Untitled

tata iles

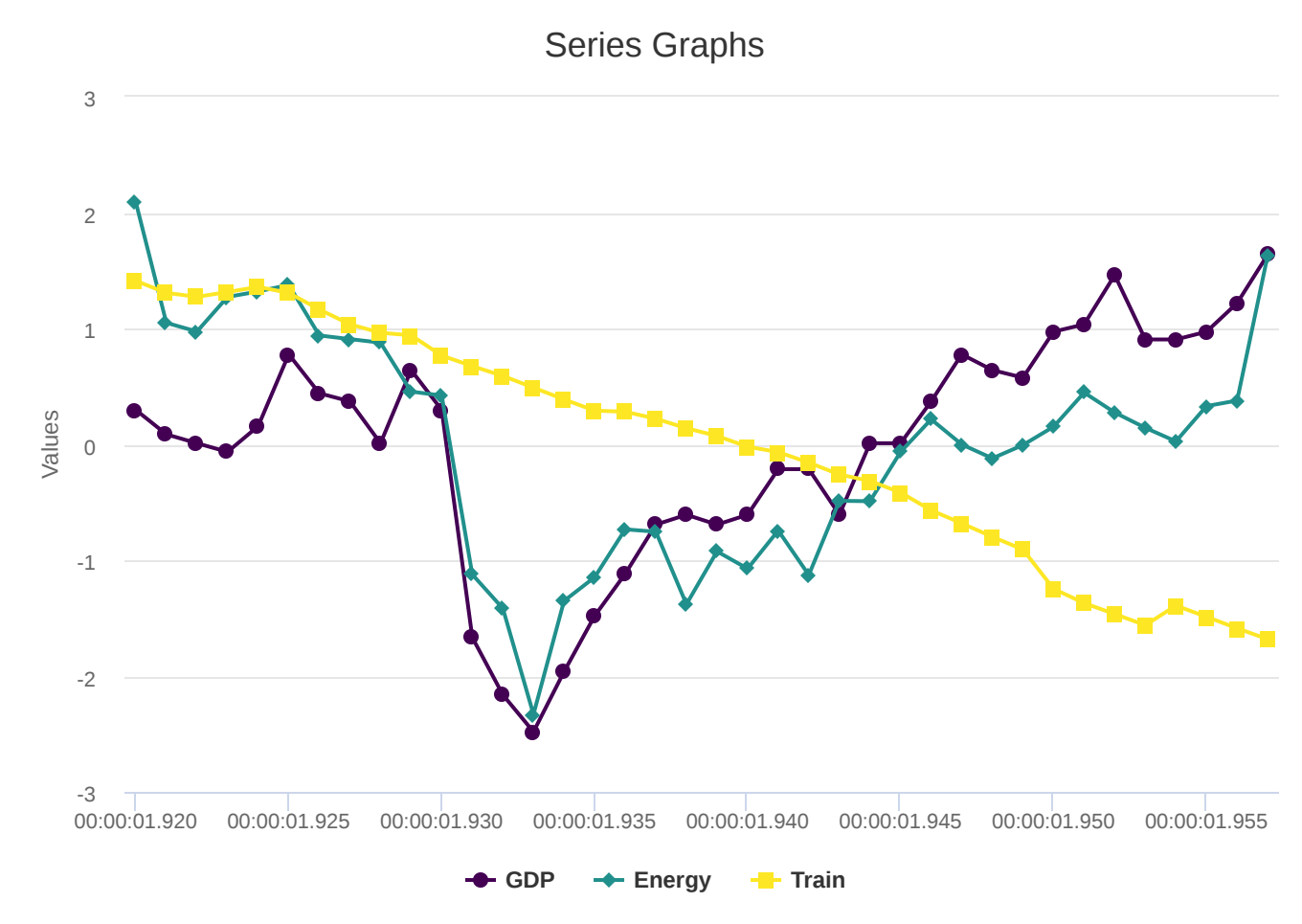
2023-11-20

Data Overview

DATA

year	gdp	energy	train	crisis29
1920	7.774015	-0.4400503	0.3762355	0
1921	7.741534	-0.8229508	0.3547919	0
1922	7.729735	-0.8505724	0.3476756	0
1923	7.718241	-0.7407919	0.3562757	0
1924	7.752335	-0.7235725	0.3655147	0
1925	7.847762	-0.7026208	0.3546624	0

Series Visualization



Modeling

Causality test

No causality effects from the dependent variable

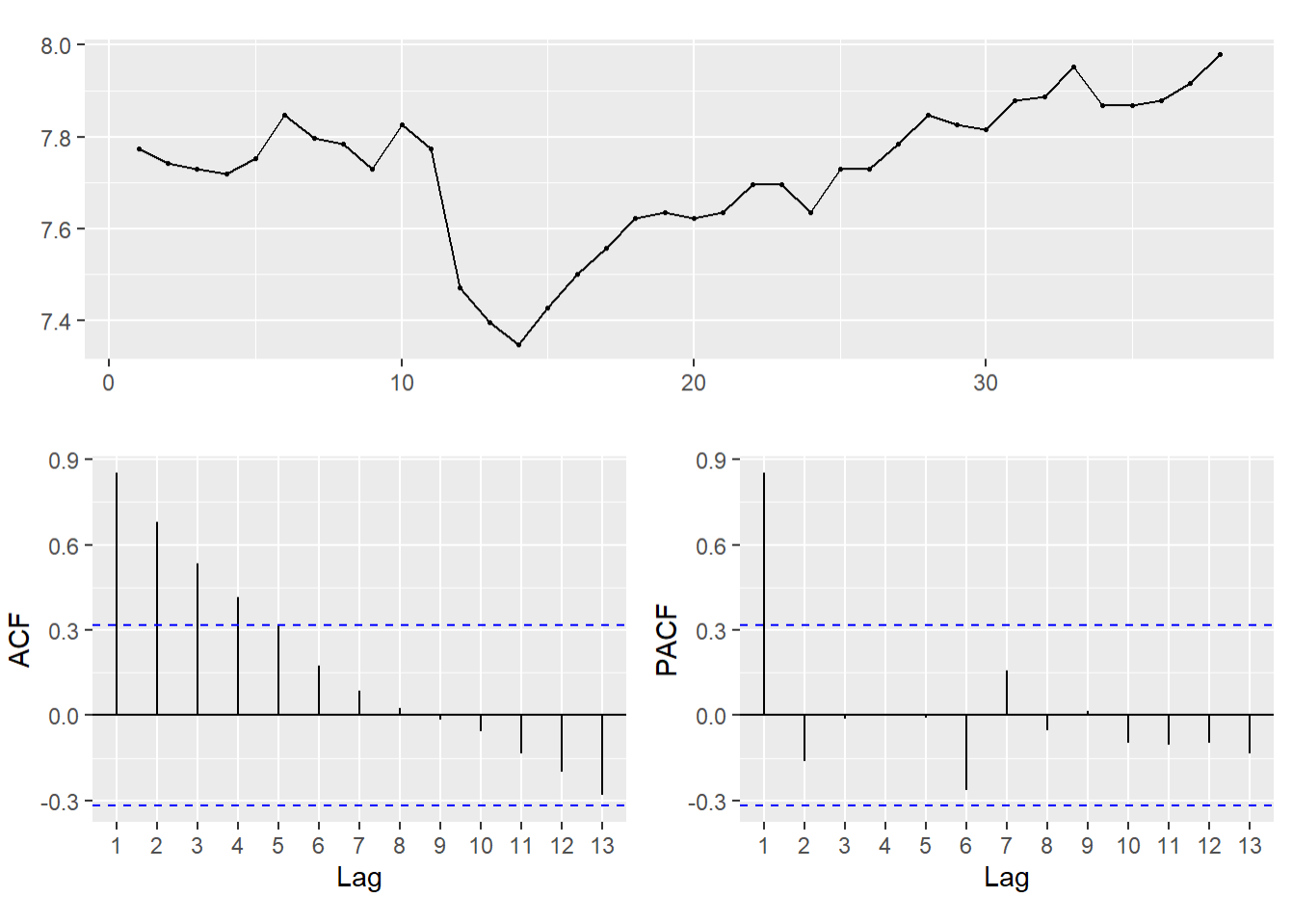
```
## Does gdp cause energy
##
```

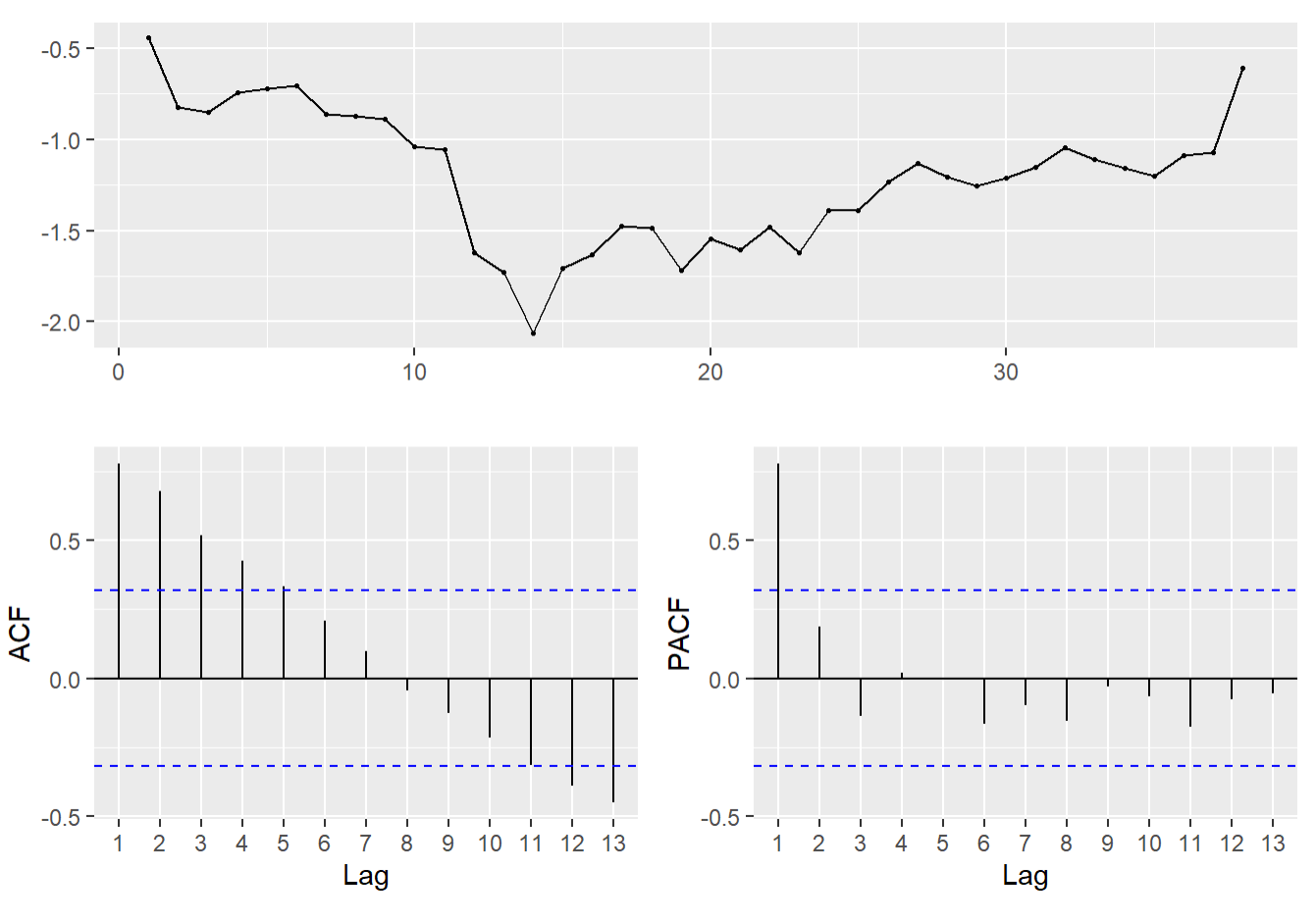
```
## Granger causality test
##
## Model 1: data$energy ~ Lags(data$energy, 1:1) + Lags(data$gdp, 1:1)
## Model 2: data$energy ~ Lags(data$energy, 1:1)
##   Res.Df Df      F  Pr(>F)
## 1     34
## 2     35 -1 3.096 0.08748 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

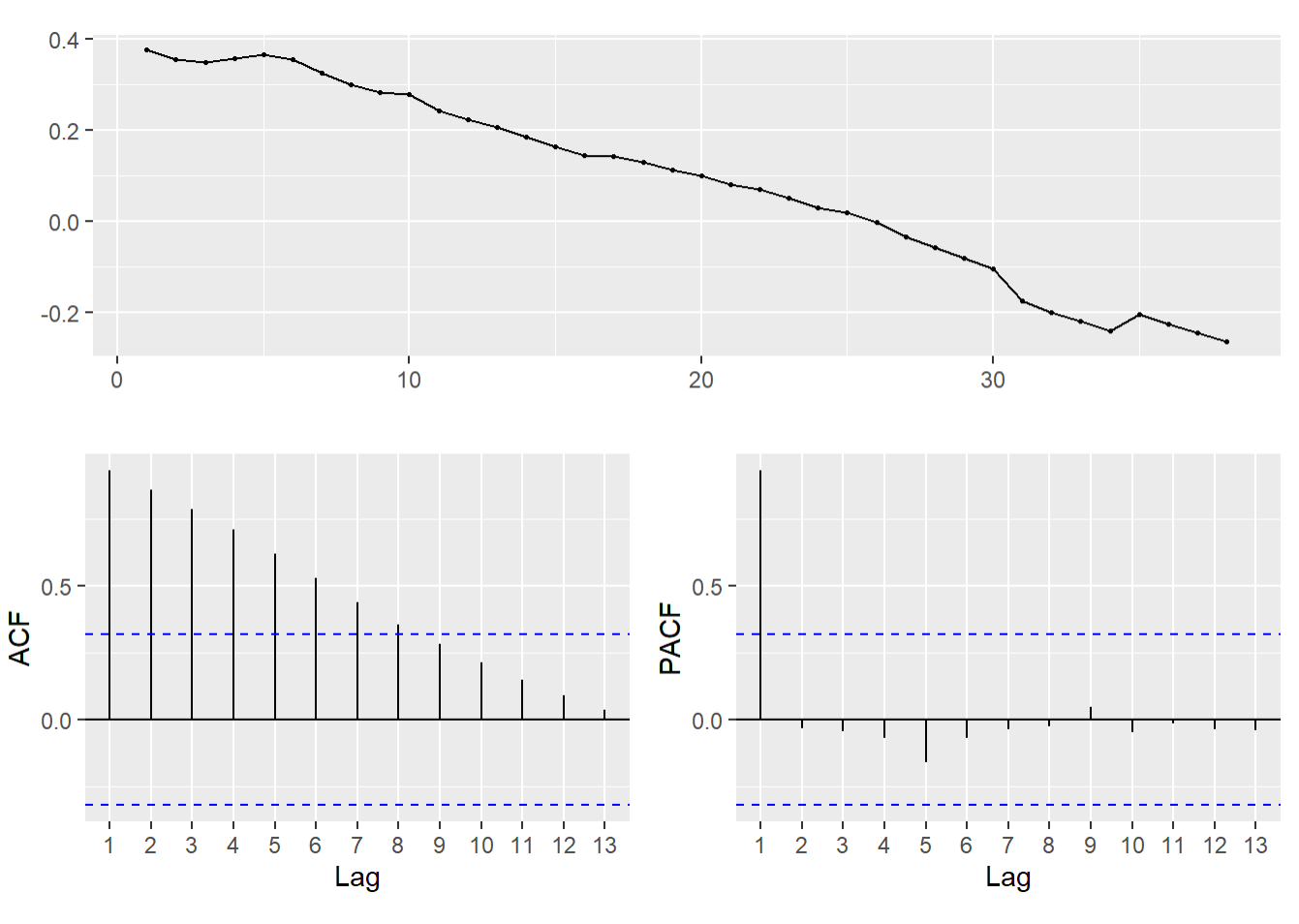
```
## -----------------------------------------------------
## Does gdp cause train
```

```
## Granger causality test
##
## Model 1: data$train ~ Lags(data$train, 1:1) + Lags(data$gdp, 1:1)
## Model 2: data$train ~ Lags(data$train, 1:1)
##   Res.Df Df       F Pr(>F)
## 1     34
## 2     35 -1 0.1055 0.7473
```

Stationarity tests








```
## $gdp
##
##  Phillips-Perron Unit Root Test
##
## data:  newX[, i]
## Dickey-Fuller Z(alpha) = -6.0832, Truncation lag parameter = 3, p-value
## = 0.7464
## alternative hypothesis: stationary
##
##
## $energy
##
##  Phillips-Perron Unit Root Test
##
## data:  newX[, i]
## Dickey-Fuller Z(alpha) = -4.3709, Truncation lag parameter = 3, p-value
## = 0.856
## alternative hypothesis: stationary
##
##
## $train
##
##  Phillips-Perron Unit Root Test
##
## data:  newX[, i]
## Dickey-Fuller Z(alpha) = -8.5679, Truncation lag parameter = 3, p-value
## = 0.5872
## alternative hypothesis: stationary
```

Stationarity Results

Serie	pp test
gdp	I(1)
energy	I(1)
train	I(1)

Select ARDL Order

```
## $best_model
##
## Time series regression with "ts" data:
## Start = 1923, End = 1957
##
## Call:
## dynlm::dynlm(formula = full_formula, data = data, start = start,
##     end = end)
##
## Coefficients:
##  (Intercept)     L(gdp, 1)     L(gdp, 2)        energy  L(energy, 1)
##      4.92155      -0.03991       0.43875       0.09585       0.21966
## L(energy, 2)  L(energy, 3)         train   L(train, 1)      crisis29
##      0.04908      -0.16418      -0.72860       0.51991      -0.22304
##
##
## $best_order
##    gdp energy  train
##      2      3      1
##
## $top_orders
##    gdp energy train       AIC
## 1    2      3     1 -129.1314
## 2    2      3     0 -128.7007
## 3    2      3     2 -127.7867
## 4    3      3     1 -127.1314
## 5    3      3     0 -126.7437
## 6    2      3     3 -126.2347
## 7    3      3     2 -125.8261
## 8    1      0     0 -124.6062
## 9    1      1     0 -124.4190
## 10   3      3     3 -124.2902
## 11   1      3     0 -122.8175
## 12   1      0     1 -122.6120
## 13   1      1     1 -122.4419
## 14   2      4     1 -122.3465
## 15   2      4     0 -121.7400
## 16   2      3     4 -121.6378
## 17   2      5     5 -121.4070
## 18   1      3     1 -121.0964
## 19   2      4     2 -120.9922
## 20   1      2     0 -120.7206
```

Best Model

```
##
## Time series regression with "ts" data:
## Start = 1923, End = 1957
##
## Call:
## dynlm::dynlm(formula = full_formula, data = data, start = start,
##     end = end)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.061712 -0.020231  0.003541  0.018827  0.049467
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   4.92155    1.23864   3.973 0.000531 ***
## L(gdp, 1)    -0.03991    0.14716  -0.271 0.788457
## L(gdp, 2)     0.43875    0.15228   2.881 0.008019 **
## energy        0.09585    0.04123   2.325 0.028503 *
## L(energy, 1)  0.21966    0.06077   3.615 0.001323 **
## L(energy, 2)  0.04908    0.06241   0.786 0.439025
## L(energy, 3) -0.16418    0.04085  -4.019 0.000471 ***
## train        -0.72860    0.38632  -1.886 0.070965 .
## L(train, 1)   0.51991    0.38775   1.341 0.192025
## crisis29     -0.22304    0.03786  -5.892 3.79e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03305 on 25 degrees of freedom
## Multiple R-squared:  0.9687, Adjusted R-squared:  0.9575
## F-statistic: 86.01 on 9 and 25 DF,  p-value: < 2.2e-16
```

Validation tests

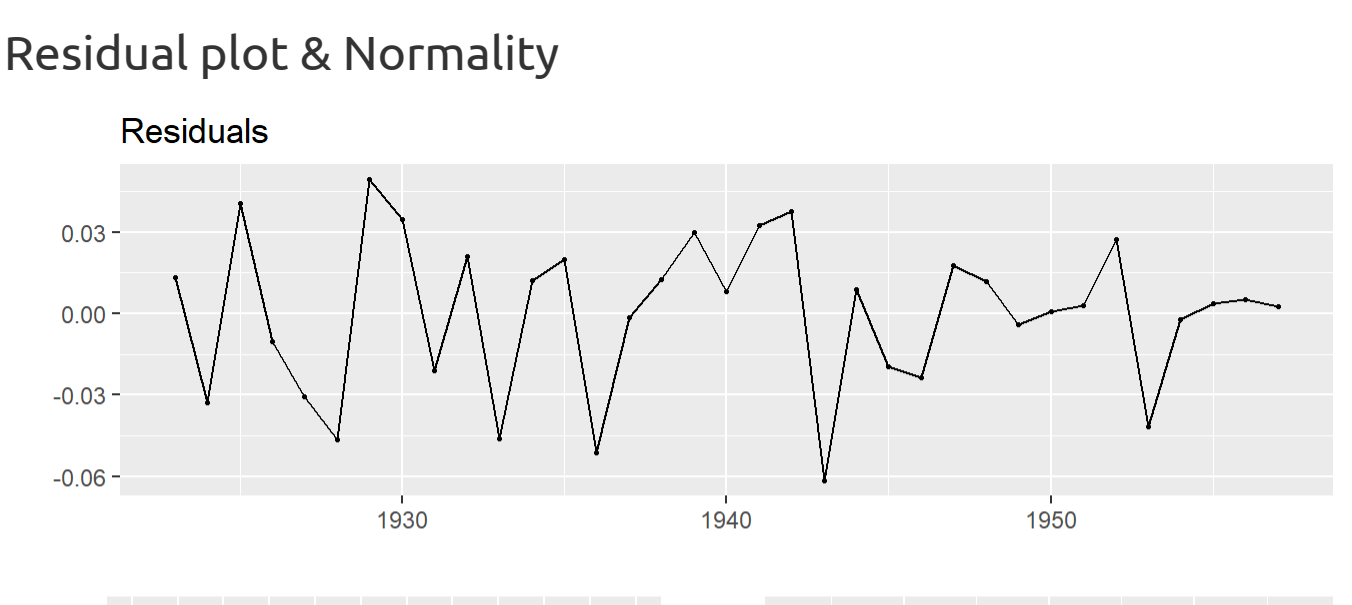
Autocorrelation & Heteroscedasticity

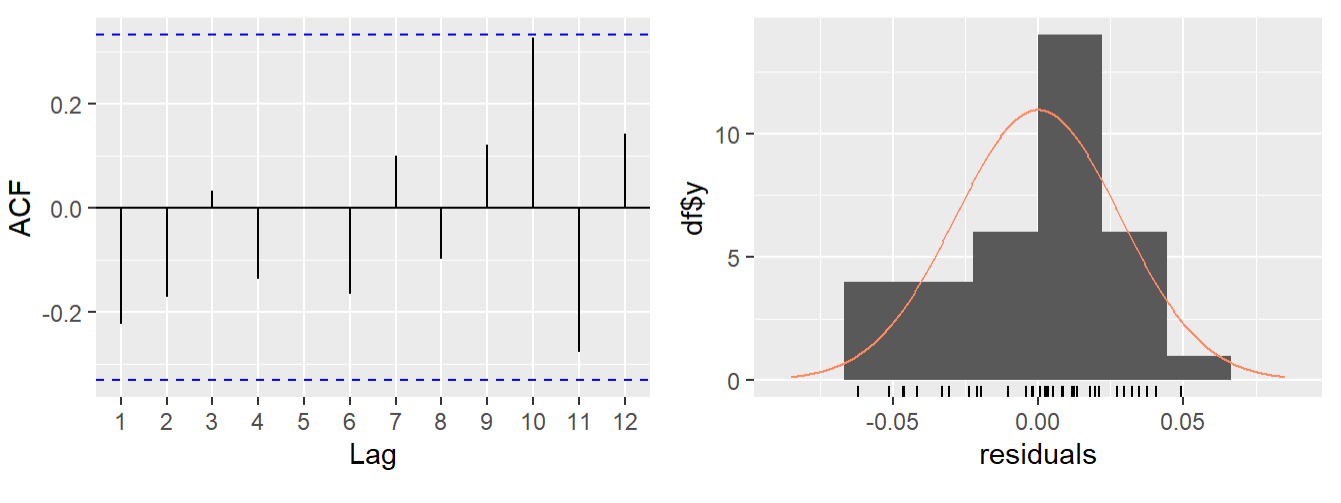
Residuals are not autocorrelated and are homoscedastic

```
##
##  Breusch-Godfrey test for serial correlation of order up to 1
##
## data:  ardl_model
## LM test = 3.5892, df = 1, p-value = 0.05816
##
##
##  Breusch-Godfrey test for serial correlation of order up to 2
##
## data:  ardl_model
## LM test = 5.8404, df = 2, p-value = 0.05392
```

```
##
##  studentized Breusch-Pagan test
##
## data:  ardl_model
## BP = 8.6995, df = 9, p-value = 0.4655
```

Residual plot & Normality






```
##
##  Breusch-Godfrey test for serial correlation of order up to 13
##
## data:  Residuals
## LM test = 18.423, df = 13, p-value = 0.1421
```

Model Stability

Short term

Model is stable

```
##
##  RESET test
##
## data:  ardl_model
## RESET = 0.1795, df1 = 1, df2 = 24, p-value = 0.6756
##
##
##  RESET test
##
## data:  ardl_model
## RESET = 0.40267, df1 = 2, df2 = 23, p-value = 0.6732
```

Long term

Model is stable

```
##
##  Bounds F-test (Wald) for no cointegration
##
## data:  d(gdp) ~ L(gdp, 1) + L(energy, 1) + L(train, 1) + d(L(gdp, 1)) +     d(energy) + d(L(energy, 1)) + d(L
(energy, 2)) + d(train) +     crisis29
## F = 7.7487, p-value = 0.00848
## alternative hypothesis: Possible cointegration
## null values:
##  k  T
##  2 35
```

Final Equation

Short term

```
##          Term   Estimate Std. Error    t value     Pr(>|t|)
## 1 (Intercept)  8.1867729 0.04185323 195.606710 2.425884e-41
## 2      energy  0.3333774 0.03319706  10.042377 2.943907e-10
## 3       train -0.3471395 0.06238132  -5.564799 8.710727e-06
```

Long term

```
##
## Time series regression with "zooreg" data:
## Start = 1923, End = 1957
##
## Call:
## dynlm::dynlm(formula = full_formula, data = data, start = start,
##     end = end)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.061712 -0.020231  0.003541  0.018827  0.049467
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      4.92155    0.97822   5.031 2.80e-05 ***
## d(L(gdp, 1))    -0.43875    0.13300  -3.299 0.002728 **
## d(energy)        0.09585    0.03790   2.529 0.017577 *
## d(L(energy, 1))  0.11510    0.04835   2.381 0.024605 *
## d(L(energy, 2))  0.16418    0.03782   4.340 0.000179 ***
## d(train)        -0.72860    0.36744  -1.983 0.057638 .
## crisis29        -0.22304    0.03592  -6.210 1.22e-06 ***
## ect             -0.60116    0.11998  -5.011 2.96e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0318 on 27 degrees of freedom
##   (0 observations deleted due to missingness)
## Multiple R-squared:  0.8569, Adjusted R-squared:  0.8198
## F-statistic:  23.1 on 7 and 27 DF,  p-value: 7.598e-10
```