Discussion: System Priors for Econometric Time Series by M. Andrle and M. Plail

Konstantinos Theodoridis

Cardiff Business School

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Research Questions

- Can the choice of time-series model parameter priors be **motivated** by **economic theory**?
- Does this lead to a **better** inference?
- Can theory motivated priors be **implemented** easily?

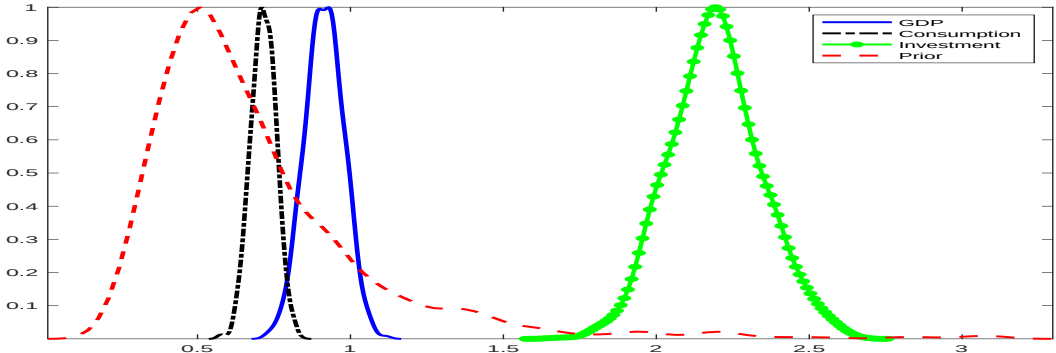
The Issues

- Authors' Model:

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \sigma \epsilon_t \tag{1}$$

where ϕ_1, $\phi_2 \sim N(0, \sigma_\phi)$, $\sigma \sim IG(\mu_\sigma, \sigma_\sigma)$ and $\epsilon_t \sim N(0, 1)$

Figure: Prior versus Data Information about Demand Components Volatility



Related Literature & Issues Can Be Addressed with System Priors

- VAR with Steady-State Priors (Villani (2009)):
  - Breaks
  - Great Moderation Trends
  - ZLB
- DSGE-VAR (Del Negro and Schorfheide (2004), Filippeli and Theodoridis (2015), Filippeli et al. (2018)):
  - Short macroeconomic samples
  - Bringing SVAR models closer to DSGE
- DSGE Endogenous Priors (Del Negro and Schorfheide (2008), Christiano et al. (2011), Chin et al. (2015), Mumtaz and Theodoridis (2017)):
  - Unrealistic ML estimated DSGE implied moments
  - Small Open Economy DSGE models (Justiniano and Preston (2010))

How It Works

Let $\mathcal{M}(\varpi)$ denote a vector of model-implied data moments and $\widehat{\mathcal{M}}$ its empirical counterpart

$$\widehat{\mathcal{M}} = \mathcal{M}(\varpi) + \mathcal{V} \tag{2}$$

As explained in Del Negro and Schorfheide (2008), a conditional distribution that reflects the beliefs about the above moment conditions can be obtained by combining the conditional density of (2), $\mathcal{L}\left(\mathcal{M}(\varpi)|\widehat{\mathcal{M}}\right)$, Bayes theorem, and the primitive prior distribution of the structural parameter:

$$p\left(\varpi|\widehat{\mathcal{M}}\right) \propto \mathcal{L}\left(\mathcal{M}(\varpi)|\widehat{\mathcal{M}}\right)\pi(\varpi). \tag{3}$$

Does It Work?

Table: Chin et al. (2015)

Mnemonic	Description	Data	Mode	5^{th}	95^{th}
$\rho_{r^L, r^{L,*}}$	Correlation between Domestic and Foreign Long-Term Rate	0.93	0.93	0.93	0.94
ρ_{r^S, r^L}	Correlation between Short- and Long-Term Domestic Rate	0.90	0.89	0.89	0.90
$\rho_{r^S, r^{S,*}}$	Correlation between Domestic and Foreign Short-Term Rate	0.84	0.79	0.79	0.80
ρ_{y, y^*}	Correlation between Domestic and Foreign GDP	0.65	0.65	0.64	0.66
ρ_{π, π^*}	Correlation between Domestic and Foreign Inflation	0.85	0.83	0.83	0.84
ρ_{c, c^*}	Correlation between Domestic and Foreign Consumption	0.62	0.61	0.60	0.62
σ_{r^S}	Standard Deviation of Domestic Short-Term Interest Rate	4.50	4.67	4.62	4.72
σ_{r^L}	Standard Deviation of Domestic Long-Term Interest Rate	3.63	3.48	3.43	3.53
$\sigma^*_{r^S}$	Standard Deviation of Foreign Short-Term Interest Rate	4.02	3.56	3.50	3.62
$\sigma^*_{r^L}$	Standard Deviation of Foreign Long-Term Interest Rate	3.12	2.68	2.61	2.73
σ_y	Standard Deviation of Domestic GDP	2.19	2.15	2.08	2.22
σ_{y^*}	Standard Deviation of Foreign GDP	2.09	2.12	2.03	2.18
σ_π	Standard Deviation of Domestic Inflation	4.07	4.69	4.64	4.74
σ^*_π	Standard Deviation of Foreign Inflation	2.04	3.00	2.95	3.05
σ_q	Standard Deviation of Real Exchange Rate	11.22	11.36	11.28	11.43
σ_w	Standard Deviation of Domestic Wage	1.53	1.71	1.67	1.76
σ^*_w	Standard Deviation of Foreign Wage	1.47	1.63	1.57	1.68

Comments & Suggestions

- This is a great paper and it proposes a very powerful tool/methodology
- System priors is the only way forward in my view for both time-series and structural models
- The authors could extend their paper with more applications to illustrate their usefulness of their methodology
- More importantly, selecting the first moment of $\mathcal{M}(\varpi)$ is straightforward in most cases, however, selecting its second moment is not. The standard deviation determines the "weight" of $p(\mathcal{M}(\varpi))$ to the estimation model. This step requires a lot of experience (Del Negro and Schorfheide (2008) approach is quite convoluted)
- It would be good if the author could explore the use of one (or more) hyperparameter (s) (similar to Del Negro and Schorfheide (2004) and Filippeli et al. (2018)) that would allow the user mechanically to select the tightness of $p(\mathcal{M}(\varpi))$

Chin, M., T. Filippeli, and K. Theodoridis (2015): "Cross-country co-movement in long-term interest rates: a DSGE approach," Bank of England working papers 530, Bank of England.

Christiano, L. J., M. Trabandt, and K. Walentin (2011): "Introducing financial frictions and unemployment into a small open economy model," *Journal of Economic Dynamics and Control*, 35, 1999–2041.

Del Negro, M. and F. Schorfheide (2004): "Priors from General Equilibrium Models for VARs," *International Economic Review*, 45, 643–673.

Del Negro, M. and F. Schorfheide (2008): "Forming priors for DSGE models (and how it affects the assessment of nominal rigidities)," *Journal of Monetary Economics*, 55, 1191–1208.

Filippeli, T., R. Harrison, and K. Theodoridis (2018): "DSGE-based priors for BVARs and quasi-Bayesian DSGE estimation," Bank of England working papers 716, Bank of England.

Filippeli, T. and K. Theodoridis (2015): "DSGE priors for BVAR models," *Empirical Economics*, 48, 627–656.

Justiniano, A. and B. Preston (2010): "Can structural small open-economy models account for the influence of foreign disturbances?" *Journal of International Economics*, 81, 61–74.

Mumtaz, H. and K. Theodoridis (2017): "Fiscal Policy Shocks and Stock Prices in the United States," Working Papers 817, Queen Mary University of London, School of Economics and Finance.

Villani, M. (2009): "Steady-state priors for vector autoregressions," *Journal of Applied Econometrics*, 24, 630–650.