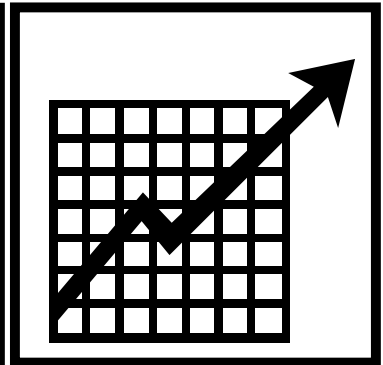


Notes in Macroeconometrics

# Briefing in Macroeconomic Forecasting

*(Incomplete version)*



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### I. Forecasting Methods:

- Subjective: guesses or forecast based on experience does not follow clear rules and rely solely on intuition.
  - Model-Based: arise from a rule, theory, model which formalise the relationship between the variables of interest, however the models can be divided into causal and non-causal models;
- [1] Causal Models: utilise an explanation how the values are determined, could be either quantitative or qualitative despite the uselessness of the qualitative models in macroeconomics that do not show magnitudes.
  - [2] Non-Causal Models: concerned only with prediction rather than understanding the behaviour, these models could be simple or complex, the main advantage of these models that they are cheap and relatively simple, the main disadvantage though that they don't explain the behavioural relationships and imply that what happened in the past will continue in the future, this requires *ceteris-paribus* assumption to be valid.

The correct causal model is expected to give better forecasts than a non-causal model, these two types can appear to be very similar if the non-causal is a time-series model, but the interpretation is very different, the time-series variables are included for their desirable statistical properties.

### II. Econometric Forecasting Steps, Holden (1992)

The main steps of constructing macroeconomic model for forecasting are as follows:

- [1] Selection of theory; explaining macroeconomic behaviour and to determine the variables of interest.
- [2] Formulate theory as series of equations.
- [3] Obtain Data.
- [4] Using appropriate techniques (e.g: the econometric methods).
- [5] Given estimated equations, generate predictions of future out-of-sample values.

### III. Measurement of Forecasting Accuracy:

#### *Root Mean Square Error (RMSE)*

Out of sample forecasting performance could be measured by various measures, if the forecasts are  $F$  with outcomes  $A$  then the accuracy could be measured simply by the difference which is the error or the Mean Error, then a number of measurements are obtained and usually used by economists, which are Mean Error (**ME**) Mean Absolute Error (**MAE**), Mean Square Error (**MSE**) and Root Mean Square Error (**RMSE**), all of these measures could be seen from the RMSE equation below:

$$RMSE = \left[ \sum_{k=1}^K (y_{t+k} - y_{t+k}^F)^2 / N_K \right]^{1/2} \dots\dots\dots(1)$$

Where  $F$  is the forecasts,  $N$  is the number of forecasts and  $K$  is the forecast horizon  $y_{t+k}^F$  is the forecast using data series of length  $t$  for a horizon of  $K$ , if all the forecasts are correct then RMSE would collapse to zero, the existence of error makes RMSE positive number and the forecasts improves as RMSE is closer to zero, the RMSE is one of the most convenient and commonly used measure of forecast accuracy, it is directly linked to the mean and variance of the forecast error this can be seen by denoting the forecast error by  $F_e$ , defined as shown below:

$F_e = \sum_{k=1}^k (y_{t+k} - y_{t+k}^F)^2$  and by denoting the mean of  $F_e$  by  $\bar{F}_e$ , then the sum of squares could be expressed as:

$$\begin{aligned} \sum (F_e)^2 &= \sum (F_e - \bar{F}_e + \bar{F}_e)^2 \\ &= \sum (F_e - \bar{F}_e)^2 + n(\bar{F}_e)^2 \dots\dots\dots(2) \end{aligned}$$

The above is true since  $\sum (\bar{F}_e)^2 = n(\bar{F}_e)^2$ , the first term in (2) is the forecast error variance, and the second term is the Mean Error (ME), thus the RMSE will increase as the mean and variance of the error increase, Holden (1992) argues that calculating only the Mean Error (ME) is preferred due to the fact that many positive and negative errors in the forecast might cancel each other, another problem of RMSE is that it's a "squared error" then it would show the accuracy of the forecast but not the direction of the forecast and its error.

Other forecast accuracy measured are discussed in Pindyck and Rubinfeld (1981).

#### IV. Nothing Defeats the Random Walk?

On forecasting the exchange rate, Meese & Rogoff (1983) influential paper on forecasting the exchange rate showed that the Random Walk model outperformed most empirical models, the RW model is given by:

$$y_t = y_{t-1} + \varepsilon_t$$

Meese & Rogoff used both causal and non-causal models and employed RMSE as the main criteria for assessing the forecasting performance, since the results of Meese and Rogoff the forecasting experience of other variables than the exchange rate it became known in the literature that '*nothing defeat the RW*', given the fact that most macroeconomic variables non-stationary variables integrated of order one  $\sim I(1)$  as shown in Nelson & Plosser (1982) most of the time the RW would have a great forecasting ability but its not necessarily defeating all models at all times, but because of this performance of the RW, then its very useful to compare the forecasts with the RW forecasts. Hence an adjustment of RMSE into a new accuracy measurement called the RMSE ratio, explained below

$$RO = \frac{RMSE_x}{RMSE_{RW}} \dots\dots\dots(3)$$

RO is a measurement based on RMSE where  $RMSE_x$  is the RMSE obtained from model x compared with RMSE of the RW, a ratio of  $RO < 1$  indicates that model x defeats the RW and has a forecasting validity.

#### Mean Square Prediction Error (MSPE)

Another measurement of forecasting accuracy, since every econometric model has an error term then a residual-based approach is implemented by setting the prediction error to be the residual of the econometric estimation of a model, hence for every equation there would be a prediction error and a MSPE defined as:

$$MSPE = \frac{1}{H} \sum_{i=1}^H \varepsilon_i^2 \dots\dots\dots(4)$$

where,  $\varepsilon_i$  is the out of sample residuals estimated from the initial econometric model, H is the prediction (forecasting) horizon, clearly expression (4) show the mean of the sum of squares of the

residuals, the more precise is the model then the smaller is the residuals, it is also clear that -as in the RMSE- the MSPE is always a positive number.

### V. Sample STATA .Do Programmes:

#### RMSE

```
gen time=_n
tsset time
reg y x1 x2 x3 in 1/90
predict fy in 91/100, xb
gen y_E = (fy - y) in 91/100
gen y_SE = y_E^2
egen y_SSE = sum(y_SE) in 91/100
egen y_MSE = mean(y_SSE)
gen y_RMSE= sqrt(y_MSE)
sum y_RMSE
tab y_RMSE
```

#### RO

```
gen time=_n
tsset time
reg y x1 x2 x3 in 1/90
predict fy in 91/100, xb
gen y_E = (fy - y) in 91/100
gen y_SE = y_E^2
egen y_SSE = sum(y_SE) in 91/100
egen y_MSE = mean(y_SSE)
gen y_RMSE= sqrt(y_MSE)
gen yL1= y[_n-1]
constraint define 1 yL1=1
cnsreg y yL1 in 1/90, constraint (1)
predict fy_rw in 91/100, xb
gen y_E_rw = (fy_rw - y) in 91/100
gen y_SE_rw = y_E_rw ^2
egen y_SSE_rw = sum(y_SE_rw) in 91/100
egen y_MSE_rw = mean(y_SSE_rw)
gen y_RMSE_rw = sqrt(y_MSE_rw)
gen y_RO = y_RMSE / y_RMSE_rw
```

#### MSPE

```
gen time=_n
tsset time
reg y x1 x2 x3 in 1/90
predict y_SPE in 91/100, resid
gen y_SPE = y_SPE^2
egen y_SSPE = sum(y_SPE) in 153/172
egen y_MSPE = mean(y_SSPE)
sum y_MSPE
tab y_MSPE
```

**References**

- [1] Holden, K (1992), "Macroeconomic Forecasting", ch8 in *Current Issues in Macroeconomics*, Greenaway, David (editor), Macmillan, pp.163-181.
- [2] Nelson, C.R. and C.I. Plosser, (1982), "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications", *Journal of Monetary Economics*, vol. 10, pp.139-162.
- [3] Pindyck, R.S and Rubinfeld, D.L, (1981), "Econometric Models and Economic Forecasts", Newyork, McGraw-Hill.