

Short term forecast at Bank of Italy



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① Issues of short-term forecasting

- Selection of information
- Ragged-edge dataset: different timeliness of indicators (soft/hard data)
- Dealing with mixed frequency variables

② New challenges

- Growing number of indicators to be exploited for macroeconomic analysis
- Increasing uncertainty surrounding forecast since the recent economic turmoil

Economic Outlook

The forecasting models target two main economic aggregate:

- **GDP:**
 - *point forecast for q-o-q growth*
 - Bridge models
 - Dynamic Factor Model and Kalman filter
 - Bayesian Averaging Model - bridge
 - Euro BIG
 - *medium-to-long run component of euro area GDP quarterly growth*
 - €-coin
- **Industrial Production (IP)**
 - OLS based on electricity consumption and survey data.
 - Bayesian VAR

FORECASTING GDP

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Models are estimated some times per month:

- when new relevant information is released
- immediately before the Governing Council meeting

Bridge Models

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The focus is on the supply side. Further models for the demand side are provided to collect information on national accounts components.

BM are fed with monthly variables aligned at the end of the quarter using univariate AR models. For (Italian) industrial production and export specific models forecast are provided.

Bridge Models with targeted predictors

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- More data are not always better for forecasting (Boivin and Ng (2006))
- Using thresholding methods for pre-selecting indicators can improve factor forecasts (Bai and Ng (2008))

therefore, we need some efficient selection device for the predictors.

Reference

Forecasting economic activity with targeted predictors, by Bulligan, Marcellino and Venditti, 2012:

The forecasting gains obtained by exploiting the timely information provided by monthly indicators can be further increased by carefully screening available information.

Bridge Models with targeted predictors (cont.)

- **Step I:** use thresholding methods for selecting 'targeted' predictors
 - ① FORWARD selection
 - ② LASSO (Least Absolute Shrinkage Selection Operator)
 - ③ LASSO-EN (Least Absolute Shrinkage Selection Operator-Elastic Net)
 - ④ LARS (Least Angle Regression)
- **Step II:** extract information from panel of targeted predictors through:
 - ① General To Specific routine $\Rightarrow$ **BRIDGE MODELS**
 - ② Static principal components $\Rightarrow$ **FACTOR MODELS**

Bridge Models with targeted predictors (cont.)

Having identified a set of targeted predictors: [▶ Table](#)

- we set up a **factor model** by:
 - ① Extracting the first 6 static principal components (F) of TP;
 - ② Adding them as additional regressors in a AR model for GDP, under AIC:

$$GDP_t = A(L)GDP_{t-1} + B(L)F_t + u_t \quad (1)$$

where the parameters of the models are optimized at each iteration.

- we set up a **Bridge model** through a General-to-Specific approach:
 - ① start from a General Unrestricted Model
 - ② drop insignificant variables

Bayesian Model Averaging - bridge

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Bayesian model averaging (BMA) is used to select the predictors' set for bridge models

Reference

Selecting predictors by BMA in bridge models, by Bencivelli, Marcellino, Moretti, 2012

Bayesian Model Averaging - bridge (cont.)

Let Y be the information set, each model M_s in the models space has:

- a prior distribution: $p(M_s) = \frac{1}{S}$ (we assume all models to be equally probable);
- a likelihood function: $p(y|Y, M_s)$;
- a posterior distribution: $p(M_s|y) \propto p(y|Y, M_s)p(M_s)$

Averaging across model, the posterior density function of the quantity of interest y takes the form:

$$p(y|Y) = \sum_{s=1}^n p(y|Y, M_s(\theta_s))p(M_s(\theta_s)|Y). \quad (2)$$

The density in equation (2) could be simulated through MCMC Model Composition algorithm MC^3 .

► MC^3

► Dataset

Euro-BIG a bayesian indicator for growth

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- Euro-BIG is estimated by a mixed frequency data small scale dynamic factor model with stochastic volatility
- Important shifts in business cycle volatility is documented:
- It is shown that stochastic volatility contributes to a significant improvement in density forecast accuracy.
- present some interesting tools that crop out of the Bayesian estimation setting:
 - density forecasts / fan charts for GDP short term forecasts
 - probability distributions of the news content of indicator releases

Reference

Forecasting euro area GDP with EURO-BIG (Bayesian Indicator of Growth), by Marcellino, Porqueddu and Venditti,

Euro-BIG a bayesian indicator for growth (cont.)

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- The model has a time varying state space representation

$$\mathbf{y}_t = F(\beta)\mu_t$$

$$\mu_t = H(\phi)\mu_{t-1} + \eta_t$$

- $\mathbf{y}_t$ collects both quarterly and monthly variables,
- μ_t includes the unobserved factor and idiosyncratic shocks
- $\eta_t \sim N(0, Q_t)$.
- Q_t collects the drifting volatilities $\sigma_i \lambda_{i,t}$

Euro-BIG a bayesian indicator for growth (cont.)

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$$\begin{aligned} \mathbf{y}_t &= F(\beta)\mu_t \\ \mu_t &= H(\phi)\mu_{t-1} + \eta_t \end{aligned}$$

- ① Elements of $F(\beta)$
- ② Elements of $H(\phi)$
- ③ Time constant elements of $Q_t(\sigma_i)$
- ④ Time varying elements of $Q_t(\lambda_{i,t})$
- ⑤ Variances of s-vol $(\sigma_{\eta,i})$
- ⑥ The unobserved state vector (μ_t)

Uncorrelated disturbances: estimation can be performed

€-coin

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- €-coin is a real time estimator of the medium to long-run component of GDP. Its main objective is to make an assessment of economic activity that is
 - a comprehensive and non-subjective
 - b timely
 - c free from short-run fluctuations
- the indicator is estimated by the generalized dynamic factor model (see Forni et al., 2005)

Reference

New Eurocoin: Tracking economic growth in real time, by Altissimo, Cristadoro, Forni, Lippi, Veronese (2007)

► Figure

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The Industrial Production Index is an important regressor to estimate GDP itself. Therefore, its forecast is a crucial task. We use two models:

- ① an Ordinary Least Squares model basically based on electricity consumption and other indicators transformed conveniently to exploit the dynamic relationships between the regressors and the dependent variable.
- ② a bayesian VAR model with the Kalman filter to tackle with the ragged edge problem.

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The model is estimated twice a month t :

- on the first of t
- on the fifteenth of t

depending on the issue of data on electricity consumption (the final data relative to $t - 1$ and the progressive information relative to t , respectively).

OLS based on filtered regressors

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- Search for the best specification with energy consumption data and tackle the problem of choosing the proper functional form.
- Also analyzed the predictive power of models based on data from business surveys.
- a simple combination of forecasts was not the best way to exploit all the available information. Its optimal use is achieved by specifying an econometric model which includes data on electricity consumption and data from business surveys.

Bayesian VAR and Kalman Filter

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- A large - bayesian VAR (BVAR) is employed to forecast and nowcast the Italian Industrial Production Index (IP)
- The *shrinkage* model allows us to rely on a large dataset without incurring in the *curse of dimensionality problem*
- We tackle with the *ragged-edge* problem by
 - selecting many timely indicators
 - using Kalman Filter to fill missing data

► Dataset

Reference

Forecasting Italian Industrial Production by a Bayesian - VAR, by Aprigliano (Work in progress)

Bayesian VAR and Kalman Filter (cont.)

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Let $\mathbf{Y} = (Y_1, \dots, Y_T)'$ and $Y_t = (y_{1t}, \dots, y_{it}, \dots, y_{nt})'$. We estimate the augmented model

$$\mathbf{Y}^* = \mathbf{X}^* \mathbf{B} + \mathbf{E} \quad (3)$$

where $\mathbf{X}^* = (\mathbf{X}', \mathbf{X}'_d)'$ and $\mathbf{Y}^* = (\mathbf{Y}', \mathbf{Y}'_d)'$ where $\mathbf{X}_d$ and $\mathbf{Y}_d$ are auxiliary variables which replicate the priors we set up.

Bayesian VAR and Kalman Filter (cont.)

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- Modified version of the *Minnesota* priors: different shrinkage parameters for each regressor, according to its coherence with IPI.
- A rolling window is used for the estimation; its length is fixed so as to deal with homogenous oscillating features in the sample.
- We assess both the point and the density forecasts by using *relative root mean squared forecasting errors* and *weighted likelihood ratio test*, respectively.

THANKS FOR YOUR ATTENTION

BMA and the MC^3

The random walk:

- 1 Pick model M^0 ;
- 2 Model M^1 is selected by randomly including one more variable or excluding an existing one from M^0 ;
- 3 Compute the acceptance probability for model M^{s+1} conditional on model M^s is:

$$p(M^s, M^{s+1}) = \min \left[\frac{p(y|M^{s+1})p(M^{s+1})}{p(y|M^s)p(M^s)}, 1 \right], \quad (4)$$

- 4 Model M^{s+1} is retained only if its acceptance probability is *enough* higher than that of M^s .

This method allows to span only the fraction of the model space displaying a higher acceptance probability.

Note: the correlation (corr) of each indicator with GDP is reported.

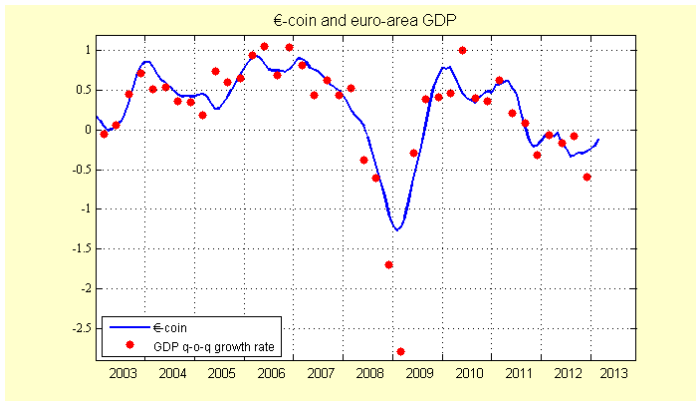
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