Suggested Solution to Assignment 2

Note: Please take a look at the R script for this solution. The results and the figures are appended at the end of this document.

1. (a) Looking at the figure we don't find an obvious trend. Intuitively speaking, if purchasing power parity holds in the long-run, real exchange rate should revert back to its mean.

   (b) AIC and BIC select the same number of lags. We reject the null of unit root. The test statistic is very similar to the one reported in Lothian and Taylor, though not exactly similar to what they report.

   (c) Reject the null hypothesis for the floating period.

   (d) Reject the null at 10% significance level for the gold standard period as well. This validates the standard economic theory that even in a period of fixed nominal exchange rate, it is not possible to control the movements in the real exchange rate.

   (e) For PP test, we reject the null of unit root in (b) and at 10 percent in (d).

   (f) For ERS test we reject the null of unit root in all cases, though mostly at 5% and 10% significance levels.

2. This question relates to the estimation of Taylor type monetary policy reaction function. Taylor rule describes how the central bank changes interest rate in response to fluctuations in inflation and output gap. Orphanides (2001) used the following regression to estimate the Taylor rule:

$$FFR_t = \beta_0 + \beta_1 GAP_t + \beta_2 INFL\_GB_t + \beta_3 FFR_{t-1} + e_t$$

   where β_1 and β_2 measure the response coefficient of interest rate to output gap and inflation. Note that GAP is output gap, INFL_GB is Fed's forecast of inflation.

(a) Since the CUSUM stat lies within the 95% confidence interval, we don't reject the null of parameter stability in the above linear regression model in the above regression equation.

(b) As shown in Figure 2, the supF statistic does cross the critical value around 1980. This suggests evidence of instability in the monetary policy reaction coefficient.

(c) If we choose the number of breaks based on BIC, Bai and Perron test suggests two breaks in the monetary policy reaction function. The break dates are 1980:Q3 and 1985:Q4. These break dates coincide with the big decline in inflation and the chairmanship of Paul Volcker who was known for his hawkish stance on inflation.

(d) The estimated parameters for different regimes are as follows

Sample	β_0	β_1	β_2	β_3
1966:Q1-1980:Q3	0.778	0.195	0.512	0.666
1980:Q4-1985:Q4	2.900	0.115	1.281	0.299
1986:Q1-1995:Q4	1.029	0.251	0.154	0.806

(e) 95% confidence band associated with 1980:Q3 break point is [1979:Q4, 1980:Q4] and the confidence band associated with 1985:Q4 break is [1985:Q3, 1986:Q3].

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QUESTION 1
(B)
###############################################
# Augmented Dickey-Fuller Test Unit Root Test #
###############################################

Test regression drift


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.228645 -0.035456 -0.001937  0.039164  0.275859 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.19330    0.05310   3.640 0.000349 ***
z.lag.1     -0.12158    0.03331  -3.650 0.000336 ***
z.diff.lag   0.11875    0.07071   1.679 0.094683 .  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.07053 on 195 degrees of freedom
Multiple R-squared:  0.06736,	Adjusted R-squared:  0.05779 
F-statistic: 7.042 on 2 and 195 DF,  p-value: 0.001115


Value of test-statistic is: -3.6503 6.6644 

Critical values for test statistics: 
      1pct  5pct 10pct
tau2 -3.46 -2.88 -2.57
phi1  6.52  4.63  3.81


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(c)
############################################### 
# Augmented Dickey-Fuller Test Unit Root Test # 
############################################### 

Test regression drift 


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.16648 -0.06605  0.01194  0.05933  0.16330 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)  
(Intercept)   0.5614     0.3009   1.866   0.0867 .
z.lag.1      -0.3703     0.2026  -1.828   0.0925 .
z.diff.lag    0.4933     0.2670   1.848   0.0894 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.09886 on 12 degrees of freedom
Multiple R-squared:  0.2874,    Adjusted R-squared:  0.1686 
```

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F-statistic:  2.42 on 2 and 12 DF,  p-value: 0.1309


Value of test-statistic is: -1.828 1.8046 

Critical values for test statistics: 
      1pct  5pct 10pct
tau2 -3.75 -3.00 -2.63
phi1  7.88  5.18  4.12

(d)
############################################### 
# Augmented Dickey-Fuller Test Unit Root Test # 
############################################### 

Test regression drift 


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.071240 -0.023539 -0.001254  0.021922  0.076656 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)  
(Intercept)   0.4848     0.1804   2.687   0.0105 *
z.lag.1      -0.3058     0.1137  -2.690   0.0105 *
z.diff.lag    0.1702     0.1541   1.104   0.2762  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.04125 on 39 degrees of freedom
Multiple R-squared:  0.1571,    Adjusted R-squared:  0.1139 
F-statistic: 3.635 on 2 and 39 DF,  p-value: 0.03568


Value of test-statistic is: -2.6897 3.6177 

Critical values for test statistics: 
      1pct  5pct 10pct
tau2 -3.58 -2.93 -2.60
phi1  7.06  4.86  3.94

(e)
################################## 
# Phillips-Perron Unit Root Test # 
```

```
###################################

Test regression with intercept


Call:
lm(formula = y ~ y.l1)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.221971 -0.033154 -0.002466  0.039181  0.275978 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.17922    0.05194   3.451 0.000684 ***
y.l1         0.88690    0.03256  27.238  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.07107 on 197 degrees of freedom
Multiple R-squared:  0.7902,    Adjusted R-squared:  0.7891 
F-statistic: 741.9 on 1 and 197 DF,  p-value: < 2.2e-16


Value of test-statistic, type: Z-tau  is: -3.6215 

         aux. Z statistics
Z-tau-mu             3.598

Critical values for Z statistics: 
                     1pct     5pct     10pct
critical values -3.464384 -2.87607 -2.574439


################################### 
# Phillips-Perron Unit Root Test # 
################################### 

Test regression with intercept 


Call:
lm(formula = y ~ y.l1)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.14393 -0.09766  0.01649  0.09506  0.14186 
```

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   0.3617     0.2832   1.277   0.2223
y.l1          0.7704     0.1904   4.046   0.0012 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1038 on 14 degrees of freedom
Multiple R-squared:  0.539,     Adjusted R-squared:  0.5061
F-statistic: 16.37 on 1 and 14 DF,  p-value: 0.001203


Value of test-statistic, type: Z-tau  is: -1.5418

         aux. Z statistics
Z-tau-mu            1.5973

Critical values for Z statistics:
                     1pct      5pct     10pct
critical values -3.922695 -3.065881 -2.674475


##################################
# Phillips-Perron Unit Root Test #
##################################

Test regression with intercept


Call:
lm(formula = y ~ y.l1)

Residuals:
      Min        1Q    Median        3Q       Max
-0.079851 -0.022965  0.001586  0.025914  0.081066

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   0.4414     0.1658   2.663    0.011 *
y.l1          0.7222     0.1045   6.911  2.2e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.04115 on 41 degrees of freedom
Multiple R-squared:  0.5381,    Adjusted R-squared:  0.5268
F-statistic: 47.76 on 1 and 41 DF,  p-value: 2.204e-08
```

```
Value of test-statistic, type: Z-tau  is: -2.8356

         aux. Z statistics
Z-tau-mu            2.8396

Critical values for Z statistics:
                     1pct      5pct     10pct
critical values -3.588831 -2.930296 -2.602965
```

(f)

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###############################################
# Elliot, Rothenberg and Stock Unit Root Test #
###############################################

Test of type P-test
detrending of series with intercept

Value of test-statistic is: 2.0169

Critical values of P-test are:
                1pct 5pct 10pct
critical values 1.91 3.17  4.33


###############################################
# Elliot, Rothenberg and Stock Unit Root Test #
###############################################

Test of type P-test
detrending of series with intercept

Value of test-statistic is: 0.086

Critical values of P-test are:
                1pct 5pct 10pct
critical values 1.87 2.97  3.91


###############################################
# Elliot, Rothenberg and Stock Unit Root Test #
###############################################

Test of type P-test
detrending of series with intercept

Value of test-statistic is: 2.631

Critical values of P-test are:
```

```
                1pct 5pct 10pct
critical values 1.87 2.97  3.91




###############################QUESTION 2#############################
        supF test
(b)
data:  fs.taylor
sup.F = 31.227, p-value = 8.789e-05


(c)
         Optimal (m+1)-segment partition:

Call:
breakpoints.formula(formula = mod.taylor, data = orphanides)

Breakpoints at observation number:

m = 1         59
m = 2         59 80
m = 3   21    59 80
m = 4   21 39 59 80
m = 5   21 39 59 77 95

Corresponding to breakdates:

m = 1                   1980(3)
m = 2                   1980(3) 1985(4)
m = 3   1971(1)         1980(3) 1985(4)
m = 4   1971(1) 1975(3) 1980(3) 1985(4)
m = 5   1971(1) 1975(3) 1980(3) 1985(1) 1989(3)

Fit:

m   0      1      2      3      4      5
RSS 162.80 127.30  94.68  82.20  75.36  72.94
BIC 401.09 395.51 383.92 390.89 404.40 424.43

(d)
                  (Intercept)       gap   infl_gb   ffr_lag
1966(1) - 1980(3)   0.7778883 0.1950970 0.5126659 0.6663677
1980(4) - 1985(4)   2.9006469 0.1156082 1.2819525 0.2999531
1986(1) - 1995(4)   1.0293308 0.2516709 0.1548369 0.8060687

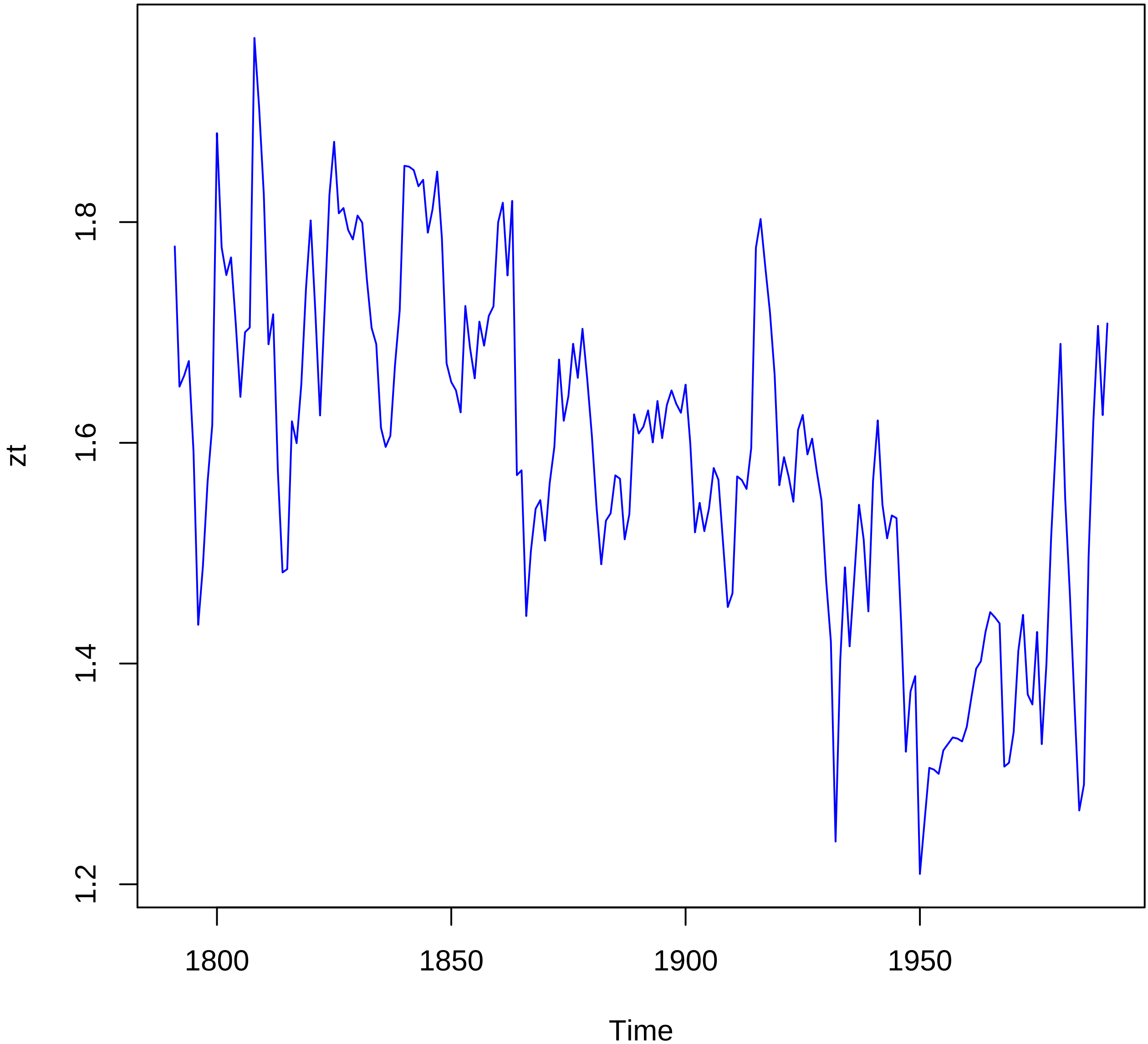
         Confidence intervals for breakpoints
```

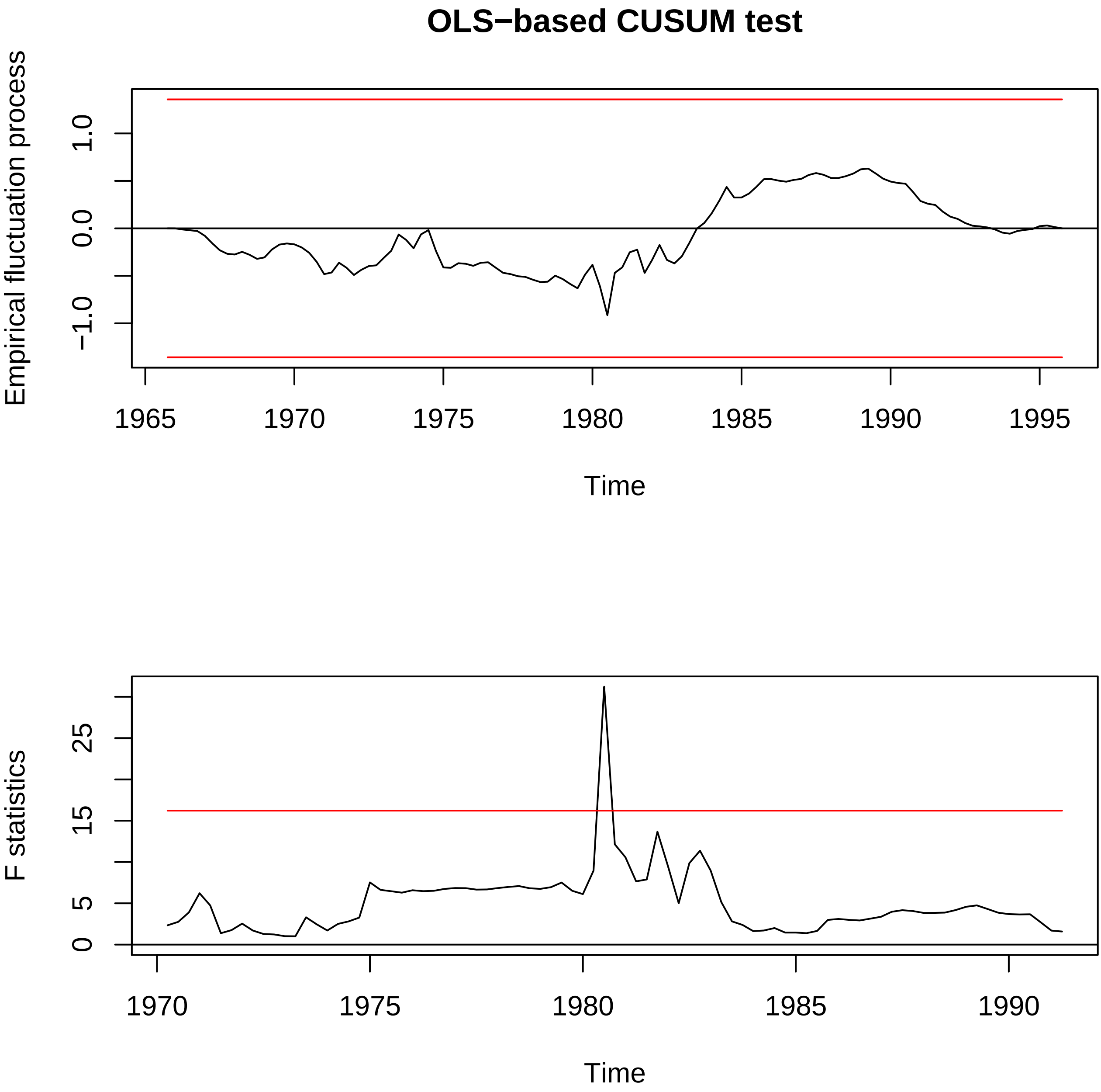
```
         of optimal 3-segment partition:

(e)
confint.breakpointsfull(object = bp.taylor)

Breakpoints at observation number:
  2.5 % breakpoints 97.5 %
1    56          59     60
2    79          80     83

Corresponding to breakdates:
  2.5 %   breakpoints 97.5 %
1 1979(4) 1980(3)     1980(4)
2 1985(3) 1985(4)     1986(3)
```


zt
1.2
1.4
1.6
1.8
1800
1850
1900
1950
Time


OLS−based CUSUM test
Empirical fluctuation process
1.0
0.0
−1.0
1965
1970
1975
1980
1985
1990
1995
Time
F statistics
0
5
15
25
1970
1975
1980
1985
1990
Time

BIC and Residual Sum of Squares