Bayesian VARs for absolute beginners: Part 1

John V. Krompas · Follow
Published in DataDrivenInvestor
5 min read · Mar 11, 2022

Listen Share

https://doc-research.org/our-events/alternative-economic-models-south/

When it comes to economic modeling for forecasting, Vector Autoregressive models (or simply VARs) are perhaps the most powerful and intuitive tool. And VARs that are estimated using Bayesian methods are perhaps the best of the best. However, most universities do not teach Bayesian VARs before the Ph.D. level, and when they do, the mathematical notions involved make understanding Bayesian VARs a tedious endeavor.

In this arti Bayesian VAR are an ch a model. We will focus on the Bayesian VAR that uses the Minnesota-Litterman prior (more on this later), which is one of the most common methods of estimating a Bayesian VAR. In another article, we will talk about alternative priors and how to choose among them.

But first, let's briefly recall what a VAR is:

A VAR is a multivariate model where the current values of the variables involved are determined both by their own past values and the past values of the other variables. This way the variables of the model are all determined endogenously, and hence the model can produce forecasts for all the variables involved, without any additional input from the researcher (quantitative or theoretical). VARs consist of as many equations as they have variables, and each equation is estimated separately by OLS.

However, VARs have two downsides: First, they do not have theoretical interpretability and second, they are informationally intensive as a large number of coefficients is estimated from a small amount of data (this is why when we estimate VARs, we want them to be "parsimonious", which means as small as possible).

Bayesian VARs save day when it comes to problem number two.

In a Bayesian setting, before the estimation the researcher makes a set of assumptions to "shrink the parameter space" where OLS must search for the optimal set of coefficients, this is what we call Bayesian shrinkage.

As these assumptions are made before the estimation, we refer to them as priors. The result of the estimation is essentially a weighted average of the prior and the OLS estimation. The first and one of the most common priors used in Bayesian VARs is the Minnesota prior (developed by Litterman in the University of the same name), which imposes a random walk behavior on the variables. Thus, it is very useful when estimating macroeconomic VARs.

Before estimating a Bayesian VAR using the Minnesota prior, the researcher has to

decide on the values of four parameters (which are usually called hyperparameters):

μ1, λ1, λ2 &

μ1 is a value corresponding to the persistence of the variables. So, when variables are stationary, this value is set at zero, whereas if the variables have a unit root it is set close to 1. It is assumed that all variables have the same level of persistence.

λ1 corresponds to the certainty of the priors we are imposing. The more certain we are that the prior describes the nature of the data. A value closer to zero implies certainty, whereas a value of ten or higher implies that you are a Jon Snow (you know nothing).

λ2 determines the strength of the cross-variable effect. In simple words, it determines how strong is the influence of past values of variable i in determining the present value of variable j in the model. It takes values between 0 and 1 The closer the value is to 1, the greater the cross-variable effect.

Finally, λ3 is the decay rate of a variable's own lags. The closer this parameter is to 1, the less is a variable influenced by its past values.

The last step is to determine an initial variance-covariance error matrix, which is essential for the estimation. You can choose to use the error variances from simple AR(1) models, assuming zero covariances up to estimating the corresponding OLS VAR (which was difficult initially but nowadays statistical packages do it easily).

That's it your Bayesian VAR is now estimated!

Keep in mind that you do not have to find the "correct" set of assumptions, you just have to get close, which you can do through trial and error.

You know now know what a Bayesian VAR is and how to estimate it. You can do so by using econometrics software such as Eviews and Matlab, or you can choose a free one from those that I have listed here!

If you found this story useful and you want to keep reading such stories and support me in