How to improve the use of models for monetary policy?

SUERF Online Workshop
“Macroeconomic models for monetary policy: State of play and way forward”

M. Darracq Paries - European Central Bank

*The views expressed are those of the presenter and not necessarily those of the ECB
Eurosystem Modelling workstream: Policy use of models

• Presentation based on ECB Occasional Paper No.267
  “Review of macroeconomic modelling in the Eurosystem: current practices and scope for improvement”

• Section 5: Assessment of model-based analysis for monetary policy preparation and scope for improvement

• Section 6: Assessment of cooperation across the Eurosystem
Scope for improving the policy use of models: assessment roadmap

Policy use of models

- Model-based economic narrative
- Forecasting with judgment (incl. the role of model-based projections)
- Model-based risk analysis
- Model-based monetary policy evaluation
- Enhanced medium-term reference scenarios
- country vs EA-wide model

Prioritisation

- Improvements with new model development
- Improvements with existing models
- Current practice

✓ Assessment differentiated across projection models and other models
✓ Assessment internalizes the constraints from the Eurosystem organizational features (notably for projections)
✓ Improvements should be considered also from the perspective of the policy process
✓ Prioritisation scoring: $\text{policy-impact} = (\text{feasibility-constraints}) \times (\text{resource-cost})$
## Policy use of models: main suggestions

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The charts explain the December 2020 BMPE NCB3 baseline. The category “Interest rate shocks” comprises shocks which mainly explain the short-term interest rate (monetary policy shock), the long-term interest rate (shock to banker’s survival rate) and the lending rate (shock to retail bank’s markdown). The category “Foreign and trade” captures shocks to foreign demand, foreign prices, US 3-month and 10-year interest rates, competitor’s export prices, oil prices, import demand, export preferences, mark-up shocks to export prices and import prices and a foreign risk-premium shock. The category “Domestic demand” includes domestic risk-premium shocks and shocks to government spending whereas “Domestic supply” captures supply-shocks, namely: transitory and permanent technology shocks as well as wage and price mark-ups. Category “Other” includes measurement errors and residuals from bridge equations.
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Forecasting with judgement: analytical roadmap

[Starting from the previous baseline,] simulate the impact of changes in assumptions

Further condition on new data and changes in short-term forecasts for selected macro aggregates

Revisions in potential output and other nominal or financial anchors

New assumptions → New data and short-term outlook → Changes in long-term trends → Model-based projections

Judgement on assumptions → Judgement on ST outlook propagation → Other judgement → Projections with judgment

Amend the impact of assumptions due to:
- Views on the structural drivers of the assumptions
- Views on the transmission channel of the assumptions

Amend the impact of data and ST outlook due to:
- Statistical factors not relevant for the outlook
- Persistence of ST outlook revisions

Scenario-type judgemental interventions
Model-based projections: cross-check of the Dec. 2020 BMPE

Real GDP – Euro area
(q-o-q growth rates, in %)

HICP – Euro area
(y-o-y growth rates, in %)

<table>
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<tr>
<th>Year</th>
<th>December 2020 BMPE</th>
<th>NAWM II - proj. update</th>
<th>ECB-BASE - proj. update</th>
<th>ECB-BASE - cond. projection</th>
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<tr>
<td>2021</td>
<td>3.89</td>
<td>2.68</td>
<td>2.61</td>
<td>2.67</td>
</tr>
<tr>
<td>2022</td>
<td>4.23</td>
<td>4.12</td>
<td>4.67</td>
<td>2.95</td>
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<tr>
<td>2023</td>
<td>2.12</td>
<td>3.53</td>
<td>4.23</td>
<td>2.70</td>
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<tr>
<td>2021</td>
<td>1.00</td>
<td>1.12</td>
<td>1.02</td>
<td>0.85</td>
</tr>
<tr>
<td>2022</td>
<td>1.14</td>
<td>1.11</td>
<td>1.18</td>
<td>0.98</td>
</tr>
<tr>
<td>2023</td>
<td>1.36</td>
<td>1.23</td>
<td>1.45</td>
<td>1.39</td>
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Source: ECB/NCB projections database and ECB/NCB staff calculations

'Projection updates' correspond to model-based updates of the previous (B)MPE baseline on the basis of changes in assumptions as well as new data and changes in the short-term outlook up to 2021Q1. 'Conditional projections' correspond to model-based forecasts, conditioned on the new assumptions, new data as well as the short-term outlook up to 2021Q1. The grey areas represent the 68% confidence intervals from the ECB BASE forecast and from ECB BASIR forecast. They are centered around December BMPE. The darkest intervals correspond to ECB BASIR. In the ECB BASE model, the density forecast is computed using a bootstrap method that re-samples the in-sample residuals of the model. The forecasted value of an endogenous variable is calculated by adding the re-sample residual to the value forecasted by the model and the distribution is obtained by repeating the process 500 times.
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Statistical risk metrics: predictive densities across models

2023 Real GDP – Euro area
(annual growth rate, in %)

Source: ECB, ECB calculations based on: Benchmark BVAR (Bayesian VAR with constant coefficients and volatilities), AR-SV (BVAR with an AR(1) process for stochastic volatility), Z-model (BVAR with heteroskedasticity modelled as a function of predicted paths for VIX and the Oxford stringency index) and T-model (heteroscedasticity via fat tails, t-student distributed errors).
**Statistical risk metrics: Model combination predictive densities**

**2023 Real GDP – Euro area**
(annual growth rate, in %)

- Tilted BVAR comb
- Dec 2020 BMPE
- BVAR comb

**2023 HICP– Euro area**
(annual growth rate, in %)

- Tilted BVAR comb
- Dec 2020 BMPE
- BVAR comb

Source: ECB, December 2020 BMPE Real GDP and HICP inflation values. ECB calculations based on an optimal pooling combination of BVAR models (“BVAR comb”) as described in Bańbura et al. (2021), and the same density combination tilted to the median of the December 2020 BMPE (“Tilted BVAR comb”) according to entropic tilting methods, where the distributions are re-weighted so that their median coincides with the December 2020 BMPE.
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Alternative pandemic scenarios for the euro area: analytical roadmap

- **Real side**: Estimated-loss approach to derive the first quarters for GDP growth in the pandemic scenarios
- **Potential output**: Evaluation of the supply side implication of the pandemic scenarios
- **Global factors**: Alignment with the international environment and global trade spillovers
- **Financial**: Assumptions on the scope for real-financial amplification in the scenarios
- **Model simulation**: Derivation of the full macroeconomic outcomes for the scenarios using ECB-BASE conditional projections
- **Cross-check**: Real-nominal consistency of the scenarios, Labour market dynamics, Other judgement
- **Final scenarios**
Alternative pandemic scenarios

**ECB-BASIR uncertainty ranges**

**Real GDP**
(index, 2019 Q4 = 100)

- December BMPE
- March MPE

Source: ECB projections database and ECB staff calculations.

Notes: The grey areas represent the 90% and 68% confidence intervals from the ECB-BASIR forecast. They are centred around the March MPE. In the ECB-BASIR model, the density forecast is computed using a bootstrap method that re-samples the in-sample residuals of the model and considers the uncertainty related to pandemic developments, like the efficiency of vaccination campaign and underlying virus fundamentals. The ECB BASIR forecast is conditional and uses the value produced by the ECB staff for the Fiscal, Foreign, UIP, Transfers, Exchange rate, House prices, Financial, Wealth, Inventories and Policy Rule blocks. The dotted line depicts the severe scenario, while the dashed line reports the mild.
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| **MP sensitivity analysis around an enhanced medium-term reference scenarios (MTRS)** | ✓ Harmonise the MP simulation protocol for the various policy processes: review model selection and assess the relevance of heterogeneity in simulation outcomes  
✓ Enhance the MTRS towards a fully-fledged model-based medium-term extension of the baseline and conduct regular scenario analysis around the MTRS, notably on policy conduct | Best practices among other institutions (i.e. FED) |
NAWM structural narrative of the medium-term reference scenario

Real GDP – Euro area
(q-o-q growth rates, in % deviations from steady-state)

Private consumption deflator inflation – Euro area
(y-o-y growth rates, in % deviations from 1.9%)

Source: ECB staff calculations using the NAWM II.
The category “Interest rate shocks” comprises shocks which mainly explain the short-term interest rate (monetary policy shock), the long-term interest rate (shock to banker’s survival rate) and the lending rate (shock to retail bank’s markdown). The category “Foreign and trade” captures shocks to foreign demand, foreign prices, US 3-month and 10-year interest rates, competitor’s export prices, oil prices, import demand, export preferences, mark-up shocks to export prices and import prices and a foreign risk-premium shock. The category “Domestic demand” includes domestic risk-premium shocks and shocks to government spending whereas “Domestic supply” captures supply-shocks, namely: transitory, permanent and investment specific technology shocks as well as wage and price mark-ups. Category “Other” includes the contribution of the initial conditions.
Policy sensitivity analysis around a medium-term reference scenario

Real GDP – Euro area
(index =100 2019q4)

HICP– Euro area
(y-o-y growth rates, in %)

Short-term nominal interest rate
(annual %)

Source: ECB staff calculations based on the NAWMII.
Notes: The charts show the response to different unconventional monetary policies around the medium-term reference scenario as of the December 2020 BMPE. The blue dashed line shows the case in which the central bank promises a lower-for-longer interest rate curve in the future, for 4 quarters after the rate hits its minimum value. The yellow dashed lines represent the case in which the lower-for-longer policy is in place for 6 quarters. Finally, the dashed red lines show the case in which an APP policy is in place, promising to keep a stock of asset purchases of 10% of annual GDP over the MTRS horizon.
Cooperation modalities

Assessment of cooperation modalities within the Eurosystem

• **Recommendation** on Information sharing and modelling infrastructure
  - A central ESCB infrastructure that supports the efficient use of a wide range of tools by simplifying data and knowledge transfer
  - (On a voluntary basis,) building up of repository of models for common use

• **Recommendation** on organization strategies
  - Enhance the modelling hub function of the WGEM
  - Foster the connectivity with similar groups of other central banks, financial institutions, data providers, universities
  - Engage in co-development of new shared models
A new framework to manage projections end-to-end

The Projections EnableR platFORM (PERFORM) provides a unified user-experience for ECB experts, … enabling sharing of data, collected from various sources, using common functions to validate and process data and to run models to produce forecasts and visualise data/prepare reports …

… orchestrating the projections process collaboratively, in an access-controlled environment for decision-making, achieving traceability and reproducibility.
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