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Simple Macroeconomic Forecast Distributions

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Overview

An economist's favorite pastime

- various institutions issue forecasts for annual macroeconomic targets
  - most prominent targets: (real) GDP growth and inflation
  - for Germany, sources are (among others) the Bundesbank, the ifo institute, the OECD
  - fixed-event forecasts: target date is fixed, forecast date is not
- forecasts are often disseminated widely
  - extensive media coverage, influence on political discussions
  - relevant for real-world outcomes (public budget planning, collective bargaining)

Can we really be that sure?

- usual practice: issue point forecasts only
  - uncertainty is at best acknowledged, rarely quantified
- forecasts of different horizons are often left uncontextualized
- distributional forecasts supposedly would require extra modeling effort

Prognose der EU

Deutschland vermeidet 2023 Rezession

Stand: 13.02.2023 12:56 Uhr

Nach Einschätzung der EU-Kommission dürfte sich die konjunkturelle Lage in Deutschland besser entwickeln als gedacht. Das Wachstum wird den Prognosen zufolge aber sehr gering ausfallen.

In ihrem aktuellen konjunkturellen Ausblick vertritt die EU-Kommission die Einschätzung, dass Deutschland im Jahr 2023 nicht in eine Rezession fallen wird. Die Brüsseler Behörde erwartet beim Bruttoinlandsprodukt (BIP) ein kleines Plus von 0,2 Prozent. Damit hat sich die Prognose deutlich gebessert, nachdem sie im November noch ein Minus von 0,6 Prozent veranschlagt hatte.

Source: tagesschau.de

Contributions of this work

- show that attaching prediction intervals to an existing base of point forecasts can be
  - simple
  - cheap
  - transparent
- provide competitively performing distributional forecasts for
  - GDP growth and inflation
  - all G7 countries
  - current and next year targets

Data Source: IMF World Economic Outlook

- survey by the IMF staff, published bi-annually
  - contains forecasts with up to 6 years horizon and historic truth values
  - publication in April (horizon for current year $\approx$ 8 months) and in October ($\approx$ 2 months)
- publicly available[1] in an accessible format
- targets: real GDP growth and CPI inflation
- time range: available since 1990, giving $\sim$30 years of forecast-truth pairs
- target locations: forecasts are issued for 196 countries in total

[1] International Monetary Fund. 2023. *World Economic Outlook: Navigating Global Divergences.* Washington, DC. October.

Methods

We apply an attractively simple and cheap method. For a given country and target:

- given forecasts $\hat{y}_{t,h}$ and the realized true values y_t ...
  - for target year t, horizon h
- ... construct sets $\mathcal{E}_{t,h} = \{\hat{e}_{t^*,h} | t - R \leq t^* < t\}$, containing the last R forecast errors
  - based on *absolute* errors $\hat{e}_{t,h} = |y_t - \hat{y}_{t,h}|$
  - currently: $R = 9$
- for $\alpha \in \{0.5, 0.8\}$, compute $q^{\alpha}_{t,h} = Q(\mathcal{E}_{t,h}, \alpha)$
- and compute the upper and lower endpoints of a central prediction interval as
  - $u^{\alpha}_{t,h} = \hat{y}_{t,h} + q^{\alpha}_{t,h}$
  - $l^{\alpha}_{t,h} = \hat{y}_{t,h} - q^{\alpha}_{t,h}$
- use PAVA-type reordering if intervals shrink with increasing horizon
- assess central interval coverage, score via the weighted interval score (WIS)[2]

[2] Bracher, J. et al. 2021. *Evaluating Epidemic Forecasts in an Interval Format.* PLoS Computational Biology 17 (2)

Benchmarks

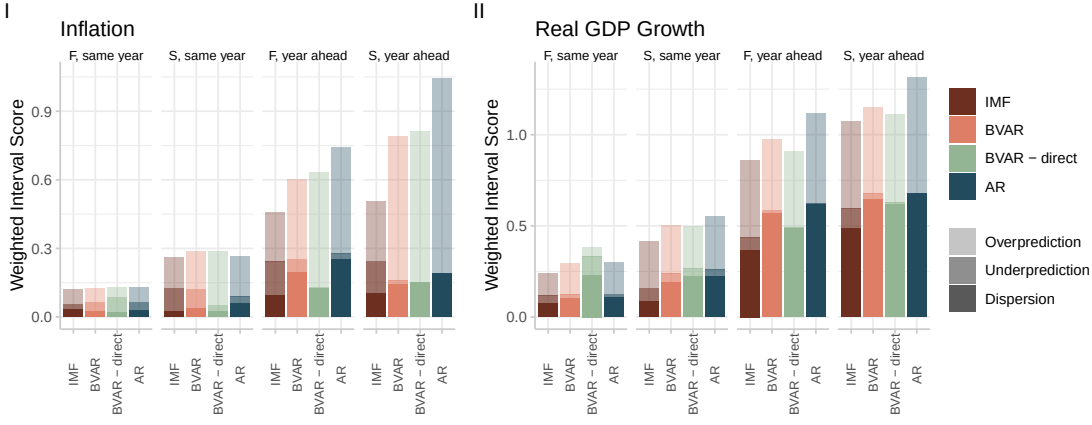
We compare with benchmarks:

1. same methodology, alternative point forecasts
   - autoregressive (AR) model
   - Primiceri Bayesian vector autoregressive (BVAR) model[3]
2. directly generated distributional forecasts
   - obtained from the BVAR model

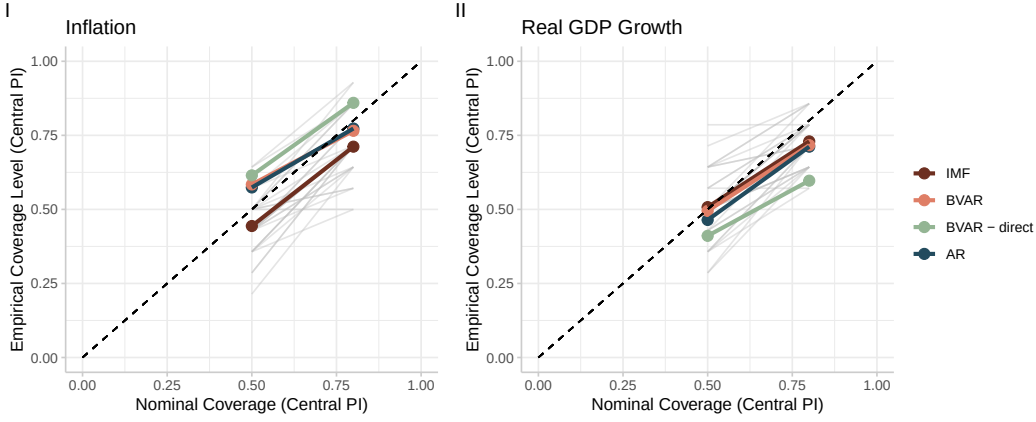
- trained on quarterly data, with slight informational advantage

[3] Primiceri, G. 2005. *Time Varying Structural Vector Autoregressions and Monetary Policy.* Review of Economic Studies 72.

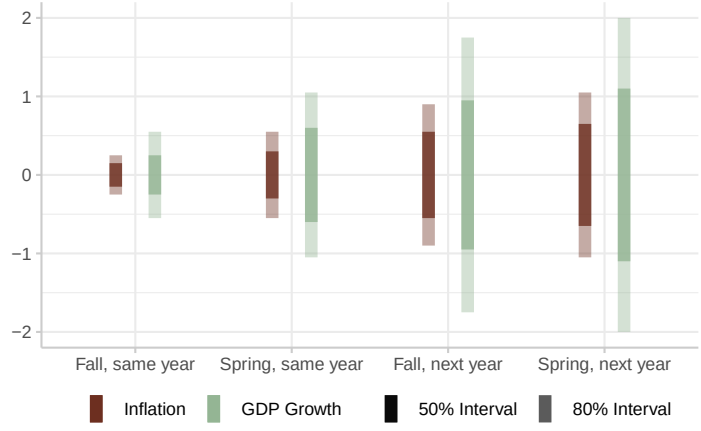
Scores


I
Inflation
F, same year
S, same year
F, year ahead
S, year ahead
Weighted Interval Score
0.0
0.3
0.6
0.9
IMF
BVAR
BVAR − direct
AR
II
Real GDP Growth
F, same year
S, same year
F, year ahead
S, year ahead
Weighted Interval Score
0.0
0.5
1.0
IMF
BVAR
BVAR − direct
AR
IMF
BVAR
BVAR − direct
AR
Overprediction
Underprediction
Dispersion

Calibration - Interval Coverage Levels



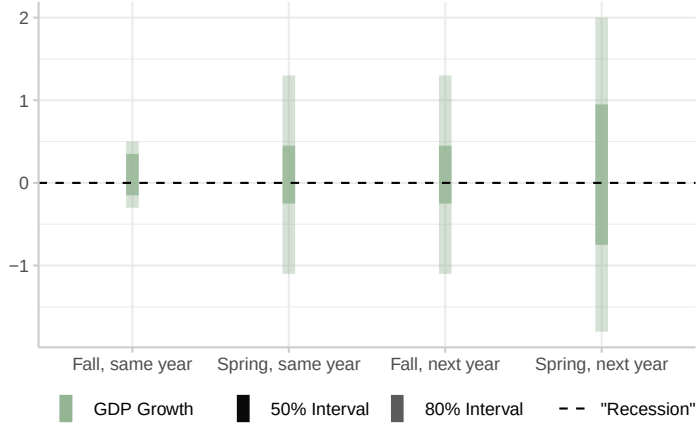
Increasing Uncertainty



Average length of intervals

	50%	80%
GDP Growth		
Fall, SY	0.5	1.1
Spring, SY	1.2	2.1
Fall, NY	1.9	3.5
Spring, NY	2.2	4.0
Inflation		
Fall, SY	0.3	0.5
Spring, SY	0.6	1.1
Fall, NY	1.1	1.8
Spring, NY	1.3	2.1

Will Germany avoid recession?



Robustness Checks / Alternative Methods

- error extraction method: absolute vs. directional errors
  - similar scores, worse calibration link
- window method: rolling vs. expanding window
  - slightly improved coverage and scores, at the cost of interpretability link
- potential dependency of results on quantile extraction
  - ordering between forecasts remains the same with sample-based CRPS link

Summing up

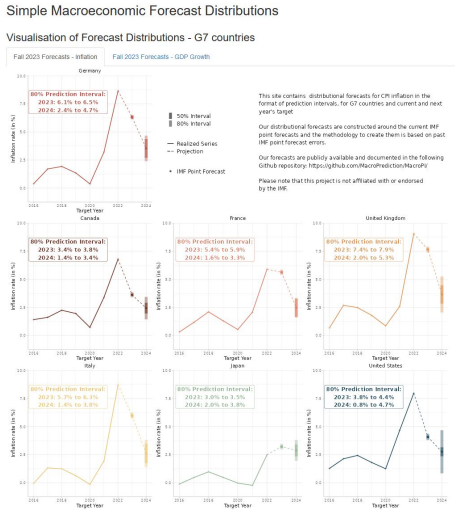
- Attaching distributional forecasts via past forecast errors to an existing base of point forecasts is
  - cheap
  - competitive
  - transparent
- Uncertainty around point forecasts is often substantial, making its communication necessary
- IMF forecasts are valuable source for distributional forecasts in their own right

- Outlook
  - scale to more countries and forecast sources
  - implement alternative method that utilizes the cross-section dimension
  - make forecasts easily and publicly accessable via shiny app

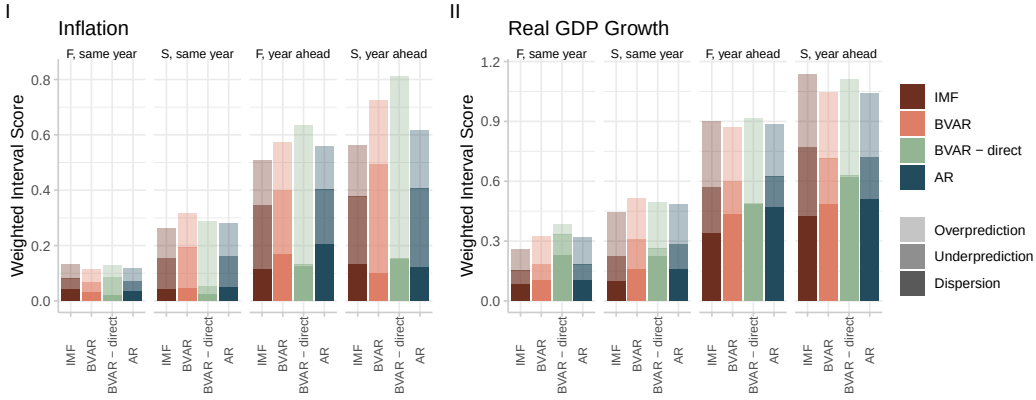
Making it public

Shiny App:
https://probability-forecasting.shinyapps.io/macropi/

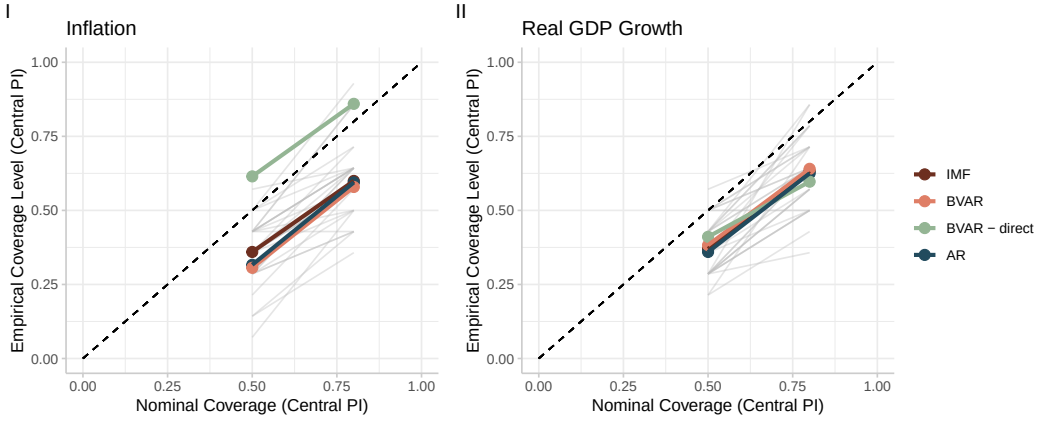
GitHub repo with our forecasts:
https://github.com/MacroPrediction/MacroPI



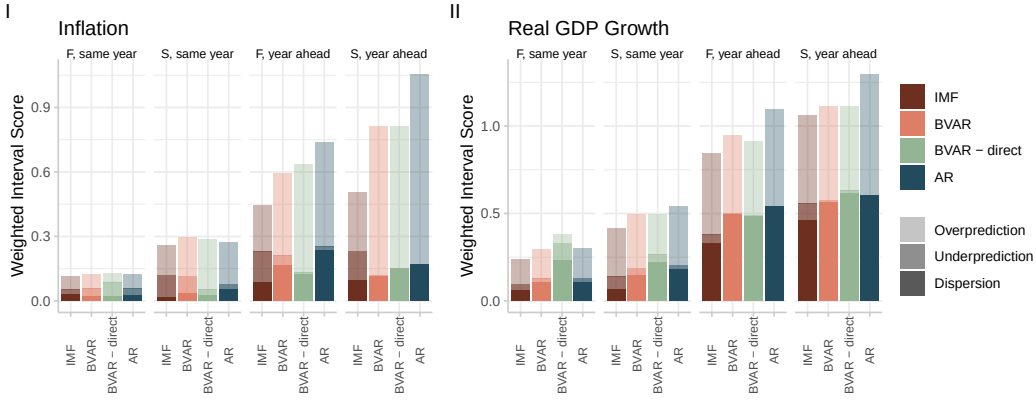
Directional Errors - Scores



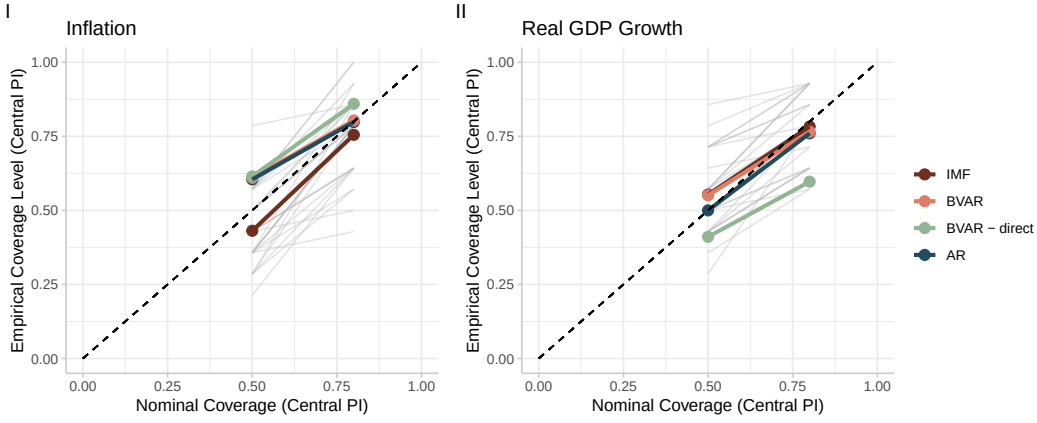
Directional Errors - Coverage



Expanding Window - Scores



Expanding Window - Coverage



CRPS by sample