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RISKDATA RESEARCH REPORT

THE PRO-CYCLICAL NATURE OF LINEAR VAR MEASURES:

SHOULD A RISK MEASURE BE REACTIVE OR ANTICIPATIVE?

Riskdata RESEARCH

RiskData S.A.

6, rue de l'Amiral Coligny, 75001, Paris, France

TEL: +33 1 44 54 35 00, FAX: +33 1 44 54 35 01

research@riskdata.com

Why VaR reactivity is dangerous

It is often thought that a reactive VaR measure is a good one. We will argue the contrary. Reactivity of a VaR measure means that upon a sudden market event, for example a jump in one of the factors relevant to the risk of a fund, the risk measures immediately increases. It is perceived that such a risk measure will let the manager react quickly to changing market conditions and adjust her/his positions accordingly. However, quite the contrary is true. Reactivity of a VaR measure only shows that it does *not* in fact reveal all the hidden risks of a fund and leads to a very dangerous circle.

A reactive VaR creates a mechanism that leads to a dangerous cyclical cascade of market events as shown in the figure:

FACTOR JUMP → RISK INCREASE → SELL ORDER → LIQUIDITY CRISIS → FACTOR JUMPS FURTHER

This is the typical risk adjustment chain that induced the 1987 crisis, as well as a number of other crisis, including the 2008 credit squeeze.

On a wider scale this pro-cyclical nature of a reactive VaR encourages the deepening of a crisis. For a manager it induces the cancelation of risky positions in illiquid times that are least favorable.

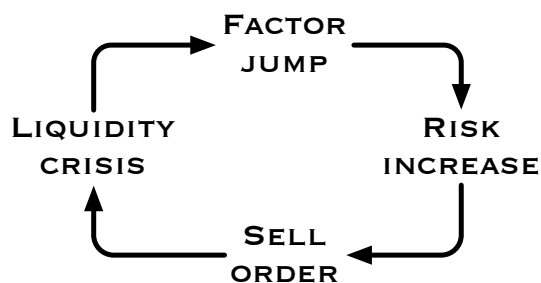


FIGURE 1: A cycle caused by a reactive risk measure.

Linear models, even with fat-tails, are reactive

In most factor risk models a fund is modeled by a function that is typically linear in factors

$$\text{Fund returns} = \text{Model function}(\text{factors}) = k_1 \cdot F_1 + \dots + k_n \cdot F_n.$$

In this case, the risk of a fund is determined by two things:

- (i) the joint density of factors, and
- (ii) the coefficients k_i .

Following a jump of one of the factors, two things typically occur:

- (a) The distribution of the factor is changed. This may possibly be a substantial change since the factor distributions are estimated by deliberately overweighting the recent past. This is done in order to produce better percentages of exceptions in backtesting.
- (b) The correlation between the fund and the factor changes, typically increasing the coefficients k_i . This is sometimes referred to as a correlation break, where in effect it is simply a sign of nonlinearities which the linear model is not able to capture.

Both of these reactions will increase the risk estimate, and sometimes when acting jointly by a substantial amount.

Back-filling the fund history in order to produce longer term statistics does not remedy the issues and is just an intermediary step resulting ultimately in same mechanism of risk reaction to a factor jump.

StressVaR is nonlinear: it is anticipative, not reactive

In the FoFiX risk estimate based on a *set of nonlinear single factor models*, what happens following a factor jump is quite different.

- The factor distribution quantiles typically do not change. They are calculated from a very long (more than 20 years) history of factor returns and updates to the densities are not very common. Even the 2008 crisis did not produce many factor returns that have changed substantially the long term quantiles. The quantiles are rather adjusted in size only if a jump of exceptional magnitude occurs.
- Since the single factor models are already nonlinear, the coefficients measuring the dependency of the fund to the factor are typically not changed much. The correlation breaks occur in linear models, the nonlinear models already capture the possible option-like factor dependencies.

Therefore in the FoFiX model, following a factor change, the risk of the fund might be adjusted but not significantly revised.

One could wonder whether in this approach the fund risk is under-estimated? Not at all! The risk was already taken into account and *anticipated*. A reactive VaR reveals the hidden risk after it has happened, an anticipative VaR already has the hidden risk calculated in.

In comparing the response to a large factor move of the FoFiX nonlinear approach to the linear, there are basically 2 possibilities:

- (a) Upon a factor move, the linear risk doesn't change much. In this case, the linear and the nonlinear risk are in the same ball park and the jump does not induce a large change in allocation. There is no "hidden risk".
- (b) Upon a factor jump, the linear risk jumps as well. In this case, the nonlinear risk was *already* high - precisely at the level which the linear risk eventually reached when the factor jumped.

Therefore, when using a linear model, a factor jump may trigger an increase in the risk measure which in turn generates a sell order. However, this sell order is in the worst timing - when everybody using similar models is also selling. Using a nonlinear model, the risk would have been anticipated and revealed before. Accordingly, the allocation would have been lowered long ago when selling was not a problem.

A REACTIVE VAR REACTS TO A SURPRISE FACTOR JUMP AND TRIGGERS A SELL ORDER AT A TIME OF LOW LIQUIDITY.

AN ANTICIPATIVE VAR PREVENTS SURPRISES AND TRIGGERS A SELL ORDER BEFORE IT IS LATE.