Forecasting After Breaks

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Friday, 18th of December 2020, 9:00-13:30

This virtual tutorial will explain the theory and practice of forecasting when facing a nonstationary and evolving world, where the model differs from the data generation process (DGP). It covers the main sources of forecast error and explains how to produce forecasts following structural breaks, discussing how to robustify forecasts when there are shifts in distributions. Applications to empirical time series will demonstrate the approach. The OxMetrics software package will be used for the empirical applications.

Timetable

9:00 – 9:55 Session 1: Introduction to Forecasting

Economic forecasting occurs in a non-stationary and evolving world, when the model and mechanism differ. The framework and basic concepts are sketched following a review of a number of time series which highlight the frequency and large magnitudes of breaks. Two important forms of non-stationarity dominate in practice: evolving processes driven by stochastic trends and sudden, often unanticipated, location shifts. The key concept of unpredictability is discussed as fundamental to understanding the properties of forecasts. Nine sources of forecast errors are described, revealing the role of location shifts in forecast failure (the `hedgehog phenomenon). The distinction between determining economic relationships or testing theories and forecasting is emphasized, showing cases where good models may forecast badly and bad models may forecast well.

9:55 – 10:10 Break

10:10 – 11:05 Session 2: Why breaks matter more than other forecasting problems

In this session we examine where forecast errors arise, focusing on practical issues that confront most forecasters. The error sources include allowing for structural change at or near the forecast origin, the forecasting model to be mis-specified over the sample period, the parameters of the model to be estimated (possibly inconsistently) from data which might be measured with error, the forecasts to commence from incorrect initial conditions, and innovation errors to cumulate over the forecast horizon. A forecast error taxonomy reveals the central role of unanticipated location shifts, and helps explain the outcomes of forecasting competitions. Other potential sources of forecast failure seem less relevant.

11:05 – 11:25 Break

11:25 – 12:20 Session 3: Possible solutions to forecast failure

There are a range of potential solutions to forecast failure. Six central possibilities are forecasting the break or during it, differencing or smoothed differencing, co-breaking, intercept corrections, rapid up- dating, and pooling. We note recent research on forecasting breaks, and the demanding conditions under which that might be possible, as well as learning about breaks during transitions. Designer indicator saturation will be explained to forecast once a break has occurred, a strategy

successful used in forecasting Covid-19 cases and deaths. The possible roles of parsimony and collinearity in forecasting highlight the potential importance of excluding irrelevant, but changing, effects. While intercept corrections help robustify forecasts against biases due to location shifts, they are ineffective for measurement errors: conversely EWMA corrections are excellent for measurement errors, but not breaks. Rapid updating is related both to moving windows and to forecasting breaks, with some properties that can help alleviate failure. Forecast pooling can sometimes help but needs to be combined with model selection to exclude bad forecasting devices.

12:20 – 12:35 Break

12:35 – 13:30 Session 4: Robustifying forecasts

In the final session we shall explore one method of robustifying forecasts to location shifts. Differencing lowers the polynomial degree of deterministic terms: double differencing usually leads to a mean-zero, trend-free series, as continuous acceleration is rare in economics (except perhaps during hyperinflations or major technological shifts). The impact on forecast performance is traced. A new explanation for the empirical success of second differencing is proposed, with smoothing robust devices useful in managing the bias-variance trade-off. Selection between robust and congruent in-sample models will be discussed, with the potential to switch between models following breaks suggesting a possible solution to the trade-off. Empirical applications will be discussed, including the M4 forecasting competition and the Covid-19 forecasts for cases and deaths produced here.

Reading

Papers shown with http addresses are open access or can be obtained from a website.

Key reading:

- Castle, Jennifer L., Clements, M.P. and Hendry, D.F., (2019) *Forecasting, An Essential Introduction*, Yale University Press.

Background

- Clements, Michael P. and Hendry, David F. (1998) *Forecasting Economic Time Series*. Cambridge: Cambridge University Press.
- Clements, M.P. and Hendry, D.F. (2002), 'An Overview of Economic Forecasting', Chapter 1 in Clements, M.P. and Hendry, D.F. (eds.) *A Companion to Economic Forecasting*. Oxford: Blackwells.
- Castle, Jennifer L., Clements, M.P. and Hendry, D.F. (2017), 'An Overview of Forecasting Facing Breaks', *Journal of Business Cycle Research*, 12, 3–23. https://www.economics.ox.ac.uk/materials/papers/14384/paper-779.pdf
- Ericsson, Neil R. (2017), 'Economic Forecasting in Theory and Practice: An Interview with David F. Hendry', *International Journal of Forecasting*, 33, 2, 523–542. https://www.federalreserve.gov/econresdata/ifdp/2016/files/ifdp1184.pdf
- Hendry, D.F. (2015), *Introductory Macro-econometrics: A New Approach*, Timberlake Consultants Press. http://www.timberlake.co.uk/macroeconometrics.html

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- Castle, J.L., Doornik, J.A. and Hendry, D.F. (2019). 'Some forecasting principles from the M4 competition', Nuffield College Working Paper 2019-W01. https://www.nuffield.ox.ac.uk/economics/Papers/2019/2019W01_M4_forecasts.pdf
- Castle, J.L., Fawcett, N.W.P. and Hendry, D.F. (2011), 'Forecasting Breaks and Forecasting During Breaks', Chapter 11 in Clements, M.P. and Hendry, D.F. (eds.) *Oxford Handbook of Economic Forecasting*, Oxford: Oxford University Press.
- Castle, J.L., Clements, M.P. and Hendry, D.F. (2017), 'Robust Approaches to Forecasting', *International Journal of Forecasting*, 31, 99–112. https://www.economics.ox.ac.uk/department-of-economics-discussion-paper-series/robust-approaches-to-forecasting

Software

- Doornik, J.A. (2018) *An Introduction to OxMetrics 8*. London: Timberlake Consultants Press.
- Doornik, J.A. and Hendry, D.F. (2018) *Empirical Econometric Modelling Using PcGive*: Volume I. London: Timberlake Consultants Press.