VAR Models For Generating Scenarios In ALM: Do's And Don'ts

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PRESENTATION SUMMARY

Besides their macroeconomic applications, Vector AutoRegressive (VAR) time series models are often used to generate scenarios of economic variables for Asset and Liability Management (ALM) purposes, for example for pension funds or life insurance companies. The purpose of this presentation is threefold:

1. Illustrate that the statistical properties of VAR or other scenario models in terms of their expected values, volatilities, correlations and dynamics (auto- and cross-correlations), can have an enormous impact on the outcomes of ALM or investment models and thereby also on the important policy decisions that are based on these outcomes.
2. Provide a better understanding of the dynamic behavior of VAR models.
3. Highlight and illustrate important pitfalls of VAR and also more general scenario models that can be encountered in practice, as well as suggest remedies for these pitfalls.

The presentation basically consists of two parts. In the first part we give some background and general properties of VAR models. In the second part we mention a number of do's and don'ts when applying VAR models for generating scenarios in practice which are illustrated by a total of eight examples. Five of these examples are contained in the Appendix of the presentation.

Part I

We begin the presentation with the basic specification of a VAR model and explaining how this can be used for generating scenarios of yield curves, investment returns, inflations rates, exchange rates, etc. The simplicity of VAR models together with the fact that they can describe almost any type of stochastic (economic) process stimulated their use for generating scenarios for ALM. However, this great flexibility of VAR models may at the same time pose problems when trying to estimate them on the in general limited

macroeconomic data available. In small samples the lack of prior model "structure", either theory driven or based on empirical observations, can lead to poor quality and very uncertain estimates. Besides these short sample problems of estimating VAR models, also choices need to be made about the model order, the estimation procedure and possible transformations of the time series used for estimation. Each of these choices can have a substantial impact on the properties of the stochastic process described by an estimated VAR model and thereby also an enormous impact on the outcomes of ALM or investment models and on the important policy decisions that are based on these outcomes. We illustrate this important observation with an example from the field of ALM for pension funds in which a "slightly" different specification of the scenario generation model can cause a 20% point difference in the amount of stocks in the strategic asset allocation of the fund. We show that an important reason is the great difference in the long term correlation between equities and inflation that is in the scenarios. It is therefore of great importance to have a good understanding of the dynamics of the VAR (or other) model that is being used. Some instruments to gain this understanding are the expected values and (conditional) auto covariance structure of the model, impulse response functions, deterministic simulations, eigenvalues and eigenvectors of the parameter matrices and finally multivariate spectral densities. The spectral densities are less well known in econom(etr)ics but form a very powerful and intuitive tool that directly relates to the fluctuating character of economic and financial variables. In the Appendix of the presentation we illustrate the interpretation of spectral densities on a simple 2 dimensional VAR(2) model.

Part II

As mentioned in the introduction, the second part of the presentation highlights and illustrates some important pitfalls of VAR and also more general scenario models that can be encountered in practice, as well as suggest remedies for these pitfalls. In the eight examples that are included we no longer make the direct link to the potential effects on strategic policy decisions. Implicitly however this link is still there through the shown sensitivity of the (stochastic) scenario properties combined with the policy example discussed in part I. In this summary we suffice with a list of the do's and don'ts and the examples that are given in the presentation. Please note that five of the eight examples are contained in the Appendix of the presentation.

- Know what to model before how to model
- Incorporate forward looking information in your scenarios
- Check if your scenarios are indeed consistent with your assumptions about their (stochastic) behavior
    - ➔ *Example 1: Check consistency*
- Understand the (multi-period) dynamic behavior of your model

- Look beyond conditional variances
- Make a distinction between true correlations and phase shifts in time
  - ➔ *Example 2: Correlations and phase shifts (Appendix)*
- Also consider VAR model orders higher than just p=1
- Avoid automated model selection procedures
  - ➔ *Example 3: Automated model selection (Appendix)*
- Use restricted types of VAR models
  - ➔ *Example 4: Yule Walker estimator (Appendix)*
- Use simple univariate AR models as a reference
- Don't model bond returns but yield curves and cash flows instead
  - ➔ *Example 5: Yield curves and bond returns*
- Don't model individual interest rates
  - ➔ *Example 6: VAR and Nelson & Siegel*
- Beware of the symmetry and thin tails of the Normal distribution
  - ➔ *Example 7: Normal distribution (Appendix)*
- Use other models for risk neutral valuation scenarios
- Don't go blind on statistical testing and goodness of fit criteria
  - ➔ *Example 8: Statistical testing (Appendix)*
- Don't forget about the low frequencies / long term fluctuations

As a final Don't: Never ever just generate "some random scenarios" and then proceed with a detailed subsequent analysis!! As we illustrate in this presentation, the impact of the scenario properties on policy decisions can be enormous. So, proceed with great care when constructing economic scenarios with VAR or any other model.

References

Due to its nature, there is no direct paper underlying this presentation. However, on the final slide there is a list of references. If you want to know more about empirical macroeconomics, VAR scenario modeling and spectral analysis techniques, the 800 page Ph. D. Thesis

Steehouwer, H. (2005), "*Macroeconomic Scenarios and Reality. A Frequency Domain Approach for Analyzing Historical Time Series and Generating Scenarios for the Future*", Free University of Amsterdam.

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