Incorporating External Information into DSGE Model Forecasts

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Introduction

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

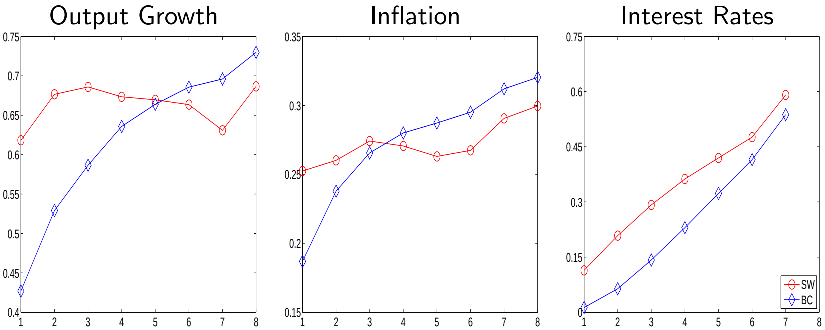
- This talk is based on a (not quite written yet) chapter for the *Handbook of Economic Forecasting*: "DSGE Model-Based Forecasting"

- 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

DSGE Model

- 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



- $h = 1$ 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:

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

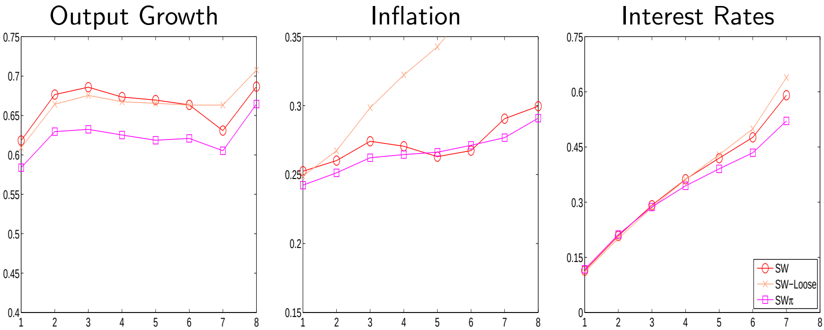
  Time-varying inflation target evolves according to:

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

- 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



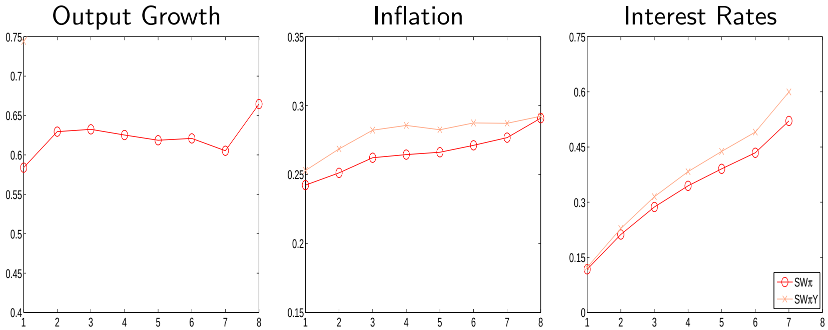
- Smets-Wouters: red
- Smets-Wouters with loose prior on π_*: salmon
- DSGE model with inflation expectations: magenta

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:

$$Growth_t^{O,40} = \gamma + \mathbb{E}_t \left[\frac{1}{40} \sum_{k=1}^{40} (y_{t+k} - y_{t+k-1} + z_{t+k}) \right],$$

With and Without Output Growth Expectations

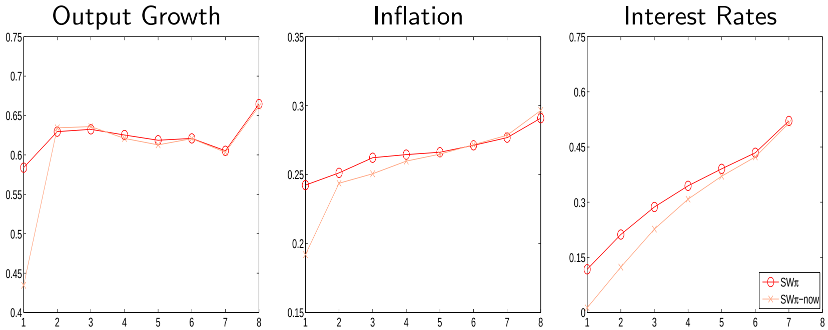


- DSGE model with inflation expectations: red
- DSGE model with inflation and output growth expectations: salmon

Incorporating External Nowcasts (No Model Modification)

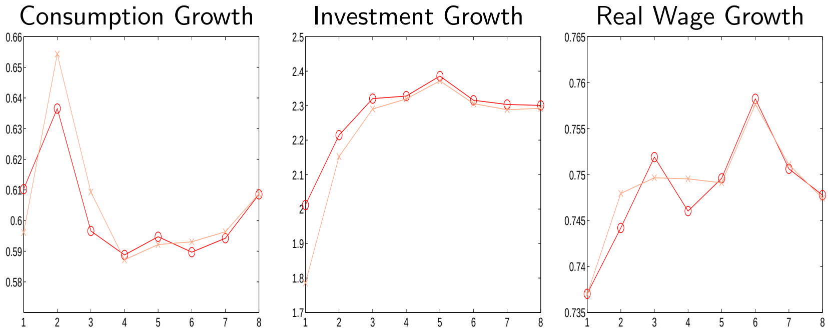
- "Standard" DSGE model forecasts ignore information from current quarter.
- *Approach 1 (News):* true Y_{T+1} = external info Z_T + *noise*
- *Approach 2 (Noise):* external info Z_T = true Y_{T+1} + *noise*
- Approaches are the same for hard conditioning: *noise* $= 0$.
- Under both approaches the forecaster essentially obtains information about the shocks ϵ_{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

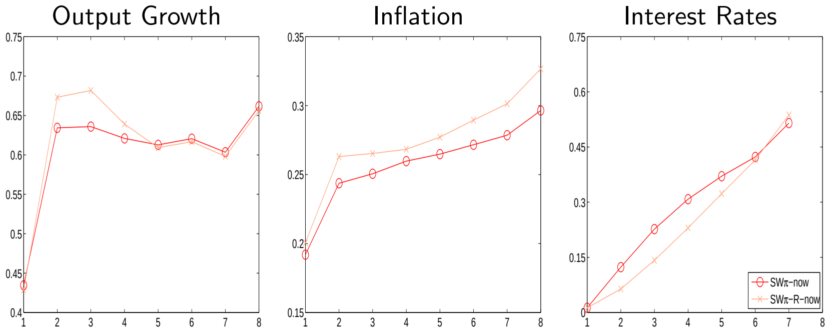
Incorporating Interest Rate Expectations

- 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 $r_t^m = \rho_{r^m} r_{t-1}^m + \sigma_{r^m}\epsilon_t^m$.
- Augment r_t^m by anticipated shocks that capture future expected deviations from the systematic part of the monetary policy rule:

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

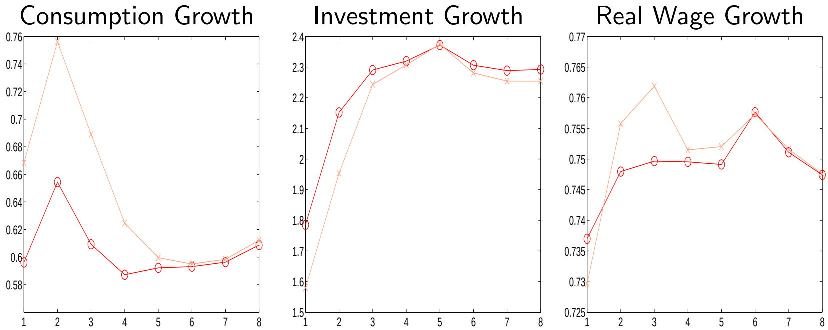
- Policy shocks $\epsilon_{k,t-k}^m$, $k = 1, \ldots, K$, are known to agents at time $t-k$, but affect the policy rule with a k period delay in period t.

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

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*.