Value at Risk 2.0: news anchor or fortune teller?

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VAR 2.0

In this point of view (POV) document, we capture the behavior of VAR during a crisis and weaknesses to which banks are exposed to using the current approaches. We also evaluate various regulatory measures to address these weaknesses and discuss their shortfalls. In the end, we provide suggestions to compute forward-looking VAR as an alternative to current backward-looking approaches

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Background

History repeats itself is a common adage in our world. The financial world also uses this as an assumption in designing various pricing and risk management models. However, the recent COVID-19 crisis has once again brought this assumption under the spotlight. The COVID-19 crisis has hit the financial market hard in ways which are far worse than the 2008 global recession. We are seeing some unprecedented events like the UK selling three-year bonds with a negative yield for first time ever and price for early US$ 2021 contracts surged above 100, indicating a negative interest rate (Source: Bloomberg[1]). Similarly, oil prices for WTI May future at CME went deep into the negative territory.

Every crisis in the past has brought disruption not only in people's lives but also in the ways we think. The disruption leads to thinking outside the box and questioning things which were taken as status quo. One such crisis in 1987 brought a disruption in risk management when value-at-risk (VAR) was introduced as a risk metric. On the other hand, the current COVID-19 crisis is leading to the question of the accuracy and efficacy of VAR as a risk management tool and as an input to capital computation.

VAR measures the maximum loss in value of a portfolio over a predetermined time period for a given confidence interval. Using a probability of 99% percent and a holding period of 10 days, an entity's value at risk is the loss that is expected to be exceeded with a probability of only 1% during the next 10-day period.

[1] Source: https://www.bloomberg.com/news/articles/2020-05-07/negative-u-s-policy-rate-seen-by-early-2021-in-futures-market

Current approach

Soon after its introduction, VAR became a widely used risk metric across banks. One of the major reasons for increased use of VAR was its ability to compress the riskiness of the portfolio to a single number which makes it comparable across different portfolios. VAR is also used to set the trading limits and if the losses breach the VAR limit, traders may have to close the position. But VAR is not only used in risk management but as per Basel 2.5 guidelines, it is also used (along with stressed VAR) to calculate the required market risk capital. Hence VAR is a very crucial tool used across banks.

There are three approaches to compute VAR – historical simulation method, monte carlo simulation method and parametric approach. Historical simulation method is the most favored method within banks while the parametric approach is rarely used. In the historical simulation method, VAR is computed using returns for past 252 days. In monte carlo simulation method, instead of using the historical data for the returns of asset, the returns are generated using underlying stochastic model, e.g., Geometric Brownian Motion (GBM) is used to forecast stock prices. However, the parameters of these processes are calibrated using historical data only.

In order to check accuracy of VAR models, the banks perform back testing to compare calculated VAR with actual P&L movement. The number of breaches allowed will depend on confidence interval assumed while computing VAR. If VAR was computed at 99%, it is expected to have two to three breaches in a year. Number of breaches more than expected numbers lead to penalty on capital as per Basel's traffic light approach.

VAR: A backward-looking and procyclical tool

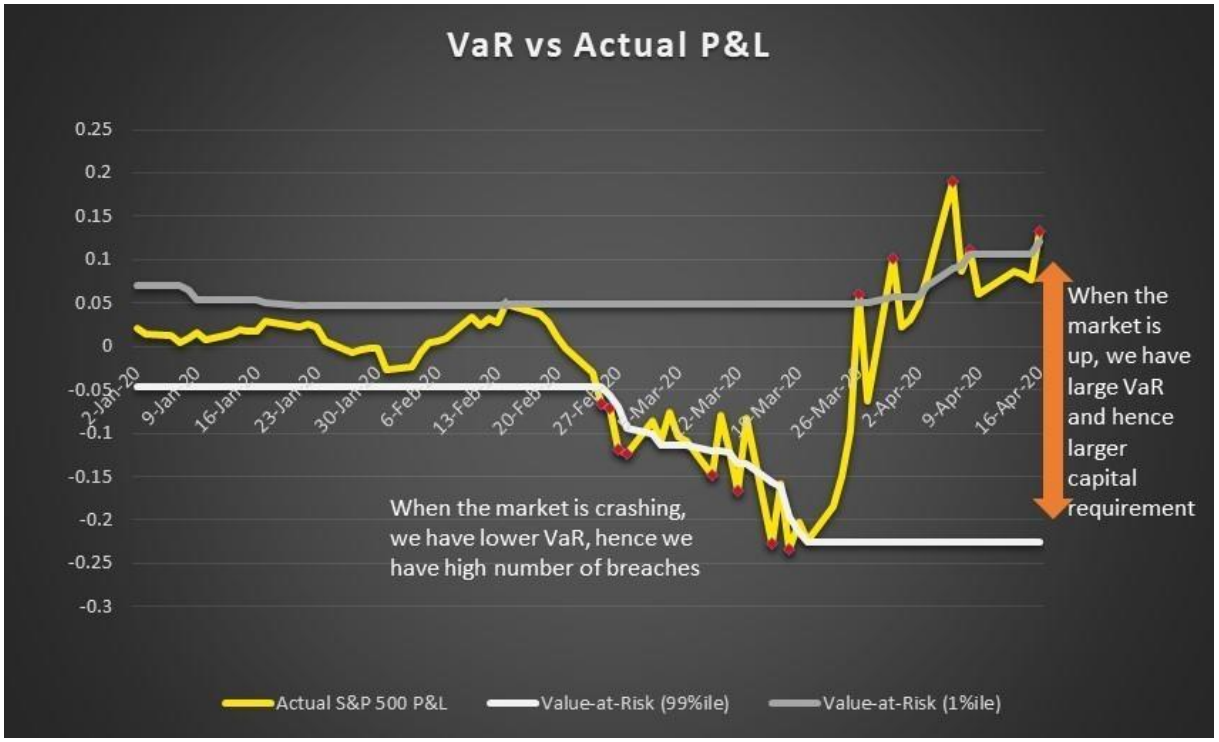
Recent coronavirus pandemic has caused extreme downfall in global markets and this has led to several banks breaching their VAR. In recent fillings, HSBC reported 15 VAR back testing breaches during Jan-Mar 2020 period while BNP Paribas reported nine such incidents for the same period. Other firms including ABN Amro, Deutsche Bank and UBS have also reported such back testing outliers (Source: Bloomberg[2]).

The issue here is that VAR is calculated using the historical data and assumes that the future will follow the same pattern as the past. Hence it is backward looking. It is also procyclical, which means that before the crisis when the higher capital is required, VAR is under-estimated and hence the market risk capital requirement is low. In the same way, when the crisis has passed and banks are required to free up the capital to inject liquidity in the market, we see high VAR numbers and high capital requirement.

This can be clearly seen in the below graph where we have shown the VAR and actual P&Ls of a hypothetical portfolio consisting of S&P 500 basket. We can see that when the market crashed in March 2020, VAR was lower. Later, even when the market has started to recover, VAR continues to remain very high. The graph also depicts multiple breaches during March when P&L losses were higher than VAR.

[2] Source: https://www-bloomberg-com.cdn.ampproject.org/c/s/www.bloomberg.com/amp/news/articles/2020-05-06/hsbc-bnp-repeatedly-breached-trading-limits-in-market-mayhem

Figure 1: VAR and P&L for hypothetical portfolio



It is observed that risk managers have also become over reliant on VAR and they fall into the false security till VAR continues to remain within limit. However, traders can take excessive but remote risk while keeping their portfolio within VAR limit as this does not capture the tail risk. For example, in the recent crisis, trading losses at the US units of Deutsche, RBC exceeded VAR by 1,000% (Source: Risk.net[3]). This weakness will be addressed by considering expected shortfall once banks move to FRTB as discussed in next section.

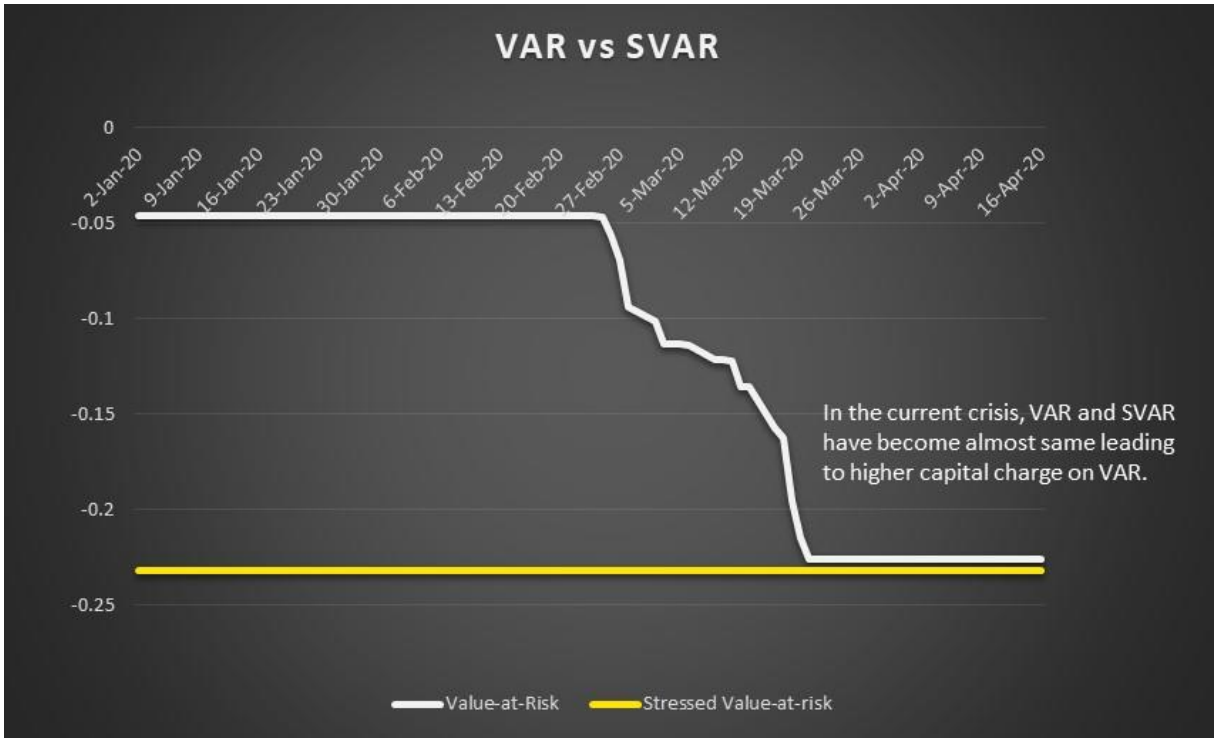
Regulatory approaches and impact of VAR on market risk capital

Regulators' approach towards shortcomings of VAR have been reactive rather than proactive. After 2008 recession, Basel committee introduced SVAR (stressed VAR) as many banks fell short of the required capital. The idea behind SVAR was that under stressed conditions, banks may require more capital, and such capital requirements aren't fully captured in normal value-at-risk calculations.

However, during the crisis when the market collapses, this creates an issue of double counting as banks' VAR numbers increase to the level of SVAR to reflect the losses during crisis (Figure 2). Further, more back testing breaches are observed during crisis increasing the multiplier and leading to additional capital requirements. For example, due to excess breaches observed by ABN AMRO in the first quarter of 2020, capital multiplier increased to 3.5x from 3x. As a result, its capital charge was 57% higher than three months prior (Source: Risk.net[4]).

[3] Source: https://www.risk.net/risk-quantum/7545691/trading-losses-at-us-units-of-deutsche-rbc-exceed-var-by-1000
[4] Source: https://www.risk.net/risk-quantum/7544816/six-var-breaches-at-abn-amro-in-q1

Figure 2 VAR and SVAR of a hypothetical portfolio

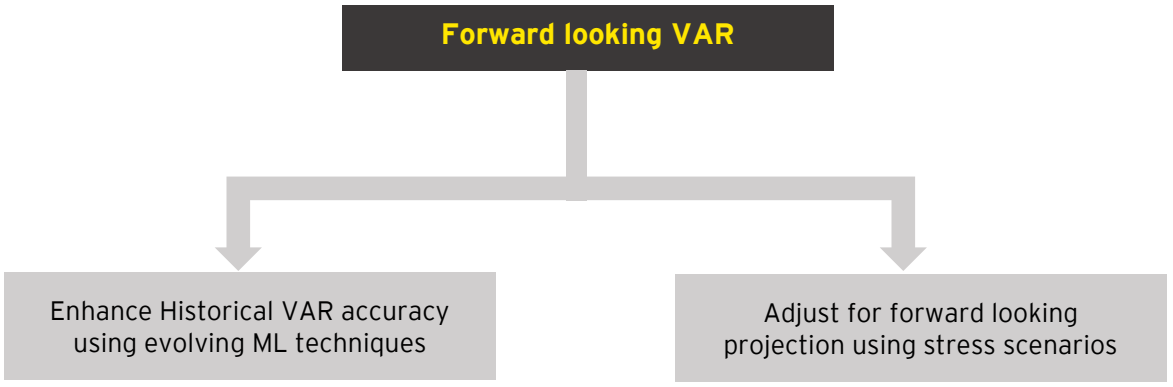


This stop-gap method for calculating market risk-weighted assets in Basel 2.5 is supposed to be remediated by the introduction of FRTB framework. FRTB replaces VAR with expected shortfall. Expected shortfall gives more weightage to the losses in the tail events and is calibrated to the worst year for a bank's portfolio. In crisis period, this does not lead to double counting and reduce the capital volatility.

On the other hand, major disadvantage of expected shortfall is that it is difficult to back test. Therefore, in FRTB, banks' risk models are still back tested using VAR. Higher breaches in VAR require banks to switch to standardized approach from IMA for Risk Weighted Assets (RWA) calculation which is a more conservative approach and may incur higher capital. So, although FRTB would solve the problem of double-counting VAR, the issue of backward looking and procyclical approach in VAR continue to pose a problem in the FRTB approach of capital computation as well.

Potential forward-looking solutions

To make VAR responsive, Exponentially Weighted Moving Average (EWMA) approach can be used as it increases weightage to recent events. However, this still does not incorporate truly forward-looking events. In order to overcome procyclical and backward-looking nature of current methodology, we propose following ideas for improvement. We start with enhancing current approach of historical VAR computation and then add a forward-looking element into the same.



1. Enhancing historical VAR accuracy:

Historical VAR takes past one-year data to predict the worst loss on any day. However, as market conditions change, even one-month old data may not accurately represent these recent conditions. We can make VAR model to be more responsive by reducing VAR time horizon. However, very small number of data points may not give statistically reliable estimates.

Additionally, data scientists believe that advanced ML techniques like neural networks can capture more statistical parameters than captured by traditional techniques used in financial modelling. It helps in incorporating fat tails closer to reality than assumed by normal distributions or may not be reflected in historical period. The challenge here is to train such models which can require large amount of data (to the extent of 5,000 data points). Getting financial data that deep may not be possible and not useful as the nature of market continue to evolve and shift with time.

To handle both the challenges, one can go for high frequency data or add a layer of other ML techniques to generate synthetic data which is random but at the same time has similar statistical properties as original ones. This synthetic data can be used to train the ML models and compute more accurate VAR. Industry is leveraging classical ML techniques like support vector machines and random forests as well developing more advanced techniques like Restricted Boltzmann machines (RBMs) to generate the synthetic data.

Data generators can give banks an additional advantage of populating time series data for new or illiquid securities.

2. Adjust historical VAR for forward looking scenarios:

In addition to improving current historical estimate, we propose to incorporate forward looking scenarios in the VAR.

This approach is inspired from CCAR. As part of CCAR, Fed comes up with projections of 28 macroeconomic variables for three scenarios (Baseline, adverse, severely adverse). Like this, the bank's economic research team can come up with forward-looking projections for similar macro-economic variables for different scenarios. The bank can then use existing stress testing infrastructure to expand the shocks at more granular level and compute P&L impact on existing portfolio. Post this, banks will have four numbers – one historical VAR which is computed using the ML approach described above and three P&L impacts corresponding to each scenario. Banks can then assign a suitable weightage to each scenario and come up with weighted average P&L impact. Weights here need to reflect the sentiment and extent of stress possible in the recent future. The idea also has its basis in computation of ECL where Banks first compute ECL numbers for base, best and worst scenarios. Final ECL impact is computed as weighted average of impact from each scenario.

Both the above enhancements when combined can help in making VAR model better fit for the purpose.

To conclude, the global financial crisis was an eye opener specially how we perform market risk management. Post the crisis, each risk management practice/tool was critically evaluated and updated by the banks and the regulators. However, recent market movements due to COVID-19 have shown that we have failed to mitigate all the weaknesses underlying widely used risk metrics like VAR. Regulators globally need to relook the VAR approaches and the capital computation methodology. The evaluation should not only be done from the lens of conservativeness but to make it more commensurate to the underlying risks. Most importantly, its high time that we incorporate forward-looking views in VAR computation because we don't want VAR to act as a news anchor but as a fortune teller.

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