Computer Tutorial 4: State Space Models and TVP-VARs

Data and Matlab code for all questions are available on the course website.

Exercise 1: *Inflation Persistence in the US*
Use the unobserved components model of Stock and Watson (2007) "Why Has U.S. Inflation Become Harder to Forecast?," Journal of Money, Credit and Banking. The program, TVP_AR_SW.m, contains code for the model given in their equations (8) - (11) which we replicate here:

$$\begin{aligned}
\pi_t &= \tau_t + \eta_t, \;\; \eta_t \sim N\left(0, \sigma_t^{\eta}\right) \\
\tau_t &= \tau_{t-1} + \varepsilon_t, \;\; \varepsilon_t \sim N\left(0, \sigma_t^{\varepsilon}\right) \\
\log\left(\sigma_t^{\eta}\right) &= \log\left(\sigma_{t-1}^{\eta}\right) + v_t^{\eta}, \;\; v_t^{\eta} \sim N\left(0, \gamma_1\right) \\
\log\left(\sigma_t^{\varepsilon}\right) &= \log\left(\sigma_{t-1}^{\varepsilon}\right) + v_t^{\varepsilon}, \;\; v_t^{\varepsilon} \sim N\left(0, \gamma_2\right)
\end{aligned}$$

We provide data on three measures of inflation (π_t), CPI inflation, PPI inflation and GDP deflator inflation. Use the code to plot trend inflation (τ_t) and the volatilities σ_t^{η} and σ_t^{ε}. Is there evidence that σ_t^{η} is varying over time? Is there evidence that σ_t^{ε} is varying over time?
Optional: Stock and Watson (2007) also estimate a model (see their equations (5) and (6)) where state and measurement equation variances are constant ($\sigma_t^{\eta} = \sigma^{\eta}$ and $\sigma_t^{\varepsilon} = \sigma^{\varepsilon}$). You can also consider models where there is stochastic volatility in one equation but not the other (i.e. $\sigma_t^{\varepsilon} = \sigma^{\varepsilon}$ but σ_t^{η} is time varying or $\sigma_t^{\eta} = \sigma^{\eta}$ but σ_t^{ε} is time varying). Modify the code to estimate these models and compare results to the full model.

Exercise 2: *The Homoskedastic TVP-VAR.*:
Use the code that runs the homoskedastic TVP-VAR (Homo_TVP_VAR.m) and was used for the empirical illustration of Section 4.1.1 of the monograph by Koop and Korobilis. Extract impulse responses for different time periods and investigate how sensitive results are to the choice of prior.

Exercise 3: *The Heteroskedastic TVP-VAR:*
Use the code (Hetero_TVP_VAR.m) that runs the TVP-VAR with stochastic volatility model of Primiceri (2005, Review of Economic Studies) and was used for the empirical illustration of Section 4.3 of the monograph by Koop and Korobilis. Get impulse responses for different time periods, and plot graphs of the time-varying volatilities. Compare your results to those of Exercise 2.