A MARGIN CALCULATION METHOD FOR ILLIQUID PRODUCTS

Marcell Béli
E-mail: beli.marcell@gmail.com

Csilla Szanyi
KELER CCP
Rákóczi street 70-72, Budapest, 1074, Hungary
E-mail: szanyi.csilla@kelerkszF.hu

Kata Váradi
Department of Finance
Corvinus University of Budapest
Fővám square 8, Budapest, 1093, Hungary
E-mail: kata.varadi@uni-corvinus.hu

KEYWORDS
Margin, central counterparty, illiquidity, IPO, counterparty risk, Value-at-Risk.

ABSTRACT
The role of the central counterparties (CCPs) on the market is to take over the counterparty risk during the trading on stock exchanges. CCPs use a multilevel guarantee system to manage this risk. The margin has a key role in this guarantee system, and the paper will focus only on this level. The main motivation of this paper is to introduce a potential margin calculation method which is compliant with the EMIR regulation and also does not put unnecessary burden on the market participants. We will introduce this method for two special type of products: (1) the illiquid products and (2) for the case of initial public offerings (IPOs). The specialty of these two product types, that there is no available historical time series of the securities’ prices, so no risk management models can be used by the CCPs to calculate the margin.

REQUIREMENTS OF THE REGULATOR AND MARKET PARTICIPANTS
The role of the central counterparties is crucial on the financial markets since all trades on stock exchanges are being settled through CCPs. In case of a trader’s default, the CCP ensures that the trade will be fulfilled for the other party. In order to guarantee this settlement, a CCP must have a waterfall system of guarantees, in which margin has a notable weight. Since CCPs’ effect on the market stability is important from risk point of view, the regulators turned towards them lately. According to this the European Parliament and Council has launched in 2012 the EMIR (European Market Infrastructure – 648/2012/EU) regulation. EMIR and its supplementation, the Technical Standard (TS – 153/2013/EU) containing the following requirements regarding the margin calculation method of the CCPs (EMIR Article 41, TS Chapter VI):
- General assumptions: ‘Margin shall ensure that a CCP fully collateralises its exposures with all its clearing members, … at least on a daily basis. A CCP shall adopt models and parameters in setting its margin requirements that capture the risk characteristics of the products cleared and take into account the interval between margin collections, market liquidity and the possibility of changes over the duration of the transaction.’ (EMIR, Article 41., 2012)
- Liquidation period: at least ‘two business days for financial instruments other than OTC derivatives.’ (TS, Article 26, 2013)
- Confidence interval: ‘for financial instruments other than OTC derivatives, 99%.’ (TS, Article 24, 2013)
- Portfolio margining: ‘a CCP may calculate margins with respect to a portfolio of financial instruments provided that the methodology used is prudent and robust.’ (EMIR, Article 41., 2012)
- Look-back period: ‘Initial margins should cover …exposures resulting from historical volatility calculated based on the data covering at least the latest 12 months … including periods of stress. Margin parameters for financial instruments without a historical observation period shall be based on conservative assumptions.’ (TS, Article 25, 2013)
- Procyclicality: ‘Applying a margin buffer at least equal to 25% of the calculated margin which allows to be temporarily exhausted in periods, where calculated margin requirements are rising significantly.’ (TS, Article 28, 2013)

In the literature several risk measures exist that quantify the risk, and could be applied by CCPs in order to fulfil the regulatory requirements. The two most common models are the Value-at-Risk (VaR) model (Jorion, 2007) and Expected Shortfall (ES) (Acerbi – Tasche, 2002, Acerbi et al. 2001) models. Both of the models have their advantages and disadvantages, for example the advantage of the VaR model, that it is easy to interpret; less data is enough to calibrate the model; it is not sensitive to the outlier data; easy to backtest (Acerbi – Székely 2014, Yamai – Yoshiba 2005), and it is elicitable (Ziegel 2014, Gneiting 2011). While the advantage of the ES is that it is coherent (Artzner et al. 1997, 1999, Pflug 2000, Frey – McNeil 2002, Acerbi – Tasche 2002), and can handle the fat tail risk (Yamai – Yoshiba 2005). Most of the CCPs uses these measures in their margin calculation models. For example KELER CCP applies the VaR model in their risk management system, with the following VaR parameters in order to fulfil the requirements of the
regulators: minimum holding period is 2 days, confidence level is 99%, the look back period is at least one year, and the procyclicality buffer is 25% (KELLER CCP, 2017).

Besides the regulatory requirements, there are needs of the market participants as well. These needs were identified by Béli – Váradi (2016), and they also provided a solution for the margin calculation, which calculation will be introduced in more details in the next chapter, now only the market needs and the solution are shown briefly:

- stable margin: using a margin band.
- easy to reproduce the margin, so only a few expert decision should be in the calculation: (1) creating margin groups, in which the assets have the same parameters; (2) using liquidity and expert buffers besides the procyclicality buffer, based on the result of the backtest; (3) defining stress in order to be able to calculate the look back period objectively.
- the margin should follow market trends efficiently: using exponentially weighted moving average (EWMA) standard deviation besides the equally weighted standard deviation during the calculation of the VaR model.
- automatic and objective procyclicality buffer management: procyclicality buffer exhaustion and build back based on the relative relationship of the two standard deviations (EWMA and equally weighted standard deviations).

This paper will be built on the model of Béli – Váradi (2016), so in the next chapter we will show the model in more details. The new findings in our paper are, that we will show how that model can be easily used for illiquid products and in the case of IPOs. We have chosen this model, because it fulfills every regulatory requirements and every need of the market participants.

MARGIN CALCULATION METHODOLOGY

In the model of Béli – Váradi (2016) the risk measure is the VaR, calculated with a delta-normal method (Jorion, 2007), where the assumption is that the logreturn of an asset is normally distributed. The parameters that are needed for the VaR model is the mean and the standard deviation. Since they use daily returns in their calculation, they assume that the mean is 0, while the standard deviation is being estimated from the one year look back period (assuming that it contained a stress event) in two ways, once an equally weighted standard deviation and once an EWMA weighted standard deviation. They always use the one, which gives the smaller VaR value based on Equation 1. Then they calculate the VaR for prices as well, according to Equation 2.

$$ VaR^\text{yield}_t = \min(\sigma_{\text{equal}}, N^{-1}(99%); \sigma_{\text{EWMA}}, N^{-1}(99%)), $$

$$ VaR^\text{price}_t = -P_t + P_t \cdot e^{\sqrt{VaR^\text{yield}_t}}, $$

where $T$ is the liquidation period, while $P_t$ is the price of the asset at time $t$, and $VaR^\text{price}_t$ is the Value-at-Risk at the day $t$, calculated on the price level. It means that this is the maximum loss one can have on a 2 days basis (requirement of the regulator) on a 99% significance level, expressed in HUF.

After this, they increase the value of the VaR with liquidity- and expert buffers according to Equation 3, which buffers change between every margin groups – the assets are being grouped into different margin groups in order to have as unified buffers as possible. The more risky an asset, the higher these buffers will be.

$$ KSzFmargin_t = VaR^\text{price}_t \cdot (1 + \phi) \cdot (1 + \theta), $$

where $\phi$ is the liquidity buffer, while $\theta$ is the expert buffer.

The next step is, that the procyclicality buffer is being taken into account as well, based on Equation 4, where $\pi$ is the procyclicality buffer.

$$ P\text{R}margin_t = KSzFmargin_t \cdot (1 + \pi), $$

Based on the regulation the procyclicality buffer can be exhausted if the margin would change notable due to market conditions. Béli – Váradi (2016) worked out a method, in which they exhaust and build back the procyclicality buffer in an objective way, and by keeping the margin stable (more details in Béli – Váradi (2016)). The following Equations 5, 6 and 7 show the method, which is based on the relative relationship between the equally and EWMA weighted standard deviations. If the EWMA standard deviation is higher than the equally weighted, the buffer can be exhausted, while the equally weighted is higher with 25% than the EWMA, then the buffer should be built back fully into the value of the margin, which will be called MINmargin.

$$ margin_{\text{pro-exhaustion}} = \max(margin_t - 1; KSzFmargin_t), $$

$$ margin_{\text{pro-build back}} = \min(margin_{\text{pro-exhaustion}}, PR\text{margin}_t), $$

$$ MINmargin_t = \begin{cases} \sigma_{\text{EWMA}}, \max \left( \frac{margin_{t-1} - 1}{KSzFmargin_t}; 1 \right) > \sigma \quad \text{if} \\ margin_{\text{pro-build back}} > PR\text{margin}_t \end{cases}, $$
The last step is, that the margin should be stabilized as much as possible, so they use a margin band – which is a certain percent above the MINmargin, and it is called MAXmargin – and till the margin do not reach one of the bands, that margin, which is effective on the market, will not be changed. In their model they have shown how it is working in case of liquid Hungarian stocks. We will introduce how it works in case of illiquid stocks, and IPOs. Their result can be seen in Figure 1 and 2 for OTP stock. On Figure 1 the relation of the two standard deviations can be seen, while on Figure 2 the margin calculation can be seen on different levels as it was introduced in the equations above.

**Figure 1: equally weighted and EWMA weighted standard deviation of the OTP**

**Figure 2: OTP margin**

From Figure 1 and 2 it can be seen, that the procyclicality buffer was exhausted in the case when the EWMA standard deviation was greater than the equally weighted standard deviation. For example in the period from the beginning of May 2015, the PROMargin is ‘visible’, which means, that the MINmargin is lower than the PROMargin, so, the procyclicality buffer is exhausted. Also it can be seen, that the margin was not changed as often as the KSzFmargin, PROMargin, MINMargin and MAXmargin are changing. It only changes when the margin reaches one side of the margin band (the MINmargin or the MAXmargin).

**MARGIN FOR ILLIQUID PRODUCTS AND IPOS**

Under illiquid products we mean those products, that didn’t have Instrument Liquidity Measure (ILM) – a weighted spread measure, calculated by KELEG CCP on an intraday basis. It is the same measure as the Budapest Liquidity Measure (BLM) (more information about BLM can be found in Kutas – Vég (2005) – for more than 200 days in the last 250 trading days. Based on this, these assets do not have a historical time series of closing prices, since there was no trading at all. Under IPO we mean the Initial Public Offering of a product, which is the first time in a company’s life, when they sell their shares for investors through a stock exchange for institutional investors and also for private investors. So based on this, there is no price history for these assets, since it was not publicly traded before the IPO.

In case of illiquid securities and IPOs, in order to deal with the lack of price history, we base margin computation on the past time series of a market product that can be considered average and represents the market, to replace the insufficient time series of these products. We have chosen the index’s time series for this purpose. In the case of the Budapest Stock Exchange’s (BSE) products the BUX index’s time series will be used, since the illiquid products and IPOs which we are analysing are traded on the BSE, and the index on that market is the BUX index. As margin determination is based on standard deviation parameters, as this is required to determine VaR, the BUX’s historical logreturns provide this standard deviation parameter. However, as the BUX shows the movement of the entire market, where liquid, less risky products are overrepresented, using such data to determine the margin would result in significant underestimation of risk. To solve this we will increase the margin parameters of the model, the liquidity-, expert buffers and margin band to 100%, but calculating VaR based on the data of the BUX index. For comparison, the parameters Béli – Váradi (2016) have used in case of the OTP are: liquidity buffer: 15%; expert buffer: 15%, margin band: 25%.

The specialty of the IPOs compared to the illiquid products, that one year after the IPO – if it is not an illiquid stock of course – there will be enough data to calculate margin based on the VaR model with those parameters that belong to the margin group, in which the asset is going to be grouped into. We decided to do it this way, because it is the most prudent approach by a CCP to assume that an IPO asset is in the lowest risk category, and handle it, as a risky illiquid product.

A key element of the methodology is that the starting margin value can be objective in the case of IPOs, if on the first day the margin is determined as the arithmetic
mean of MINmargin, and MAXmargin, computed in line with the above methodology (Equation 8).

\[
\text{margin}_t = \frac{\text{MINmargin}_t + \text{MAXmargin}_t}{2}, \tag{8}
\]

However, the computation of MINmargin is different than in the basic methodology, due to the lack of data, thus on the first day the PROMargin value will be the MINMargin value, according to Equation 9.

\[
\text{MINmargin}_1 = \text{PROMargin}_1, \tag{9}
\]

It is important to note that yield based VaR is computed from BUX values, but the price of the security is used to calculate the price based VaR, this is the reason why the margin will be different product-by-product.

There are no other changes in the methodology. Figure 3 and 4 illustrate the margin used in the case of the Update stock’s initial public offering under the new methodology. Figure 3 shows the value of the standard deviations that is the basis of the margin, while on Figure 4 the margin is presented.

The time series contain not only the IPO period, and the following one year, where the margin is based on the BUX index’s parameter, but the period after the first year is over, and the parameters are being estimated from the own price history of the Update.

As one year after the IPO the Update equities were listed in the Standard category on the BSE (based on the categorization of BSE (2016)), the drop in the margin after one year is due to the major decrease in buffer values. The Figure 3 shows that there was a big jump in the standard deviation data (November 2015) when standard deviation was computed based on the own past time series of the security, not the BUX index’s time series anymore. This increase in the value of the standard deviation should have been reflected in the increase of the margin in Figure 4, but it was offset by the decrease of buffers. Based on this we can conclude that it may be justified to use 100% buffer values in the case of all IPOs, as BUX presumably have lower risk than a newly listed product.

In Figure 5 we show the standard deviations of the BUX index for the whole analysed period. These standard deviations are needed for the margin determination for the illiquid products.
Figures 6 and 7 illustrate the margin determined in the case of illiquid products, with 100% buffers, for Finext and Őrimester. In addition to being illiquid, the Finext IPO took place in the analysed period shown in the figure.

**BACKTEST**

To analyse whether the margin methodology we are using is appropriate for margin determination or not we are using backtests. A model can be considered good, if the backtest gives back the same result as the level of the significance level, so the 99% in our model. We have to check whether the actual price change have exceeded the value of the margin or not for each day in the last 250 days. If the price change exceeds the value of the margin in more than 99% of the days, then the model can be considered as not adequate.

We perform the backtest in two different ways for each product. On one hand we check how many times the actual daily price change exceeded the margin applied in the past 250 trading days, and on the other hand we check how many times the actual daily price change exceeded the VaR value. In the case of VaR, the VaR computed with equally weighted standard deviation and the VaR with EWMA weighting are not checked separately, but always the lower value is used in the back testing, as this is the one used for margin determination also.

However, a high knockout number was expected in the case of illiquid securities and IPO during the backtesting of the VaR values, as VaR parameters are determined from the index time series that have a lower risk than in the case of illiquid securities and IPO, which needs to be reflected in the back testing. The use of higher buffers is designed to manage this risk.

The result of the margin backtest was 100% in the case of all the three analysed asset, as it can be seen in Figures 8, 9 and 10. In these figures the columns show the actual price changes, the two lines in the bottom of the figures are the VaR values, while the uppermost line is the margin. The columns never exceed the line of the margin.

In case of Update’s backtest in Figure 8 it can be seen that the actual price change exceeded the value of the VaR for several days. Altogether it happened 14% of the cases, so the result of the backtest is only 86%, which we have expected before the backtest, namely to not to reach 99%. So this confirms in the case of these products, that 100% buffers and the margin band were needed, and was sufficient both for illiquid contracts and IPO.

The backtesting of Finext is not possible according to Figure 10, since there was no trading activity in the security at all during the whole analyzed period.
CONCLUSION

We have built a margin calculation model for illiquid products and IPOs based on the model of Béli – Váradi (2016). Our model is easy to use, and understand, moreover the same methodology can be used as for liquid products. The new result of our model was, that we have estimated the parameters of the risk measure from an index’s time series, since for illiquid products and IPOs we do not have adequate data for parameter estimation. Also we have shown, that in case of IPOs it is necessary to handle the products the same way as we do in the case of illiquid products for risk reduction reasons. To handle the high risk level of these products, we have used 100% buffers, and margin band values to handle risk, which was proven by the backtest.

REFERENCES


AUTHOR BIOGRAPHIES

MARCELL BÉLI was a Market Risk Manager at KELER CCP. He graduated at Corvinus University of Budapest in 2014 and obtained the PRMT™ designation also in 2014. In his earlier research he investigated the Equity Premium Puzzle and connected areas.

CSILLA SZANYI is a senior risk controller at KELER CCP. She majored in finance at Corvinus University of Budapest, at the Department of Finance in 2010. Her main responsibilities at KELER CCP are market risk management on the cleared capital and energy markets, and the evolvement of the risk management framework considering the compliance with EU and Hungarian regulations.

KATA VÁRADI is an Associate Professor at the Corvinus University of Budapest (CUB), at the Department of Finance. She graduated also at the CUB in 2009, and after it obtained a PhD in 2012. Her main research area is market liquidity, bonds markets, capital structure of companies and risk management.