Factors of Peruvian Copper Exports
OLS and assumption violations for a time serie

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Contents

Data and variables

- volCobre: (Numeric) Traditional product exports (Thousands of tons). Source BCRP
- fdi: (Numeric) Private sector financial account (Millions of US$) - Foreign Direct Investment. Source BCRP
- copPrice: (Numeric) Copper price (US$ per pound). Source BCRP
- exchRate: (Numeric) Real Exchange Rate (base 2009=100) - Bilateral. Source BCRP
- gdpChina: (Numeric) Current Price Gross Domestic Product in China, Chinese Yuans, Quarterly, Seasonally Adjusted. Source Federal Reserve Bank of St. Louis (base 2009 = 100)

Descriptive Statistics

Table 1: Descriptive Statistics

Statistic	volCobre	fdi	gdpChina	copPrice	exchRate
Min	106.3	-2459.3	32.50	64.78	83.79
1st Qu	230.0	446.8	61.86	150.92	94.91
Median	286.6	1448.0	134.29	270.64	100.50
Mean	336.8	1312.4	150.64	244.42	103.08
3rd Qu	362.3	1933.3	225.24	326.01	113.91
Max	752.0	4149.0	374.16	437.31	121.52

Initial Variables
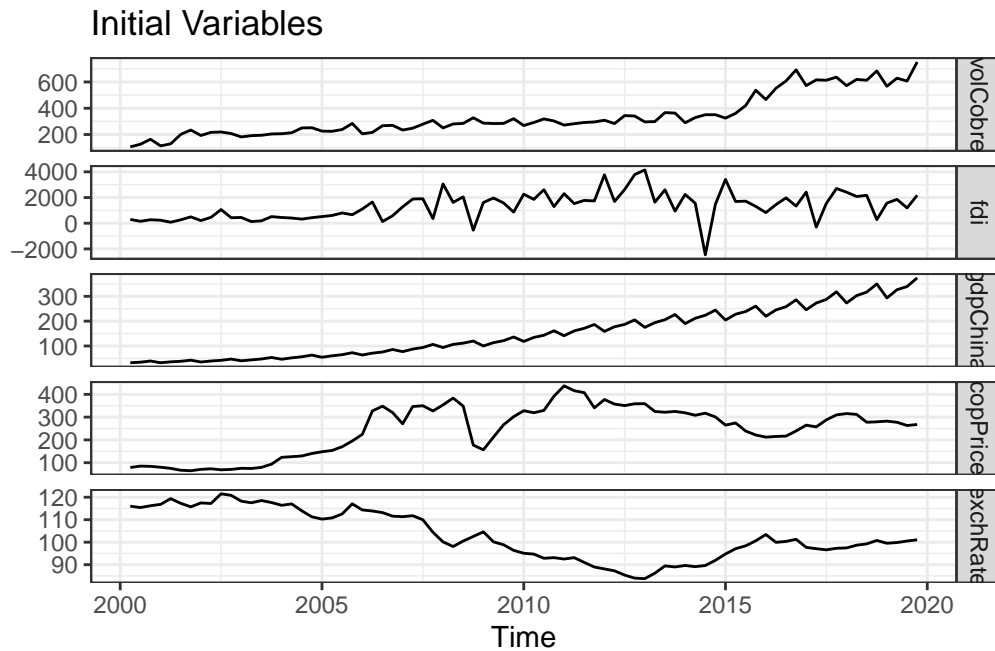
Unit root test

It is necessary to test if there are unit roots, in order to determine if the variables can be used in the model

```
## $volCobre
##
##  Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -1.7599, Lag order = 4, p-value = 0.6738
## alternative hypothesis: stationary
##
##
## $fdi
##
##  Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -2.6454, Lag order = 4, p-value = 0.3117
## alternative hypothesis: stationary
##
##
## $gdpChina
##
##  Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -2.2722, Lag order = 4, p-value = 0.4644
## alternative hypothesis: stationary
##
##
```

```
## $copPrice
##
##   Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -1.81, Lag order = 4, p-value = 0.6534
## alternative hypothesis: stationary
##
##
## $exchRate
##
##   Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -0.59892, Lag order = 4, p-value = 0.9752
## alternative hypothesis: stationary
```

All the variables have unit roots, so they will be changed to percentage variation to evade this problem.

```
## $volCobre_var
##
##   Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -3.5972, Lag order = 4, p-value = 0.03916
## alternative hypothesis: stationary
##
##
## $fdi_var
##
##   Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -3.6605, Lag order = 4, p-value = 0.03368
## alternative hypothesis: stationary
##
##
## $gdpChina_var
##
##   Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -3.5777, Lag order = 4, p-value = 0.04085
## alternative hypothesis: stationary
##
##
## $copPrice_var
##
##   Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -3.9842, Lag order = 4, p-value = 0.01477
## alternative hypothesis: stationary
##
```

```
##
## $exchRate_var
##
##  Augmented Dickey-Fuller Test
##
## data:  X[[i]]
## Dickey-Fuller = -3.7349, Lag order = 4, p-value = 0.02724
## alternative hypothesis: stationary
```

Now, no variable has unit roots.

In the next graph it is shown how the variables look after the change.

Percentage Variation
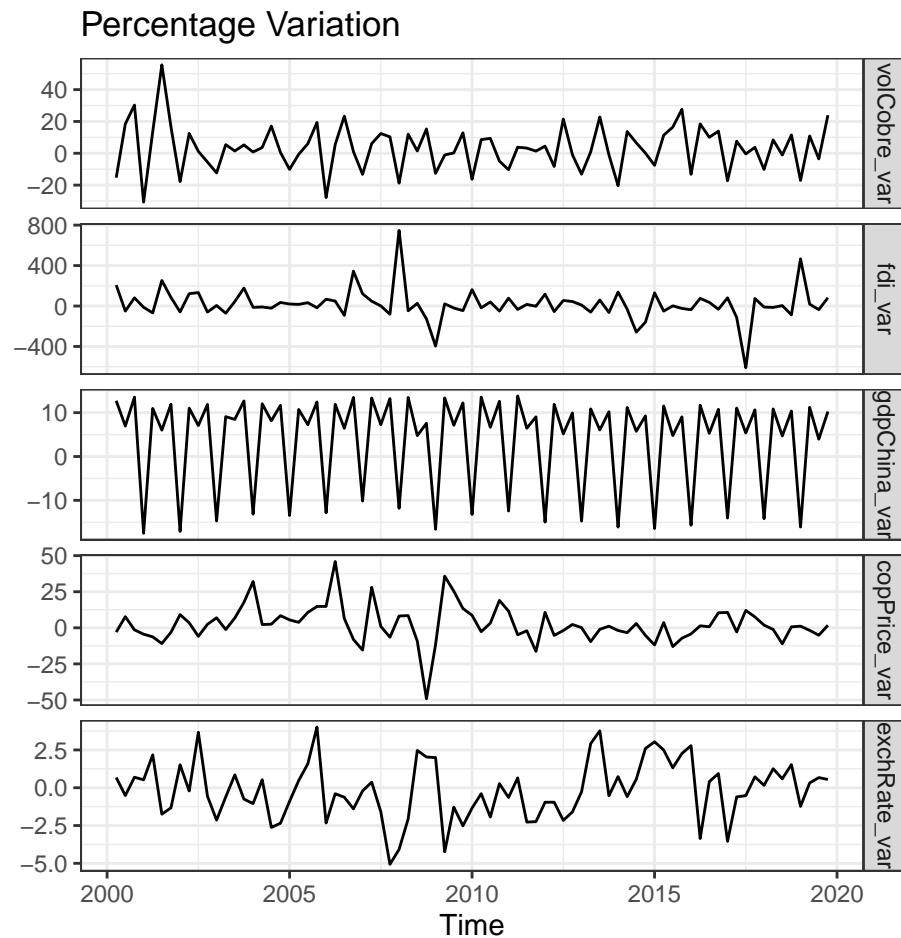
Correlation analysis

Table 2: Pearson Correlation

	volCobre_var	fdi_var	gdpChina_var	copPrice_var	exchRate_var
volCobre_var	1.00	-0.11	0.64	-0.12	0.07
fdi_var	-0.11	1.00	-0.18	0.06	-0.25
gdpChina_var	0.64	-0.18	1.00	0.01	0.02

	volCobre_var	fdi_var	gdpChina_var	copPrice_var	exchRate_var
copPrice_var	-0.12	0.06	0.01	1.00	-0.29
exchRate_var	0.07	-0.25	0.02	-0.29	1.00
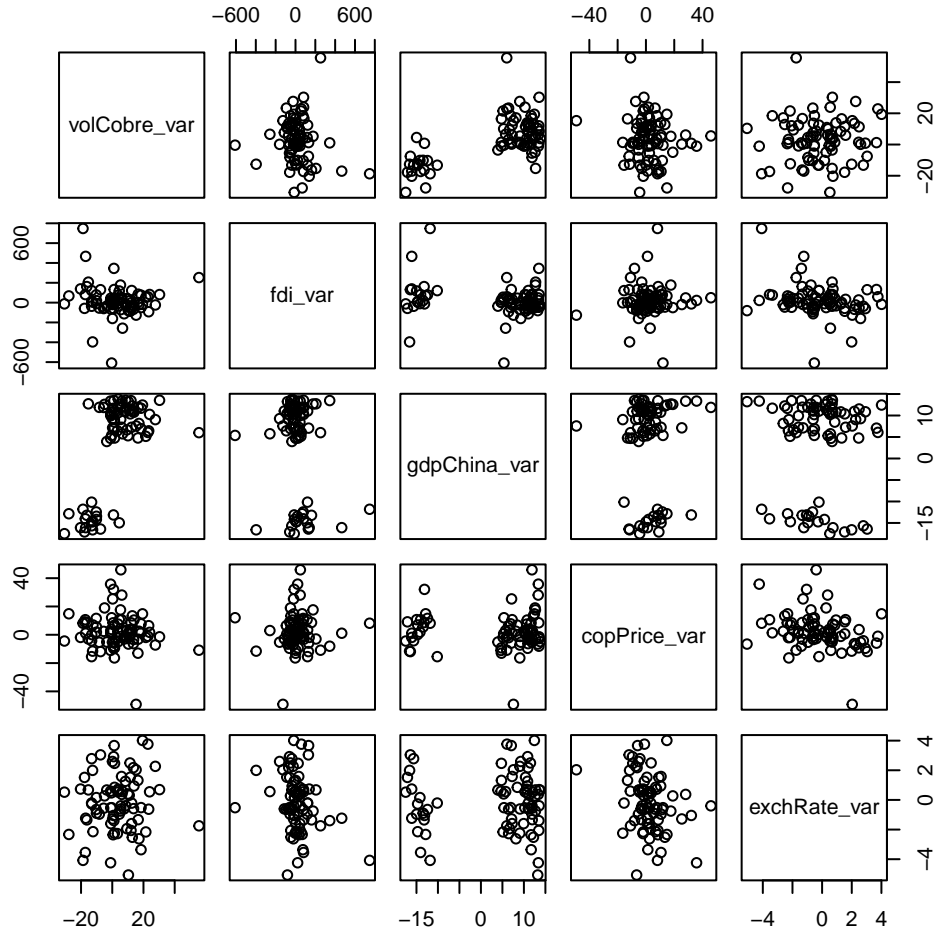
Econometric Analysis

This report aims to test the violation of the assumptions of OLS. Further information of each of the test and the theory behind was explained in a meeting.

OLS Regression

term	estimate	std.error	statistic	p.value
(Intercept)	0.2473819	1.3595513	0.1819585	0.8561128
fdi_var	0.0016835	0.0083641	0.2012782	0.8410333
gdpChina_var	0.8508594	0.1184402	7.1838735	0.0000000
copPrice_var	-0.1265571	0.1037649	-1.2196527	0.2264696

| term	estimate	std.error	statistic	p.value
exchRate_var	0.2456261	0.7095708	0.3461615	0.7302036

Multicolinearity

Variance Inflation Factor (VIF) was used. No variable has more than 5 in VIF index, so there is no problem of multicolinearity.

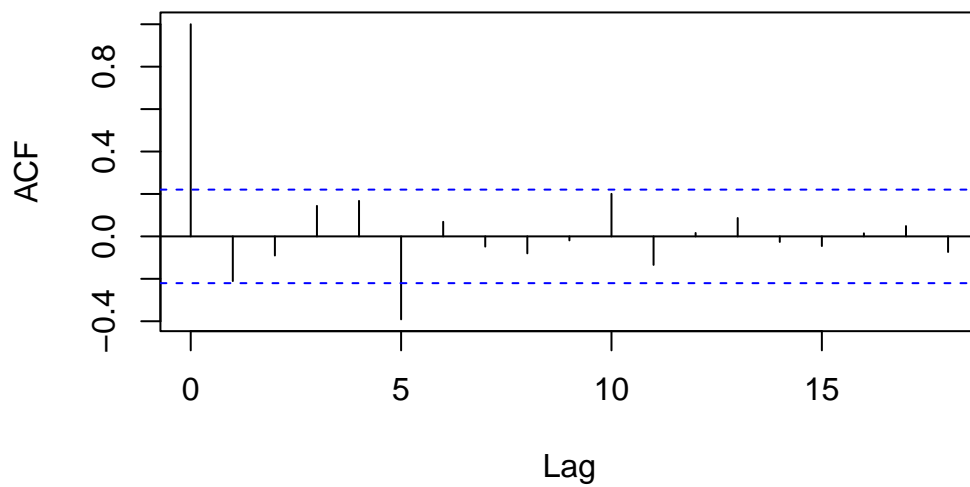|	x
fdi_var	1.102454
gdpChina_var	1.034474
copPrice_var	1.094601
exchRate_var	1.163692

Autocorrelation

The Durbin Watson test was asked to be used to determine if there was an AR(1) case. However, it could had been used other tests and other codes to determine the level of ARIMA. This topic would not be explained in this report.
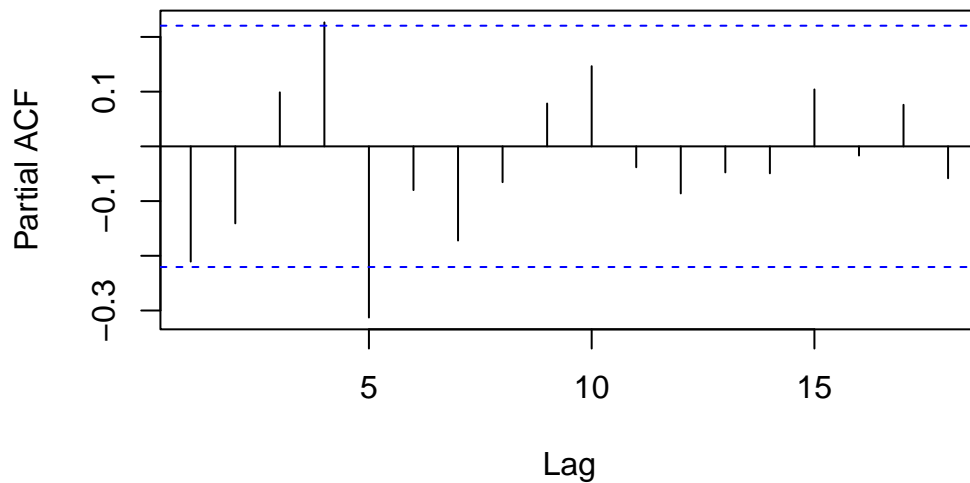
Residuals of the Regression
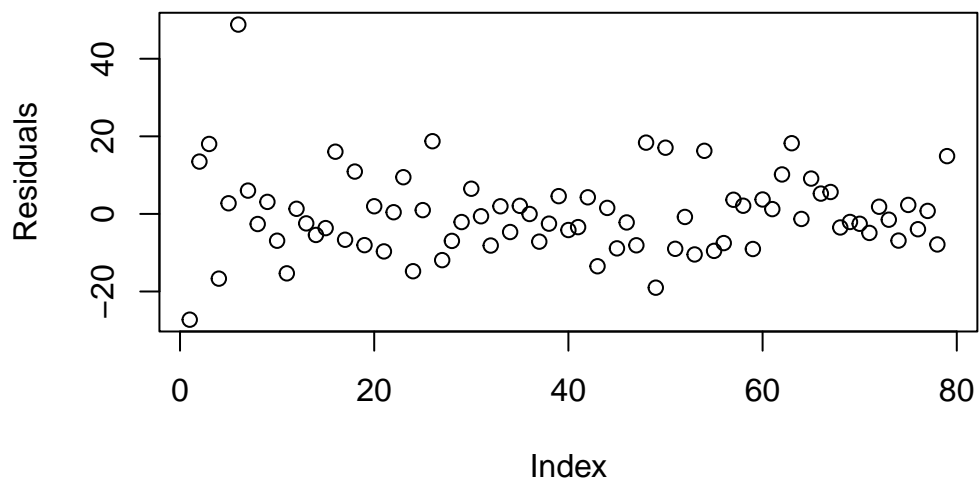
ACF

PACF

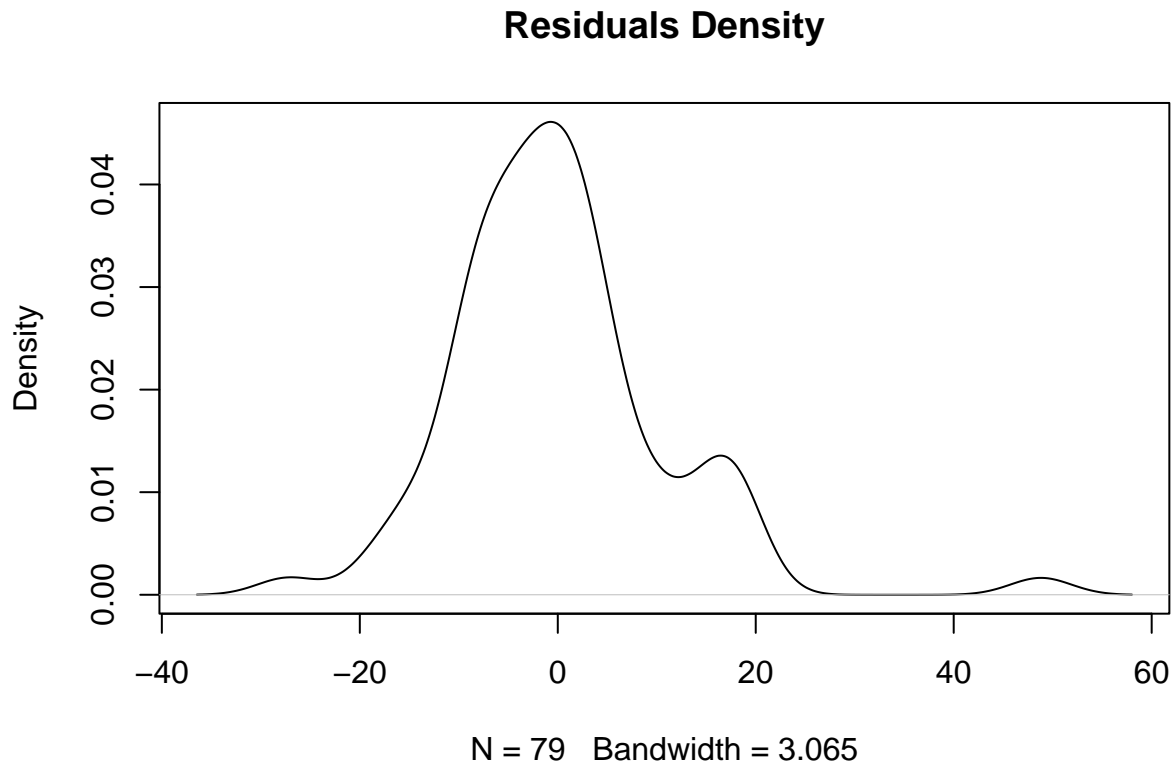

```
##
##   Durbin-Watson test
##
## data:  m1
## DW = 2.3143, p-value = 0.9208
## alternative hypothesis: true autocorrelation is greater than 0
```

Normality

Jarque Bera Test was asked to be used.

```
##
##  Jarque Bera Test
##
## data:  residuals(m1)
## X-squared = 77.056, df = 2, p-value < 0.00000000000000022
```

Residuals Density

N = 79   Bandwidth = 3.065

Heteroskedasticity

The Ho of Glejser test affirms that there is Homocedasticity. The test rejects the Ho.

statistic	p.value	parameter	alternative
9.748901	0.0448766	4	greater

Inestability

Two test were run, Chow test and Cusum test. Both demonstrates that there is no structural change.

```
##
```

```
##  M-fluctuation test
##
## data:  m2
## f(efp) = 1.002, p-value = 0.7896
```

Recursive CUSUM test