How Can the Global Market Shock More Effectively Complement the Fundamental Review of the Trading Book?

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In the blog post "Why is the FRTB Expected Shortfall Calculation Designed the Way it Is?," we performed a VaR calculation for a simple portfolio consisting of a long $100 million position in the Dow Jones Small Cap Equity Index and two long positions in five-year, $500 million notional default swaps, one written on the Investment Grade index and the other written on the High Yield index. We then worked through for that portfolio how the new FRTB Expected Shortfall (ES), which is the modeled component of the FRTB, corrects problems with the VaR calculation by stressing five risks not captured by VaR.

In this policy-oriented note, we examine the Global Market Shock (GMS) component of the Federal Reserve's stress test and compare it to the FRTB. We find that the GMS essentially stresses the same five risks as the FRTB. Thus, implementation of the FRTB without a significant redesign of the GMS would significantly increase capital requirements not by capturing new risk but by increasing capital charges for the same risk.

In this note, we quantify how the FRTB captures the same risks as the GMS for a simple, representative portfolio. We then observe that the GMS has not been fundamentally updated since its inception but needs to be if it is to complement rather than duplicate the FRTB. We conclude with some options for updating the GMS along with the pros and cons.

How Does the GMS Capture the Same Risks as the FRTB?

Having witnessed a failure of VaR during the financial crisis, market risk managers and the regulatory community focused much more on stress testing as an alternative risk management model. A stress test is simply a specification of shocks to asset values that would be applied to a portfolio of assets. For example, the 2023 GMS specifies that a shock of -26.3 percent be applied to all U.S stock positions that a bank held on Oct. 14, 2022. The 2023 GMS also requires a shock of 177.4 percent to IG spreads and 80.0 percent to HY spreads. If a bank had our sample portfolio, these shocks would be applied to the equity and CDS positions, and the changes in values would be simply summed. For example, the change in value of the $100 million equity position would be $26.3 million, which would be simply added to the change in value of the CDS positions to get the total GMS loss.

Market risk managers and the regulatory community turned to stress tests because they measure risk not captured by VaR. In the previous blog post, we discussed the five risk management problems with VaR.

- VaR does not capture rare large losses effectively
- The future will not be like the past
- All asset classes do not have the same 10-day liquidation period
- We cannot always rely on diversification to reduce risk
- VaR cannot be estimated reasonably when the risk factors are relatively illiquid

Stress tests are inherently forward-looking and so they do not necessarily rely on past data and therefore do not assume the future will be like the past. Because they are forward-looking and the shocks are partially judgmentally determined, stress tests can capture rare large losses even for very illiquid assets that cannot be estimated reasonably using VaR. A stress test can also be very flexible: liquidity horizons do not need to be the same for all assets. Because asset changes are simply summed up, there is no reliance on diversification to reduce risk.

Thus, at least in principle, the FRTB and the GMS capture the same basic risks not included in VaR. However, does the GMS do anything else that would continue to justify its current specification after adoption of the FRTB? Does the GMS capture any fundamental risks that the FRTB fails to incorporate?

The GMS shocks are clearly defined every year by the Federal Reserve and are independent of a bank's portfolio, but the shocks implicit in the ES calculation are opaque, since they depend on the specifics of a bank's portfolio and result from a simulation. To compare implicit ES shocks to the GMS, we need to account for the portfolio dependency and model simulation. To account for portfolio dependency, we need to use a portfolio that is simple but also representative of the major risks the banks subject to the GMS face. Although the portfolio analyzed in the previous blog post, long credit and equity, may have seemed arbitrary, it was in fact chosen since it reflects those risks. Banks subject to the GMS typically will have significant long exposure to equity and credit risks. Besides that, the equity and GMS shocks are large relative to FX and interest rate shocks, while commodity exposure might be net long or short. We will therefore use our representative portfolio from the previous blog post as a simple proxy for a banks' major risk factors.

Methodology For Calculating FRTB Implied Returns

Comparing the GMS to ES is complicated by the fact that ES shocks result from a set of model simulations while the GMS is a single shock. To state the ES to the GMS shocks is a comparable manner, we must find a way to summarize the FRTB historical ES simulation and liquidity scaling in an implicit single ES shock for each of the underlying returns in the portfolio so that we can directly compare it to the single shocks in the GMS. The most straightforward method is to perform the same simulation and FRTB scaling calculation as we did in the previous blog post, but rather than performing it on the assets themselves, instead perform the calculations on the returns that produced the asset values. In other words, we run through exactly the same ES calculations for returns as we did for the assets, resulting in a single, scaled ES shock that can be compared to a GMS shock.

For example, to calculate the 10-day ES of IG returns for the portfolio including equities, IG, and HY, we average the top five IG returns in the ES historical simulation that correspond to the top five portfolio losses. On the other hand, to calculate the 10-day ES of IG returns for the portfolio consisting of just IG and HY CDS, we average the top five IG returns that correspond to the top five IG plus HY CDS losses. Exhibit 1 shows the results of those calculations for 10-day IG returns.

Exhibit 1

Equity, IG and HY Included	10-day ES IG Return	IG and HY Included	10-day ES IG Return
$ES_{EQ,IG,HY}$	32.0%	$ES_{IG,HY}$	32.0%

Given these values, we can calculate the diversified ES and the undiversified ES for IG returns by scaling them to the appropriate risk horizons. The IG return calculations proceed exactly as they would if we were calculating ES for the positions in the portfolio, except that we do not include equities since IG returns do not contribute to equity ES. Exhibit 2 shows the diversified ES IG return calculations while exhibit 3 demonstrates the undiversified ES return calculations.

Exhibit 2

Days 0-20	Days 20-40	$ES^2_{diversified}$	$ES_{diversified}$
$2(32\%)^2$	$+\,2(32\%)^2$	40.9%	64%
We have two 10-day periods in which equities, IG, and HY share a common liquidity horizon, so we scale the 10-day $ES^2_{EQ,IG,HY}$ by two	We have an additional two 10-day periods in which IG and HY share a common liquidity horizon, so we scale the 10-day $E^2_{IG,HY}$ by two. Equities drops out since its liquidity horizon terminated after 20 days	Sum the numbers in the two-time buckets	Take the square root of 40.9% to get the final ES estimate for diversified IG returns

Exhibit 3

Days 0-40	$ES_{undiversifed}$
$4(32\%)^2$	64%
We have four 10-day periods in which IG and HY share a common liquidity horizon, so we scale the 10-day $E^2_{IG,HY}$ by four.	Note that we did not include equities in the undiversified calculation, since IG returns do not affect equity returns

We can calculate the final IG return by averaging the diversified return in Exhibit 2 and the undiversified return in Exhibit 3, as required by the FRTB calculation. However, since the capital formula multiplies the ES result by 1.5, we also multiply by 1.5 in this case. The final estimate of the implied IG return in the FRTB is

$$(64\% + 64\%) * \frac{1.5}{2} = 96\%$$

Comparing Implied FRTB Returns to GMS Shocks

We can repeat those same calculations to find the implied equity and HY returns and compare to the GMS shocks. Exhibit 4 shows the results for various portfolio combinations in order to measure the sensitivity to the composition of the underlying sample portfolio. Exhibit 4 allows us to compare the GMS and the EMS using the common standard of a single shock in which ES model simulations have been converted to a single implicit shock.

Exhibit 4

Implicit single ES shocks from FRTB compared to GMS single shocks

FRTB Sample Portfolios ($ mil)	Equity	IG	HY	IG
100 EQ + 500 IG + 500 HY (From the previous blog post)	-52%	96%	142%	176%
1000 EQ + 500 IG + 500 HY (Dominated by Equities)	-52%	91%	141%	174%
100 EQ + 5000 IG +500 HY (Dominated by IG CDS)	-49%	115%	124%	203%
FRTB Liquidity Horizon	20 days	40 days	60 days	120 days
Historical GMS Shocks	**Equity**	**IG**	**HY**	
2023	-26.3%	177.4%	80.0%	
2022	-38.3%	326.7%	206.8%	
2021	-26.0%	548.2%	247.8%	
2020	-26.0%	432.9%	336.2%	
2019	-20.3%	339.3%	318.9%	
2018	-28.1%	427.9%	315.1%	
2017	-19.2%	185.0%	198.0%	
2016	-29.4%	162.3%	168.2%	
2015	-29.4%	156.9%	165.1%	
Historical GMS Average	-27.0%	306.3%	226.2%	

We see in Exhibit 4 that the GMS shocks have often moved around over time. Part of that movement is a result of GMS scenario design but some of it, especially for CDS returns, is designed to compensate for changes in spread levels. For example, the HY shock in 2023 is lower than the historical average of past GMS exercises, but that lower shock compensates for the fact that the HY spread on Oct. 14, 2022, the GMS run date, was relatively high.

Both the FRTB and the GMS are projecting a severe downturn consistent with the financial crisis of 2008-09 in credit, coupled with an equity downturn that is more consistent with a standard recession. Looking at the comparisons, we see that the implied equity shocks from the FRTB are higher than the GMS shocks. The implied equity shocks in the FRTB were calculated using a small cap portfolio, which required the use of a 20-day liquidity horizon. Had we used a 10-day horizon instead, the -52 percent equity shock for the example portfolio would have dropped to -37 percent, which is more consistent with the GMS shocks, but still higher. Thus, the GMS equity shocks, at least for U.S. stocks, seem consistently calibrated to something like a 10-day liquidity horizon and a standard recession.

Turning to the credit shocks, the FRTB implied HY shocks are generally lower than the GMS shocks, implying an implicit liquidity horizon in the GMS for HY greater than 60 days. The FRTB implied IG shocks are dramatically inconsistent with the GMS shocks, which are much larger, implying an implicit liquidity horizon in the GMS that is much greater than 40 days. Indeed, the last column of Exhibit 4 reports the implied FRTB shock under the assumption that IG has the largest liquidity horizon defined under FRTB, 120 days. It is not clear why IG in the GMS seems to be calibrated to a much higher liquidity horizon than HY, while the reverse is true in the FRTB.

In summary, this analysis suggests that equity shocks are similar, although the FRTB is on the more severe side. The difference between the two regimes is primarily a consistent pattern in the GMS of shocking the liquidation period in HY more than the FRTB and the liquidation period in IG much more than in the FRTB. Although that might be a justifiable stress test under some circumstances, it is difficult to see why the GMS should stress differential liquidity risk in the CDS market every year. If that were a consistent risk, why would it not have been incorporated into the FRTB?

What should the basic goals of an updated GMS design process be?

Any update of the GMS design process should aim to capture a different set of risks than does the FRTB. To achieve this, the GMS should be recalibrated so that implementation of the FRTB does not increase market risk capital. As described above, any increase in market risk capital as a result of FRTB adoption would not reflect a more nuanced view of risk (and a realization that it is higher) but rather a duplication of the same risks. Keeping market risk regulatory capital relatively constant is important because large increases in market risk capital requirements without an actual increase in the risk could damage market liquidity, one of the important risks that the FRTB was designed to address. At some point, increases in market risk capital do not make the system safer but rather become a Catch-22. Capital increases damage to liquidity and therefore more capital is required to account for the loss of liquidity. Therefore, the Federal Reserve should be cautious about imposing additional market risk capital requirements that may make the liquidity risks that the FRTB was designed to measure a self-fulfilling prophecy.

First step in updating the GMS: keeping market risk capital neutral

The update to the GMS could start by changing some pieces to keep market risk capital relatively constant once the FRTB is implemented. There are at least three options for accomplishing this goal, each with pros and cons.

Option 1:

Review risk factors from the GMS stress test that are already subject to a stress test in the FRTB because they fall into the non-modellable risk factor bucket.

Pros:

- Would eliminate obvious, clear-cut cases in which the same risks are stress tested
- Non-modeled risks contribute very significantly to the increase in market risk capital from FRTB

Cons:

- Regulators will have to monitor potential regulatory arbitrage in which banks put risk factors into the non-modellable bucket in order to be subject to a potential lower capital charge in the GMS
- Tends to benefit firms that have worse data and risk management practices

Option 2:

Remove private equity from the GMS

Pros:

- Very easy to implement
- Very easy to predict results by bank
- Effects do not depend on how FRTB is implemented as non-modeled risks do

Cons:

- Private equity is in the banking book so not really related explicitly to the FRTB/GMS risk overlap

Option 3:

Reduce HY shocks and reduce IG shocks even more

Pros:

- Eliminates consistent liquidity stress test in which IG is stressed more than HY, making it easier to focus on risks different from the FRTB in a GMS update

Cons

- May be desirable to have some differential liquidity stresses in the credit markets components of the GMS

Second step in updating the GMS: stressing different risks than the FRTB

As pointed out by the Federal Reserve, the first step in scenario design is to conduct risk identification exercise. For supervisory purposes, risk identification would focus on emerging risks and system vulnerabilities that are not necessarily captured by the FRTB. Once those risks are identified every year, there are a number of options for scenario design, each with its own pros and cons.

Option 1:

Design the GMS using a narrative approach. For example, a narrative could be developed around some emerging risk such as supply chain disruptions, acceleration of inflation, conflict on the Korean peninsula, etc.

Pros:

- The GMS is easy to interpret and clear about the risks it captures
- Since the most important shocks are hand-crafted, it is easy to incorporate judgment in the GMS design process
- Easy to target specific risks

Cons:

- It is harder to maintain coherence of shocks when they are hand-crafted
- The Federal Reserve may not want to include particular narratives if they touch on potential monetary policy choices
- Manual work may be required, which can be time-consuming

Option 2:

Another approach to generate the GMS scenario is to use a model. For example, a statistical model of the risk factors could be used to simulate paths, and then particular paths could be selected according to specific risk criteria and liquidity assumptions. For example, paths could be selected that have larger HY rather IG shocks and a particular simulated path could be made the official scenario. Also, correlations could be explicitly broken in the simulation in order to stress the risk of breakdown of historical correlations.

Pros:

- A highly flexible methodology to stress new types of risks by examining many scenarios while keeping the result to a single scenario

Cons:

- Significant upfront development costs
- Scenarios created may not be easily interpretable
- Can incorporate some judgment but not as easily as using the narrative approach

Option 3:

Combine Options 1 and 2 so that the fundamental statistical models contain interpretable macroeconomic and financial relationships rather than pure econometric models for financial assets.

Pros:

- Combines the advantages of interpretability with simulation of possible outcomes that may break historical patterns and correlations

Cons:

- Hardest of the three options to implement

Of course, the Federal Reserve already uses some aspects of options 1-3 in its GMS scenario design. However, any attempt to capture different risks in the GMS has historically been overwhelmed by the differential liquidity risk stress between IG and HY that has consistently been present in GMS specifications. As noted in option 3 of the "First Step" above, a notable advantage of correcting the capital increase problem by adjusting the spread shocks is that it will be easier to focus the GMS on different risks.

Conclusion

The upcoming introduction of the FRTB, which will update the market risk capital standard, provides an opportunity for the Federal Reserve to revamp the GMS. The GMS should be re-designed to complement the FRTB by covering different risks. Furthermore, the re-designed GMS should not raise market risk capital unless there is a clear increase in the underlying risks. There are many options to achieve these objectives, each with its own set of trade-offs. In the first step of the GMS update, it may be best to incorporate all three options in varying degrees. In the second step of the GMS update, option 3 is the best methodology, but it is also the most expensive and time-consuming to implement. Given the complexity of the various options for updating the GMS and the significant impact any changes will have on U.S. financial markets, a robust notice-and-comment period will be especially important.
