Journal of Financial Risk Management, 2022, 11, 142-153
https://www.scirp.org/journal/jfrm
ISSN Online: 2167-9541
ISSN Print: 2167-9533

COVID Impact to Equity Margin Loans—A Practical Approach to Measure Risk with the Client Behavior Assumptions

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How to cite this paper: Miao, R. L. (2022). COVID Impact to Equity Margin Loans—A Practical Approach to Measure Risk with the Client Behavior Assumptions. *Journal of Financial Risk Management, 11,* 142-153.
https://doi.org/10.4236/jfrm.2022.111007

Received: February 13, 2022
Accepted: March 12, 2022
Published: March 15, 2022

Abstract

Equity margin loan deals are loans to counterparties secured by collateral in the form of equities. Credit exposure arises when the equity collateral falls below the value of loan. During the life of the deal, the counterparty has to give more shares (or cash) to banks or brokerage houses in case of a fall in the share price, so that the level of the collateral amount stays approximately the same and does not deteriorate. The objective of this paper is to attempt to review the risks associated to margin loan deals and propose some suggestions to factor in certain margin call delays or liquidation uncertainties under the stressed COVID-19 situation. Moreover, we also showed a sample practical approach to measure the tail risk of margin loan which included the counterparty's likely behavior under stress and used a callable bond pricing logic to assess the likely time and moral hazard problem of the counterparty to walk away from margin loans.

Keywords

Equity Margin Loan, COVID, Behavior Assumption, Tail Risk, Moral Hazard

1. Introduction

Equity margin loan deals are loans to counterparties secured by collateral in the form of equities. Credit exposure arises when the equity collateral falls below the value of loan. During the life of the deal, the counterparty has to give more shares (or cash) to banks or brokerage houses in case of a fall in the share price, so that the level of the collateral amount stays approximately the same and does not deteriorate.

Conversely, banks or brokerage houses may have to release some shares (or

some of the cash that had been posted by clients through rebalancing) following a significant rise in the share price.

Such deals also have stopping conditions: if the share price falls to a very low value or crash, the deal terminates and the counterparty has to return the cash back to banks or brokerage houses.

Pricing: Xia and Zhou (2007) are pioneers in solving the margin loan problem. They valued margin (stock) loans using the classical GBM model and a purely probabilistic approach. Zhang and Zhou (2009) then extended their framework to a regime switching model and solved the problem using variational inequalities. Dai and Xu (2010) studied the margin loan problem with finite maturity under GBM, and Siu, Yam and Zhou (2016) considered margin loans with callable feature.

There are also some other researchers investigated margin loan valuation problem with jump-diffusion models. Huang et al. (2012) have also discussed the equity margin loan business in China market. However, we found there are very limited papers focusing on the discussion of how to quantify the risks of margin loans. Although margin loan deals usually have risk mitigation mechanisms, these risk reducing mechanisms are not enough to make the deal riskiness: if there is large crash in the share price and the counterparty walks away (for non recourse deals the counterparty has the right to walk away, for recourse deals the counterparty might default due to moral hazard issues), FIs might have to sell the collateral shares in the market and accordingly make a loss.

In just a few months, Coronavirus Disease 2019 (COVID-19) has spread quickly around the world, its effect on global economies profound yet not fully known. Recently, a frenzy of selling has caused sharp declines in virtually all asset classes, with a sweeping wave of margin calls and forced liquidations in the market since March 2020. More recently, the collapse of the hedge fund Archegos Capital sent shock waves throughout Wall Street, with shares sent crashing, and calls for increased oversight of the banking industry. Archegos faced off with its prime brokers in late March 2021 as they demanded collateral to cover the fund's exposure on swaps it had purchased on Viacom CBS and other technology stocks. Archegos failed to meet the margin calls, prompting a massive $20 billion fire stock sale as the banks, or at least some of them, rushed to sell off the fund's positions to make cash so that Archegos could pay what was owed. Therefore, we think margin loan risk measurement is worth reviewing under COVID-19 stress scenario and their limitations need to be discussed.

The paper first summarized the key deal features of margin loans. Then we presented another recent case from India which could be a good reference for our studying later. Amidst the outbreak of COVID-19, the Bombay High Court ("Court") in the recent case of Future Group Wholesale Limited ("Plaintiffs") v. IDBI Trusteeship Services Limited ("Defendants"), granted an ad-interim relief to Future Group, restraining their lenders (UBS AG) from selling the shares pledged to them. The shares, when pledged, were listed at close to INR 350 per share and fell to below INR 100 thereby severely breaching the security cover

agreed with the lender causing the lender to invoke and sell the pledged shares, which has been, at least temporarily, been restrained by the order of the court.

We are not going to focus on the legal part about above case in our paper. Instead, we would like to highlight these legal uncertainties under COVID-19 when we assess the risk of margin loans and try to quantify the potential impact to FIs.

We feel the COVID-19 pandemic event is an opportunity for all the stakeholders in FI sector to revisit their contractual obligations and the related models used. It will help each FI functions crystallize their respective rights and obligations so that they are better prepared for a COVID-19—like situation in the near future.

The objective of this paper is to attempt to review the risks associated to margin loan deals and propose some suggestions to factor in certain margin call delays or liquidation uncertainties under the stressed COVID-19 situation. Moreover, we also showed a sample practical approach to measure the tail risk of margin loan which included the counterparty's likely behavior under stress (moral hazard risk) and used a callable bond pricing logic to assess the likely time of the counterparty to walk away from margin loans.

2. Deal Features

2.1. Deal Definition in Brief

At $t = 0$ FIs lend cash to the counterparty (the Loan amount) and receive collateral as a guarantee number of shares N_0, such that

$$N_0 \times S_0 \times \text{Initial LtV} = \text{Loan Amount} \tag{1}$$

Here S_0 is the equity price at time zero and the ratio between the loan amount and the collateral shares value is called Loan to Value (LtV).

FIs also receive fees for the service provided to the counterparty (typically the fee is paid every 3 months or 6 months in arrears).

Now we are going to turn on the attention to the deal features, whose purpose is to reduce the risk FIs face *i.e.* the share equity price following down and FIs have to sell out the shares in the market which could make a loss. There are also additional features force the counterparty to return shares (or cash) when the value of the shares becomes too small (when LtV hits the margin trigger level in the contract). Note that FIs usually would need to release shares or cash to client when the LtV becomes too large.

Also in the case of trigger events (e.g. one day move of −25% or worse, equity price below 50% of the original price, weekly move of −30% or worse etc.), the deal terminates early.

2.2. Margin Calls and Rebalancing

There is a signal for re-balancing when the share price moves in such a way that the LtV falls outside the range [Initial LtV $-X_1$%, Initial LtV $+X_2$%] (where X_1 and X_2 are specificed in the contract). In that case, FIs need to call or release

shares or cash in order to bring back the LtV to the contract reset value.

The LtV is:

$$\mathrm{LtV}(t) = \frac{\text{Loan Amount} - \text{cash account}(t)}{N(t) \times S(t)} \tag{2}$$

where the cash account is the net value of the cash posted by counterparty through margin calls since the beginning of the deal. The cash account cannot be negative and its initial value is 0. The numerateor in the formula for the LtV is the Cash at Risk and is always smaller than the Loan Amount. Typically the margin call process will need 2 business days.

Counterparty could post either shares or cash for margin calls. And usually in the contract, there are a maximum number of shares counterparty can post. So when the limit in the number of shares is hit, the remaining of margin calls should be done by cash only.

2.3. Stopping Rules

As mentioned in the introduction, the deals usually have some features whose goal is to offer banks or brokerage houses more protection: in case of the share price behaving in a worrying way, the deal could be terminated early and FIs could exchange loan amount and shares early.

Typically, the stopping rules are:

1) if the share price falls more than 25% in one day.

2) if the share price falls below 50% of its original value.

Not all the deals have such features and the different stopping rules could be copes differently in the risk measurement. Typically in China stock market, all share prices need to follow the 10% daily up/down limit for each single stock, hence the daily stock price trigger could be replaced by weekly price drop.

3. Case Study from Indian Stock Market

Indian household consumer retail company Future Retail Limited's (FRL) market capitalization eroded by 71.2% (in INR terms) year to date (June 5), due to the onset of the pandemic and even more so the six notch rating downgrade by rating agencies that occurred through April 23 (see **Figure 1**). The downgrade was driven by an increase in gross debt (pro-forma) by 2.2x since March last year to USD 864 million, sale of pledged shares, malicious rumors, and the freeze of operations of most of its stores because of the lockdown (N.D.A., 2020).

1) **Facts**: Pursuant to Debenture Trust Deed dated January 12, 2018 and April 4, 2019 ("Debenture Trust Deed"), Future Group Wholesale Limited ("Borrower") had borrowed a sum of about INR 6.1 billion from IDBI Bank and UBS AG London Branch ("Lenders") by issuing debentures. Future Corporate Resources Private Limited ("Future HoldCo"), being the promoter of Future Retail Limited and the Borrower, pledged the 8% equity shares of FRL ("FRL Shares") to secure the debentures.

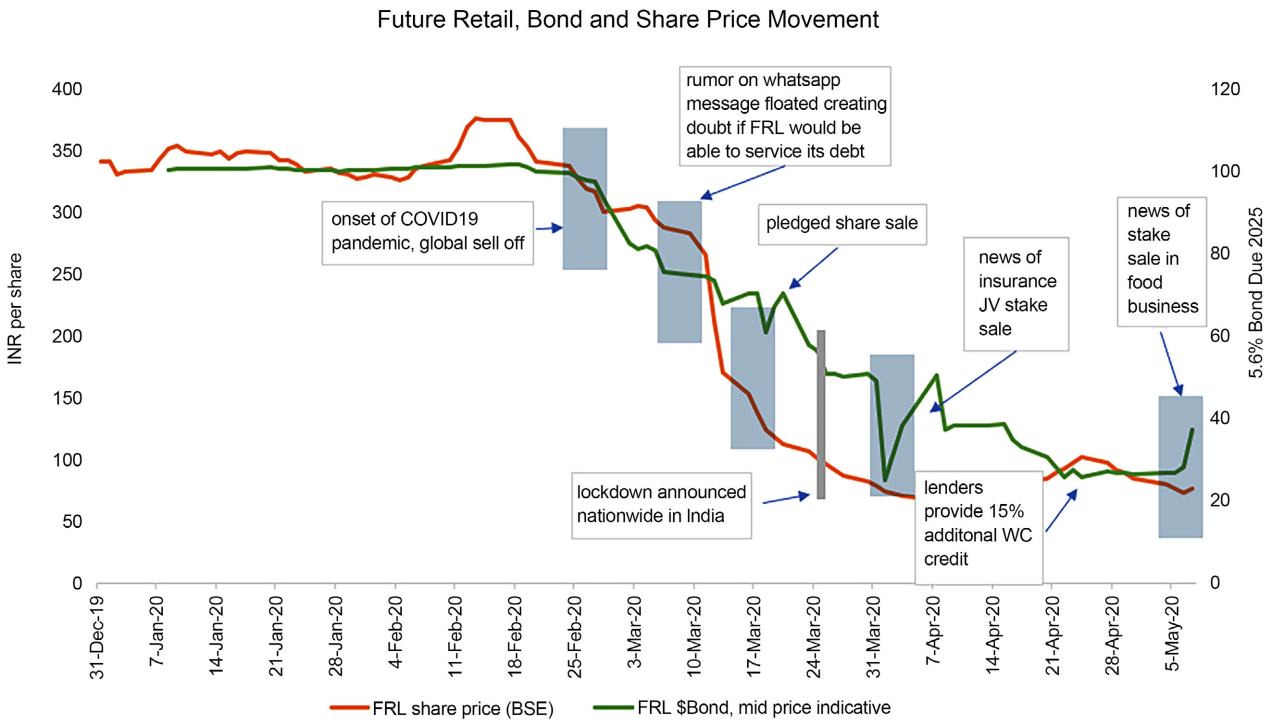

Figure 1. Future retail share and bond prices (data from Bloomberg and BSE).

2) **Security cover breached**: At the time of Debenture Trust Deed the price of FRL Shares was INR 350 per share. Owing to the outbreak of COVID-19 the share market collapsed FRL Shares declined 76.4% from INR 350 to 80.6 on May 8, creating a mark to market losses of INR 4.796 billion (estimated, see **Figure 2**), which breached the agreed upon security cover in the DTD. As the price of FRL Shares fell, the Lenders through their debenture trustee, issued notices of default to FCRPL and Future Group because of latter's inability to maintain the minimum-security cover stipulated in the Debenture Trust Deeds.

3) **Covid-19 caused the security cover breach**: In view of above, the Borrower and Future HoldCo filed an application before the Court seeking to restrain the Lenders from selling FRL Shares in the market. The Borrower argued the collapse in the share market was due to the present COVID-19 situation and if FRL Shares are sold in this situation, irreparable loss will be caused to the Future Group.

4) **Lender left exposed**: On the other hand, the Lenders argued that though they have to recover from the Borrower INR 6.1 billion, the value of FRL Shares is presently not more than INR 3.5 billion. Hence, there can be no question of granting any restraining order.

5) **The court**, however held that considering the present situation of market and COVID-19, ad-interim protection should be granted to the Plaintiffs till next date of hearing and restrained the Lenders from selling the FRL Shares on March 30, 2020. The Bombay High Court also suggested Rural Fairprice Wholesale Ltd. to consider providing additional security to its lenders. Despite the Future Retail group making a proposal to offer a charge on an immovable property

IDBI pledge share sale Illustrative pledged shares calculation (in mn) *(pre warrant conversion)*	
FCRPL shares in FRL	222.55
Holding in %	44.28% *Dec. 31, '19*
FCRPL stake encumbered/pledged	8.00%
# shares pledged	17.80
Pledge @350 / share	6,231.46
MTM @ 80.6	4,796.45 *May 4, '20*

Figure 2. Estimated mark to market loss (data from BSE).

as additional security, UBS AG stated that the proposed additional security is not "commercially viable," according to a May 15 order by the Bombay High Court. The Bombay court is hearing arguments on whether the stay on enforcing the share security should continue.

While the India government through a notification has clarified that the COVID-19 pandemic is a force majeure event, this relief does not in most cases impact the repayment obligations of the borrower under the financing documents as most loan-related contractual agreements don't have force majeure clause. For lenders, a payment default by a borrower could trigger a number of other events of default across the financing documents. This could include occurrence of material adverse event, breach of financial ratios, failure to comply with underlying project documents, and inability to achieve commercial operations on time, among others.

When addressing margin issues or liquidation processes in the current market, it is important to anticipate the litigation and business issues that may arise especially in different jurisdictions. While every situation is unique and presents new or different challenges, the following suggestions are worth considering for FIs to well estimate the tail risk under COVID-19 for margin loan risk models:

1) Risk measures to be chosen.

2) Conservative behavioral assumptions both for borrowers and local regulators under COVID-19, and possibly extend the time required for liquidation.

3) Possible assumption review of block sales and its discount.

4) Choose Stock Price Process which could capture large movements.

4. Practical Model

We now start to show our proposed practical model below:

4.1. Risk Measures to Be Chosen

Given the nature of these deals are over-collateralized, the loss distribution (at a 1 year horizon) from Monte Carlo simulations is such that with a high probability with zero loss. But there is a small probability of a large loss. It's therefore a tail risk of the loss distribution that we want to measure, and the two obvious possibilities are VaR and ES.

Most of the financial institutions use VaR approach to estimate the potential risk. The historical simulation could not reflect the fat tail risk of these deals and not able to factor in the margin call processes and other mitigation in placed to protect the lenders.

Given the fat tail of the loss distribution, ES will give FIs more information about the extreme scenarios since by definition it is the average of the most extreme losses.

4.2. Behavioral Assumptions

In principal, if counterparty always meets its obligations in the contract the lender will never make any losses. Actually this is not always true. Counterparty sometimes walks away due to his/her financial pressures. So the lenders need to make some assumptions about the counterparty's behavior when they are measuring the tail risk from the margin loan deals.

Below proposal is similar to the logic for investors to judge when the issuer will call back their callable bonds.

How will the counterparty behave when the shares value is worth less than 95% of the cash at risk?

If at any time, the shares value posted by counterparty is worth less than 95% of the cash at risk, the possibility of the counterparty walks away will be high.

In that case the lender would need to sell all the collateral shares in the market-negotiation with counterparty about him/her buying back some of the shares is not possible.

The rational behind the assumption is that the only thing that keeps the counterparty in the deal is the fact that we owe him/her more than he/she owes us. We assume 95% rather than 100% to model the counterparty's attachment to the deal. As they might consider the relationship with banks or brokerage houses and don't want to walk away at the first opportunity.

Analyze the amount of cash the counterparty is willing to spend during the COVID-19 (from lender's point of view)

The counterparty might have to give lenders some cash in case of margin calls under current market environment. Depending on their financial situation (and on many other things!), when they have to post cash they either do it or they refuse/cannot meet their obligations and the deal terminates.

Let's call **Client's Cash** the maximum cash amount the counterparty is ready to post as collateral during the life of the deal before they decide to walk away. Clearly if it is zero, the deal terminates at the first time they are required to post cash (which might be in an early stage, so that the deal's effective duration will be short and FIs would not take much risk by dealing with such a counterparty). If the deal is likely to terminate early because of a first time margin call, the likelihood of losing money for the deal may be small as lenders could exit the deal and liquidate the equity shares earlier than peers.

Similarly, if Client's Cash = Loan Amount, FIs would usually face less risk as the counterparty would always meet their obligations. So it is usually for inter-

mediate values of Client's Cash that the deal is more risky.

Hence FIs may need to estimate the Client's Cash amount in their own risk models, as different cash amount will generate different losses.

What happens in case of early termination?

In case of early termination, FIs (lenders) are left with shares which might crash anytime, and the counterparty is not willing to return the cash. But, depending on the market conditions, counterparties may be willing to post additional non-cash collateral like property or other assets to keep the deal not early terminated.

The negotiation with the counterparty (for them to buy back shares and repay the loan) can take a couple of days to few months. And the enforce process may take longer esp. under COVID-19 like the India case above. Currently lot of regulators have already imposed some policies to support the affected corporate negatively impacted by COVID-19. While the majority of margin agreements provide FI lenders with broad discretion and flexibility in issuing and enforcing margin calls, forced liquidations (or selective enforcement) may result in substantial litigation as well as significant business concerns. In the case of forced liquidations, counterparties may reach out to attorneys, who may examine the margin issues and other aspects of the counterparty's investments and potential losses to determine if legal claims can be asserted (including, e.g., why the customer was concentrated in one security or leveraged to the degree that a call could be triggered).

FIs' internal risk models shall have the flexibility to adjust the time lags between counterparty defaults and the start of liquidation.

4.3. Possible Assumption Review of Block Sales and Its Discount

A block trade is the sale or purchase of a large number of securities. A block trade involves a significantly large number of equities being traded at an arranged price between two parties.

However, in order to make expert judgment about the possibility to liquidate the collateral shares based on block sales, below points need to be analyzed:

1) Information about the potential brokers in the region which could be engaged as liquidation agent.

2) Historical track records of liquidation based on block sale in the region (size of block sale and discount/premium rate in each sale).

3) Floating share ratio in comparison to peers in the region.

4) Conduct stress scenario tests for the collateral shares.

Under COVID-19, the global economic has been slowdown. Risk-off sentiment will largely affect the potential block sale discount for certain stocks. Hence we would suggest FI lenders to review their block sale discounts in their models if any.

4.4. Stock Price Process to Be Chosen

The modeling of the stock process is crucial in analysing risk for margin loans.

Indeed, a stock following a lognormal process would not create material losses, because losses happen when the stock falls down by a large amount relatively quickly.

In addition to the "fat tails" of common stock returns, revealing above-normal chances of large price changes, there is asymmetry in large stock price changes. While the normal distribution is, by definition, symmetric and has zero skewness, returns on most of the major stock indexes have negative skewness. Thus, large price declines are more likely to occur than equally large price increases (see Figure 3). This suggests that there are some forces exacerbating price declines. Moreover, stock volatility is higher in bear periods, lower in bull periods.

FIs may improve their risk models via change the stock price process from GBM to stochastic models.

4.5. A Practical Approach to Measure the Tail Risk

We will mainly focus on non recourse deals in our model below as we could make a post deal adjustment to the loss distribution of the non recourse version of deals for these recourse one. That adjustment will take into account of the default probability of the counterparty, the recovery rate, and the correlation between the counterparty's default and the collateral crashing.

Moreover, in our sample approach, we assumed the stock is following the t-GARCH(1, 1) process below:

$$\begin{cases} \sigma_n^2 = \alpha\left(\sigma_{n-1}\phi_{n-1}\right)^2 + \beta\sigma_{n-1}^2 + \gamma\sigma_{LT}^2 \\ S_n = S_{n-1}\exp^{-\frac{\sigma_n^2}{2}\delta t + \sigma_n\phi_n\sqrt{\delta t}} \end{cases} \tag{3}$$

where ϕ_n is drawn from a t-distribution with specified degree of freedom and variance one, $\delta t = \frac{1}{260}$, S_n is the stock price at n business dates after $t = 0$. (α, β, γ) are the GARCH parameters, and σ_{LT} is the long term vol.

Note that for simplicity we assumed that the physical drift is zero, interest rate is the same as loan rate, and that we use the log-Euler discretisation method.

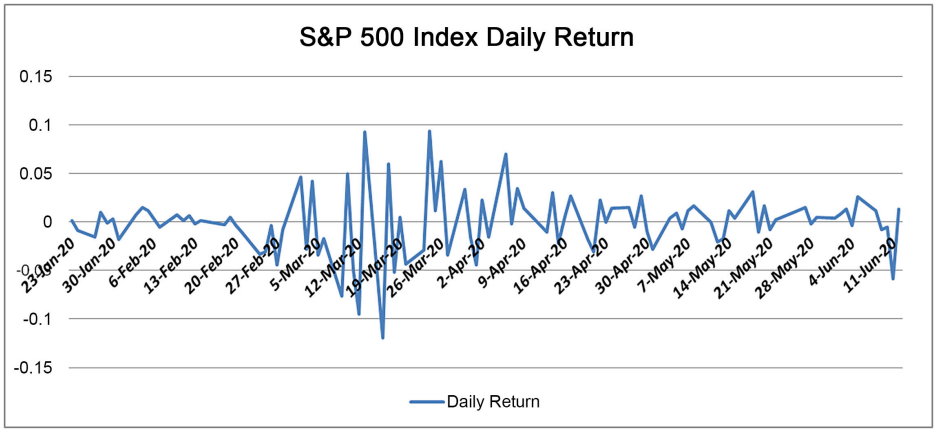

Figure 3. SP500 Index daily return since COVID-19 (data from Yahoo Finance).

The justification for such a process is that we are interested in both large moves and clustering. We model large moves by t-distribution and clustering by GARCH(1, 1). One could have made other choices like uncertainty process etc. But our choice here keeps the number of parameters to evaluate relatively low.

We will use 99.73% confidence level for the Expected Shortfall. And please note for t-distribution with 5-degrees of freedom, the following holds: ES(99.73%) = VaR(99.9%).

In order to estimate the **Client's Cash** in the model, we firstly assume the Client's Cash is a random drawn from an admissible range (x − 10% × Loan Amount, x + 10% × Loan Amount): we want to find x to determine the range for possible values of the Stop Loss.

Our approach is conservative and gets around the estimation issue: we estimate the risk (the expected shortfall) for different values of x and we assume the worst. For a given deal, our expected shortfall is the worst one over all possible values of x. In mathematical terms, the reported risk for a deal is ES*, defined as

$$\mathrm{ES}^{*} = \min_{x} \mathrm{ES}(x) \tag{4}$$

where ES(x) means that for each simulation, the stop loss is randomly drawn from the range defined by x.

The above approach is a mixture of worst case scenario approach (this approach assumes the worst when faced with uncertainty) and of a stochastic approach (for each simulation, the stop loss is simulated within a range).

Stock liquidity is also a consideration for us to estimate the liquidation process. We assume it is 25% of the Average Daily Traded Volume (ADTV), where the ADTV can be estimated from Bloomberg data. In case of the crowdedness (other similar sell pressure in the market), the number of shares we can sell per day should be adjusted. For simplicity, we don't factor in the potential block sales in the liquidation. And this part could be discussed separately.

The expected shortfall is of course smaller if the time required to sell the shares is short. We assume that the shares are sold off evenly throughout the selling period, and so at a value inferior to the mid value to reflect the transaction costs.

Our PnL is then 0 if the money made by selling the collateral shares is greater than our cash at risk, and the difference between the two otherwise. It is in that later situation that we make a loss.

It's worth noticing that the PnL has a payoff similar to the payoff of a discrete Asian put option.

4.6. Numerical Example

We will present a case study here (Table 1).

Loan Amount = 150,000,000

$T = 1$

LtV = 50%

Table 1. ES as a function of Stop Loss.

Average Stop Loss	ES
18.7 m	−10.45%
28.1 m	−11.42%
32.8 m	−12.01%
37.5 m	−11.65%
75 m	−10.99%
112.5 m	−8.44%

Lower bound for LtV before rebalancing = 40%

Upper bound for LtV before rebalancing = 60%

Initial number of shares = 12,000,000

Minimum number of shares = 11,000,000

Maximum number of shares = 13,000,000

For the liquidity, we assume we call sell up to 500,000 shares per day.

Two business days are necessary between signal for rebalancing and actual rebalancing. One could make the days required longer for some uncertain regions or weaker deal structures.

Now for the process parameters: $\sigma(t=0)=\sigma_{LT}=0.5$ (both the short-term and long-term volatility are 50%).

The other process parameters are: $\alpha=0.06,\beta=0.93,\gamma=0.01$ and the degree of freedom for t-distribution is 5.

The Stop Loss effect

Sensitivities

With sigma = 0.4, ES = −5.35%.

If we can sell 1 million shares per day, ES = −6.9%.

If the mid LtV is 60% (with collateral lower and upper calls at 50% and 70% respectively), ES = −23.84%

5. Conclusion

We have studied a recent case from India capital markets that might be useful as a good reference for margin loan business risk measurement under COVID-19. Later we reviewed the key features in a margin loan deal and proposed some improvements for FI lenders to better quantify the tail risk associated to non recourse margin loan deals.

We later showed a sample approach based on our suggestions to quantify the tail risk associated to non recourse margin loan deals. The most important inputs for these non recourse deals are LtV, the volatility of the equity, and its liquidity. The model behaves as we expect it to do in terms of sensitivities, satisfying the properties we want to have for stock prices (fat tail and clustering). More importantly we have made some reasonable and conservative assumptions about the couterparty's behavior. Our model could be further enhanced by hav-

ing more accurate stock pricing processes (like stochastic models) and analyze the block sale discount within different markets as different markets have different depth and liquidity.

We think this is a good chance to review the related risks and models for margin loan and prepare for COVID-19 similar cases in future.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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