Incorporating External Information into DSGE Model Forecasts

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The use of DSGE models at central banks has triggered a strong interest in their forecast performance.

This talk is based on a (not quite written yet) chapter for the *Handbook of Economic Forecasting*: “DSGE Model-Based Forecasting”

We focus on methods of incorporating external information from the Blue Chip survey into DSGE model forecasts:

- Long-run inflation expectations;
- Long-run output growth expectations;
- Nowcasts;
- Short-/Medium-term interest rate expectations
Smets and Wouters (2007) model, modified to absorb real time information as specified below.

**Observables**: output, consumption, investment, real wage growth, hours worked, inflation, Federal Funds rate.

**Real time data**, following Edge and Gürkaynak:

- Recursive out-of-sample forecasting.
- All estimation samples start in 1964.
- **Blue Chip samples**: forecast origins aligned with Blue Chip survey publication dates. We consider January, April, July, and October, ending April 2011
- **Greenbook samples**: forecast origins aligned with Greenbook dates. We consider March, June, September, and December, ending Sept. 2004
h = 1 is current quarter nowcast.
Growth rates, inflation rates, interest rates are QoQ %
Incorporating Inflation Expectations

- High-inflation rates from 1970-1982 lead to fairly large estimate of steady-state inflation rate (4 % annualized);

- Upward bias in current inflation forecasts;

- Remedy: anchor target inflation rate using long-run inflation expectations.

- Modify policy rule:
  \[ R_t = \rho R_{t-1} + (1 - \rho_R)(\psi_1(\pi_t - \pi^*_t) + \ldots \]
  \[ \text{Time-varying inflation target evolves according to:} \]
  \[ \pi^*_t = \rho_{\pi^*} \pi^*_{t-1} + \sigma_{\pi^*} \epsilon_{\pi^*,t}, \]

- Augment measurement equations:
  \[ \pi_{t,40} = \pi^*_t + \mathbb{E}_t \left[ \frac{1}{40} \sum_{k=1}^{40} \pi_{t+k} \right] \]
With and Without Inflation Expectations

- Smets-Wouters: red
- Smets-Wouters with loose prior on $\pi_*$: salmon
- DSGE model with inflation expectations: magenta
Output Growth Expectations

- Low frequency movements in output growth rates, e.g. productivity slowdown in the 1970s.
- Incorporate long-run expectations about output growth
- To capture divergence of model expectations and Blue Chip expectations, introduce a shock process to technology growth rates
- Measurement equation:

\[ \text{Growth}_t^{O,40} = \gamma + \mathbb{E}_t \left[ \frac{1}{40} \sum_{k=1}^{40} (y_{t+k} - y_{t+k-1} + z_{t+k}) \right] \]
With and Without Output Growth Expectations

- DSGE model with inflation expectations: red
- DSGE model with inflation and output growth expectations: salmon
“Standard” DSGE model forecasts ignore information from current quarter.

Approach 1 (News): true $Y_{T+1} = \text{external info } Z_T + \text{noise}$

Approach 2 (Noise): external info $Z_T = \text{true } Y_{T+1} + \text{noise}$

Approaches are the same for hard conditioning: $\text{noise} = 0$.

Under both approaches the forecaster essentially obtains information about the shocks $\epsilon_{T+1}$ as well as the state $s_T$ at forecast origin.

The following results are generated under Approach 2, using nowcasts for output growth, inflation, and interest rates.
With and Without Blue Chip Nowcasts

- DSGE model with inflation expectations: red
- DSGE model with inflation expectations and nowcasts: salmon
With and Without Blue Chip Nowcasts

- **DSGE model with inflation expectations**: red
- **DSGE model with inflation expectations and nowcasts**: salmon
We are utilizing multi-step interest-rate forecasts from Blue Chip.

BC interest-rate forecasts are treated as observations of agents’ expectations in the model.

Introduce anticipated monetary policy shocks to absorb difference between measured expectations and model-based expectations.

SW model allows for a serially correlated monetary policy disturbances

\[ r_t^m = \rho r_{t-1}^m + \sigma r_t^m \epsilon_t^m. \]

Augment \( r_t^m \) by anticipated shocks that capture future expected deviations from the systematic part of the monetary policy rule:

\[ r_t^m = \rho r_{t-1}^m + \sigma r_t^m \epsilon_t^m + \sum_{k=1}^{K} \sigma r_{t-k}^m \epsilon_{k,t-k}^m. \]

Policy shocks \( \epsilon_{k,t-k}^m, k = 1, \ldots, K \), are known to agents at time \( t - k \), but affect the policy rule with a \( k \) period delay in period \( t \).
With and Without Interest Rate Expectations

- DSGE model with inflation expectations and nowcasts: red
- DSGE model with inflation expectations and nowcasts and interest rate expectations: salmon

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With and Without Interest Rate Expectations

- DSGE model with inflation expectations and nowcasts: red
- DSGE model with inflation expectations and nowcasts and interest rate expectations: salmon
Conclusion

- External information can be useful to improve forecasts with DSGE models.

- A time-varying inflation target combined with long-run inflation expectations worked well in a number of models.

- Using external nowcasts improves DSGE model forecasts in the short-run. For some series improvement carries over to medium-run.

- Using long-run output growth expectations did not improve forecasts.

- Using interest-rate expectations in conjunction with anticipated policy results produced mixed results at best. Anticipated policy shocks generate some awkward dynamics. However, interest rate forecasts, in particular near ZLB, improve.

- References to the literature and many more results will be available in *Handbook Chapter*. 