the third layer of this DW, which is the own capital of the CCP, the skin-in-the-game (SITG). While EMIR (European Market Infrastructure Regulation), the European regulatory background for CCP, expects a 25% contribution to the guarantee system of its own capital, experts challenge the necessity of such a level of own capital inclusion. The size does not serve only as a line of defense against clearing member default, but it also creates incentives for both CCPs and its participants to adjust their risk-taking depending on the level of SITG contributed. In our model, we quantify the SITG and show the difference between covering the losses exclusively with the defaulting member's own resources and the SITG or also with non-defaulting members' contributions.

INTRODUCTION

Following the global financial crisis in 2008, CCPs gained a significant role since the crisis exposed the vulnerability of the whole financial system. Regulators and every actor of the market are interested in assuring the resilience of the clearinghouses. The reinforcement of financial stability has gone far since the crisis; however, further implementations and improvements are to be made.

The CCP becomes a "central" party between traders, becoming a buyer to the seller, and a seller to the buyer, a process called novation. The two 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). Many researchers (Duffie, 2015, Lopez and Saeidinezhad, 2017, Markose et al., 2015) point out that the CCPs may bear systematic risks, but the benefit they provide is undeniable. For example besides taking over counterparty risk, the CCP takes market participants' trading exposures onto its balance sheet, relieving the counterparties of multilateral risk exposures.

In order to assure robustness to default, CCPs operate a default waterfall system. These are resources of the CCP, serving the assurance of absorption of losses generated by the default of a participant. EMIR requires three typical resources of the waterfall system: margins, skin-in-the-game, and default fund contributions.

Our research aims to analyze how much "skin" is enough for a CCP to withstand extreme shocks to protect the non-faulty members' default contribution to be exhausted. Researchers examined the loss mutualization role of the default waterfall, of which the CCP's own capital takes part as well. The dependency among members may have negative externalities when members take excessive risk in the hope of higher returns, even on the cost of the CCP. The trade-off regulators face while CCPs collect the default fund contributions is to prevent members from excessive risk-taking and, at the same time, keeping the funding cost low, pushing the incentives towards safer investments. The default fund designs and the capital a CCP is including in the fund affect the incentives of participants.

The paper proceeds as follows: at first, the default waterfall is briefly presented, followed by the detailing of the skin-in-the-game amount effect on incentives. In the third part, the model is presented. Lastly, results are detailed, and the paper closes with our conclusion.

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LITERATURE

A CCP's leading role and purpose are to centralize counterparty risk management in the financial markets they operate (Pirrong, 2011). Hughes and Manning (2015) compare the risk profiles of CCPs and banks. In their perspective, the primary financial risk of a CCP stems from the likelihood that the CCP executes the replacement trades in its matched book at a disadvantageous price. Consequently, market liquidity risk arises in the case of a member's default. For banks, the most critical risk factor is the credit risk of their borrowers.

Researchers (including Murphy and Nahai-Williamson 2014; and Pirrong 2011, 2014, Hughes and Manning 2015) identify the vulnerable points by which a CCP could trigger or amplify systematic risk that includes liquidity risk, information, and incentive issues, too.

Regulatory background

Authorities have put great attention to strengthen the global safeguards for central clearing by adopting the CPMI-IOSCO Principles for Financial Market Infrastructures, dedicated Financial Stability Board guidance, and the EMIR regulation in 2012. EMIR requires CCPs to ensure the resilience and stability of the financial system.

CCPs must operate a default waterfall system (EMIR, Article 45, 2012) in order to have access to financial resources in the event of a clearing member's (CM) default. The main elements of the default waterfall, are the margin, the default fund, and the skin-in-the-game. EMIR Article 41 and chapter VI. of the regulatory technical standards (RTS, 2013) – supplementation of EMIR – require CCPs to have proper margining methodologies that enable CCPs to cover losses of the defaulting member. This is the first layer of defense; therefore, the regulatory background sets rigorous requirements for CCPs regarding the methodology. The aim is that the amount of the defaulting member's margin shall be enough to cover the losses it generates. It is also important to mention that the statistical model shall cover the losses *in normal market conditions*. The parameters for non-OTC financial assets have a confidence level of at least 99%; lookback period of 250 days that includes a stressed period, liquidation period is at least two days. EMIR also emphasizes the importance of the inclusion of procyclicality. Different procyclicality handling methods are analyzed by Berlinger et al. (2018), Szanyi et al., (2018), give an overview of the deficiencies and potential improvements of the procyclicality requirements.

While margins serve to cover losses from day-to-day business, the second layer, the default fund contribution sources (EMIR, 2012, Article 48), serve to protect the system in extreme market conditions. This is why it is required to be designed to withstand extreme but plausible market conditions. According to the practice (e.g., KELER CCP, 2020), EMIR (2012, Article 49.), the default fund contribution value is determined by stress tests. RTS (2013) demands historical and hypothetical scenarios, and CCPs should cover the default of the CM with the highest, or the second and third highest (max(1;2+3)) exposure. Loss-mutualization and cross guarantee between clearing members appear at this level. However, the rule is to exhaust the resources of the defaulting member's contribution first. The non-defaulting members' contributions are used only after the third layer of defense is proven to be inadequate.

The applicable regulations involve the CCP in the game as well. The third layer is the so-called skin-in-the-game, which is the own funds of the CCP. Depending on the policy and default waterfall model the CCP applies, there could be a second skin-in-the-game as a resource if the funds mentioned above are not enough to cover the losses.

For reaching the end of the default waterfall (R&R CCP, 2019), in case of the inadequacy of funds, the CCP must be prepared. A recovery plan is put into force if the CCP reaches its funds' limits (Cont, 2015).

Skin-in-the-game and the role it plays

The current regulatory framework requires a considerable fraction of the CCP's equity at 25 percents, according to Article 35 of EMIR, to provide as skin-in-the-game in the default waterfall system. It is related to incentives too that the CCP management and not just the shareholders should bear the consequences if it is inevitable to reach out for the CCP's capital buffer (Cont, 2015). Cont (2015), Murphy (2017) and McPartland and Lewis (2017) point out that in case the waterfall is exhausted, both contributions of faulty and non-faulty members' contributions are proven to be inadequate, and before entering the recovery phase of the CCP, there should be another tranche, which is known in the literature as another part of the skin-in-the-game, the senior tranche. The senior tranche is not mandatory, but several CCPs opt for it in order to avoid using more drastic tools of recovery.

However, Murphy (2017) also raises a prominent, but unanswered question in the debate: "*how much skin is enough to create good incentives for the CCP?*" He suggests that regulators are the ones who should answer. Cox (2015) suggests that supervising authorities "*should have the responsibility to ensure that a sufficiently objective and balanced decision is reached*," and he does not give a precise answer to the question. The concern is critical because while in the European Union, the contribution is a pre-set percentage, according to CME, in 2018, in the United States, the exchange contributed about $375m, or roughly 5.25% of its capital (Suprise, 2015).

Reasoning against high skin-in-the-game

Compared to the regulator's opinion, CCP experts have precisely the opposite judgment. CME highlights that "*Skin in the game doesn't protect end client.*" (Daly, 2015) In their view, concentration risk is the biggest fear

CCPs can have because it can encourage moral hazard of the clearing members as CCPs contribute more substantial financial resources to the default waterfall. To deal with concentration risk, they propose to handle the most significant exposures in a way, that the clearing member causing it, would pay for that risk by additional collaterals so that when they fail, those funds are available to resolve the default (Suprise, 2015). Otherwise, the end clients would also suffer from the exhaustion of the CCP's financial resources. On the long run, this would benefit neither the CCP nor the end clients, especially if the default events accumulate.

Incentives regarding for-profit CCPs

CCP capital contributions matter since the owners and users are distinct and so have responsibilities toward one another; moreover, they may also have very different interests as well. The for-profit CCP's primary purpose is to maximize its own expected utility. The most prominent aspect of a for-profit CCP is that its default waterfall can be funded either solely by clearing members or by the CCP. Both have their benefits and drawbacks, all affecting the incentives of every participant in the system.

A wholly clearing member-funded waterfall's risk is that it prefers a higher return on equity instead of safety, potentially leading to limited exposure to default risk, resulting in sloppy risk management practices. The improper management concusses and minimizes the credibility of the CCP, leading to misbelief in its role in fulfilling proper risk management responsibilities.

The amount of the skin-in-the-game can be harmful to be too high or too low. Researchers also point out that this layer does not only have a loss-absorption function, but it also indicates the risk profile and the incentives of the CCP that may alter the incentives and risk perception of clearing members. Murphy (2017) highlights, if a CCP's capital contribution to the waterfall is too small, clearing members would perceive high risk in the clearing activity, so instead of joining the system, they would seek to engage trades not subject to clearing, namely, OTC trade. Regarding the incentives of risk management in case of a default, Carter and Garner (2015) also argue the CCP's skin-in-the-game value determinant.

On the other hand, a for-profit must focus on the return on equity if the contribution of the default waterfall is substantial; resulting in increasing clearing activity fees, creating a disincentive to clear trades, increasing systemic risk. Furthermore, as Cox (2015) explains, the too-high contribution to skin-in-the-game included in the waterfall could endanger the CCP's long-term existence in case of an extreme default event. Clearing members would be encouraged to avoid helping the management of a defaulted member since the junior tranche absorbs the losses. The higher the junior tranche is, the probability of funds requested from the non-defaulting members' decreases, also resulting in a decrease in incentives to be part of the default management too.

Incentives regarding clearing member-owned (user-owned) CCPs

Huang (2019), Cox and Steigerwald (2017), and McPartland and Lewis (2017) study the different ownership structures of CCPs. Another type of ownership structure worth analyzing are the mutualized CCPs, which means that they are owned by the clearing members and exchanges that use their services. In line with their use of concepts, as being owned mainly by a small number of large clearing members, they are unanimously calling them user-owned CCPs. From this structure, there could be misaligned incentives between members, as smaller members would have less impact on the decision of the policy the CCP would apply.

Compared to the for-profit model, in this case, it maximizes the total welfare surplus. Another difference the two researchers point out is the fact that these CCPs hold additional capital, and the required collateral amount is low. Nevertheless, because the owners are the same as the users, the financial resources in the default waterfall system have the same source: the capital of the system participants.

Recovery and resolution

Besides the sound risk management practices, another significant feature the regulation has addressed are the recovery and resolution regimes for CCPs to assure continuity in the provision of clearing services for systemic stability and of an orderly resolution of the CCP (CPSS-IOSCO (2012), CPMI-IOSCO (2014), FSB (2014a)).

Peters and Wollny (2018) point out the importance of preparation. The recovery plan is a crucial tool for both CCPs and regulators to be prepared to identify the critical services. The stress scenarios in case of default and non-default events may stop the CCP from being able to provide its critical services. Both quantitative and qualitative criteria could trigger the application of all or part of the recovery plan; and the recovery tools in case of different events. The plan should outline the possibilities the CCP has not just in case of a participant's default, but for events related to operational deficiencies.

If the recovery tools are proven to be insufficient, the next step is the resolution plan activation. It can be put into force even if the CCP is materially breaching its core obligations.

Resolution authorities may, however, intervene before the defined trigger point. If so, the early intervention should be adequately justified and considered as a tool of last resort, and it should be used to protect the broader financial markets. A way too early intervention can be unnecessary and very likely would have disadvantages of shifting the responsibility of the losses to the public sector. Moral hazard can be created because of a premature resolution, that would weaken the reputation of the CCP, but its ability to conduct an orderly and useful loss allocation tool as well.

MODEL

We run simulations in order to show how the size of one level of the default waterfall – the so-called skin-in-the-game (SITG) – should be defined. Our model consists of one CCP with two different financial assets: stock and currency. The currency can be traded on the options and futures markets, while the stock can be traded on the spot, options, and futures markets. After 7500 days of simulation, we shock day no. 7501 to see which clearing member will have the largest exposure, namely, would have the largest loss if it would default. We assumed in our simulation that only that clearing member will default, which has this largest exposure. Our question was, that in this case, what the minimum size of the SITG should be in two different situation: 1) the CCP should not exhaust the default fund contribution of the non-defaulting members; 2) the default waterfall is just enough not to start the recovery and resolution process.
For simulating the price evolution of the stock and currency, we use the simulation method of Illés et al. (2019). The basics of the simulation model are the following (more details can be found in Illés et al. (2019)):

1. 7500 days are simulated.
2. We run the simulation 100 times.
3. Price simulation:
   - The return of the stock and currency is simulated by arithmetic Brownian motion.
   - The correlation between the price of the two underlying is simulated with Cholesky decomposition.
   - The occurrence of stresses is modeled with a Poisson process, while the extent of the shock is modeled with lognormal distribution.
   - At the occurrence of stress, the correlation between the assets increases to 0.9 and decreased by 0.95 every day while the minimum value of their correlation is set to 0.5.
   - The applied shock parameters are summarized in Table 1.

Table 1: Parameters of the price simulation

Parameters for the price simulation with ABM		
	Stock (St)	Currency (Ccy)
α	10%	5%
σ	15%	10%
S(0)	1000 EUR	1000 EUR
dt	1 day	1 day
Shock parameters that affect the value of the shock		
μ	-20	-20.6
standard deviation	0.7	0.8
decrease of shock	0.97	0.99
Shock parameters that affect the date of the shock		
λ	0.005	0.0045

4. Four clearing members are present on the market, whose positions are summarized in Table 2.

Table 2: Number of positions per clearing members

Clearing members	CM1		CM2		CM3		CM4	
Assets	St	Ccy	St	Ccy	St	Ccy	St	Ccy
LongPut	**3**	**5**	**2**					
ShortPut					**5**	**5**		
LongCall	**3**	**5**						
ShortCall					**3**	**5**		
LongForward				**5**				
ShortForward		**5**						
LongUnderlying	**4**		**2**		**3**			
ShortUnderlying							**9**	

5. Initial margin calculation:
   - The margin of the underlying assets is calculated by the method of Béli and Váradi (2016).
   - The portfolio level margin is defined by the SPAN (Standard Portfolio Analysis of Risk) margin calculation method.
6. Default fund calculation: We identifiy four different historical stress scenarios and calculate whether in case of each scenario's price change, the margin is sufficient to cover the potential losses of each clearing member in case of default, or not, on the last day of the simulation. The value of the DF is the scenario that has the highest loss of the max(1;2+3) exposures according to EMIR. The parameters of the four applied historical scenarios:
   - 1 & 2: Min/max stock: lowest/highest stock return during the 7500 days, and taking the currency return the same day.
   - 3 & 4: Min/max currency: lowest/highest currency return during the 7500 days, and taking the stock return the same day.
7. The CM level DF contribution is defined by the ratio of the CM level initial margin levels.

The simulation model of this paper furthermore assumes that the spot and derivative markets are merged, so it calculates the margins, the default fund (DF), and the skin-in-the-game accordingly.
To examine the minimum necessary SITG level, we need the next day's prices as well. So we continue to day 7501 stressing the stock and currency returns with a hypothetical scenario. For example, we increase the return of the stock by 5% (+5%) and decrease the return of the currency by 5% (-5%) for each simulation. Having the prices for day 7501, and having the IM and DF contributions based on the previous day, we can quantify the uncovered losses for each CMs. The DF contribution, the initial margin, and the loss per CMs give the use of the CCP's own resources – namely the SITG – and given all this information, we can quantify the rate of the SITG within the default waterfall system (DW).

RESULTS

In the following we show the result of the 100 simulation by assuming the mentioned (5%, -5%) hypothetical parameters, which are much higher than the historical parameters. In our 100 realizations the average historical stress parameters were the following according to Table 3:

Table 3: Average historical stress parameters

Min stock		Max stock	
Stock	Currency	Stock	Currency
-3.54%	-0.01%	3.63%	0.04%
Min currency		**Max currency**	
Stock	Currency	Stock	Currency
-0.05%	-2.37%	0.18%	2.41%

The skin-in-the-game is the third level of the default waterfall system to cover the members' losses, the defaulting member's initial margin and default fund contribution are the previous layers. As a first step, we examine the size of the SITG within the total waterfall by answering the following two questions:

1. What should be the size of the SITG to not to have to use the non-defaulting member's DF contribution and to avoid reaching the fourth layer of the DW?
2. What should be the size of the SITG just to have a DW that covers precisely every loss of the defaulting member? That is, if we use all the four layers.

In every single realization, CM1 resulted as the defaulting member. Table 4 summarizes the size of the SITG within the DW.

Table 4: Summary of the size of SITG within the DW

	Size of the SITG within the total DW while **excluding** the application of the non-defaulting members' contribution	Size of the SITG within the total DW while **including** the application of the non-defaulting members' contribution
Min	12.57%	0.00%
Max	34.08%	19.99%
Average	22.18%	7.46%

If we use only the defaulting member's contribution to cover its losses, SITG should be at least the 12.57% of the total DW to recover, while in 27 times out of our 100 realisations, zero SITG is needed to cover all the losses if we include the non-defaulting members' contributions as well. In this case, the average SITG size is the third of the time when it does not involve the non-defaulting CMs.

Figures 1 and 2 present the differences between the built up of the DW system in the two cases. In Figure 1 and 2 we can see the value of the DW without the value of the SITG, and also the value of the SITG. Both of them are in the percentage of the total DW. The difference is that in Figure 2 the SITG is smaller, since the non-defaulting members' DF contribution can be applied as well. We call the SITG in this case as adjusted SITG.

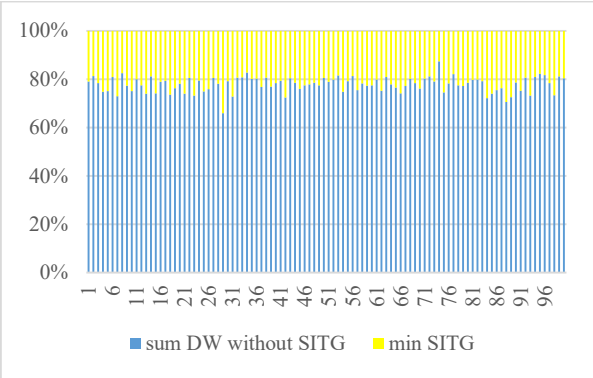

Figure 1: Default waterfall system setup covering losses without using non-defaulting members' contribution

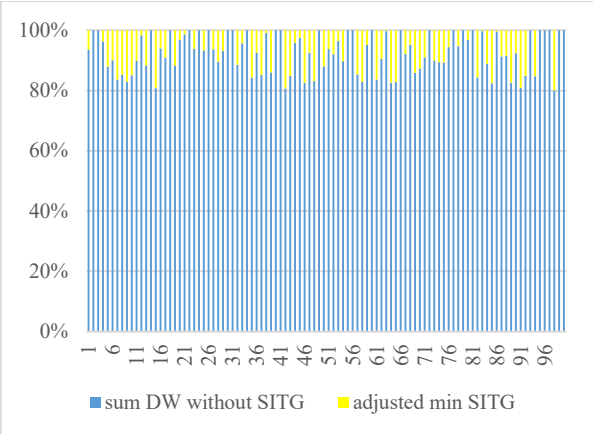

Figure 2: Composition of the default waterfall system including the non-defaulting members' contribution to cover losses

However, we ran the 7501st day's price change with the hypothetical parameters as +5% for the stock and -5% for the currency, we also study how the size of the SITG would change if we change these parameters from +/-15%.

Table 5: Sensitivity of the SITG and the adjusted SITG

	SITG		adjusted SITG	
Stock parameter	Currency parameter			
	-15%	**15%**	**-15%**	**15%**
-15%	52.97%	52.97%	49.15%	49.15%
15%	60.22%	53.56%	56.63%	48.70%

Table 5 shows the two extreme values of our results, namely when the stress parameters are +/-15%.

Looking at the results, it seems, SITG is a bit more sensitive to the change of the stress parameters if we try

to cover the losses including only the defaulting member's contribution; however, the difference is not significant. On the other hand, we can see that, based on our simulation, both SITG and adjusted SITG react symmetrically to the change in the parameter of the currency while the shock parameter of stock remains -15%. In contrast, if the stock stress parameter increases, the reaction on the negative side of the currency parameter is higher than on the positive side for both cases.

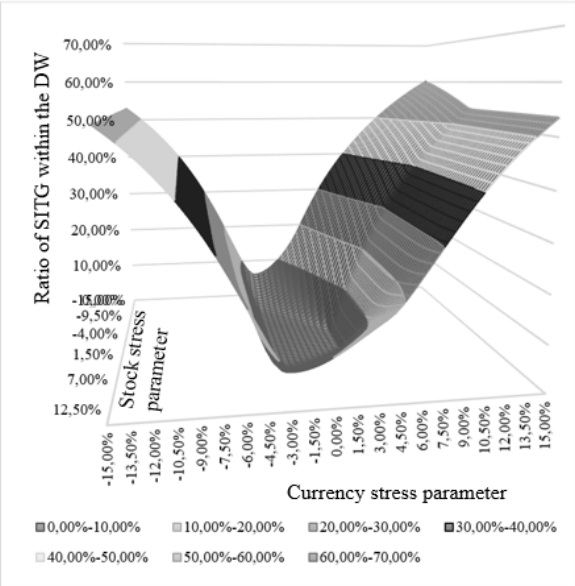

Figure 3: Sensitivity of the SITG

In Figures 3 and 4 we can see the SITG surface, which shows the minimum value of the SITG in the function of the stress parameter of the stock and the currency as well.

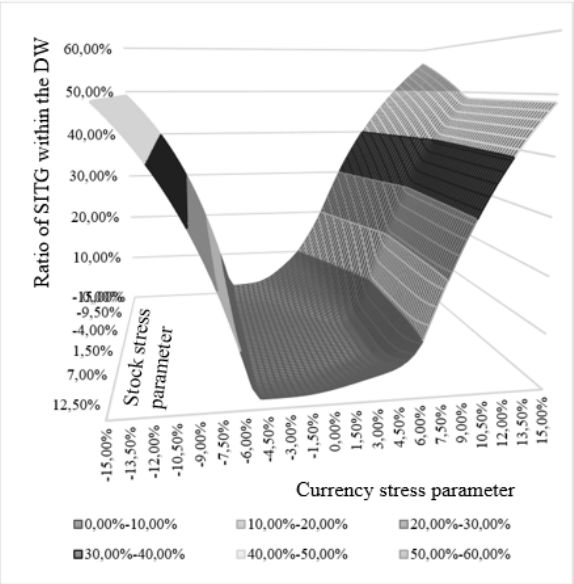

Figure 4: Sensitivity of the adjusted SITG

We can see, that till the shock parameters stay around the average shock parameters of the historical scenarios (based on the 100 simulations), the SITG stays very low, close to zero. As we start to increase the parameters, notably, the SITG will start to increase as well. The two most extreme values are presented in Table 5; we did not use parameters greater than +/-15%. Based on the historical stress parameters, we can suppose that these price changes are impossible to happen on a daily basis. Figure 3 and 4 highlight that the size of the SITG within the total DW system is less sensitive for the change of the shock parameters if we involve the non-defaulting members' contributions as well, since those can absorb the losses to a certain extent.

CONCLUSION

Assuming merged spot and derivative markets, we analyzed the size of the skin-in-the-game within the total default waterfall system from the point of view of how it can cover the defaulting member's losses. After running our model for 100 times, we quantified the SITG and showed the difference between the two cases: if we try to cover the losses excluding and including the non-defaulting members' default fund contributions as well. However, involving the non-defaulting members' money in the loss-absorption process may be unfair for them, but on the other hand, the CCP could maintain a much smaller SITG level. Our model demonstrates that the optimal level of SITG can highly depend on the risk-taking willingness of its clearing members, so the position it takes on the spot and derivatives markets. A CCP must operate a default waterfall system suitable for its risk profile and calibrate it, so it does not alter the CMs' incentives, mitigating the exacerbation of stress on the market(s) it clears.

REFERENCES

Berlinger, E., Dömötör, B., Illés, F., Váradi, K. 2016. Stress indicator for clearing houses. Central European Business Review.

Biais, B., Heider, F., Hoerova, M. 2012. Clearing, Counterparty Risk, and Aggregate Risk. IMF Economic Review 60, 193–222.

Carter, L., Garner, M. 2016. Skin in the game: central counterparty risk controls and incentives. JFMI 4, 39–54. https://doi.org/10.21314/JFMI.2016.056

Cont, R. 2015. The end of the waterfall: Default resources of central counterparties. Journal of Risk Management in Financial Institutions 8, 365–389.

Cox, R.T., Steigerwald, R.S. 2017. A CCP is a CCP is a CCP.

CPMI-IOSCO (Committee on Payments and Market Infrastructures-International Organization of Securities Commissions) 2014. Recovery of Financial Market

CPSS-IOSCO 2012. Principles for Financial Markets Infructures.

Daly, R. 2015. Do CCPs Need More Skin in the Game? Tradersmagazine.com 1.

Duffie, D. 2015. Resolution of Failing Central Counterparties, in Kenneth E. Scott, Thomas H. Jackson & John B. Taylor, Making Failure Feasible, How Bankruptcy Reform Can End "Too Big to Fail. Stanford, CA: Hoover Institution Press) Working paper.

EMIR – European Market Infrastructure Regulation: Regulation (EU) No 648/2012 of the European Parliament and of the council of 4th July 2012 on the OTC derivatives, central counterparties and trade repositories (EMIR - European Market Infrastructure Regulation) Available: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0648&from =EN downloaded: 8th February 2019.

ESMA 2012. European Securities and Markets Authority, Consultation Paper on Anti-Procyclicality Margin Measures. Available: https://www.esma.europa.eu/pressnews/esma-news/esma-consults-ccp-anti-procyclicalitymargin-measures downloaded: 8th January 2019

ESMA 2019. EU-wide CCP stress test. ESMA, February 2019.

FSB 2014. Key attributes of effective resolution regimes for financial institutions, October.

R&R CCP. 2019. General Secretariat of the Council. 2019. Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a Framework for the Recovery and Resolution of Central Counterparties and Amending Regulations (EU) No 1095/2010, (EU) No 648/2012, and (EU) 2015/2365 and Directives 2002/47/EC, 2004/25/EC, 2005/56/EC, 2007/36/EC, 2011/35/EU and (EU) 2017/1132. https://www.consilium.europa.eu/media/41614/st14540-ad01-en19.pdf.

Huang, W. 2019. Central Counterparty Capitalization and Misaligned Incentives, February. https://www.bis.org/publ/work767.htm.

Hughes, D., Manning, M. 2015. CCPs and Banks: Different Risks, Different Regulations. Bulletin.

Illés, F., Muratov-Szabó, K., Prepuk, A., Szodorai, M., Váradi, K. 2019. Together forever orseparated for life: Stress test of central counterparties in case of merged and separated markets. 33rd ECMS conference paper DOI: http://doi.org/10.7148/2019

Lopez, C., Saeidinezhad, E. 2017. Central Counterparties Help, But Do Not Assure Financial Stability. Munich Personal RePEc Archive.

Markose, S., Giansante, S., Shaghaghi, A. 2012. Too interconnected to fail", Financial network of US CDS Market: topological fragility and systemic risk. Journal of Economic Behavior and Organization 83, 627–646.

McPartland, J., Lewis, R. 2017. The Goldilocks problem: How to get incentives and default waterfalls "just right." Economic Perspectives, Federal Reserve Bank of Chicago.

Murphy, D. 2017. I've got you under my skin: large central counterparty financial resources and the incentives they create. Journal of Financial Market Infrastructures 5, 54–74. https://doi.org/DOI: 10.21314/JFMI.2017.073

Murphy, D., Nahai-Williamson, P. 2014. Dear Prudence, won't you come out to play? Approaches to the analysis of CCP default fund adequacy. ank of England Financial Stability Papers.

Pirrong, C. 2011. A Bill of Goods: CCPs and Systemic Risk. Journal of Financial Market Infrastructures 2, 55–85.

RTS – Technical Standard: Commission delegated regulation (EU) 153/2013 of 19th December 2012 supplementing Regulation (EU) No 648/2012 of the European Parliament and of the Council with regard to regulatory technical standards on requirements for central counterparties. Available: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri =OJ:L:2013 :052:0041:0074:EN:PDF downloaded: 8th January 2019.

Suprise, G. 2015. Skin in the game doesn't protect end client, CME says. GlobalCapital 106–106.

Szanyi, C., Szodorai, M., Váradi, K. 2018. A Supplement to the Regulation of Anti-Cyclical Margin Measures of Clearing Activities. Working paper SSRN 3242078.

Váradi, K., Béli, M. 2017. Alapletét meghatározásának lehetséges módszertana. Financial and Economic Review 16.

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