IFRS9 Forward-Looking Modeling and Stationarity Testing

How Reliable Is the Augmented Dickey-Fuller Test?

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IFRS9 Forward-Looking Modeling

- With the introduction of IFRS9, one key requirement practitioners had to address was the inclusion of reasonable and supportable information that is available without undue cost or effort when measuring expected credit losses.
- Several regulatory paragraphs also emphasized incorporating such information when recognizing lifetime expected credit losses.
- After several years of implementation, the most common approach observed in practice quantifies the macroeconomic environment's effect on a bank's risk parameters, usually aggregated at the segment level. For example, practitioners calculate the default rate at the segment level and regress it against macroeconomic indicators.
- Many models rely on Ordinary Least Squares (OLS) regression but differ in their design and level of aggregation. As a result, one aspect practitioners inevitably investigate is stationarity.
- Stationarity testing is typically performed either at the level of the variables used in Forward-Looking (FLI) modeling or on the model residuals under the assumption of cointegration.
- One of the most commonly used tests for stationarity is the Augmented Dickey-Fuller (ADF) test.
- Although practitioners often rely solely on statistical tests, the power of these tests is heavily influenced by the characteristics of the FLI context - most notably, the relatively low data-to-variable ratio, which presents significant challenges not only for stationarity testing but also for other critical modeling tasks.

Augmented Dickey-Fuller Test

The Augmented Dickey-Fuller test is one of the most commonly used stationarity tests in FLI modeling.

The general form of the ADF regression is:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + \varepsilon_t$$

where:

- Δy_t is the first difference of the series of the variable being analyzed;
- α is a constant (drift term);
- t is a deterministic time trend;
- β is the coefficient on a time trend;
- y_{t-1} is the lagged level of the variable;
- γ is the coefficient on y_{t-1} and the core element of the test;
- p is the number of lagged differences included in the regression;
- δ_i are the coefficients on the lagged differences;
- ε_t is the white noise error term.

Augmented Dickey-Fuller Test cont.

- The null hypothesis of the ADF test ($H_0 : \gamma = 0$) implies non-stationarity, while the alternative ($H_1 : \gamma < 0$) indicates stationarity.
- Significance is assessed using critical values from the Dickey-Fuller distribution and comparing the interpolated p-value to the chosen significance level.
- Depending on the properties of the variable being tested, the model may include a constant and/or a trend.
- The number of lags is typically selected based on the time series length or using information criteria such as AIC or BIC.
- Given the limited number of observations in FLI modeling, the choice of ADF specification can significantly influence the test outcome.
- The following slides present a framework for evaluating the power of the ADF test under specific model configurations. Practitioners are encouraged to use it as a general reference and adapt it to their specific context, as conclusions may vary with different simulation inputs.

Simulation Study

This simulation aims to investigate the ADF test's statistical power under a specific model configuration. The following steps describe the simulation design:

1. Select the order of the autoregressive process ($\phi = 0.75$).
2. Select the sample size n (20, 25, 30, 35, 40, 45, 50, 55, 60, 100, 250).
3. Simulate an autoregressive process of order one for the chosen values of ϕ and n:

$$x_{t,t\leq n} = \phi x_{t-1} + \sqrt{1-\phi^2}\varepsilon_t$$

   where ε_t is drawn from the standard normal distribution.
4. Apply the ADF test to the simulated values of x from step 3.
5. Repeat steps 3 and 4 for $N = 10, !000$ simulations, storing the estimation results.
6. Calculate the power of the ADF test as the proportion of simulations that reject the null hypothesis of non-stationarity at the 5% significance level.

Note:

The simulation is implemented in `R` using the functions `adf.test` and `ur.df` from the `tseries` (version 0.10-55) and `urca` (version 1.3-4) packages. Both functions use a fixed lag order of 1.

The `adf.test` function includes a drift and a trend by default, while the `ur.df` function excludes both in this simulation design.

Simulation Results

The following tables present the simulation results for different sample sizes and ADF test specifications.

ADF Specification: With Constant and Trend

```
##     Sample Size    Power
## 1            20    9.02%
## 2            25    9.78%
## 3            30   11.05%
## 4            35   12.58%
## 5            40   15.81%
## 6            45   19.37%
## 7            50   23.14%
## 8            55   26.43%
## 9            60   33.06%
## 10          100   74.77%
## 11          250  100.00%
```

ADF Specification: Without Constant and Trend

```
##     Sample Size    Power
## 1            20   32.10%
## 2            25   40.63%
## 3            30   50.82%
## 4            35   60.46%
## 5            40   71.13%
## 6            45   77.97%
## 7            50   83.70%
## 8            55   88.84%
## 9            60   92.81%
## 10          100   99.92%
## 11          250  100.00%
```

Conclusions

- Model design is a critical success factor in IFRS9 FLI modeling, especially given limited data availability.
- Overreliance on statistical methods without integrating expert input can compromise model quality.
- Cointegration and stationarity should not be treated as purely statistical criteria in IFRS9 FLI modeling.
- The modeling objective must guide the balance between statistical rigor and business relevance.
- Statistical diagnostics (e.g., p-values, autocorrelation, spurious regression) should be interpreted within the context of the modeling purpose.