How to improve the use of models for monetary policy?

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

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*The views expressed are those of the presenter and not necessarily those of the ECB

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EUROPEAN CENTRAL BANK
EUROSYSTEM

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:** 6 Assessment of cooperation across the Eurosystem

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Occasional Paper Series

Work stream on Eurosystem modelling — Review of macroeconomic modelling in the Eurosystem: current practices and scope for improvement
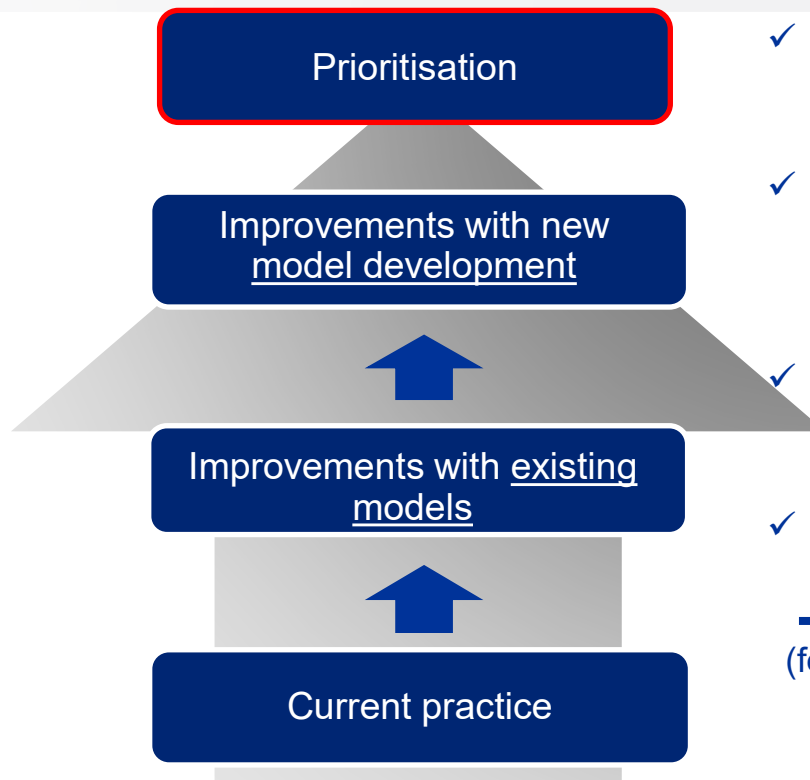
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ECB STRATEGY REVIEW

Disclaimer: This paper constitutes staff input into the Governing Council's deliberation in the context of the ECB's monetary policy strategy review. This paper should not be reported as representing the views of the Eurosystem. The views expressed are those of the authors and do not necessarily reflect those of 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:

$$\frac{\text{policy-impact}}{(\text{feasibility-constraints}) * (\text{resource-cost})}$$
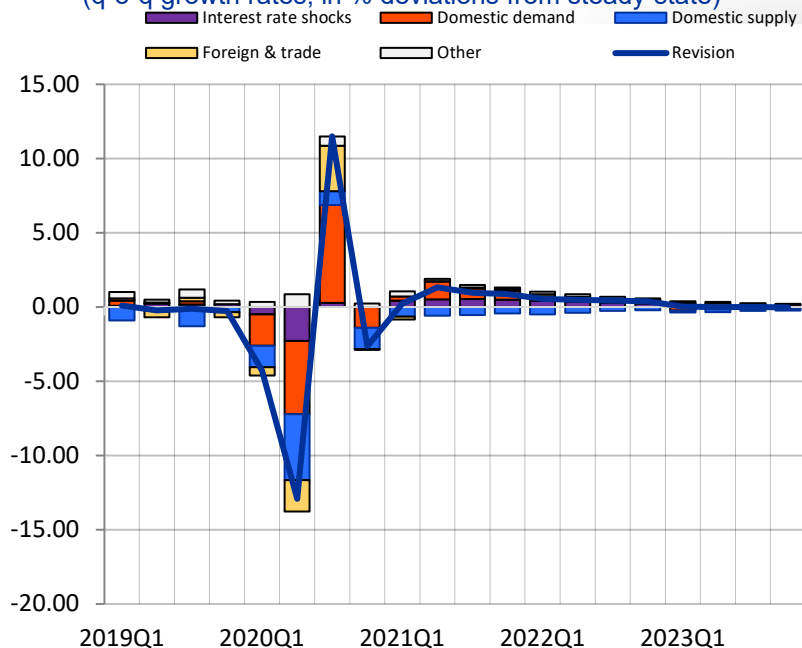
Policy use of models: main suggestions

Use cases	Recommendation	Benchmark
Model-based economic narrative	✓ Explore strategies to improve the structural underpinning of projection models ✓ Regular model-based structural analysis of forecast errors across a wide range of models	Best practices among the Eurosystem

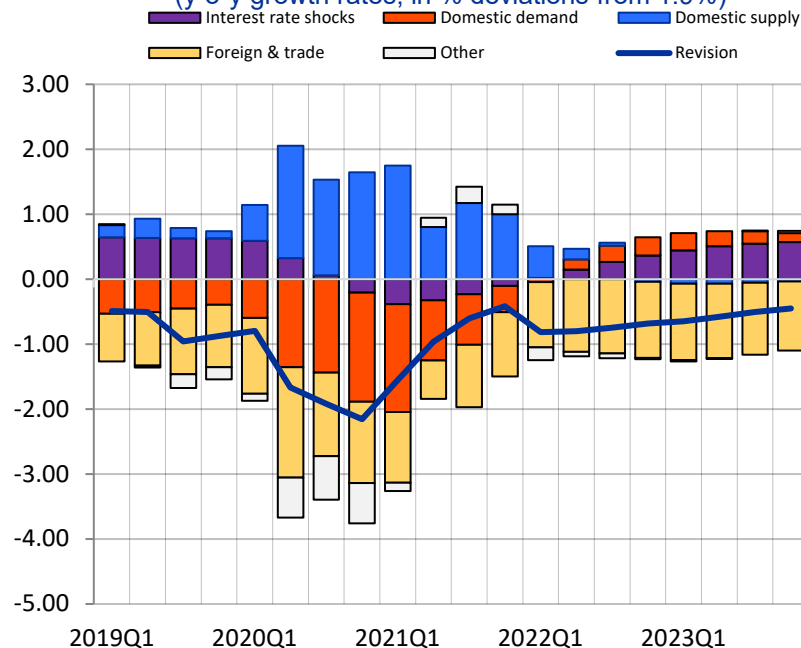# Structural narrative of the December 2020 BMPE: NAWMII

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

Legend: Interest rate shocks | Domestic demand | Domestic supply | Foreign & trade | Other | Revision

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

Legend: Interest rate shocks | Domestic demand | Domestic supply | Foreign & trade | Other | Revision
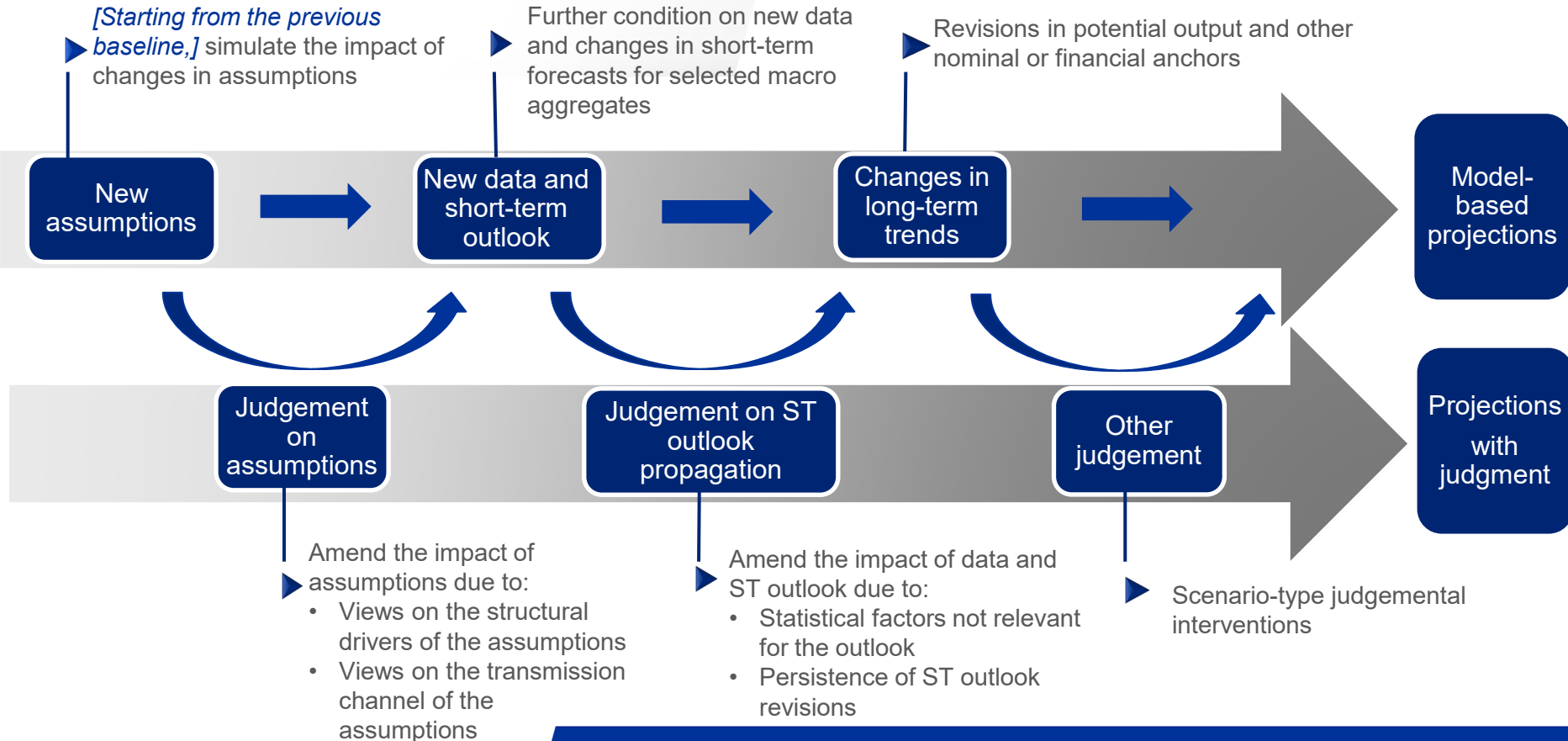
Source: ECB staff calculations using the NAWM II.
The charts explain the December 2020 BMPE NCB3 baseline. The category "**Interest rate shocks**" comprises shocks which mainly explain the short-term interest rate (monetary policy shock), the long-term interest rate (shock to banker's survival rate) 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.
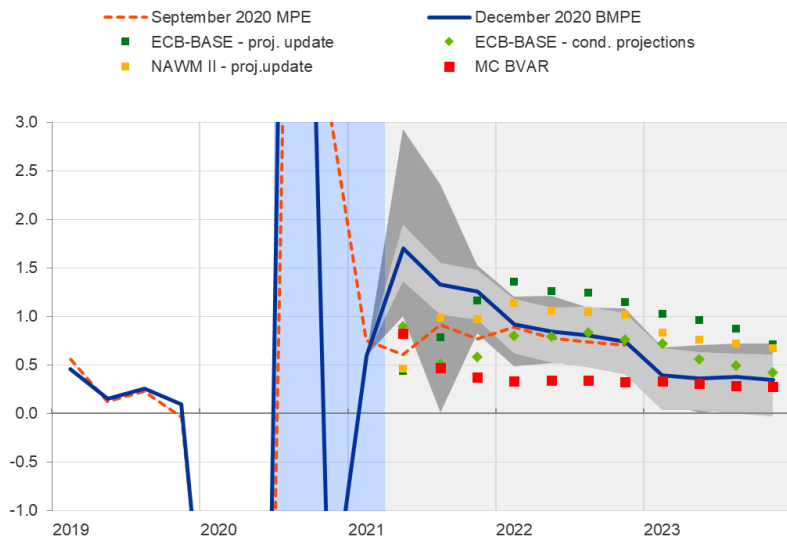
Policy use of models: main suggestions

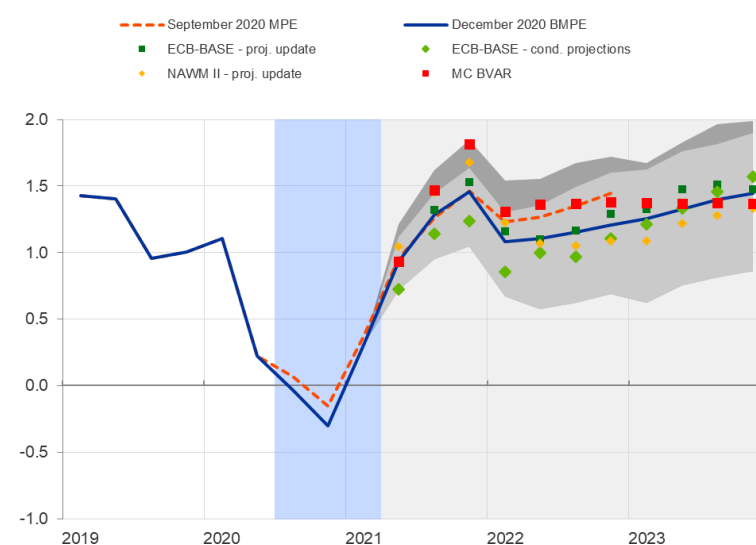| Use cases	Recommendation	Benchmark
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Forecasting with judgement	✓ Harmonize the conceptual framework for model-based projections and judgement measures	Best practices among the Eurosystem

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 %)

	GDP growth			HICP inflation		
	2021	2022	2023	2021	2022	2023
December 2020 BMPE	3.89	4.23	2.12	1.00	1.14	1.36
NAWM II - proj. update	2.68	4.12	3.53	1.12	1.11	1.23
ECB-BASE - proj. update	2.61	4.67	4.23	1.02	1.18	1.45
ECB-BASE - cond. projection	2.67	2.95	2.70	0.85	0.98	1.39

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.

Policy use of models: main suggestions
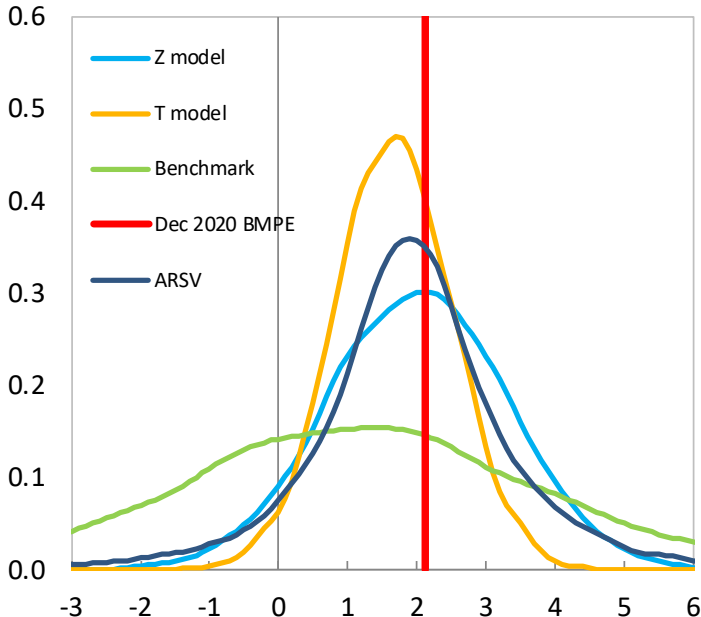
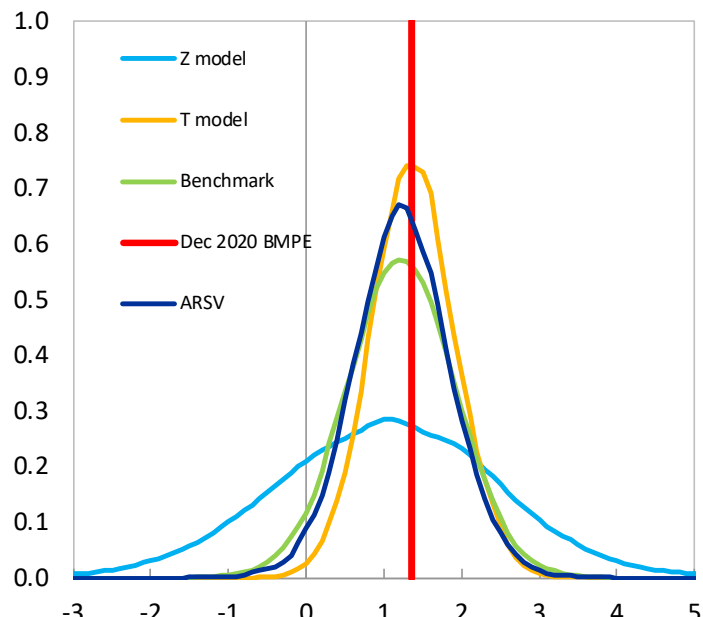| Use cases	Recommendation	Benchmark
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Model-based risk analysis and scenarios	✓ Develop, select and validate a set of time-series models delivering full predictive densities ✓ Apply model combination techniques to construct a consistent statistical distribution around the baseline	Best practices among the Eurosystem

Statistical risk metrics: predictive densities across models

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

Legend:
- Z model
- T model
- Benchmark
- Dec 2020 BMPE
- ARSV

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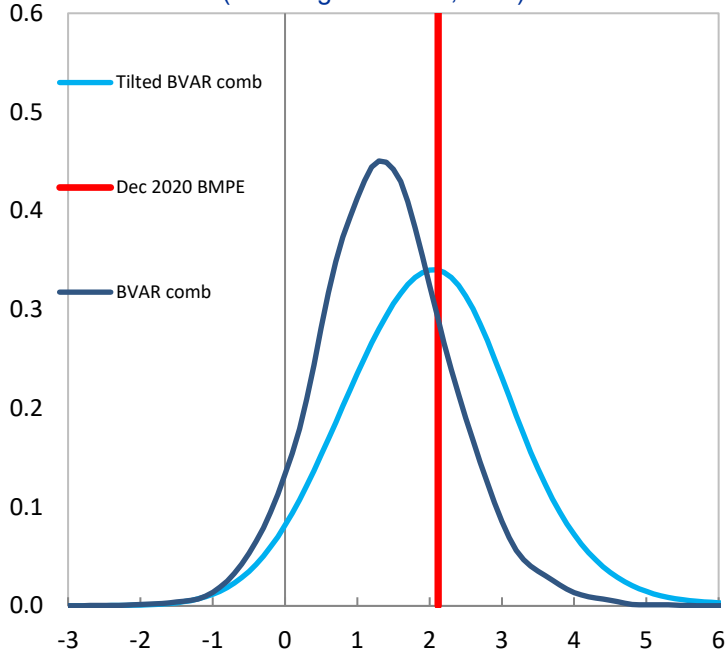(annual growth rate, in %)

Legend:
- Z model
- T model
- Benchmark
- Dec 2020 BMPE
- ARSV

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).
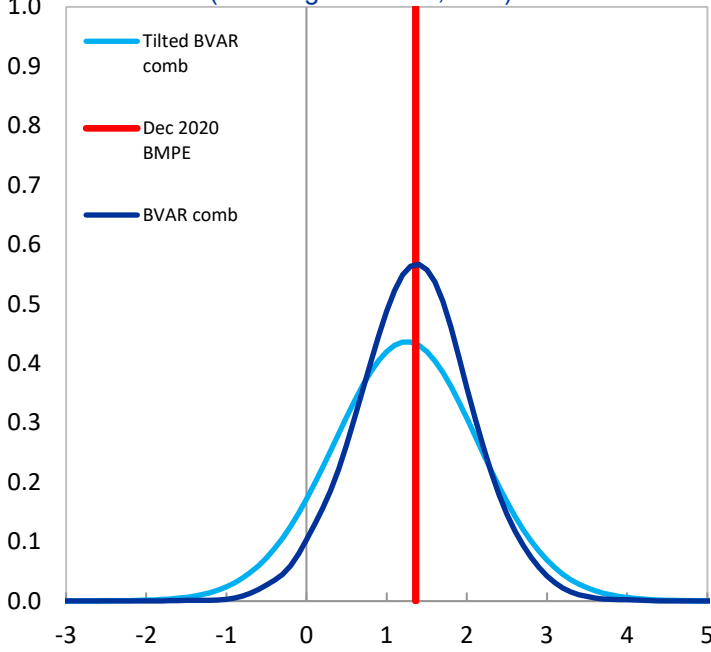
Statistical risk metrics: Model combination predictive densities

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
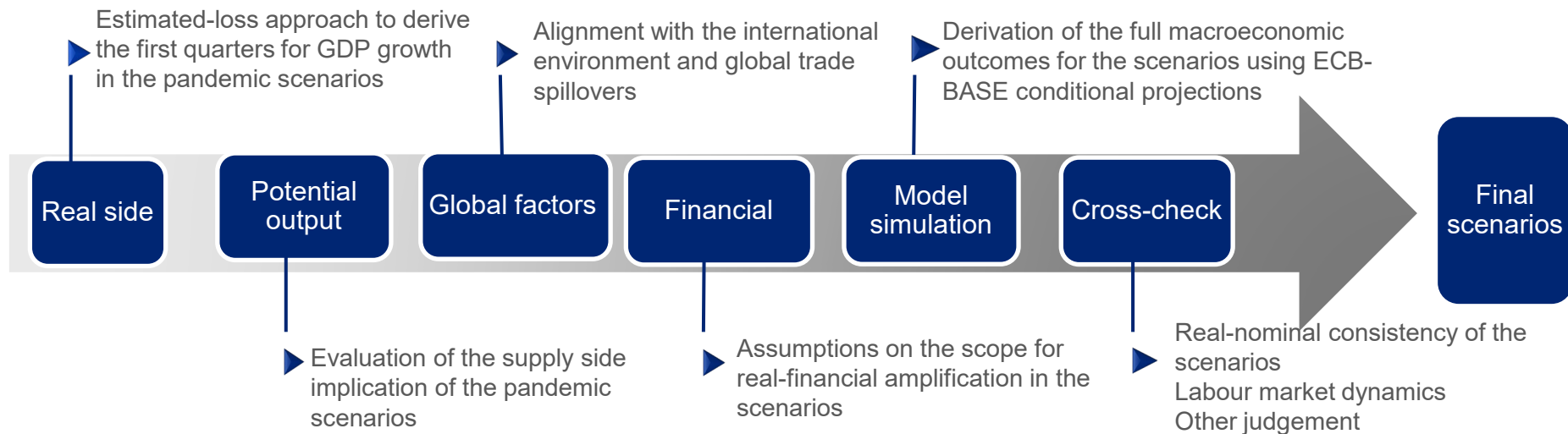- Dec 2020 BMPE
- BVAR comb

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.

Policy use of models: main suggestions

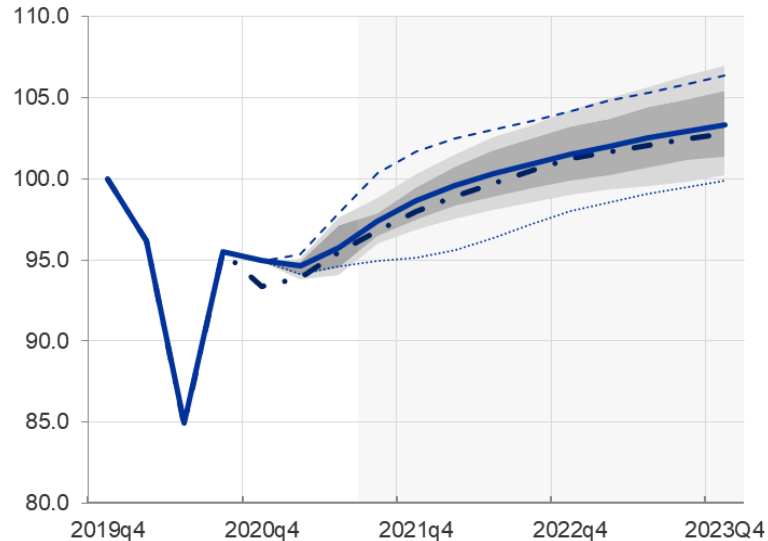| Use cases	Recommendation	Benchmark
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Alternative pandemic scenarios for the euro area: analytical roadmap

Estimated-loss approach to derive the first quarters for GDP growth in the pandemic scenarios

Alignment with the international environment and global trade spillovers

Derivation of the full macroeconomic outcomes for the scenarios using ECB-BASE conditional projections

Real side → **Potential output** → **Global factors** → **Financial** → **Model simulation** → **Cross-check** → **Final scenarios**

Evaluation of the supply side implication of the pandemic scenarios

Assumptions on the scope for real-financial amplification in the scenarios

Real-nominal consistency of the scenarios
Labour market dynamics
Other judgement

Alternative pandemic scenarios

**ECB-BASIR uncertainty ranges
Real GDP**
(index, 2019 Q4 = 100)

**ECB-BASIR uncertainty ranges
HICP inflation**
(annual percentage changes)
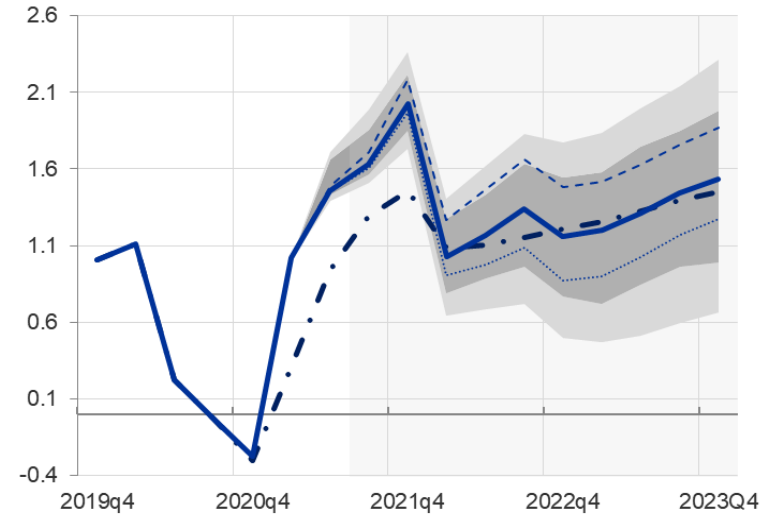
Source: ECB projections database and ECB staff calculations.
Notes: The grey areas represent the 90% and 68% confidence intervals from the ECB-BASIR forecast. They are centred around the March MPE. In the ECB-BASIR model, the density forecast is computed using a bootstrap method that re-samples the in-sample 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
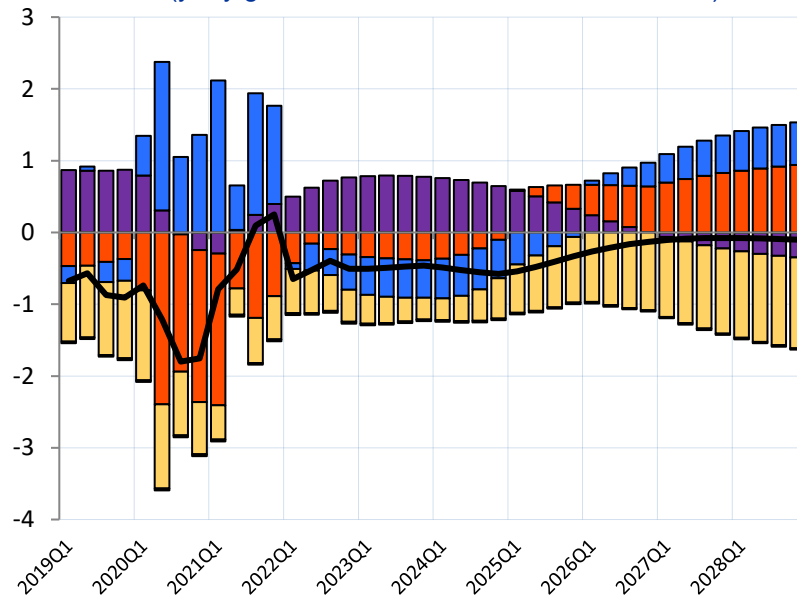
Real GDP – Euro area
(q-o-q growth rates, in % deviations from steady-state)
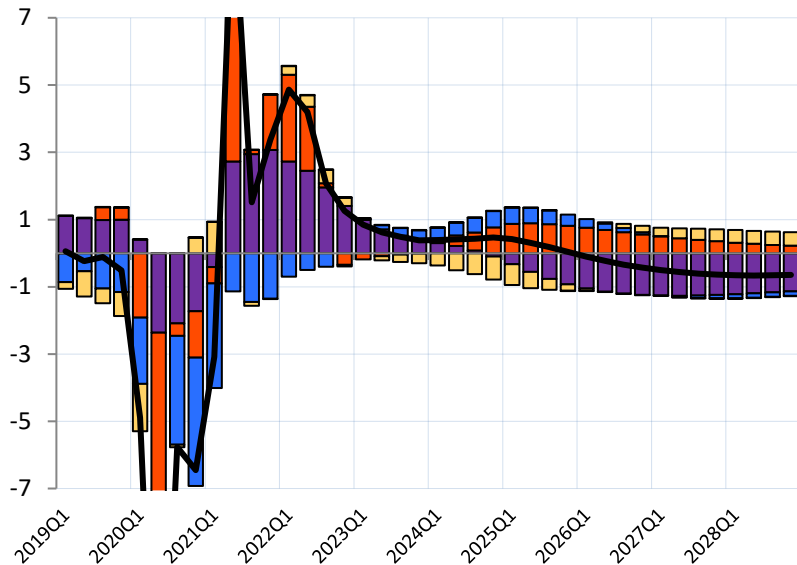
Private consumption deflator inflation – Euro area
(y-o-y growth rates, in % deviations from 1.9%)

Legend: Interest rate shocks · Domestic demand · Domestic supply · Foreign & trade · Other · Variable
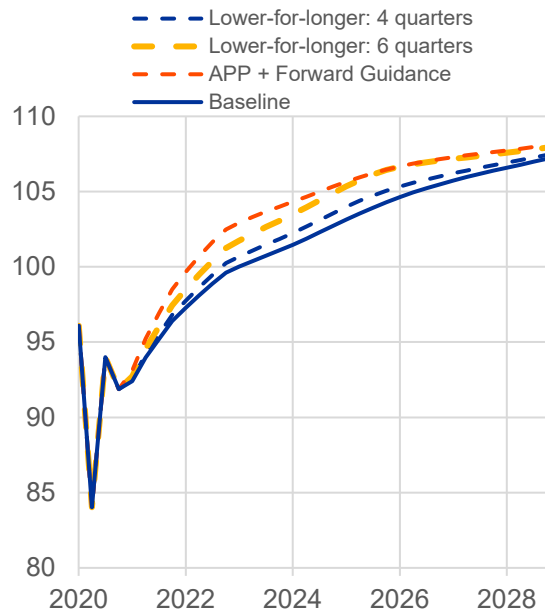
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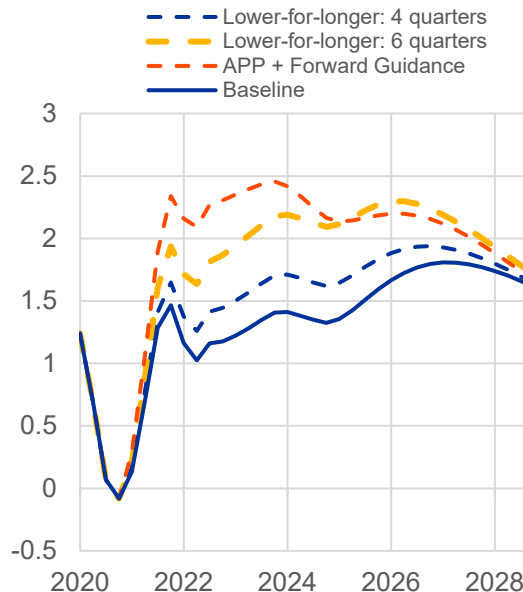# Policy sensitivity analysis around a medium-term reference scenario
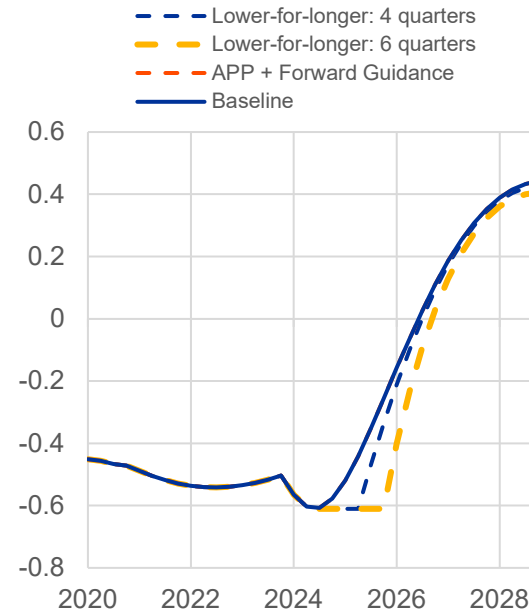
Real GDP – Euro area
(index =100 2019q4)

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 **P**rojections **E**nable**R** plat**FORM (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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Thanks