Econometrics 3 - Model Specification

Experience the process of model selection

(a) Use general-to-specific to come to a model. Start by regressing the federal funds rate on the other 7 variables and eliminate 1 variable at a time.

We first create a full general model, including all possible predictors

```
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)            -0.221      0.245  -0.903    0.367
## Inflation               0.696      0.062  11.185    0.000
## Production             -0.058      0.040  -1.447    0.148
## Unemployment            0.102      0.097   1.059    0.290
## Commodity.Prices       -0.006      0.003  -1.857    0.064
## Personal.Expenditure    0.344      0.069   4.958    0.000
## Personal.Income         0.247      0.061   4.077    0.000
## Housing.Starts         -0.019      0.005  -4.155    0.000
```

Use backward selection to remove the predictor with the lowest absolute t-value. The 2nd, more partial specific model excludes Unemployment.

```
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)            -0.291      0.236  -1.232    0.218
## Inflation               0.693      0.062  11.150    0.000
## Production             -0.025      0.026  -0.989    0.323
## Commodity.Prices       -0.007      0.003  -2.308    0.021
## Personal.Expenditure    0.369      0.066   5.618    0.000
## Personal.Income         0.252      0.060   4.162    0.000
## Housing.Starts         -0.021      0.004  -4.760    0.000
```

Running a 3rd, more specific model removes Production. All remaining variables has absolute t-values above 2, with p-values below 0.05.

```
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)            -0.240      0.230  -1.042    0.298
## Inflation               0.718      0.057  12.555    0.000
## Commodity.Prices       -0.008      0.003  -2.841    0.005
## Personal.Expenditure    0.341      0.059   5.756    0.000
## Personal.Income         0.240      0.059   4.048    0.000
## Housing.Starts         -0.021      0.004  -4.678    0.000
```

The final model predicts Interest Rates using Inflation, Commodity Prices, Personal Expenditure, Personal Income, and Housing Starts.

The coefficients for Commodity Prices and Housing Starts both have a negative sign, indicating higher asset values reduce Interest Rates. This fits economic theory, with lower Interest Rates reducing the future value of money, and increasing asset values today.

The coefficients for Inflation, Personal Expenditure and Personal Income all have positive signs, indicating that higher spending leads to higher Interest Rates. This is as expected, with higher Interest Rates acting to “cool down” the economy.

(b) Use specific-to-general to come to a model. Start by regressing the federal funds rate on only a constant and add 1 variable at a time. Is the model the same as in (a)?

I started with a model containing only an intercept. This predicts the mean average Interest Rate over all time periods.

Using forward selection (with AIC for model selection), the first variable to be added is Inflation. This is the strongest linear predictor of Interest Rates, compared to a model with only Intercept.

I next added Personal Income. This contains the most information to explain Interest Rates, when added to Intercept and Inflation.

I then, in turn, added Personal Expenditure, Housing Starts and Commodity Prices.

Neither Unemployment or Production entered the model.

```
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)             -0.240      0.230  -1.042    0.298
## Inflation                0.718      0.057  12.555    0.000
## Personal.Income          0.240      0.059   4.048    0.000
## Personal.Expenditure     0.341      0.059   5.756    0.000
## Housing.Starts          -0.021      0.004  -4.678    0.000
## Commodity.Prices        -0.008      0.003  -2.841    0.005
```

The final model predicts Interest Rates using Inflation, Personal Income, Personal Expenditure, Housing Starts and Commodity Prices.

Whilst the order of the variables is different to the model using backward selection, the two linear models are identical. The model in (b) is the same as in (a).

(c) Compare your model from (a) and the Taylor rule of equation (1). Consider R2, AIC and BIC.

Which of the models do you prefer?

The linear regression model from (a) has an R2 of 0.637, an AIC of 2914, and a BIC of 2946.

```
##   r.squared      AIC      BIC
## 1  0.637361 2914.423 2945.869
```

The linear regression using the Taylor rule of equation (1) has an R2 of 0.575, an AIC of 3014, and a BIC of 3032.

```
##   r.squared      AIC      BIC
## 1 0.5747014 3013.616 3031.585
```

The R2 in model (a) is higher, and the AIC and BIC lower compared to Taylor rule of equation (1). I therefore prefer the model from (a) as it fits the data better. It explains more of the variation in historic Interest Rates. It should be better at predicting future changes.

(d) Test the Taylor rule of equation (1) using the RESET test, Chow break and forecast test (with in both tests as break date January 1980) and a Jarque-Bera test. What do you conclude?

The RESET test is significant, rejecting the Null hypothesis that additional variables have no significant influence. We can see from the residuals and R2 that the model fit is not great, with high bias.

```
##
##  RESET test
##
## data:  list.lm$Taylor
## RESET = 3.7269, df1 = 4, df2 = 653, p-value = 0.00522
```

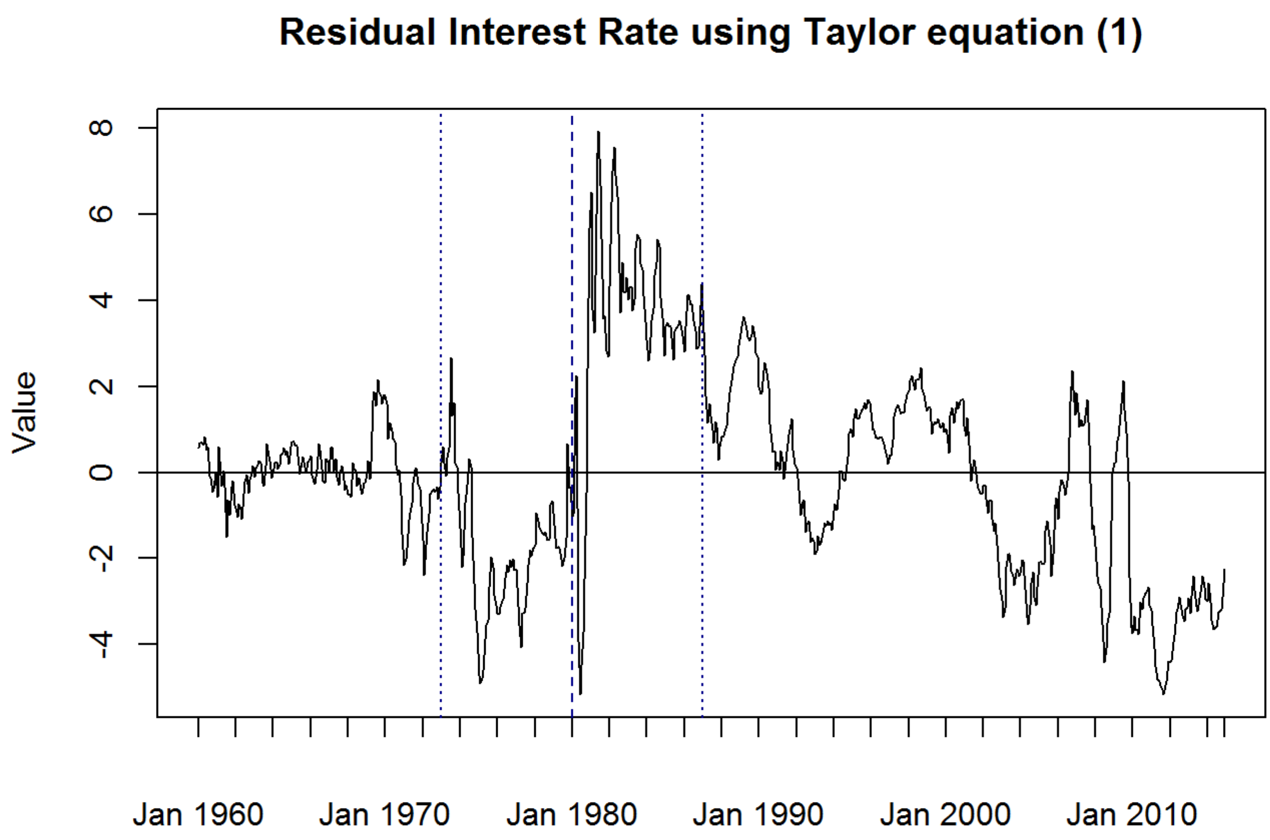
We can see that the Chow test is significant, implying a stuctural break at Jan 1980.

```
##
##  Chow test
##
## data:  list.formula$Taylor
## F = 29.908, p-value < 2.2e-16
```

The Jarque Bera normality test is significant, meaning we reject the null hypothesis of a normal distribution in the residuals.

```
##
##  Jarque Bera Test
##
## data:  list.lm$Taylor$residuals
## X-squared = 12.444, df = 2, p-value = 0.001985
```

We can see this in the residual plot, with a lot of variation in the residuals. The residuals are negative for most of the seven years before the suggested break, and mostly positive during the 7 years afterwards.



I conclude that there is a structural break within interest rate setting policy before and after January 1980. Indeed, the United States entered recession in January 1980. Two separate regressions should be run - one up and including January 1980, and one after this date.