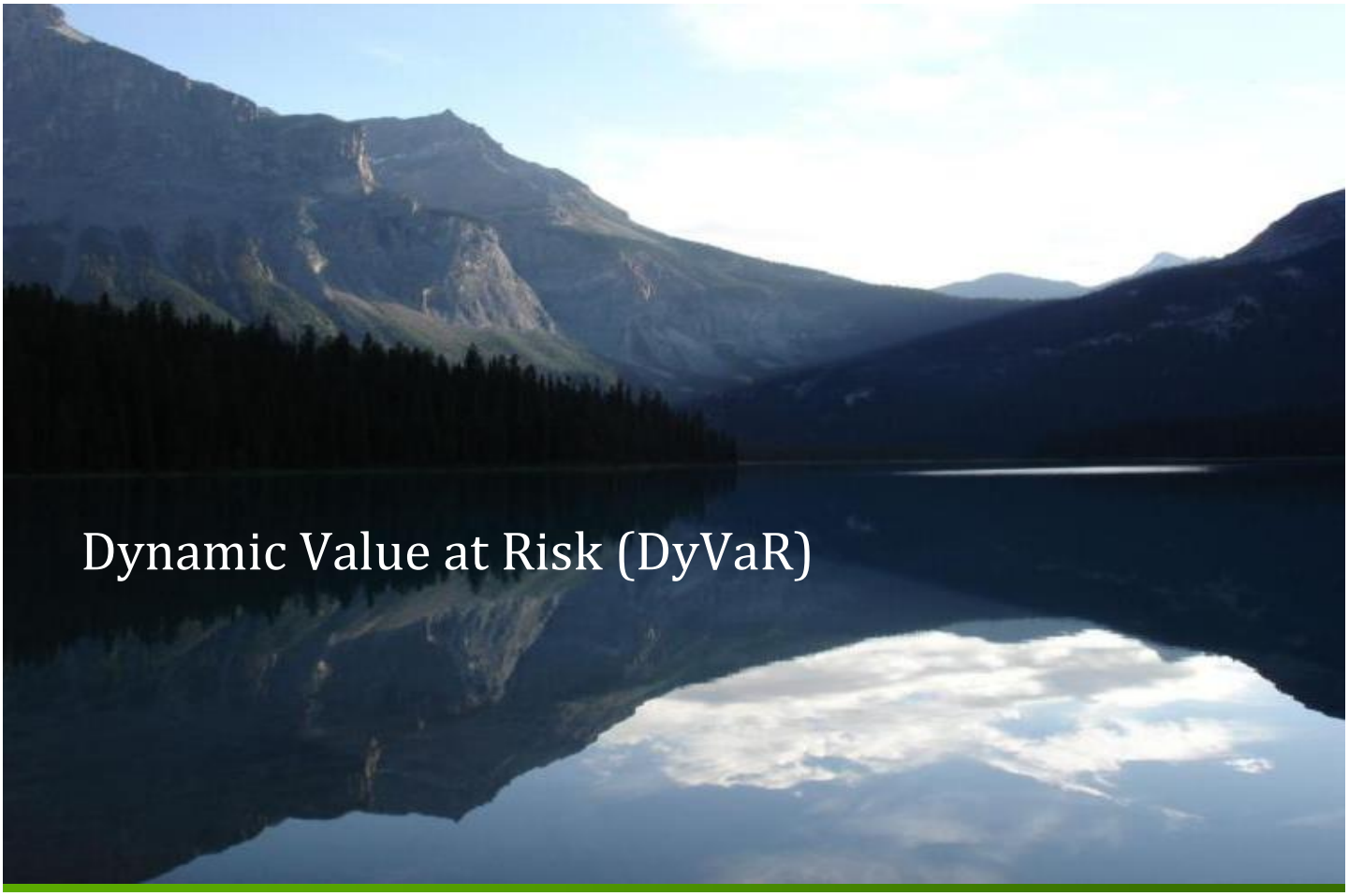

Dynamic Value at Risk (DyVaR)

Greenwood Strategic Advisors AG · Zugerstrasse 40 · CH-6314 Unterägeri, ZG
Telefon +41 41 754 7447 · Telefax +41 41 754 7448 · www.greenwood-ag.com

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1 INTRODUCTION

For nearly two decades financial institutions have been investing in tools for measuring and controlling risk. Resulting VaR (Value at Risk) systems have acquired impressive capabilities. They quantify exposures for every position of every risk-taker and sum them to produce a daily firm-wide measure of maximum likely loss across positions in almost every kind of market. To have a comprehensive, nearly real-time window on firm risk has been a huge step forward for executives and regulators, and that has made VaR a de facto standard.

But the world has changed dramatically, and VaR is widely viewed as having failed to reveal huge risks that were building in the financial system. Critics say that VaR actually contributed to the crisis by certifying what turned out to be an illusory stability, thereby justifying the continuation of practices that were eventually limited only by their inherent unsustainability. Even its supporters acknowledge that VaR gave little or no warning of the massive systemic risks that have since manifested themselves in the global financial crisis.

As that financial crisis morphs into a global macroeconomic downturn of unprecedented speed, what is to become of VaR? Was its failure to warn a sin of commission or of omission, a sign of fundamental flaws or of limitations that can be remedied? Must VaR be replaced outright, or can its obvious strengths be extended and its limitations made irrelevant through use of complementary methods for measuring and controlling a broader set of risks? Where can financial firms turn for reliable risk control under the extraordinary conditions that now prevail and seem likely to continue for some time?

2 THE LIMITS OF VAR

At least once every ten years (or so it seems in the US), a financial crisis erupts around markets which have ceased to function "normally." Yet VaR is designed to measure risk under "normal" market conditions. The ability to bound maximum losses with 99% confidence makes it easy to forget that the "normal" market conditions in which such measures might apply prevail only about 90% of the time, and that VaR sheds much less light on risks in the remaining 10%. Many managers forgot these things when money was cheap and volatility low, and to that extent VaR probably contributed to excesses that led to the financial crisis.

But those most familiar with VaR did not forget that it is based on statistical measures drawn from recent market history, and that recent history does not provide the independent observations required for laws of probability to prevail. Neither did they forget that recent history mostly excludes periods of "abnormal" market behavior. The most advanced users of VaR were keenly aware of its limitations, yet the financial crisis brought them to their knees in ways that were mostly unanticipated. That it did so testifies to the seriousness of VaR's limitations -- it suggests that the uncertainties least measured by VaR also have the biggest downside consequences.

VaR's chief limitations lie in the area of systemic crises. The days of isolated bank failures (Franklin National comes to mind) seem to be over -- recent financial crises have

all been about systemic market failures. It is a little-known but well-established dynamic fact that systemic failures are produced by the same systemic connectivity that drives so-called "normal" market behavior. In other words, most “fat-tail” market behavior and risks are driven by the feedback mechanisms that constitute the market’s underlying connective structure. Yet "abnormal" market behavior almost always surprises us for two very good reasons: 1) because the unaided human mind cannot keep track of more than two connected feedback mechanisms; and 2) because none of our traditional analysis tools (including VaR) represent that market-driving systemic connectivity. Hence both intuition and analysis are consistently blind-sided by the abrupt transition from "normal" to "abnormal" market behavior.

The web of systemic connectivity drives both the up- and the down-side of financial-market cycles and transitions between them. These behavior modes are all symptomatic of perpetual market disequilibrium (that being a characteristic of complex feedback-driven systems), and they lie within the range of what is considered "normal".

That same web of feedback mechanisms drives the less common and always surprising transition to the more extreme form of disequilibrium behavior characterized by illiquidity and market breakdown. Statistical correlations from history are unlikely to reveal the markets’ gradual approach to that dynamic tipping point – after all, most cycles do not produce systemic market failure. At the tipping point formerly reliable correlations reverse without warning, and formerly reliable positions lose back much of what was previously made -- only much faster. Normally uncorrelated positions suddenly become strongly correlated and systemic stress spreads fast. Systemic connectivity drives all of it, and operates unseen to all traditional analysis methods including VaR. No such method can reliably anticipate the growing likelihood of systemic market failure, which surely represents one of the greatest uncertainties facing financial institutions. Of all such uncertainties, systemic market failure has the broadest and most pronounced downside consequences (and the greatest upside potential if effectively managed).

3 AUGMENTING VAR

Two more little-known but well-established facts about market-driving systemic connectivity:

1) That connectivity can be qualitatively identified and diagrammed based on industry expertise, which means they can be reliably simulated;

2) Reliable simulation makes it possible to understand and anticipate “fat-tail” market conditions and to optimize positions, trading practices, and market-management policies in the face of such conditions.

In other words, dynamic simulation (simulating market-driving feedback mechanisms) can reliably measure the time-based likelihood and consequences of extreme disequilibrium or “fat-tail” behavior in markets. Dynamic simulation is the only proven method of reliably measuring risk outside the range of “normal” market conditions for which VaR was designed. It gives high-confidence advance warning of “fat-tail” market conditions and serves as a reliable platform for testing ways of minimizing losses and maximizing firm value under such conditions.

Dynamic simulation first appeared at MIT in the early 1960s in the form of System Dynamics. Since then it has broadened to include other, more specialized forms of simulation. Dynamic simulation has been thoroughly proven as a powerful force-multiplying complement to traditional

analyses in a wide range of markets.

Dynamic simulation can just as powerfully complement VaR. VaR's limitations in regards to systemic market crises are not inherent, but stem primarily from its current dependence on recent market statistics. Those limitations can be overcome with alternative numerical inputs that reliably reflect and anticipate growing "fat-tail" systemic stresses and risks – which remain invisible to most statistical measures until it is too late. Dynamic simulators can provide such inputs, enabling firms to anticipate how changing correlations and risks that accompany systemic market crises will ripple through portfolios and positions. As markets near a tipping point, either into "abnormal" cyclical behavior or back into more "normal" conditions, dynamic risk measures will increasingly diverge from backward-looking statistics, giving much earlier warning of impending market changes and measures of resulting upside and downside consequences. As inputs to VaR, dynamic measures will show and quantify rising levels of systemic risk and their performance consequences long before they would otherwise appear. Dynamic simulators can foresee and analyze likely trajectories for upcoming changes from "normal" to "abnormal" market behavior and back, greatly increasing confidence in the timing and characteristics of those changes. With reliable advance warning and greater confidence, management is much better positioned to "stop dancing" (and to start dancing again later) in the right ways and at the right points in the market cycle.

The reliability of dynamic simulation and its value as a complement to VaR stem from the very different way that these two modeling methods use market data and statistical measures. VaR (along with most traditional modeling methods) feeds in historical data as driving model inputs, whereas dynamic simulation keeps most market data separate as an independent benchmark for validity testing. VaR (along with many other traditional modeling methods) uses statistical measures to quantify relationships between factors of interest, whereas dynamic simulation represents the known causal relationships between those factors and uses statistics to measure the fidelity with which the simulator captures those relationships. Because it makes different use of market data and statistics, the dynamic simulation process reveals the strengths and timings of market-driving systemic connectivity to high levels of confidence. Furthermore, the strength and timing of those mechanisms tend to be stable over long periods. That is another little-known but well-established fact of market-driving feedback mechanisms: that even the wildest gyrations from stability to instability and back are produced by constantly shifting mutual influences among connective mechanisms that are individually quite stable over time.

Dynamic Value at Risk (DyVaR), the coupling of VaR and dynamic simulation, is likely to prove critical in ensuring efficient use of capital while improving protection against "fat-tail" risks. That is because dynamic simulation offers the only means of knowing how the likelihood of "fat-tail" conditions varies over time – which is crucial when the downside conditions in question occur just 10% of the time. Without that knowledge, large capital reserves would constrain the system during "normal" conditions and still fall far short of providing adequate protection when markets behave "abnormally". In the future, a great deal of money is likely to be made from knowing the temporal trajectories of "fat-tail" risks and being able to demonstrate to policy-setters and regulators the adequacy of counter-cyclical protections.

Dynamic Value at Risk has the potential to become the next major advance in financial risk management. If that proves true, the first firms to explore and practice it will gain a substantial competitive advantage. The fruits

of that advantage will accrue as much in the next few years as at the time of the next systemic market crisis, because it appears that we will continue to experience “fat-tail” conditions for some time yet. For that reason DyVaR is expected to be a powerful near- and long-term force multiplier in financial risk management.