

The Diversity of Forecasts from Macroeconomic Models of the U.S. Economy?

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Our Objective

- Analyse the accuracy and heterogeneity of output growth and inflation forecasts during recessions
- Focus on theory based models of the U.S. economy
- Use real-time data and reestimate the models
- Compare accuracy to best practice benchmark forecasts (Greenbook)
- Compare heterogeneity to professional forecasts collected in the Survey of Professional Forecasters

- Empirical documentation of substantial variations in the accuracy and heterogeneity of professional forecasts: Kurz, Jin and Motolese(2003, 2005), Giordani and Söderlind (2003), Kurz (2009), Capistran and Timmermann (2009)
- Theories of heterogenous expectations that induce endogenous fluctuations: Kurz (1994, ... , 2009), Brock and Hommes (1998), Branch and Evans (2009), De Grauwe (2009) and others

Reasons for Forecasting Heterogeneity

- Different modelling assumptions: fully theory based economic structure, non-structural collections of statistical relationships, simple rule-of-thumb forecasts
- Information sets used by forecasters → different parameter estimates, different estimates of the state of the economy, different forecasts
- The information sets and modelling assumptions of professional forecasters are unobservable → impact on forecasting precision and heterogeneity cannot be studied
- We use instead six models of the U.S. economy and generate forecasts for the last five NBER-defined recessions

Outline

1. Forecasting Models
2. Dataset
3. Forecasting Methodology / Examples
4. Forecasting Accuracy
5. Forecasting Heterogeneity

Forecasting Models: New Keynesian Model

- Described in Rotemberg and Woodford (1997), Goodfriend and King (1997), Woodford (2003), Walsh (2003) and many others
- Often referenced to as the workhorse model in monetary economics
- Small scale model with consistent microeconomic foundations (optimizing households and firms) and rational expectations
- Monopolistic competition + nominal rigidities → interaction of real and nominal variables
- We use as a baseline model the estimated version by Del Negro and Schorfheide (2004)
- Second specification with added mark-up and preference shocks
- 3 observable time series, Bayesian estimation

Forecasting Models: Overlapping Wage Model

- Described in Fuhrer and Moore (1995) and Fuhrer (1997)
- Earlier generation model without an explicit representative household and optimizing firms
- Supply side is modelled via overlapping real wage contracts
 - ▶ Phillips Curve depends on current and past demand and expectations about future demand
- Backward looking demand curve
- Standard monetary policy rule
- 3 observable time series, Maximum Likelihood estimation

Forecasting Models: Medium-Scale DSGE Model

- Described in Christiano, Eichenbaum and Evans (2005) and estimated by Smets and Wouters (2007)
- Builds on the baseline New Keynesian model and extends it to endogenous capital formation
- Nominal friction: sticky prices and wages, price and wage indexation
- Real frictions: consumption habits, investment adjustment costs, variable capital utilization
- Nonseparable utility, fixed production costs, Kimball aggregator
- 7 serially correlated shock processes
- 7 observable time series, Bayesian estimation

Forecasting Models: Disaggregated DSGE Model

- Described in Edge, Kiley and Laforge (2008), builds on Christiano, Eichenbaum and Evans
- Two production sectors, which differ in their pace of technological progress
- Captures different growth rates and relative prices observed in the data
- Disaggregated expenditure side: business investment, consumption of non-durables and services, investment in durable goods, residential investment
- 14 structural shocks + measurement errors
- 11 observable time series, Bayesian estimation, nonlinear implementation

Forecasting Models: Bayesian VAR

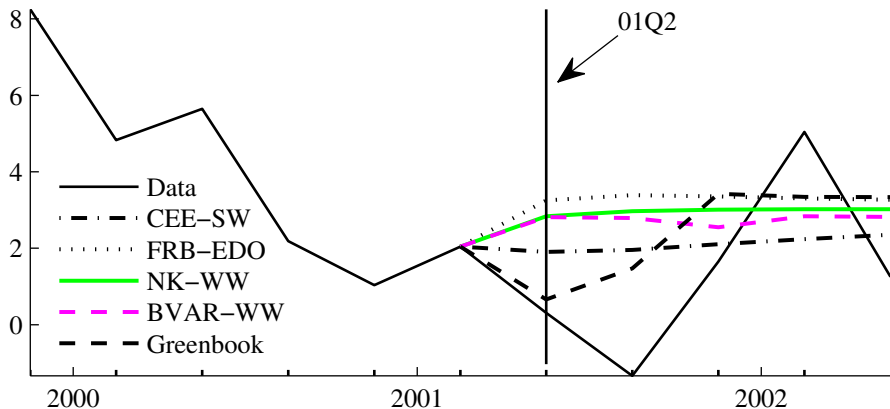
- Described in Doan, Litterman and Sims (1984)
- Atheoretical model counterpart with tight prior restrictions
- Used for a long time for forecasting
- Benchmark for forecasting comparison
- Minnesota priors to shrink parameters towards zero
- Output growth, inflation, Federal Funds Rate

- Historical data vintages as available at the time of forecast starts
- Optionally, append the current state of the economy (nowcast) as estimated by Greenbook/SPF to the data
- Data obtained from Fed St. Louis' Alfred database
- Hours and wages are taken from a dataset underlying the Greenbook projections (Faust and Wright, 2009)

Forecasting Methodology

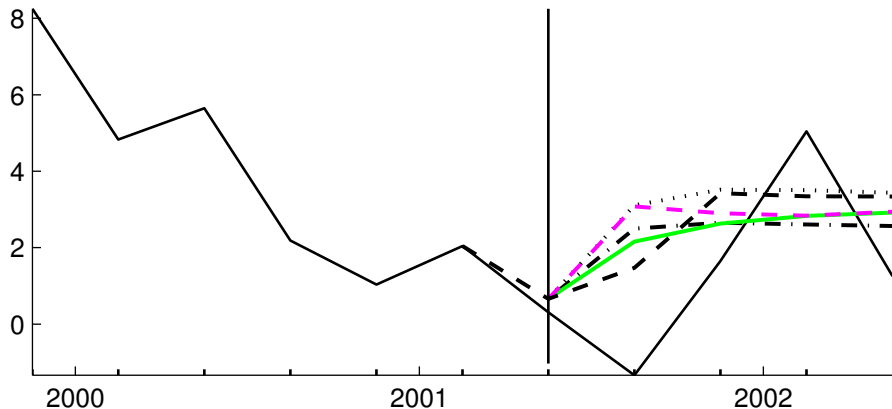
1. Model Setup: create a model file with the model equations and link them to observable time series
2. Solution: solve the model and write it in state space form
3. Data update: update the data with the current data vintage
4. Estimation: estimate the structural parameters by maximizing the likelihood or the posterior kernel
5. Forecast: compute forecasts by iterating over the solution matrices setting the expected value of future shocks to zero
6. Repeat steps 3 to 5 quarter-by-quarter for the time-period of interest
7. Repeat steps 1 to 6 for different models possibly extending the information set by additional variables as required by the respective model

Example: Forecasting the 2001 recession



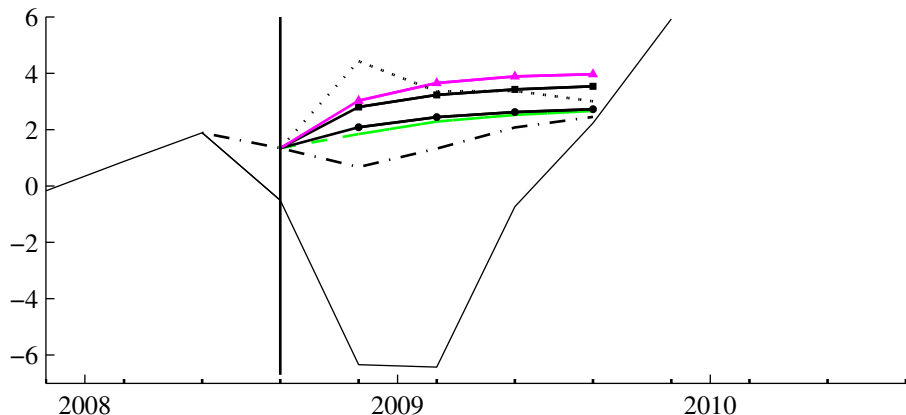
(Nowcast as estimated by the forecasting models)

Example: Forecasting the 2001 recession



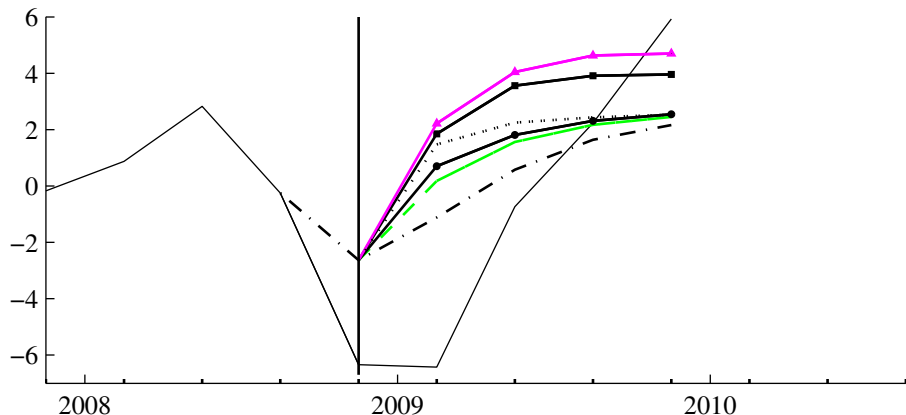
(Greenbook nowcast used as starting point)

Forecasting the 2009 recession



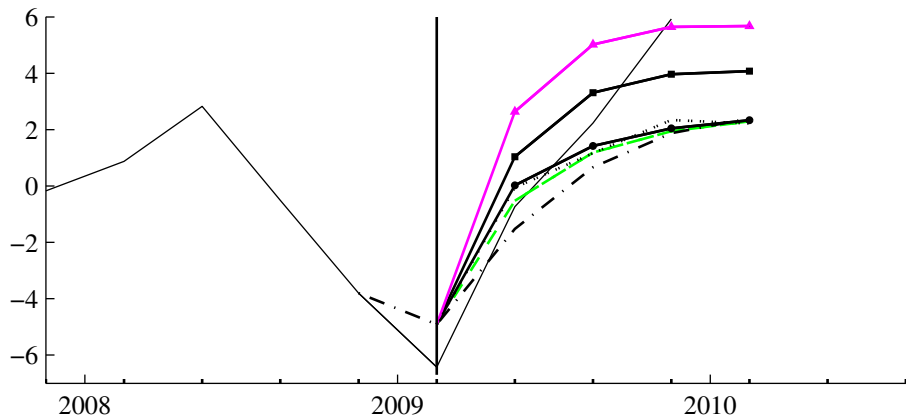
green: Del Negro & Schorfheide; black-circle: New Keynesian;
pink: Fuhrer & Moore; black-squares: Smets & Wouters;
dotted: Bayesian VAR; dashed-dotted: SPF

Forecasting the 2009 recession



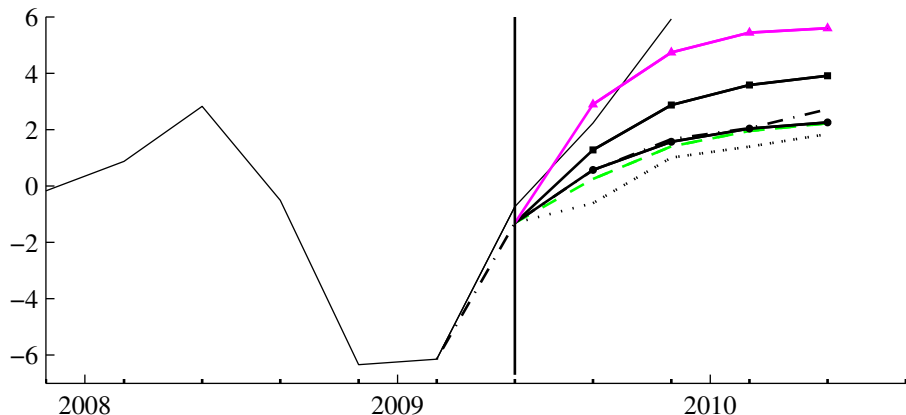
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dotted: Bayesian VAR; dashed-dotted: SPF

Forecasting the 2009 recession



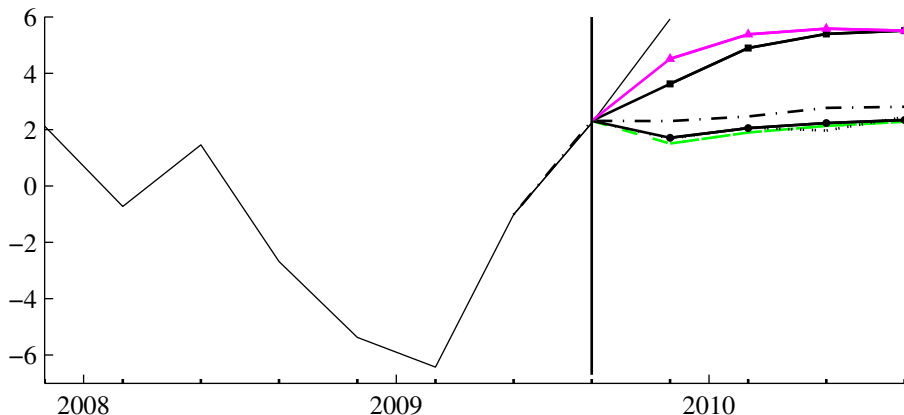
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Forecasting the 2009 recession



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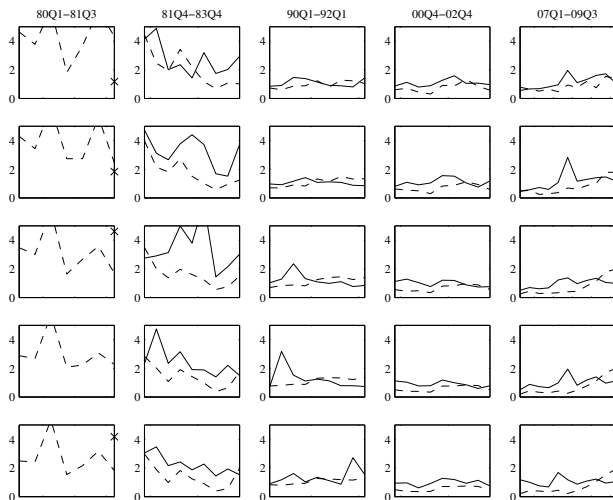
Forecast Accuracy: RMSEs of Output Growth

Sample / Horizon	NK-DS	NK-WW	CEE-SW	FRB-EDO	NK-Fu	BVAR-WW	Mean	GB	SPF
1980:1 - 1981:3									
0	5.05	5.05	5.05	5.05	5.05	5.05	5.05	5.05	—
1	8.14	8.13	6.33	6.06	7.18	6.69	5.83	6.65	—
2	6.34	6.36	4.80	5.60	6.48	6.48	4.83	5.54	—
3	5.50	5.74	5.20	5.37	6.49	7.74	5.20	6.11	—
4	5.56	5.75	4.23	4.24	4.12	5.50	4.05	5.32	—
1981:4 - 1983:4									
0	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.14
1	4.28	4.50	3.74	3.27	3.80	3.23	3.54	3.58	3.88
2	3.99	4.05	4.22	4.09	3.98	4.09	3.86	3.93	4.11
3	4.14	4.23	4.05	4.52	4.64	4.87	4.25	3.91	4.41
4	4.08	4.11	4.07	4.67	4.73	4.89	4.28	3.84	4.02
1990:1 - 1992:1									
0	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.12
1	2.64	2.87	3.22	1.70	3.11	2.00	2.47	2.09	1.45
2	2.95	3.04	3.80	1.92	3.68	2.28	2.82	2.34	2.06
3	3.08	3.13	3.78	2.42	3.67	2.55	2.94	2.31	2.54
4	2.71	2.76	3.65	2.16	3.48	2.29	2.69	2.18	2.37
2000:4 - 2002:4									
0	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.22
1	2.17	2.15	2.31	2.84	2.06	2.48	2.23	2.20	2.30
2	2.09	2.10	2.11	2.61	2.35	1.98	2.11	2.34	2.21
3	2.74	2.72	2.68	2.98	2.51	2.66	2.65	2.76	2.65
4	2.25	2.26	2.08	2.40	2.24	2.30	2.19	2.18	2.13
2007:4 - 2009:3									
0	1.94	1.94	1.94	—	1.94	1.94	1.94	—	1.94
1	3.74	3.90	4.24	—	4.54	4.85	4.21	—	3.30
2	4.52	4.62	4.94	—	5.48	5.10	4.89	—	4.11
3	5.05	5.11	5.39	—	5.83	5.27	5.32	—	4.80
4	5.50	5.52	5.86	—	6.07	5.57	5.70	—	5.39

Forecast Accuracy: RMSEs of Inflation

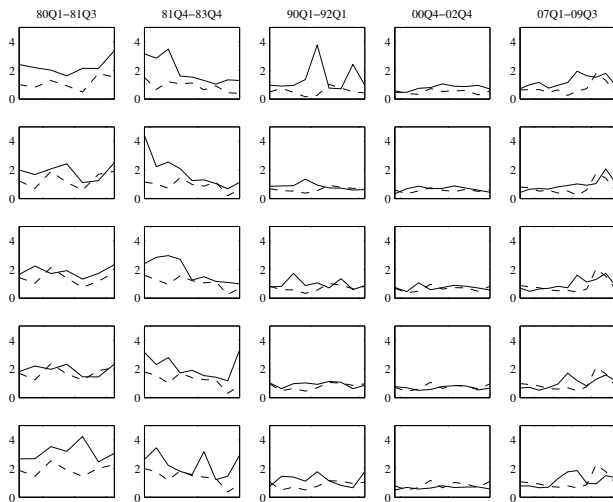
Sample / Horizon	NK-DS	NK-WW	CEE-SW	FRB-EDO	NK-Fu	BVAR-WW	Mean	GB	SPF
1980:1 - 1981:3									
0	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.52
1	2.73	2.59	2.57	2.76	2.97	2.94	2.59	1.25	1.81
2	2.89	2.56	2.49	2.53	2.76	3.33	2.59	1.66	1.92
3	2.70	1.86	1.98	1.39	1.48	2.71	1.73	1.77	2.23
4	4.02	2.92	2.54	3.00	3.15	4.94	3.22	2.21	2.56
1981:4 - 1983:4									
0	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.13
1	2.31	2.06	1.97	1.72	2.15	1.71	1.86	1.32	1.76
2	2.53	2.05	2.04	1.58	2.46	1.61	1.92	1.26	1.68
3	2.53	1.91	2.02	1.16	2.32	1.67	1.79	1.07	1.95
4	2.78	2.01	2.25	1.41	2.36	1.66	1.87	1.48	2.06
1990:1 - 1992:1									
0	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	1.09
1	1.03	1.10	1.01	0.94	1.77	0.93	1.03	0.84	0.98
2	1.42	1.58	1.36	0.81	1.61	1.04	1.23	0.95	1.01
3	1.49	1.77	1.63	1.11	0.89	0.93	1.20	1.06	1.19
4	1.31	1.70	1.62	1.34	0.87	1.07	1.16	1.02	1.19
2000:4 - 2002:4									
0	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.70
1	0.92	0.95	0.90	0.97	1.13	0.76	0.85	0.87	0.87
2	1.33	1.38	1.18	1.24	1.61	1.04	1.23	0.70	0.92
3	1.29	1.41	1.18	1.48	1.68	1.02	1.25	0.75	0.93
4	1.53	1.65	1.17	1.68	2.02	1.35	1.45	0.78	0.98
2007:4 - 2009:3									
0	1.11	1.11	1.11	—	1.11	1.11	1.11	—	1.11
1	1.15	1.19	1.00	—	1.48	1.11	1.10	—	1.03
2	1.28	1.37	1.17	—	1.56	1.22	1.28	—	1.10
3	1.50	1.61	1.30	—	1.87	1.49	1.51	—	1.24
4	1.69	1.81	1.39	—	1.92	1.59	1.65	—	1.40

Forecast Heterogeneity: Output Growth



Standard Deviations of Output Growth Forecasts; SPF: solid; Models: dashed

Forecast Heterogeneity: Inflation



Standard Deviations of Inflation Forecasts; SPF: solid; Models: dashed

Conclusion

- Investigate the accuracy and heterogeneity of macroeconomic forecasts during recessions
- Mean model forecast comes surprisingly close to the Greenbook forecast even though only a small number of data series is used
- Structural models' forecasting performance is good at the medium horizon and during recoveries
- Model forecasts and professional forecasts perform badly at turning points
- The extent of forecast heterogeneity is broadly similar for model and professional forecasts and varies substantially over time
- Forecast heterogeneity constitutes a potentially important source of economic fluctuations