

Applications

- Macroeconomic Forecasting (underlying structure – trend)
 - US Gross National Product
- Energy Forecasting (underlying structure – seasonality)
 - Total National Demand for Great Britain

Macroeconomic forecasting

What is Gross National Product (GNP)?

- It is a macro-economic measure of a country's progress, or 'health' of its economy
- It basically reflects the value of total goods and services produced in a country

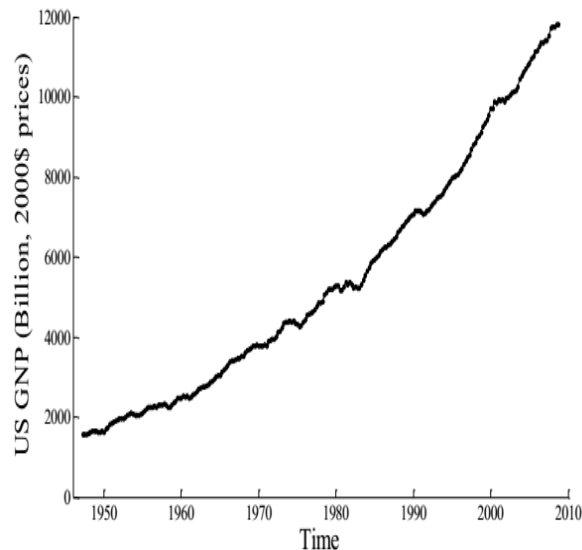
A reliable GNP forecast aids in:-

- Efficient government policy and decision-making that can go a long way in smooth functioning of an economy through timely changes in policy, providing improved decision-making and leading to greater stability of financial markets.

Macroeconomic Data

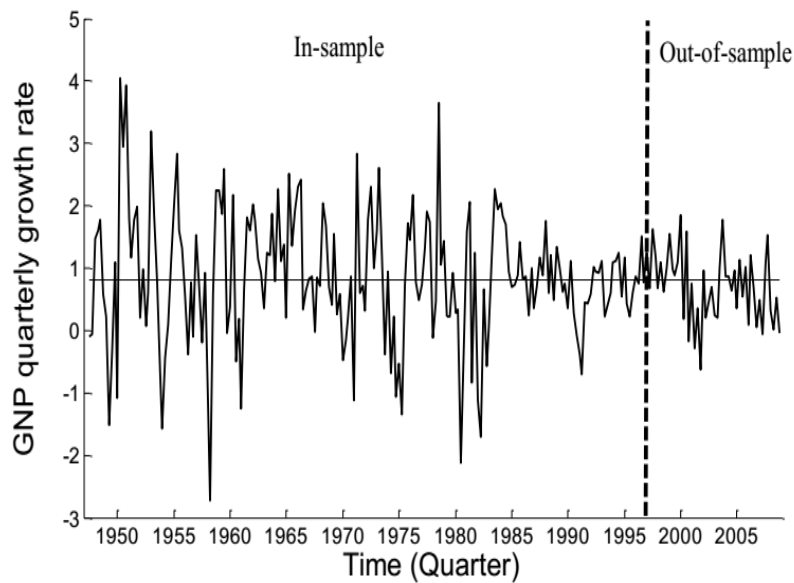
- Quarterly US GNP, measured in Billions of dollars (seasonally adjusted) at 2000 dollar prices
- Observation period: 1947Q1-2008Q3
- Data source: Federal Reserve Bank of St Louis
- Results also validated on US GNP data used by Potter (1995) measured at 1982 prices, period : 1947Q1-1990Q4

US GNP time series



- Underlying structure – Trend (hence, we need to difference the time series to make it stationary)
- Computing differences helps stabilize the mean by eliminating changes in the level (thereby removing trend or seasonality). Taking transformations such as log helps stabilize the variance.

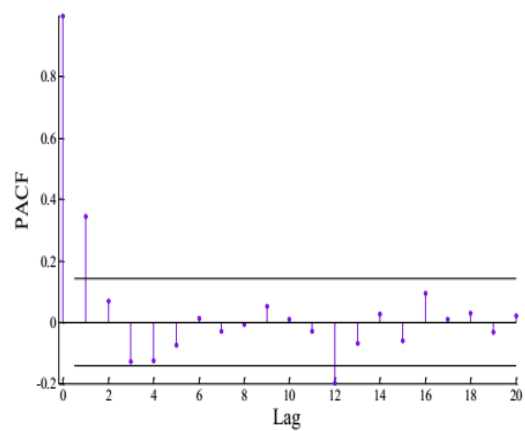
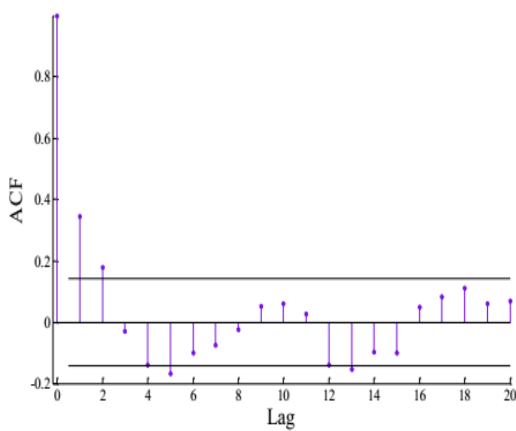
US GNP time series growth rate



US GNP quarterly growth rate. In-sample data: 1947Q2-1996Q4 (199 observations), Out-of-sample data: 1997Q1-2008Q3 (47 observations)

Estimate models on the log of quarterly growth rate (first differences) of the GNP, i.e. $x_t = 100 \log(y_t/y_{t-1})$, where y_t is the actual GNP value at time instant t . This transformation is based on the assumption that raw GNP quarterly observations are generated from a non-stationary process. Multiply the quarterly returns by 100, in order to obtain percentage returns

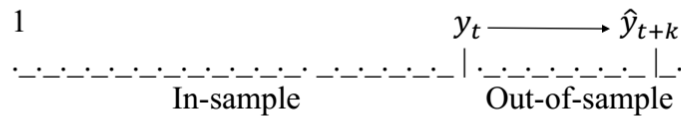
ACF and PACF



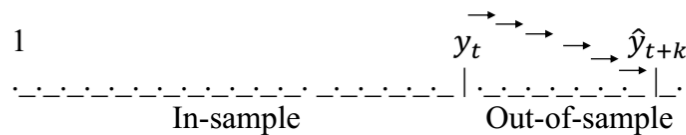
Note: we use only the training data for the analysis

Direct vs Iterative Forecasting scheme

- Direct forecasting: more robust to model misspecification



- Iterative forecasting: better if one-step ahead model is correctly specified



Forecasting scheme

- We use a rolling forecast origin through each period of the out-of-sample data and generate forecasts for horizons ranging from $k = 1$ (1 quarter) to $k = 12$ (3 years), for $t + k \leq N$, where N is the total number of observations in the time series
- Use the observations $\{y_1, y_2, \dots, y_{t+i-1}\}$, for $i=1$, to generate a one-step ahead forecast \hat{y}_{t+1} , iterate this forward multiple steps to generate a k -step ahead forecast \hat{y}_{t+k} . Repeat this process for $i=2, 3, \dots$
- The last time index of original data used in forecast generation, i.e., the origin ' $t + i - 1$ ', is rolled forward. Hence, the term, rolling forecast origin