Modelling the relationship between commodity prices

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```
rm(list = ls())
graphics.off()
```

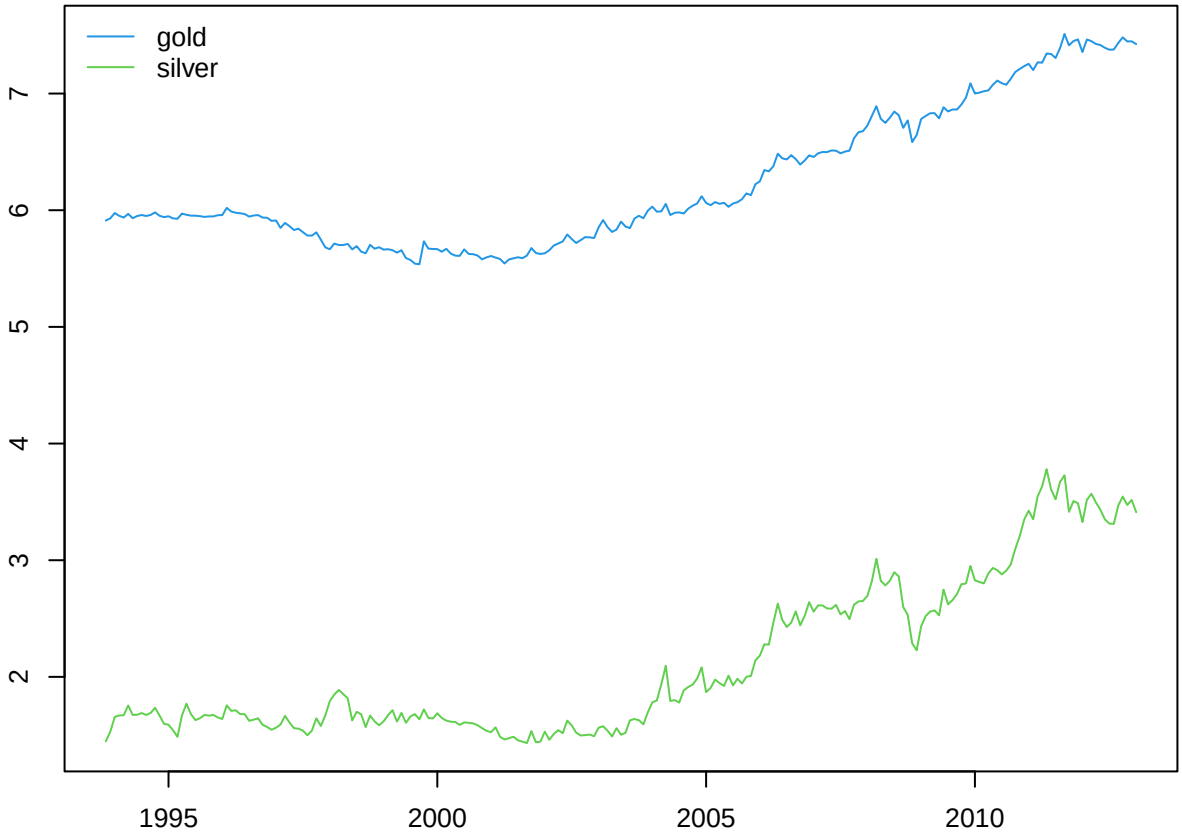
```
library(vars)
```

```
## Loading required package: MASS

## Loading required package: strucchange

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

## Loading required package: sandwich

## Loading required package: urca

## Loading required package: lmtest
```

```
# reading the dataset
data <- read.csv("comodity_price.csv")
```

```
# assigning the different minerals to variables for ease of access
gold <- ts(log(data$gold), start = c(1993, 11), frequency = 12)
silver <- ts(log(data$silver), start = c(1993, 11), frequency = 12)
plat <- ts(log(data$plat), start = c(1993, 11), frequency = 12)
pall <- ts(log(data$pall), start = c(1993, 11), frequency = 12)
```

```
# plotting the gold and silver to ensure the variables were assigned correctly
par(mfrow = c(1, 1), mar = c(2.2, 2.2, 1, 2.2), cex = 0.8)
plot.ts(cbind(gold, silver), plot.type = "single", ylab = "",
    col = 4:3)
legend("topleft", legend = c("gold", "silver"), col = 4:3,
    lty = 1, bty = "n")
```




```
# checking the trend in gold using ADF
adfg1 <- ur.df(gold, type = "trend", selectlags = c("BIC"))
summary(adfg1)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression trend
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.188979 -0.026569 -0.001586  0.024103  0.188728
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  6.410e-02  5.049e-02   1.270  0.20555
## z.lag.1     -1.309e-02  9.335e-03  -1.403  0.16210
## tt           2.168e-04  8.273e-05   2.620  0.00939 **
## z.diff.lag  -1.717e-01  6.550e-02  -2.622  0.00934 **
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04515 on 225 degrees of freedom
## Multiple R-squared:  0.05981,    Adjusted R-squared:  0.04727
## F-statistic: 4.771 on 3 and 225 DF,  p-value: 0.003035
##
##
## Value of test-statistic is: -1.4027 5.041 4.439
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau3 -3.99 -3.43 -3.13
## phi2  6.22  4.75  4.07
## phi3  8.43  6.49  5.47
```

```
# checking the lags for gold for better understanding
adfg2 <- ur.df(diff(gold), selectlags = c("BIC"))
summary(adfg2)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression none
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 - 1 + z.diff.lag)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.189135 -0.020045  0.002479  0.031442  0.192050
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1    -1.26434    0.09897 -12.775   <2e-16 ***
## z.diff.lag  0.11969    0.06589   1.816   0.0706 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04609 on 226 degrees of freedom
## Multiple R-squared:  0.5717, Adjusted R-squared:  0.5679
## F-statistic: 150.9 on 2 and 226 DF,  p-value: < 2.2e-16
##
##
## Value of test-statistic is: -12.7749
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.58 -1.95 -1.62
```

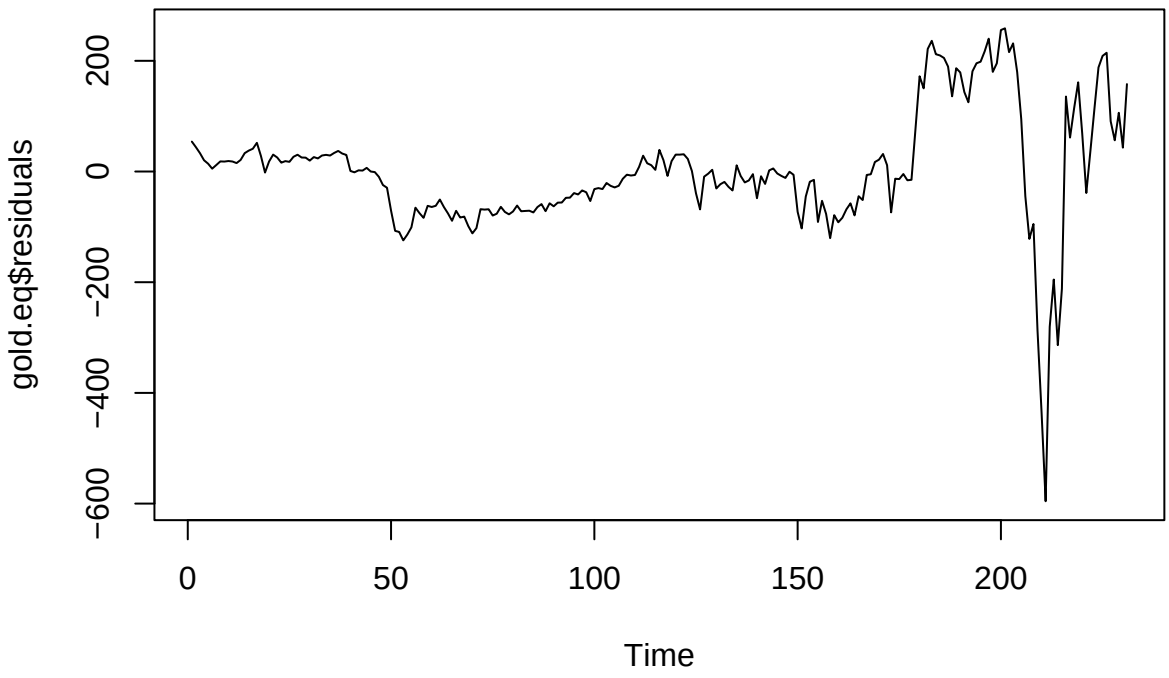
Model Selection and Estimation

```r
# assigning gold and silver to a variable which is united for model selection and estimation
dat <- ts.union(gold, silver)
```

```r
# estimating the long run regression
gold.eq <- lm(gold ~ silver, data = data)
summary(gold.eq)
```

```
##
## Call:
## lm(formula = gold ~ silver, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -595.74  -61.72   -5.73   30.41  258.65
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 119.0383    10.9113   10.91   <2e-16 ***
## silver       46.1627     0.7701   59.94   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 106.9 on 229 degrees of freedom
## Multiple R-squared:  0.9401, Adjusted R-squared:  0.9398
## F-statistic:  3593 on 1 and 229 DF,  p-value: < 2.2e-16
```

```r
# generating a plot for gold residuals
plot.ts(gold.eq$residuals)
```




```
# performing adf to confirm that the plot above is stationery
error.gold <- ur.df(gold.eq$residuals, lags = 1, type = "none")
summary(error.gold)
```

```
##
## ###############################################
## # Augmented Dickey-Fuller Test Unit Root Test #
## ###############################################
##
## Test regression none
##
##
## Call:
## lm(formula = z.diff ~ z.lag.1 - 1 + z.diff.lag)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -206.273  -12.689   -0.365   10.180  310.837
##
## Coefficients:
##            Estimate Std. Error t value Pr(>|t|)
## z.lag.1    -0.11826    0.03111  -3.801 0.000185 ***
## z.diff.lag  0.10992    0.06685   1.644 0.101492
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 48.68 on 227 degrees of freedom
## Multiple R-squared:  0.06223,    Adjusted R-squared:  0.05397
## F-statistic: 7.532 on 2 and 227 DF,  p-value: 0.0006808
##
##
## Value of test-statistic is: -3.8014
##
## Critical values for test statistics:
##       1pct  5pct 10pct
## tau1 -2.58 -1.95 -1.62
```

```
# error correction
gold.d <- diff(gold)[-1]
silver.d <- diff(silver)[-1]
error.ecm1 <- gold.eq$residuals[-1:-2]
gold.d1 <- diff(gold)[-(length(gold) - 1)]
silver.d1 <- diff(silver[-(length(silver) - 1)])
```

```
ecm.gold <- lm(gold.d ~ error.ecm1 + gold.d1 + silver.d1)
summary(ecm.gold)
```

```
##
## Call:
## lm(formula = gold.d ~ error.ecm1 + gold.d1 + silver.d1)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.179584 -0.027994 -0.004703  0.022378  0.187514
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  7.525e-03  3.071e-03   2.450   0.0150 *
## error.ecm1  -1.651e-05  2.901e-05  -0.569   0.5699
## gold.d1     -1.617e-01  9.481e-02  -1.705   0.0896 .
## silver.d1    8.750e-03  5.134e-02   0.170   0.8648
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04599 on 225 degrees of freedom
## Multiple R-squared:  0.02447,    Adjusted R-squared:  0.01146
## F-statistic: 1.881 on 3 and 225 DF,  p-value: 0.1336
```