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
DSGE Model versus Blue Chip

Output Growth

Inflation

Interest Rates

- $h = 1$ is current quarter nowcast.
- Growth rates, inflation rates, interest rates are QoQ %
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:

\[ R_t = \rho_R R_{t-1} + (1 - \rho_R) \psi_1 (\pi_t - \pi_t^*) + \ldots \]

Time-varying inflation target evolves according to:

\[ \pi_{t}^* = \rho_{\pi^*} \pi_{t-1}^* + \sigma_{\pi^*} \epsilon_{\pi^*,t} , \]

Augment measurement equations:

\[ \pi_t^{O,40} = \pi_* + \mathbb{E}_t \left[ \frac{1}{40} \sum_{k=1}^{40} \pi_{t+k} \right] \]
With and Without Inflation Expectations

- Smets-Wouters: red
- Smets-Wouters with loose prior on $\pi^*$: salmon
- DSGE model with inflation expectations: magenta
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:

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

**Output Growth**

- DSGE model with inflation expectations: red
- DSGE model with inflation and output growth expectations: salmon

**Inflation**

**Interest Rates**
“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

**Output Growth**

**Inflation**

**Interest Rates**

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

**Consumption Growth**

**Investment Growth**

**Real Wage Growth**

- 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

\[ r_t^m = \rho_{rm} r_{t-1}^m + \sigma_{rm} \epsilon_t^m. \]

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

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

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
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
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.