Econometrics Assignment 2: GDP developments in the United States and evaluation of empirical forecasts

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Table of Contents

Introduction

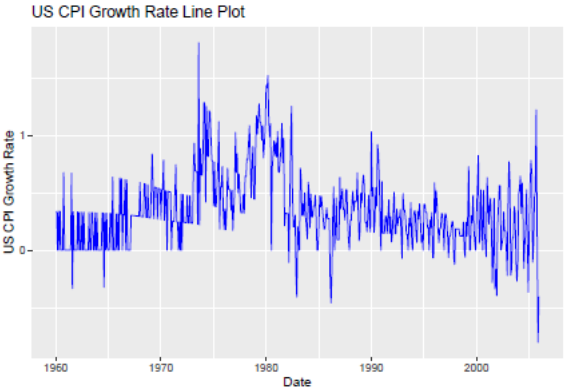

Figure: CPI development in the US

Introduction

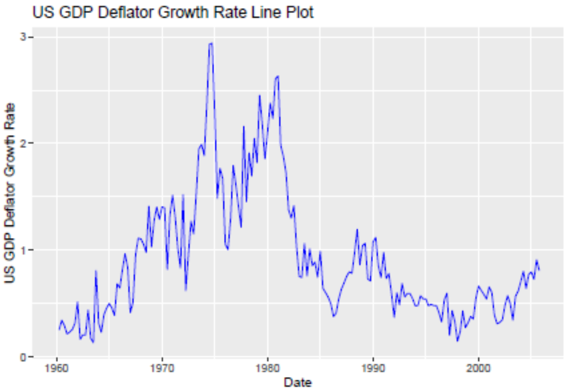

Figure: In comparison the evolution of the GDP deflator in the US

Descriptive Statistics

- US CPI Growth Rate:
  - mean: 0.34681432; median: 0.3030303; s.d.: 0.3339200
- US GDP Deflator Growth Rate:
  - mean: 0.92257517; median: 0.7445795; s.d.: 0.6089750
- US GDP Growth Rate:
  - mean: 1.76870370; median: 1.6919578; s.d.: 0.9295579
- US Employment Rate Growth Rate:
  - mean: 0.03447594; median: 0.0000000; s.d.: 3.0292401
- We observe moderate correlation between the GDP Deflator Growth Rate and the GDP Growth Rate, with a correlation coefficient of 0.43, whereas all other variable combinations do not exhibit correlation

Model specification

- We decided to specify a Partial Adjustment Model, using an inflation target (y*) of 1.5 .

$$y_t - y_{t-1} = \gamma \left(y_t^* - y_{t-1} \right), 0 < \gamma < 1.$$

$$y_t = \gamma\alpha' + \gamma\beta' x_t + (1 - \gamma)\, y_{t-1} + \gamma\varepsilon'$$

where x_t is the gdp growth rate

- We chose a 1-period lag on a yearly basis, as provided for by the data

Diagnostic Checks

- We decided to run a number of diagnostic checks in order to assess the validity of our procedure and results respectively, including the Durbin-Watson test, the studentized Breusch-Pagan test and the Shapiro-Wilk test.
  - Durbin-Watson test: DW = 1.8672, p-value = 0.1748
    - alternative hypothesis: true autocorrelation is greater than 0
  - studentized Breusch-Pagan test: BP = 54.196, df = 4, p-value = 4.789e-11
  - Shapiro-Wilk normality test (of the regression residuals): W = 0.96341, p-value = 0.000119
  - Box-Ljung test: X-squared = 39.586, df = 10, p-value = 2.004e-05
- We can therefore procede with our analysis, having rejected heteroskedasticity, autocorrelation and shown normality (of the residuals)

Economic hypotheses of relevance to the specified model

- Macroeconomic trends in the real world develop over time and are affected by past developments; as such using purely structural models to predict economic outcomes based on a number of restrictive inputs and assumptions makes little sense, as per Sims Critique (1980)
- Therefore, using models which include past trends in the prediction of future outcomes may provide a valid alternative
- Intuitively, it also makes sense to take preceding developments into account: inflation depends on past and current prices, GDP growth depends on past and current levels of GDP and the change in unemployment depends on past and current levels of unemployment.
- Furthermore, the economy is an ever-developing system which depends on past developments in order to have new capital, fund new investments and hire new workers.

1-step ahead point forecasts for the last 5 years of the model

- The VAR model's 1-step ahead forecasts for the inflation growth rate are:
  - 0.7029310
  - 0.9431371
  - 1.1833432
  - 1.4235492
  - and 1.6637553
- The Partial Adjustment model's 1-step ahead forecasts for the inflation growth rate in the last 5 years are:
  - 0.5265929
  - 0.2101944
  - 0.6725297
  - 0.4627249
  - and 0.2012072

AR(1) model forecasts for the last 5 years

- The AR(1) model's 1-step ahead forecasts for the inflation growth rate are:
  - 0.077115743
  - 0.029555784
  - 0.011327705
  - 0.004341516
  - and 0.001663952

Comparing the models

- Notice that the VAR model's forecasts for the inflation growth rate are generally higher compared to both the Partial Adjustment model and the AR(1) model
- The Partial Adjustment model's forecasts are closer in magnitude to the VAR model's forecasts but still lower.
- The Mean Absolute Error (MAE) of the VAR model's 1-step ahead forecasts is 1.249105, while the Partial Adjustment model has a significantly lower MAE of 5.107026e-16. The AR(1) model has a MAE of 0.3898489.
    - The MAE of the Partial Adjustment model is remarkably close to zero, suggesting that it achieves the closest fit to the actual data among the three models.

Comparing the models II

- The p-values of the Diebold-Mariano tests indicate significant differences in forecast accuracy between the VAR model and the Partial Adjustment model (p-value: 0.009362537), as well as between the VAR model and the AR(1) model (p-value: 0.002258156). However, the difference in forecast accuracy between the Partial Adjustment model and the AR(1) model is not statistically significant (p-value: 0.06680997).
- Based on the available information, the **Partial Adjustment model** seems to outperform both the VAR model and the AR(1) model in terms of forecast accuracy for the inflation growth rate, as indicated by its significantly lower MAE and the statistical significance of the Diebold-Mariano test when compared to the VAR model.