IFRS9 Forward-Looking Modeling

Recursive Regressions in Practice

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IFRS9 Forward-Looking Modeling Challenges

While various model designs are used in practice for developing forward-looking (FLI) models, most rely on Ordinary Least Squares (OLS) for estimation.

When developing the FLI models, practitioners usually adhere to certain principles. The following list outlines some of the most commonly applied ones:

- The model should convey a clear and coherent narrative.
- The model should capture all relevant historical events significantly impacting the target variable.
- The model should incorporate key events that are not reflected in macroeconomic forecasts.
- The model should balance the impact of the economy with other factors, such as internal changes or regulatory shifts.
- The statistical techniques used to develop the model should be straightforward and interpretable yet robust enough to capture key historical patterns and forward-looking assumptions.
- The relationship between model variables should remain reasonably stable over time.
- The model's forecasting performance must be tested on an out-of-time sample.
- Expert input should have a controlled influence on model outcomes to minimize potential bias.

The above principles often lead to specific challenges that practitioners encounter during modeling. While there isn't always a one-to-one correspondence between principles and challenges, they are closely related and can often be meaningfully linked. Most challenges stem from the limited number of observations available when developing FLI models. Given this constraint, practitioners often struggle to identify appropriate statistical methods for particular issues.

This presentation demonstrates how recursive regressions can address challenges related to the stability of relationships between variables in FLI modeling and improve out-of-time forecasting performance.

Recursive Regressions

Basics of Recursive (Expanding Window) Estimation

The following steps outline the general procedure for estimating recursive (also known as expanding-window) regressions within the OLS framework. Practitioners begin with an initial estimation window of size h. Using the first h observations, the OLS coefficients are estimated by:

$$\hat{\beta}_h = \left(X_{1:h}^\top X_{1:h}\right)^{-1} X_{1:h}^\top y_{1:h}$$

For each $j = h+1, \ldots, n$, the window is then expanded and coefficients are re-estimated until reaching the final observation n:

$$\hat{\beta}_j = \left(X_{1:j}^\top X_{1:j}\right)^{-1} X_{1:j}^\top y_{1:j}$$

This process produces a sequence $\hat{\beta}_h,\ \hat{\beta}_{h+1},\ \ldots,\ \hat{\beta}_n$, enabling practitioners to monitor the evolution of each coefficient as the dataset grows. At every estimation step, forecasts for one or more subsequent observations can be generated and incorporated into further analysis.

Recusive Regressions in FLI Modeling

Collecting the sequence of model estimates $\hat{\beta}_h, ; \hat{\beta}_{h+1}, ; \ldots, ; \hat{\beta}_n$, practitioners can further investigate the stability of the relationship between the target and the predictors. One key analysis is to examine possible changes in the sign of the coefficients over time. Besides visualization, if enough estimates are available, various statistical tests can be conducted.
Additionally, at each step of model estimation, analysts can collect out-of-time forecasts and use them as one of the criteria for final model selection. This exercise also provides valuable information about model performance on the most recent data, which is usually a key input for assessing forecast validity alongside the actual forecast values.

Simulation Study

Dataset

To illustrate the use of recursive regressions in FLI modeling, assume the final model is specified as:

$$ODR \sim GDP + WAGE_{lag4} + EURIBOR_{lag4}$$

where:

- ODR is the observed default rate (target variable);
- GDP is year-over-year GDP growth;
- $WAGE_{lag4}$ is year-over-year wage growth, lagged by four quarters;
- $EURIBOR_{lag4}$ is the 6-month Euribor rate, lagged by four quarters.

The data used for this simulation are available at the following link. Practitioners should note that this dataset is for demonstration purposes only, and simulation results should be evaluated primarily from a technical standpoint, illustrating the role of recursive regressions in FLI modeling.

Simulation Study

For the final FLI model, the simulation estimates the sequence of regression coefficients by running recursive regressions on expanding windows that initially exclude the most recent 12 quarters. In addition to analyzing how coefficients evolve over time, this exercise aims to generate a one-step-ahead forecast of the `ODR` at each iteration and compare it with the realized `ODR`.

Practitioners should see these goals as one possible approach to model analysis and a way to address specific challenges in FLI modeling. They are encouraged to extend the analysis and integrate additional insights into the ongoing development and validation of FLI models.

Simulation Results

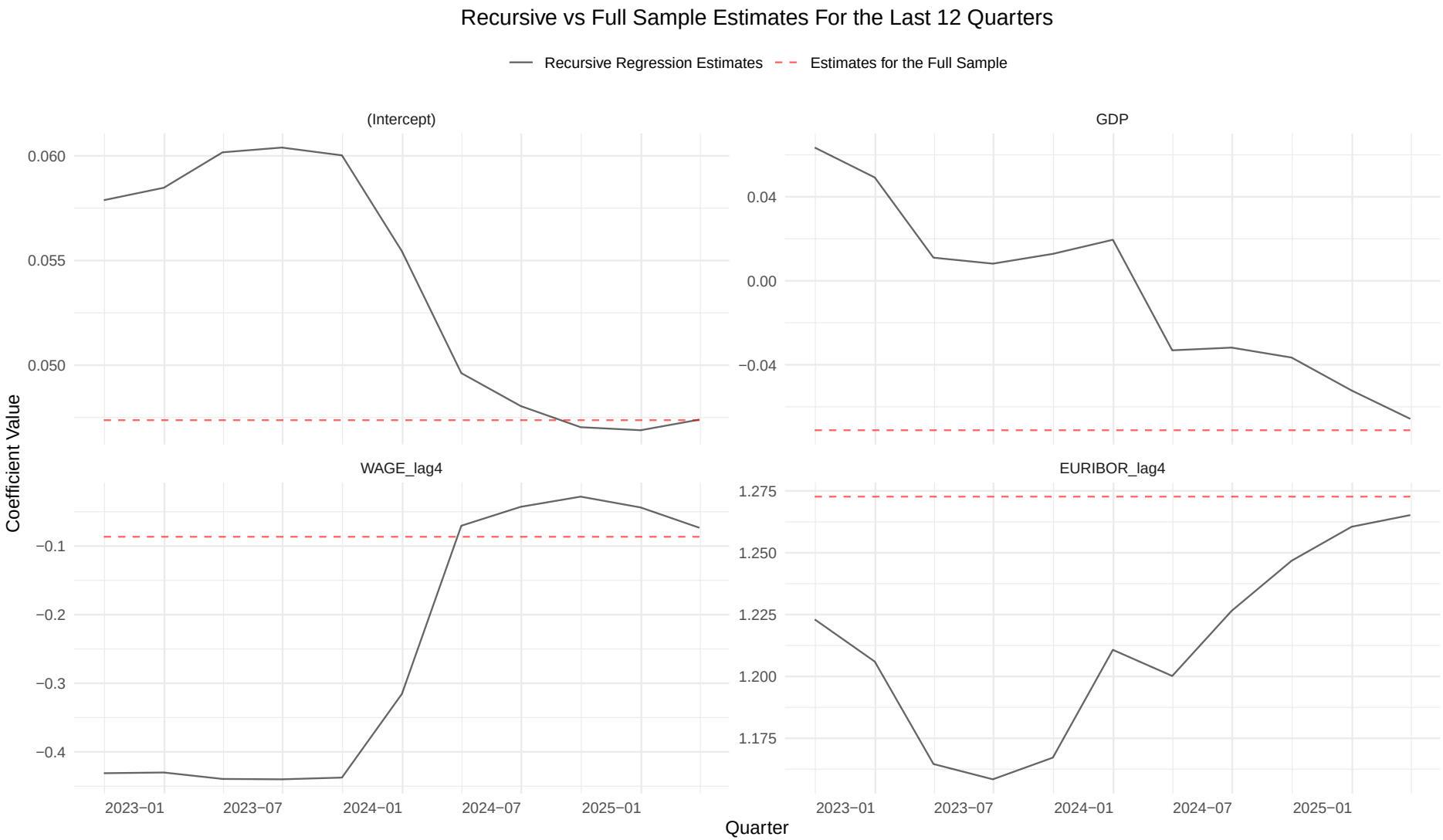
Regression Coefficients by Subsample

LAST_QUARTER	Coeff.	Estimate_Recusrive	Estimate_All
2024-12-31	(Intercept)	0.0469	0.0474
2024-12-31	GDP	-0.0522	-0.0712
2024-12-31	WAGE_lag4	-0.0438	-0.0865
2024-12-31	EURIBOR_lag4	1.2605	1.2727
2025-03-31	(Intercept)	0.0474	0.0474
2025-03-31	GDP	-0.0657	-0.0712
2025-03-31	WAGE_lag4	-0.0734	-0.0865
2025-03-31	EURIBOR_lag4	1.2652	1.2727

Recursive One-Step Forecast vs. Actual ODR

QUARTER	Forecast	Observed
2023-09-30	0.0617	0.0576
2023-12-31	0.0873	0.0542
2024-03-31	0.1164	0.0418
2024-06-30	0.0608	0.0378
2024-09-30	0.0555	0.0369
2024-12-31	0.0560	0.0384
2025-03-31	0.0513	0.0402
2025-06-30	0.0562	0.0431

Simulation Results cont.



Simulation Results cont.