A Unified Framework to Estimate Macroeconomic Stars

Saeed Zaman
Federal Reserve Bank of Cleveland
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Abstract

- Implement a **medium-scale semi-structural model** to estimate jointly several macroeconomic **"stars" – long-run equilibrium levels** of
  - *Growth rate of output (**g***), unemployment rate (**U***), real rate of interest (**R***), productivity growth (**p***), price inflation (**pi***), wage inflation (**W***)*
  - Ingredients of the model motivated by economic theory and empirical features necessitated by changing economic environment: (1) *time-variation in macroeconomic relationships*; (2) *stochastic volatility in error variances*
- Crucial element: allow for **explicit links between model-based stars and the long-run survey expectations** to improve stars' econometric estimation
- **By-products**: time-varying estimates of *wage and price Phillips curve*, *pass-through between prices and wages, evolving cyclicality of productivity, which* provide new insights into these empirical relationships' instability in US data; Other objects of interest: estimates of *output gap*, *monetary policy stance*
- Given the richness of the model, document an expansive set of empirical results

Model Description

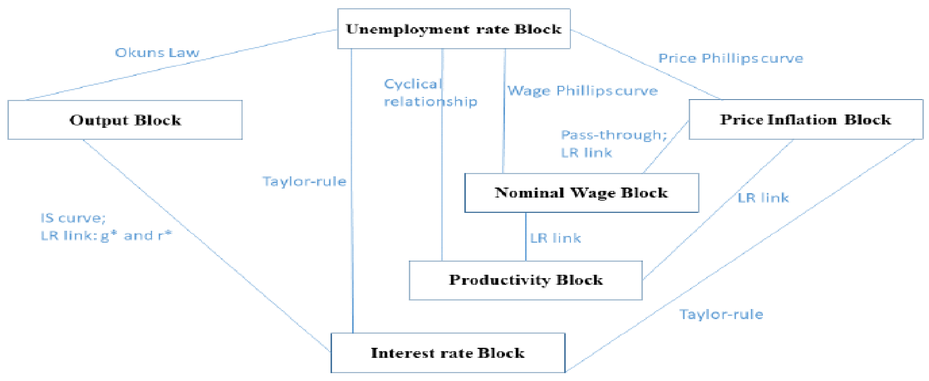

Figure 1. Visual Overview of Interactions Between Blocks of the Model

- **Star** (long-run equilibrium of a particular macroeconomic series): infinite-horizon forecast conditional on the current information set; Beveridge-Nelson trend

Estimates of Stars

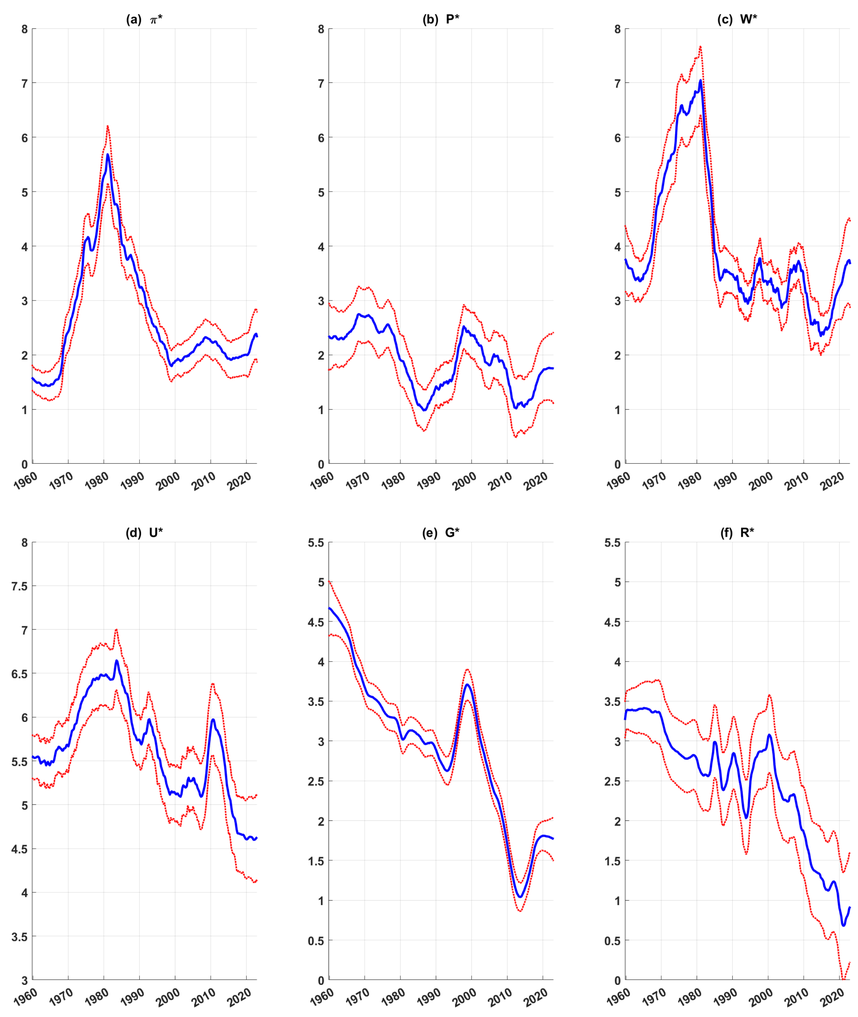

Figure 2. Smoothed estimates of Stars, posterior mean and 68% credible intervals

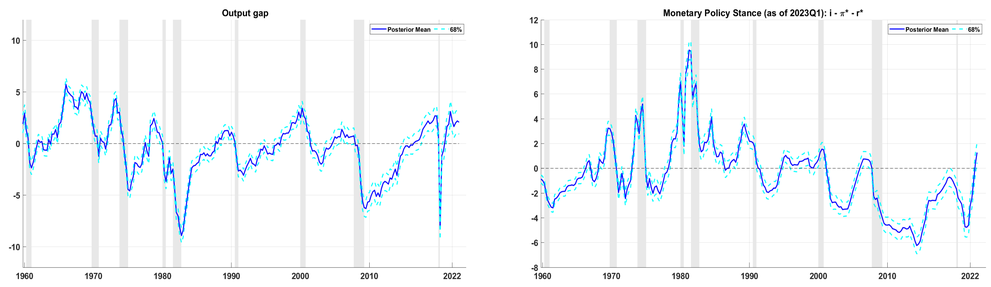

Figure 3. Smoothed estimates of other objects of interest

Sensitivity to Modeling Choices

- Baseline model and its variants: **Base-NOSV** (shut down stochastic volatility), **Base-NOTVP** (shut down time-variation in parameters), **Base-NOSV-NOTVP** (shut down both stochastic volatility and time-variation in parameters)

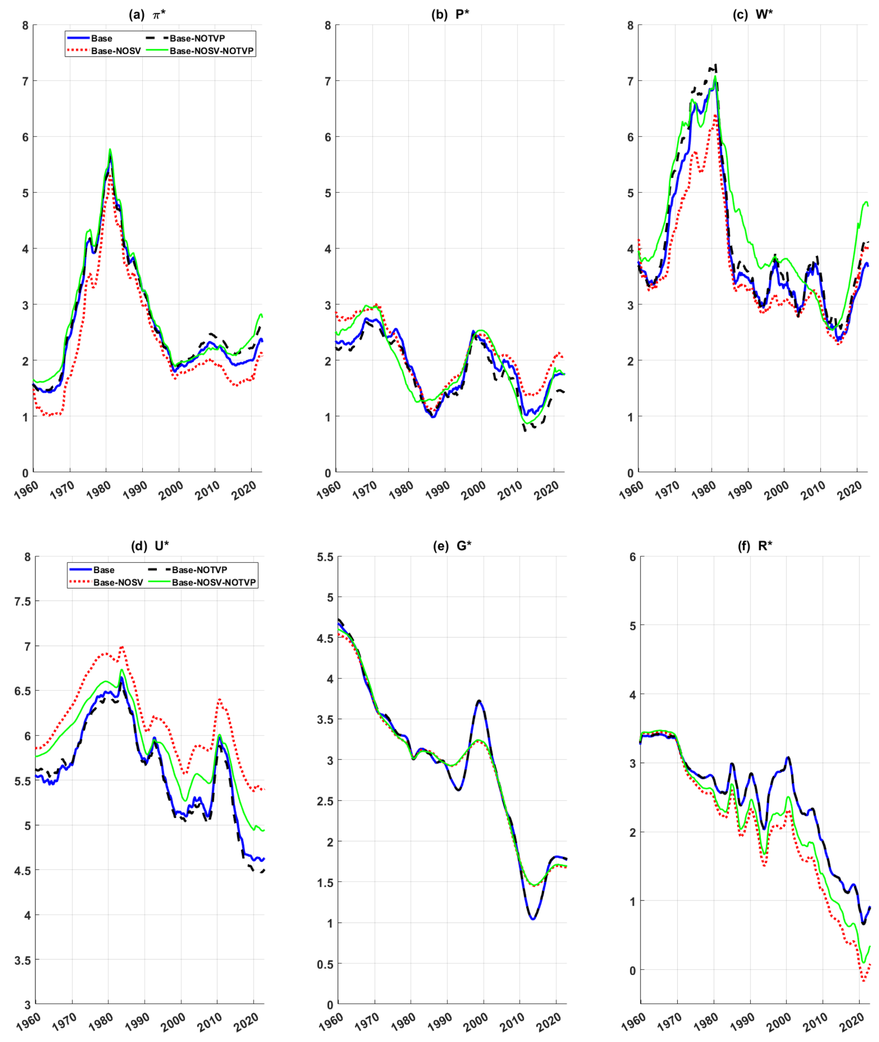

Figure 4. Smoothed estimates of Stars from Base model and its variants

	Base	Base-NOTVP	Base-NOSV	Base-NOSV-NOTVP
Inflation	-404.8	-407.9	-454.6	-458
UR	62.7	62.7	-275	-274.7
Productivity	-653.5	-655.4	-675.7	-676.9
Nominal Wage	-320.1	-328.4	-365.4	-473.1
GDP	-251.5	-251.5	-390	-390.8
Interest rate	-231.1	-232.6	-342.2	-342.6
Total	**-1798.3**	**-1813.1**	**-2502.8**	**-2616.1**

Table 1. Model Comparison: Marginal Likelihood

Empirical Findings: Highlights

- **Baseline model** (feature rich) **vs. restricted variants**: Baseline wins
- **Model yields credible estimates** of stars and the output gap
  - Prior to COVID, output gap similar to the CBO's production function approach; thereafter, more optimistic than CBO
- **Cf. to smaller-scale model estimates**: can be different enough for long periods of time to matter for policy
- **Role of survey data I**: crucial for stars estimation during the COVID-19 pandemic, without it, the high-dimensional model difficult to estimate
  - Results indicate that R*, g*, U*, and p* remained generally stable during and after the COVID, but pi* and W* have risen
- **Role of survey data II**: data alone suggest weak link between R* and g*; survey expectations data strengthen link (supporting Laubach and Williams)
- **Okun's Law in US data?** Strongly supported
- **Time variation?** Yes, strong evidence in many of the model parameters capturing important macroeconomic relationships
  - E.g., supports "..price Phillips curve has weakened over time," "The wage Phillips curve is alive," "weakening in the procyclicality of productivity"
- **Stochastic volatility?** Strongly supported in model equations defining cyclical fluctuations
- **Narrower credible intervals** around stars compared to typical estimates reported elsewhere, allowing for more precise inference
- **Real-time vs. final estimates**: progress made in mitigating well-known difficulties associated with the real-time estimation of stars
- **W-star** is new, as is its model-based decomposition into p-star and pi-star determinants (based on economic theory)
- **Real-time forecasting properties of the model?** Highly competitive
- **Estimated stars useful as terminal values for external models?** Yes

Saeed Zaman
Research department, Federal Reserve Bank of Cleveland; saeed.zaman@clev.frb.org

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