Consumer vs Producer Egg Prices Over Time

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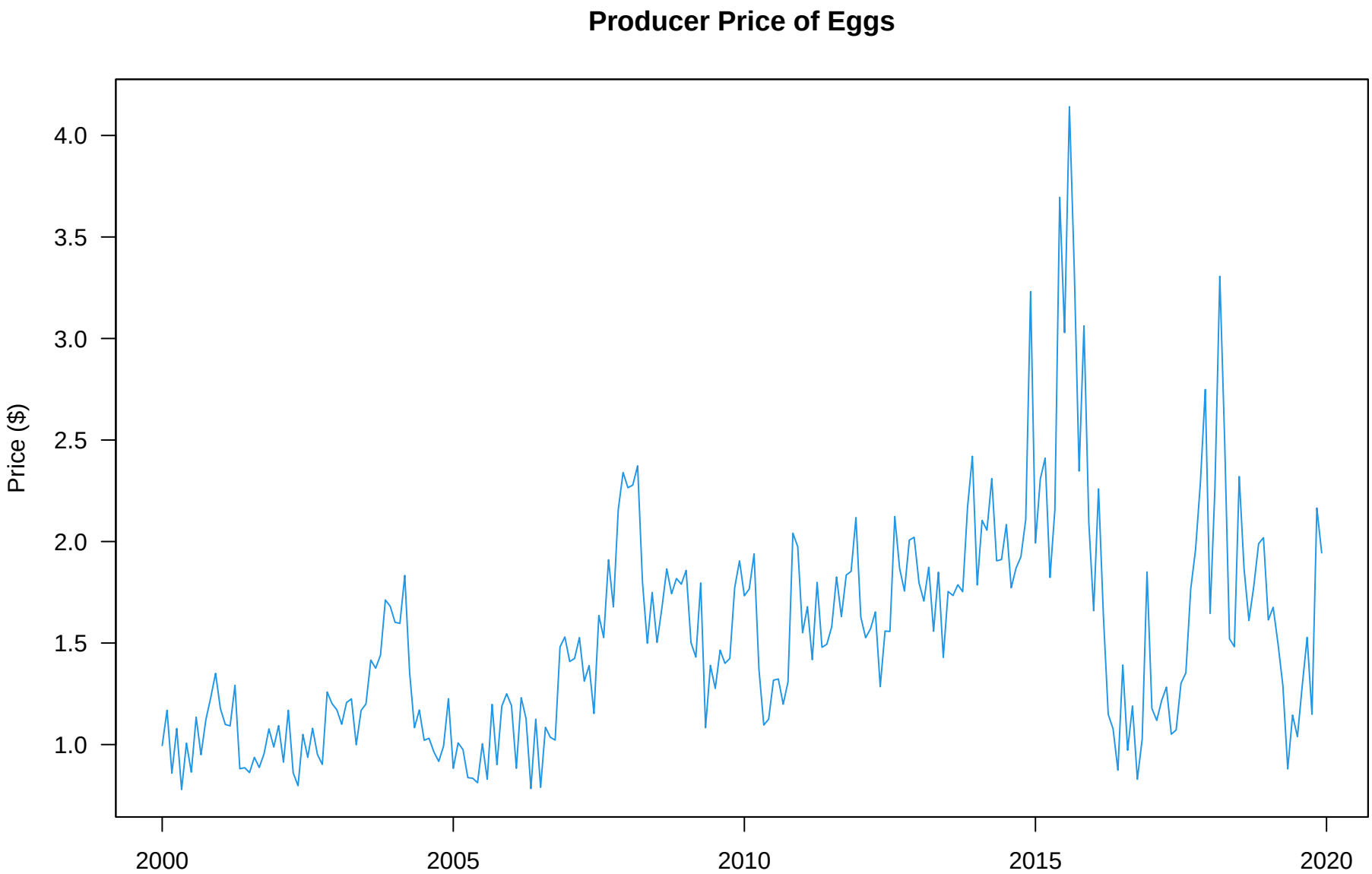
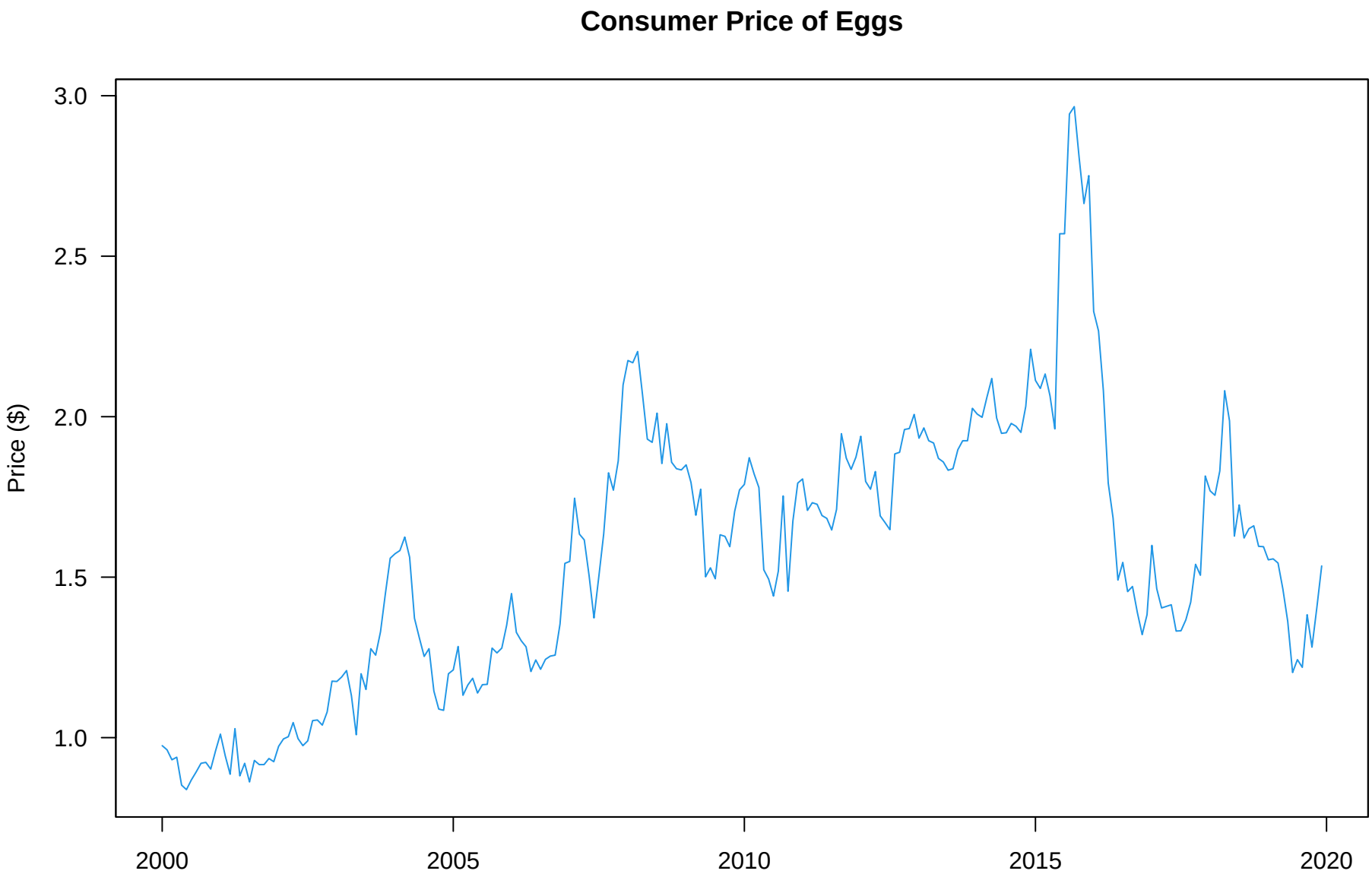
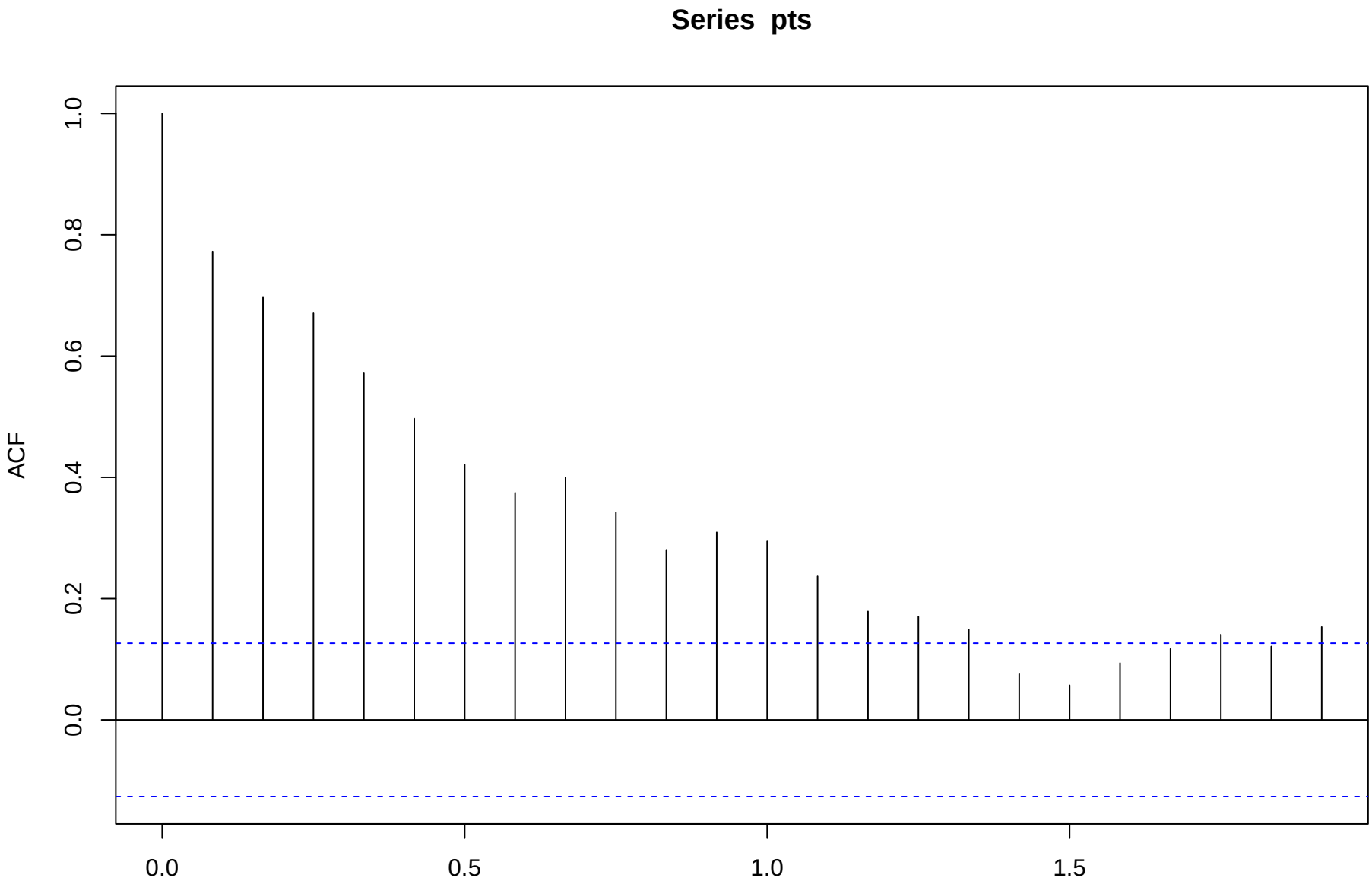
PPI of Eggs Over Time



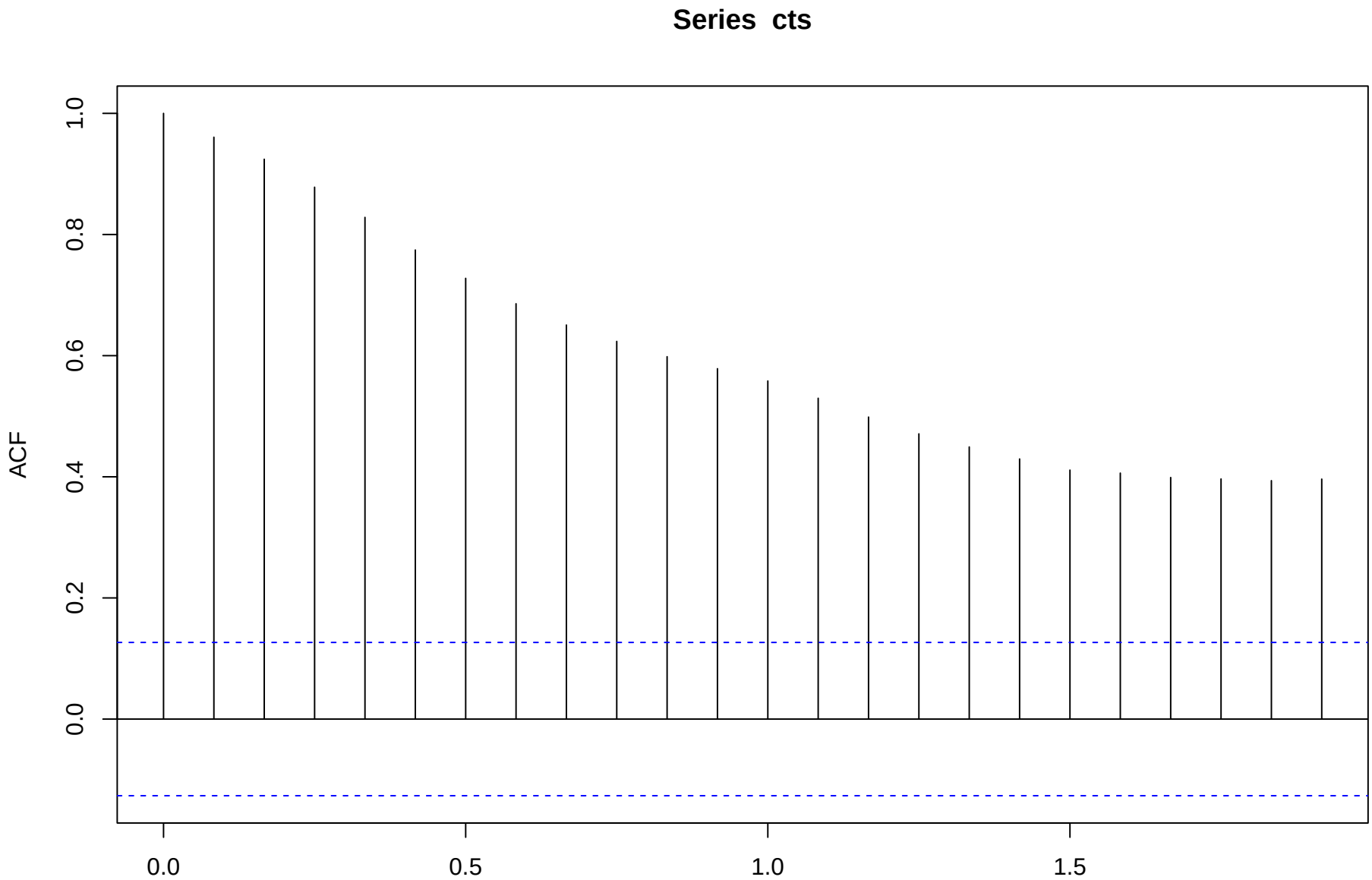
CPI of Eggs Over Time



Auto-Correlation of Producer Egg Prices



Auto-Correlation of Consumer Egg Prices



Kruskal-Wallis Test

H_0: No seasonality (i.e. medians are the same at different lags)

- Producer Seasonality
  - Reject at the 0.01 level

```
## Test used:  Kruskall Wallis
##
## Test statistic:  62.87
## P-value:  2.701813e-09
```

- Consumer Seasonality
  - Reject at the 0.01 level

```
## Test used:  Kruskall Wallis
##
## Test statistic:  66.88
## P-value:  4.77001e-10
```

Remove Seasonality

We difference with a lag of 12, to remove seasonality.

- Producer Seasonality
  - Fail to reject at the 0.01 level

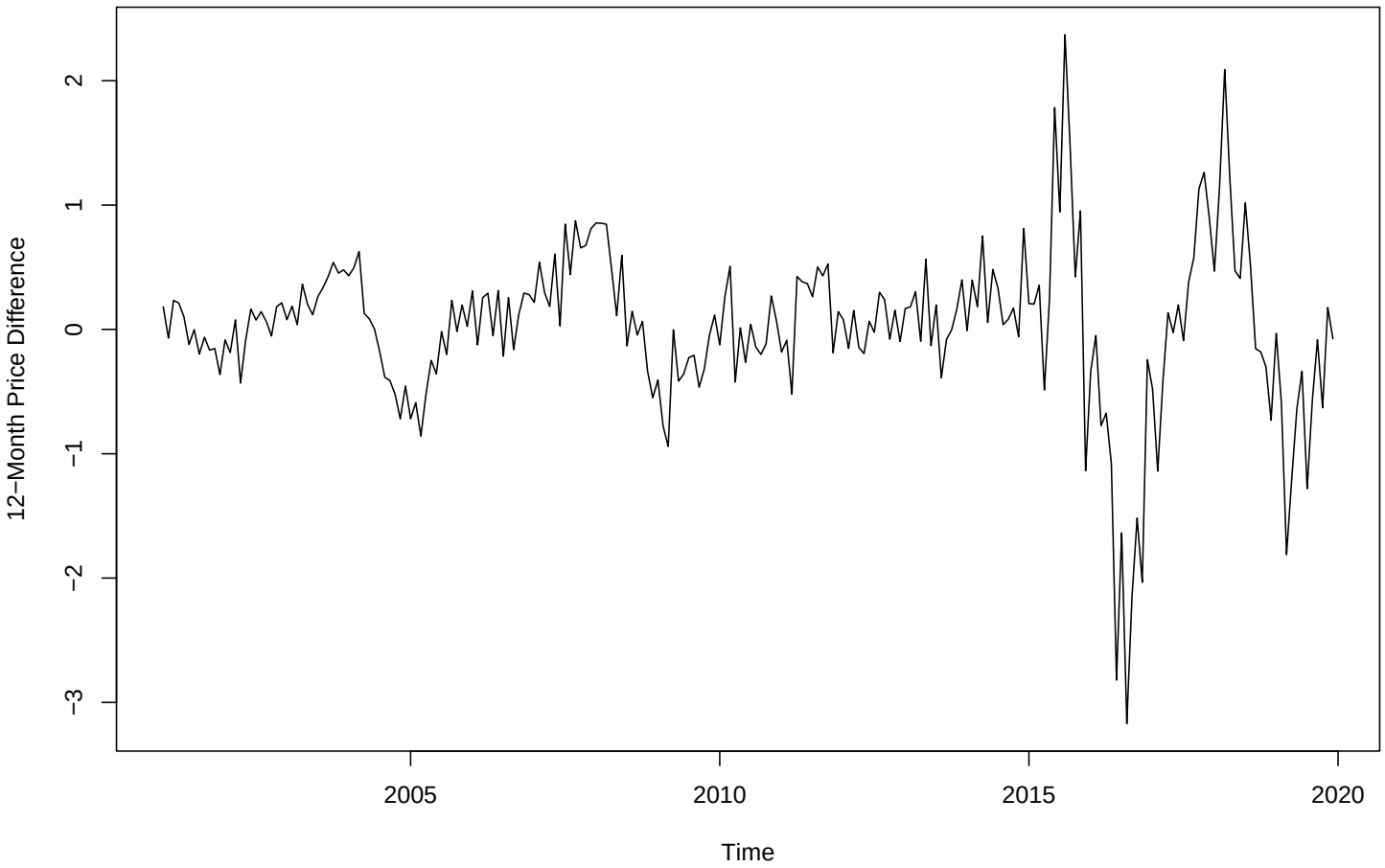
```
## Test used:  Kruskall Wallis
##
## Test statistic:  1.01
## P-value:  0.9999481
```

- Consumer Seasonality
  - Fail to reject at the 0.01 level

```
## Test used:  Kruskall Wallis
##
## Test statistic:  2.17
## P-value:  0.9978144
```

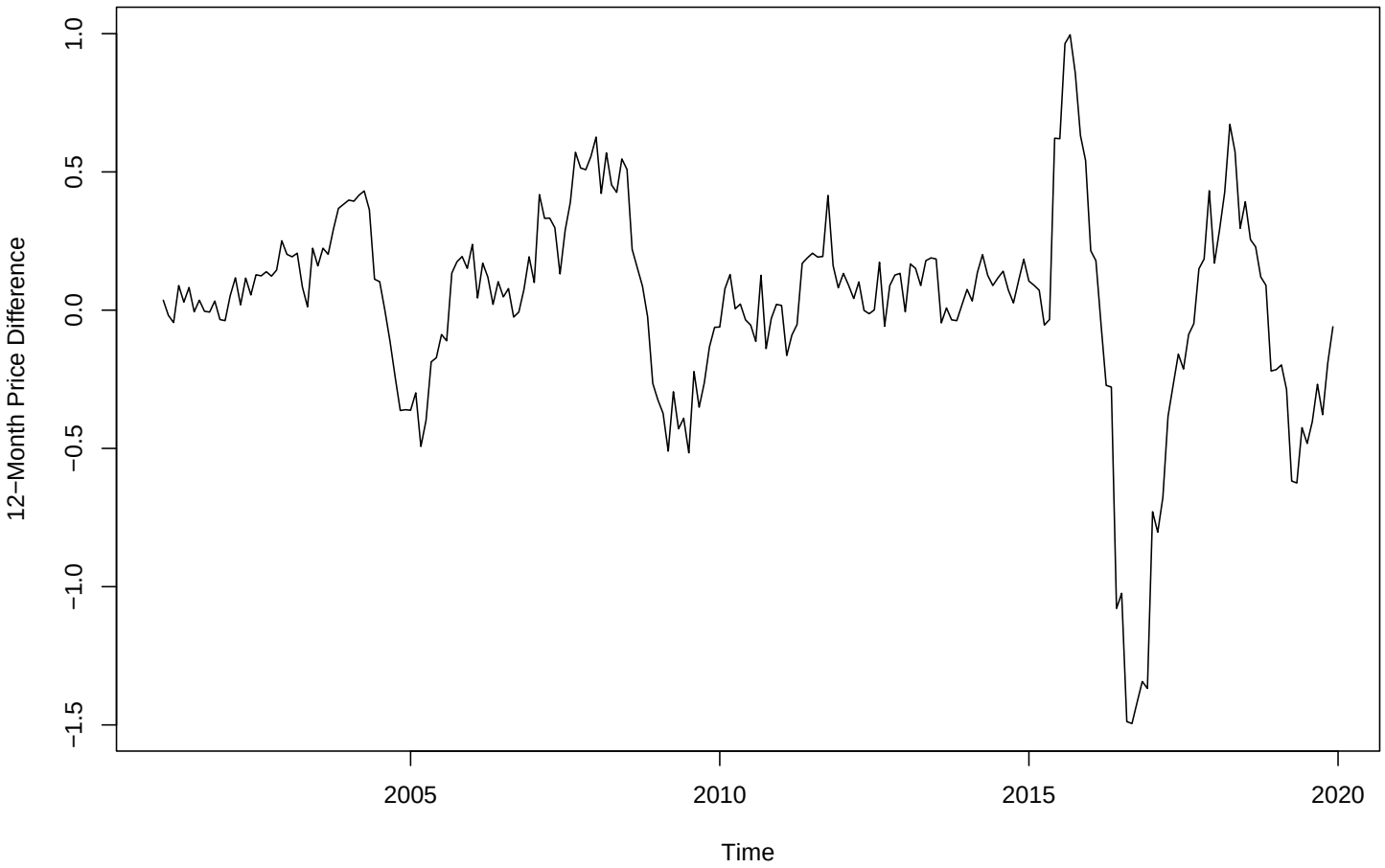
- After differencing, we are unable to conclude that there is seasonality.

Plot of 12-Month Difference in Producer Price



- Series looks to be centered at 0, suggesting stationarity.

Plot of 12-Month Difference in Consumer Price



- Process appears to have mean 0, implying stationarity.

Augmented Dickey-Fuller Test

H_0: Time series is non-stationary.

- Producer Price
  - Reject at least at the 0.01 level.

```
##
##  Augmented Dickey-Fuller Test
##
## data:  pdiff
## Dickey-Fuller = -4.9458, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
```

- Consumer Price
  - Reject at least at the 0.01 level.

```
##
##  Augmented Dickey-Fuller Test
##
## data:  cdiff
## Dickey-Fuller = -5.5471, Lag order = 6, p-value = 0.01
## alternative hypothesis: stationary
```

Vector Auto-Regressive (VAR) Model

- For multivariate series
- Relation of lags and lags of other variables
- Before we need to check if one causes the other

Granger Test

H_0: No sequence causes another.

```
## Number of targeted zero parameters:  5
## Chi-square test for Granger Causality and p-value:  50.53128 1.078826e-09
```

- Reject null hypothesis at 0.01 level and concluded there is causality between the time series.

Selecting Lag

```
## AIC(n)  HQ(n)  SC(n) FPE(n)
##     10      10       5      10
```

We use the Schwarz Criterion or BIC, and will fit an VAR process of order 5.

VAR model

```
vm <- vars::VAR(diffed, p=5)
```

We fit the model with the VAR function from the vars package.

Egg Price Coefficients

- Consumer

```
##
## Call:
## lm(formula = y ~ -1 + ., data = datamat)
##
## Coefficients:
##  pdiff.l1   cdiff.l1   pdiff.l2   cdiff.l2   pdiff.l3   cdiff.l3   pdiff.l4
##  0.215610   0.263614   0.027853   0.522284  -0.047371   0.086108  -0.021640
##  cdiff.l4   pdiff.l5   cdiff.l5      const
## -0.133561   0.003104  -0.075708   0.005330
```

- Producer

```
##
## Call:
## lm(formula = y ~ -1 + ., data = datamat)
##
## Coefficients:
## pdiff.l1  cdiff.l1  pdiff.l2  cdiff.l2  pdiff.l3  cdiff.l3  pdiff.l4  cdiff.l4
##  0.56647  -0.56518   0.16566   1.29694  -0.08707   0.38078  -0.05055  -1.62236
## pdiff.l5  cdiff.l5     const
##  0.39102   0.03979   0.01264
```

Jarque-Bera Normality Tests

H_0: residual skewness and kurtosis are consistent with normality

- Skewness
  - Fail to reject assumption that residual skewness is consistent with normality.

```
##
##  Skewness only (multivariate)
##
## data:  Residuals of VAR object vm
## Chi-squared = 1.1613, df = 2, p-value = 0.5595
```

- Kurtosis
  - Reject assumption that residual kurtosis is consistent with normality.

```
##
##  Kurtosis only (multivariate)
##
## data:  Residuals of VAR object vm
## Chi-squared = 163.66, df = 2, p-value < 2.2e-16
```

Test of Residual Serial Correlation

H_0: No residual serial correlation

- Breusch-Goldfrey Test
  - Score test

```
##
##  Breusch-Godfrey LM test
##
## data:  Residuals of VAR object vm
## Chi-squared = 51.209, df = 20, p-value = 0.0001483
```

- Edgerton-Shukur Test
  - Likelihood-Ratio (F) test

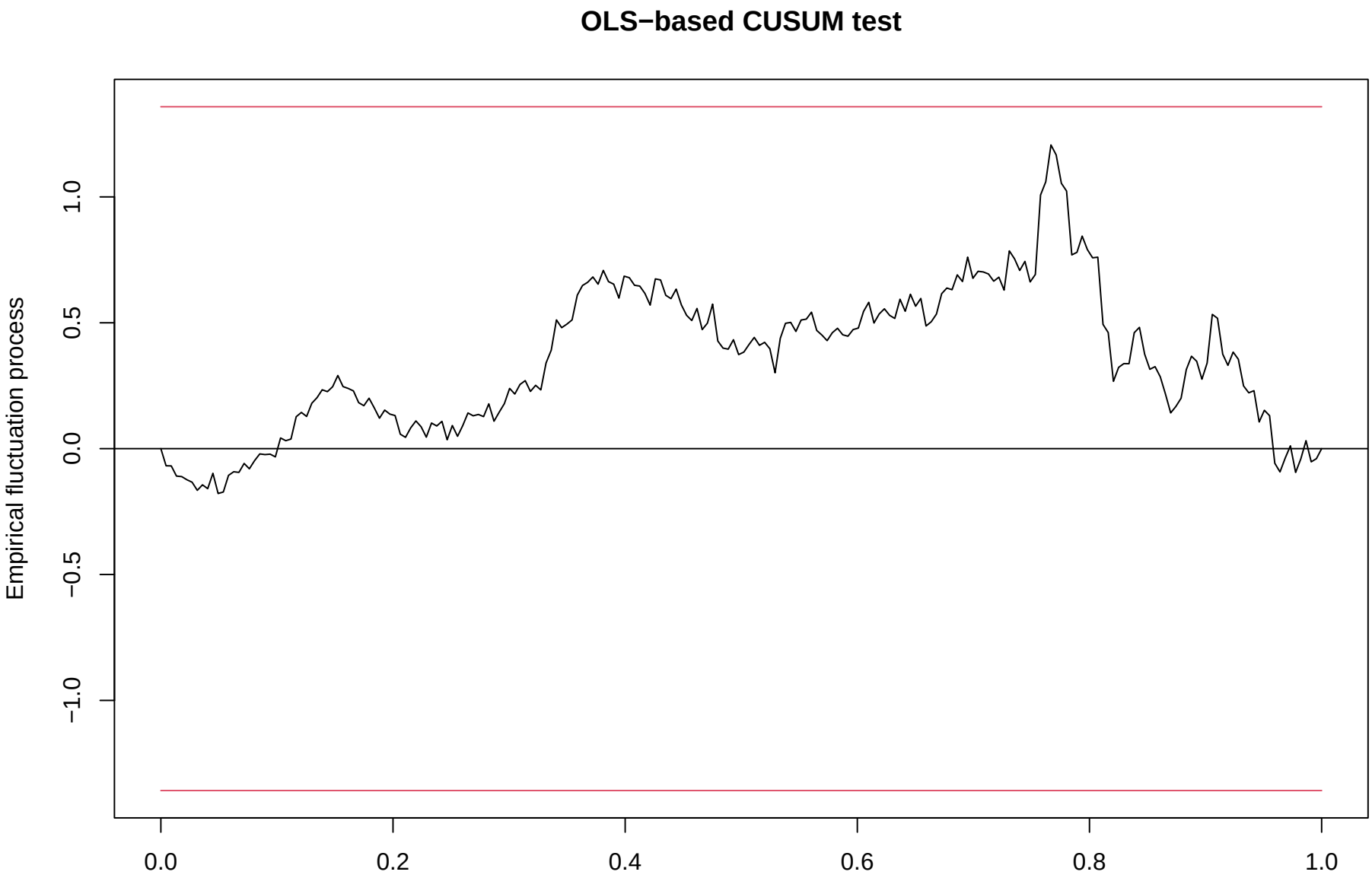
```
##
##  Edgerton-Shukur F test
##
## data:  Residuals of VAR object vm
## F statistic = 2.6095, df1 = 20, df2 = 402, p-value = 0.0002106
```

- Both tests reject assumption at the 0.01 level

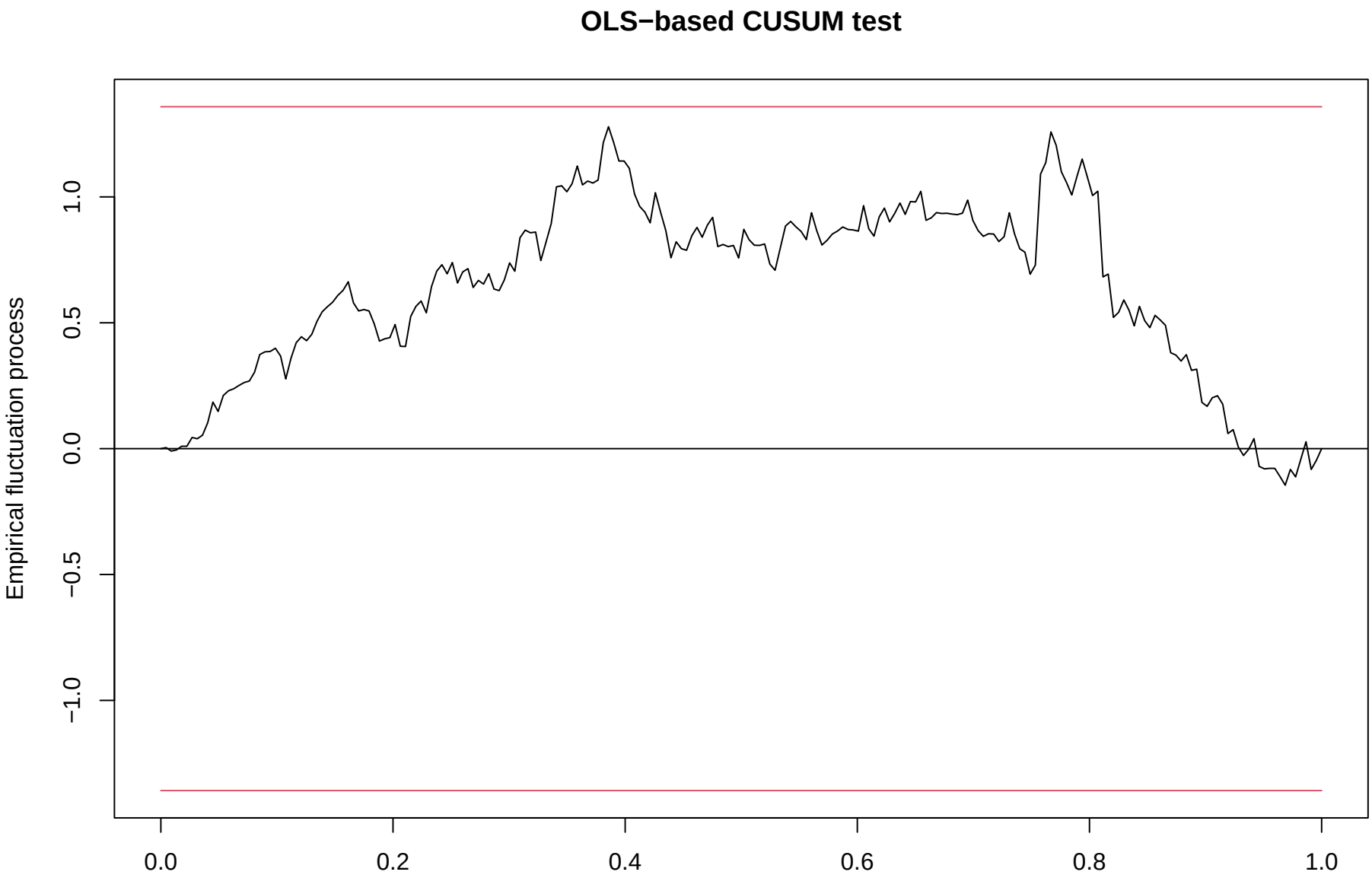
Discussion of Problems

- The residuals are both serially correlated and non-normal, these are likely symptoms of the same problem
- There seems to exist heteroscedasticity in the residuals, preventing an analytic comparison of the series.

Stability Plot for De-Seasoned Producer Egg Price



Stability Plot for De-Seasoned Consumer Egg Price



Our Model

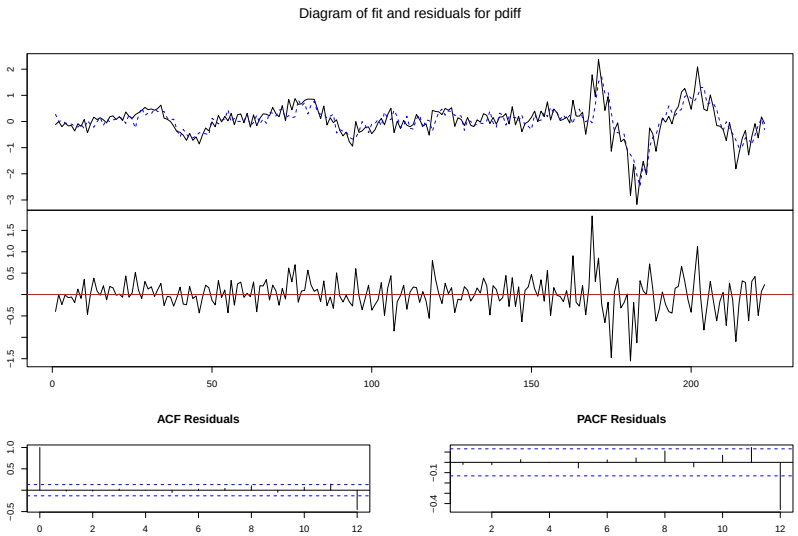


Diagram of fit and residuals for pdiff
ACF Residuals
PACF Residuals

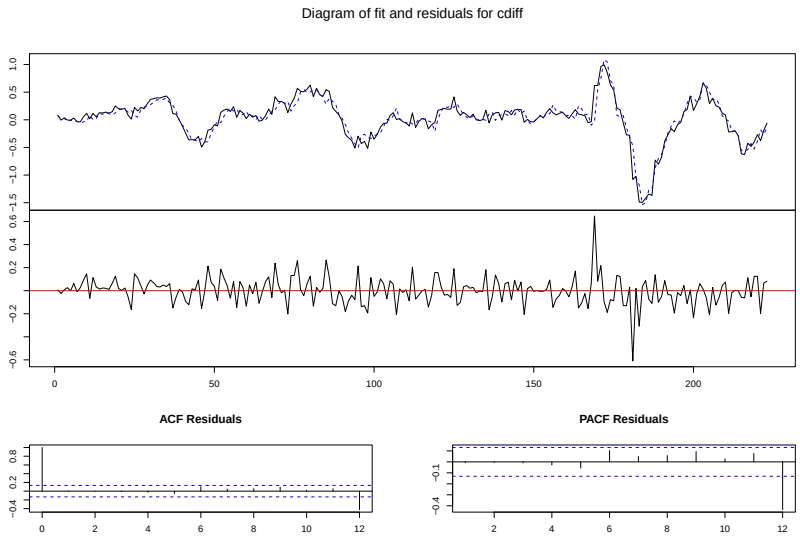


Diagram of fit and residuals for cdiff
ACF Residuals
PACF Residuals

The Fan Chart