A Real-time Comparison of Forecast Performance Across Federal Reserve Staff Forecasts, Simple Reduced-form Models, and a DSGE Model

Rochelle Edge[1], Michael Kiley[1], and Jean-Philippe Laforte[1]

[1]Division of Research and Statistics, Federal Reserve Board

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Outline of the presentation

- Describe (briefly) the *current* version of our multi-sector DSGE model.
- Turn to real-time forecasting.
  - Describe the paper's real-time environment, the Greenbook and FRB/US forecasts, and the competing forecasting models.
  - Compare the Greenbook, FRB/US, DSGE, and reduced-form model forecasts since September 1996.

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Model overview

- Our model is more disaggregated than most closed-economy models.
- The model has two production sectors:
  - A slow-growing goods producing sector, X^{slw}; and,
  - A fast-growing goods producing sector, X^{fst}.
- The model has multiple expenditure aggregates:
  - Expenditures on consumer nondurable goods and non-housing services, E^{cnn};
  - Expenditures on consumer durable goods, E^{cd};
  - Expenditures on residential capital, E^{r};
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Model features

- Nominal rigidities:
  - Sticky prices and sticky wages, where both lagged inflation and steady-state inflation determine adjustment costs.
- Real rigidities:
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  - Adjustment costs to investment;
  - Adjustment costs to cross-sectoral factor movements; and,
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Model equations

- Utility maximization by households (and cost minimization by capital owners) implies:
  - Non-durables & non-housing services consumption demand, consumer durables demand, residential capital goods demand.
  - Labor supply (i.e., wage Phillips curves).
- Cost minimization by firms (and capital owners) implies:
  - Economy-wide labor demand.
  - Non-residential capital goods demand.
- Profit-maximization by firms implies:
  - Aggregate supply for goods (i.e., price Phillips curves).
- The monetary authority follows an interest rate feedback rule.
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Estimation overview (1)

The model is estimated with Bayesian techniques using 12 data series:

Real variables	• GDP • NDS (ex. housing) consumption • Durables consumption • Residential investment • Non-residential investment • Hours in the NFB sector
Wages and prices	• Real comp. per hour in the NFB sector • GDP deflator • NDS (ex. housing) consumption deflator • Non-residential investment goods deflator
Financial market	• Yield on the 10-yr. Treasury (coupon-basis)
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All other (latent) model variables are estimated as part of the Kalman-filter routine.

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Real-time forecasting . . .

- Evaluation of the model's abitility to explain key features of the data.
- Out-of-sample forecasting performance of our DSGE model relative to atheoretical models, the Greenbook and the FRB/US model forecast.
- We try to adopt a "real-time" approach for the production of the economic model forecasts.

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The real-time environment

- For each FOMC meeting (eight times a year), staff at the Federal Reserve Board produce a detailed six- to ten-quarter forecast of the economic outlook.
- Since the March 1996 Greenbook round the staff have stored databases for each forecast round that include:
  - The Greenbook projection; and,
  - The historical data of the series that we forecast.
  - The FRB/US Forecast
- The historical data in each GB database is the source of our real-time data.
  - Complete databases are available from September 1996 onwards.

The real-time forecasts

- Greenbook forecast.
- DSGE model forecast.
- FRB/US model forecast.
- Atheoretic reduced-form model forecasts: Bayesian VAR and VAR models
- Real-time model forecasts are generated to correspond to the following Greenbook rounds:
  - September 1996 to March 2001
  - September 1996 to June 2005

The DSGE model real-time forecast

- The DSGE model is re-estimated once year using the data available at the time of the most recent August meeting.
  - By that time, the annual NIPA re-benchmarking has taken place.
- Some of the DSGE model's coefficients are re-calibrated when the model is re-estimated.
  - These coefficients are set by a procedure that minimizes the distance between the growth rates of key aggregates and their theoretical counterparts.
- Our DSGE model forecast does not condition on any of the Greenbook assumptions.

The atheoretic reduced-form model forecasts

- Our two atheoretic models are:
  - a VAR model, and
  - a Bayesian VAR model (with modified Litterman prior).
  - The number of lag is set to one.
- The VAR and BVAR models currently consist of twelve macro series – NIPA aggregates, prices, hours, and interest rates

Evaluating forecast performance

- We consider the latest release of a series as the most accurate measure.
  - This choice is not without controversy.
  - Changes in methodology that took place between now and when the forecast was made are interpreted as forecast errors.
- The usual alternative is to use the "first final" release data, that is, the release that closes the quarter until benchmarking.

Comparison with Time-Series Methods: "Top-line" variables

- The "Top-line" variables are: hours per capita, the percent change in real GDP, GDP price inflation, and the federal funds rate.
- This set captures aggregate activity and is the focus of many small modeling efforts.

Comparison with TS Methods: "Top-line" variables I

Model	1Q	2Q	3Q	4Q	8Q
			Hours per capita		
VAR(1)	2.692	2.992	3.261	3.520	2.857
Relative MAE					
DSGE/Edo	0.926	0.904	0.861	0.844	0.764
BVAR(1)	0.984	0.955	0.928	0.905	0.874
			Real GDP Growth		
VAR(1)	0.433	0.446	0.472	0.488	0.349
Relative MAE					
DSGE/Edo	0.876	0.845	0.784	0.815	0.839
BVAR(1)	0.954	0.965	0.989	1.007	1.070

Table: Mean Absolute Errors of Models: Sep. 1996-June 2005

Comparison with TS Methods: "Top-line" variables II

Model	1Q	2Q	3Q	4Q	8Q
			GDP Inflation		
VAR(1)	0.249	0.273	0.278	0.298	0.211
Relative MAE					
DSGE/Edo	0.868	0.819	0.824	0.734	0.674
BVAR(1)	0.964	0.944	0.919	0.919	0.930
			Federal Funds Rate		
VAR(1)	0.113	0.195	0.272	0.364	0.386
Relative MAE					
DSGE/Edo	1.294	1.159	1.051	0.929	0.710
BVAR(1)	1.004	1.017	1.030	1.012	1.064

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Comparison with TS Methods: "Disaggregated" variables

- Policymakers are often interested in developments within individual sectors ...
- the disaggregated series are: real personal consumption expenditures on nondurables and services, real personal consumption expenditures on durables, real business investment, and real residential investment.
- The Edo DSGE model forecast is on average more accurate than that of the VAR and BVAR for the components of consumption and business investment.
- The model has some difficulties with forecasting residential investment.

Comparison with the Greenbook and FRB/US model

- Comparison to existing methods that are more policy revelant than atheoretical models.
- We focus on a period that ends before the start of the 2001 recession.

Comparison with Staff and FRB/US Forecasts I

Model	1Q	2Q	3Q	4Q	8Q
			Hours per capita		
VAR(1)	2.229	2.321	2.478	2.696	2.496
Relative MAE					
DSGE/Edo	0.898	0.897	0.873	0.838	0.840
BVAR(1)	1.001	1.005	1.005	1.013	1.042
Greenbook	1.017	1.074	1.081	1.086	1.047
FRB/US	1.006	1.037	1.021	1.003	0.893
			Real GDP Growth		
VAR(1)	0.480	0.529	0.608	0.581	0.442
Relative MAE					
DSGE/Edo	0.781	0.788	0.715	0.777	0.770
BVAR(1)	1.044	1.001	1.047	1.040	1.096
Greenbook	1.120	1.111	1.105	1.092	0.957
FRB/US	1.033	1.229	1.113	1.054	0.891

Table: Mean Absolute Errors of Models: Sep. 1996-March 2001

Comparison with Staff and FRB/US Forecasts II

Model	1Q	2Q	3Q	4Q	8Q
			GDP Inflation		
VAR(1)	0.258	0.239	0.240	0.246	0.145
Relative MAE					
DSGE/Edo	0.795	0.832	0.846	0.847	0.864
BVAR(1)	0.964	0.970	0.969	0.972	0.965
Greenbook	0.798	0.871	0.609	0.602	0.926
FRB/US	0.659	0.900	0.888	0.793	0.884
			Federal Funds Rate		
VAR(1)	0.091	0.179	0.274	0.378	0.404
Relative MAE					
DSGE/Edo	1.043	0.851	0.756	0.693	0.755
BVAR(1)	1.020	1.019	1.020	1.020	0.993
Greenbook	0.747	0.682	0.760	0.816	0.926
FRB/US	0.747	0.682	0.760	0.816	0.926

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Conclusions

- The current version of our DSGE model yields forecasts that compete in terms of accuracy with popular alternative models.
  - Our results suggest that there is a role for DSGE models in the suite of models used by central banks for forecasting.
- Nonetheless, our results indicate that for forecasting purposes the model can be improved along a number of dimensions.
- Our results suggest that the data challenges to using a micro-founded macro model for forecasting in real time are not severe.

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