Nowcasting euro area GDP: 13 years of experience

Marta Banbura
European Central Bank

Post-crisis policy challenges and implications for macro modelling

Bank of Finland, 19 September 2019

The views expressed are those of the author and do not necessarily reflect those of the ECB.
Outline

1. General remarks
2. Some history and lessons from the crisis
3. Nowcasting framework at the ECB
4. Ongoing and future work
Nowcasting, general remarks

- **Nowcasts: particular types of forecasts**
  - Short-term forecast horizon (1-2 quarters ahead)
  - Incorporating data from various sources as soon as they are released (=> ragged edge, mixed frequency, possibly large information set)
  - “Reduced” form

- **Models implemented at many institutions and larger commercial banks**
  - Eurosystem NCBs; New York, Atlanta, St. Louis Fed; OECD; Goldman Sachs, J.P. Morgan, …
  - Automatic, “cheap” to run, judgment free, replicable

- **“Competitive” forecast accuracy**
  - Often found to perform at least as well as “institutional” or survey based forecasts

- **Uses**
  - Forecasts for real GDP
  - Interpretation of incoming data
  - Starting point and risk evaluation for “official” forecasts

See e.g. handbook chapters Bańbura, Giannone, and Reichlin (2011) or Bańbura, Giannone, Modugno and Reichlin (2013)
Some (selective) history

“Early” models

- Often single equation models (bridge equations) linking GDP to some monthly indicators (e.g. industrial production)
  - Implemented at the ECB almost from the start
    - Rünstler and Sedillot (2003)

Factor models and big data (~2005)

- Search for more comprehensive data sources
  - Surveys typically found most useful but data sets usually contain many other data types
  - Factor models typically used to deal with the course of dimensionality
    - Often ~100-300 series included
      - Giannone,. Reichlin, and Small (2008)

- Factor models with large data sets implemented at the ECB (and many other central banks) around 2006-7.
Some (selective) history

❖ **Lessons from the crisis**

- Breaks in forecast performance; failure to predict large drops in GDP even at a very short horizon

- Presence of time variation
  - Long-run mean of GDP
  - Variances (=> stochastic volatility)
  - Relationships between variables


- Need to communicate uncertainty surrounding the forecasts => predictive distributions (“fan” charts)


- The conclusion on the usefulness of financial data is not clear-cut

Andreou, Ghysels and Kourtellos (2013) find some value added
Insights from the new toolkit development

- Performance of large mixed frequency factor models declined (relative to simpler models of the bridge equation type)
  See also Ollivaud, Pionnier, Rusticelli, Schwellnus and Koh (2016)

- Examples of breaks:
  
  Relationship between hard and soft data (Surveys fell less than hard data - > some loadings get a wrong sign); declining contribution of industrial sector (intercept shift in the relationship between GDP and industrial production, not much data on the services sector)

- Simpler and smaller models and model suites often more robust to time variation and mis-specification

- Important to have several models in the toolbox and monitor performance regularly (e.g. every three/four years)

- Forecast combination typically helps to make the performance more robust

- We do not necessarily need very big data sets: enough with a few indicators

- Need to explain why the forecasts are changing
Disappointing performance of nowcasting models after the crisis

Forecasts
2009Q3-2014Q4, bridge equations and factor models

Note: Flash and latest GDP growth; DIR_SBE: system of bridge equations, DIR_DFM: dynamic factor model; For each quarter a sequence of 12 real-time updates is shown.
New suite of models for the euro area GDP growth

10 models:

1. Two types of bridge equations

   1. **Value added type**: industrial production excluding construction and value added in services; VA extrapolated using an auxiliary bridge equation(s).
   
   2. **Surveys**: PMI composite and PMI construction.

2. Two types of models used for extrapolations

   1. **Bayesian VAR** (Minnesota type priors; specification “in-differences”; shrinkage selected using marginal likelihood; Kalman smoother used for extrapolations).
   
   2. **Dynamic factor model** (including AR(1) process for idiosyncratic component).

3. Different system sizes in the extrapolations

   1. **Small** (5 variables, used in bridge equations)
   
   2. **Medium** (22 variables; further survey data, finer disaggregation of IP, retail trade, URX, car reg., trade)
   
   3. **Large** (28 variables; medium augmented by monetary aggreg., financial and intern. data)

4. Recursive estimation

   **Recursive**: starting in 1985 (adding rolling estimation over the latest 10 years of data did not improve the accuracy)
"Competitive" accuracy of the models

2009Q3-2014Q4, vs flash estimate of GDP

RMSFE

Bias

Note: For each quarter a sequence of 12 real-time forecast updates is evaluated. Projections are updated once per quarter. Bias is defined as the average difference between the forecast and the outcome. Model forecasts and projections are evaluated against the flash estimates of real GDP growth.
“Competitive” accuracy of the models

2015Q1-2019Q2, vs flash estimate of GDP

RMSFE

Note: For each quarter a sequence of 11 real-time forecast updates is evaluated. Projections are updated once per quarter. Bias is defined as the average difference between the forecast and the outcome. Model forecasts and projections are evaluated against the flash estimates of real GDP growth.
**“Competitive” accuracy of the models**

**2015Q1-2019Q2, vs final estimate of GDP**

**RMSFE**

- Model vs latest estimate
- Official projection vs latest vintage

**Bias**

- Model vs latest estimate
- Official projection vs latest vintage

**Note:** For each quarter a sequence of 11 real-time forecast updates is evaluated. Projections are updated once per quarter. Bias is defined as the average difference between the forecast and the outcome. Model forecasts and projections are evaluated against the latest vintage of real GDP growth.
What we report?

- Model based forecasts for GDP growth for next two quarters to be released
  Currently 2019Q3 and 2019Q4

- Euro area and four largest countries

- Point and density forecasts
  Risks to projections and probabilities of events

- Interpretation of forecast revisions

- Comparison to other forecasts
  Projections, NCBs’ short-term forecasts, Eurozone Barometer
Evolution of nowcasts over time

(quarter-on-quarter % growth)

Note: The red line represents the average point forecasts (from 10 different models) for real GDP growth in respective quarter from different forecast updates (indicated on the x-axis). The bars indicate the drivers of forecast revisions between the consecutive updates: ‘IP’: industrial production, ‘Hard’: unemployment rate, trade, retail trade, new car registrations, ‘Surveys’: surveys of the European Commission and the Purchasing Managers’ surveys, ‘Fin/Money’: real money and financial and credit indicators, and ‘Remainder’ or the effects of data revisions and parameter re-estimation.
Revisions are driven by **news**: outcomes/data releases different than previously forecast.

\[ \text{Revision} = \sum W_i \times \text{News}_i \]

\( W_i = f(\text{average size of news, relevance for GDP}) \)

**Model based**

See Bańbura and M. Modugno (2010)

**Note:** Previous forecast refers to a forecast from 15 March 2019. Latest forecast refers to a forecast from 29 March, incorporating the release of flash PMI for March.
State space representation and Kalman filter allow to decompose the nowcast revisions: 

\[
\mathbb{E} \left[ y_t^Q | \Omega_{v+1} \right] - \mathbb{E} \left[ y_t^Q | \Omega_v \right] = \sum_{j \in J_{v+1}} b_{j,t,v+1} \left( x_{j,T_j,v+1} - \mathbb{E} \left[ x_{j,T_j,v+1} | \Omega_v \right] \right)
\]

into a weighted average of (model) based news:

- \( b_{j,t,v+1} \): akin to the Kalman gain but for ragged-edge data
- allows to trace back the revisions to individual data releases - interpretation
- see Bańbura and Modugno (2010)
Density forecasts

Note: The blue lines represent the (combined) probability density function for real GDP growth in respective quarter from different forecast updates. The combination involves densities from the 10 different models via a linear prediction pool with equal weights. The red line corresponds to the outcome entailed in the June 2019 projections.
Current work

- **Calibration of densities**
  - Density combination schemes
    - Gneiting and Ranjan (2013)

- **Other model types**
  - Accounting for time variation in the models

- **Other data sources**
  - Payments, motorway tolls, weather, internet search, …

- **Nowcasts for other variables**
  - Expenditure components, employment, …