Demand function

tata iles - saidani akram - aissaoui younes

2023-10-24

Abstract

This project provides a synthesis of the findings from estimating a money demand function within the context of a multivariate system in the case of Algeria for the years 2002 to 2020. The research paper from which this work is based focused on the Eurozone however, we adapt its methods and concepts to the Algerian context.

Data

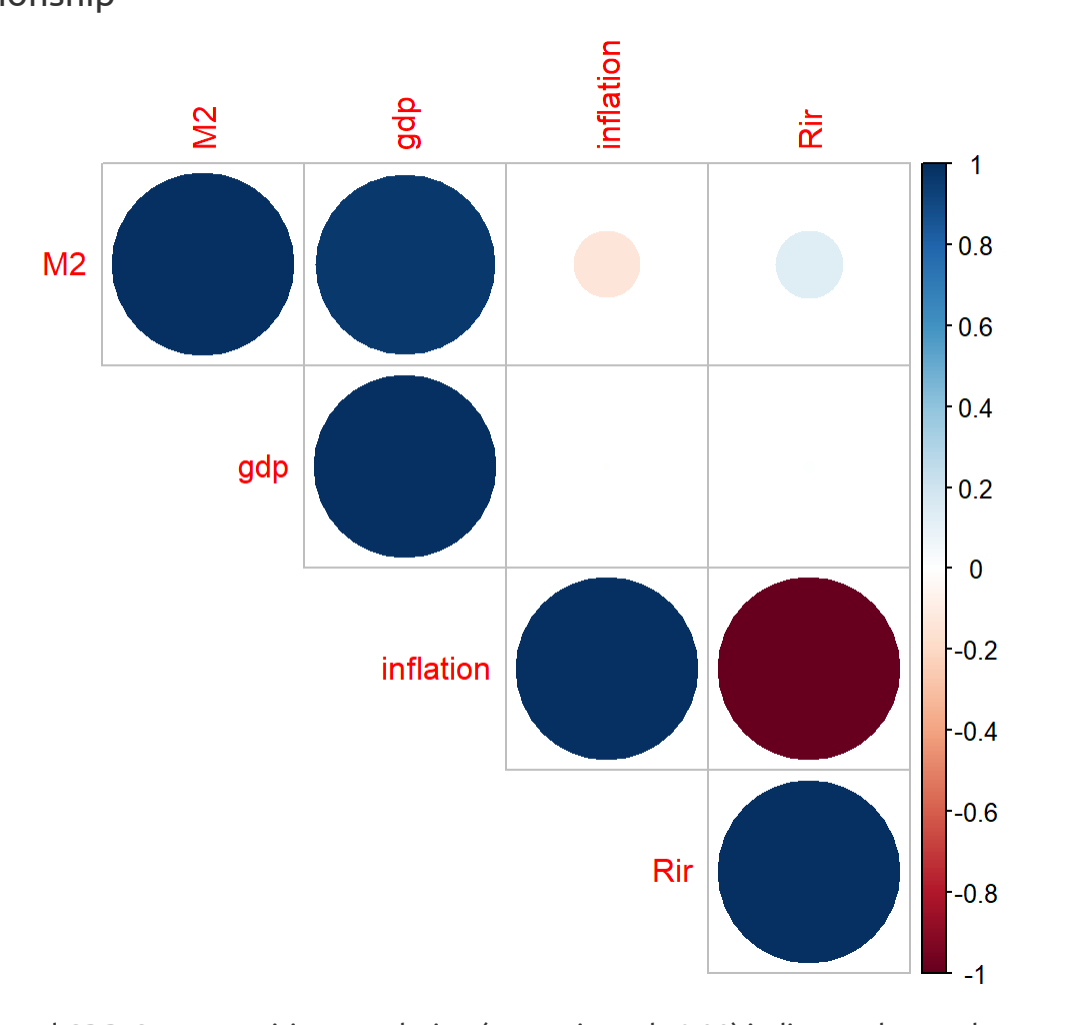
Let's take a closer look at the data:

DATA

Year	M2	GDP	Inflation	Real_Interest_Rate
2002	38101307509	4.522773e+12	1.320428	7.1682540
2003	42499881174	5.252321e+12	8.330734	-0.1899125
2004	45152762411	6.149117e+12	12.247630	-3.7841620
2005	49745056833	7.561984e+12	16.125350	-6.9970510
2006	58172694857	8.501636e+12	10.546700	-2.3037360
2007	69064333111	9.352886e+12	6.395337	1.5082080

Correlation Analysis

linear relationship



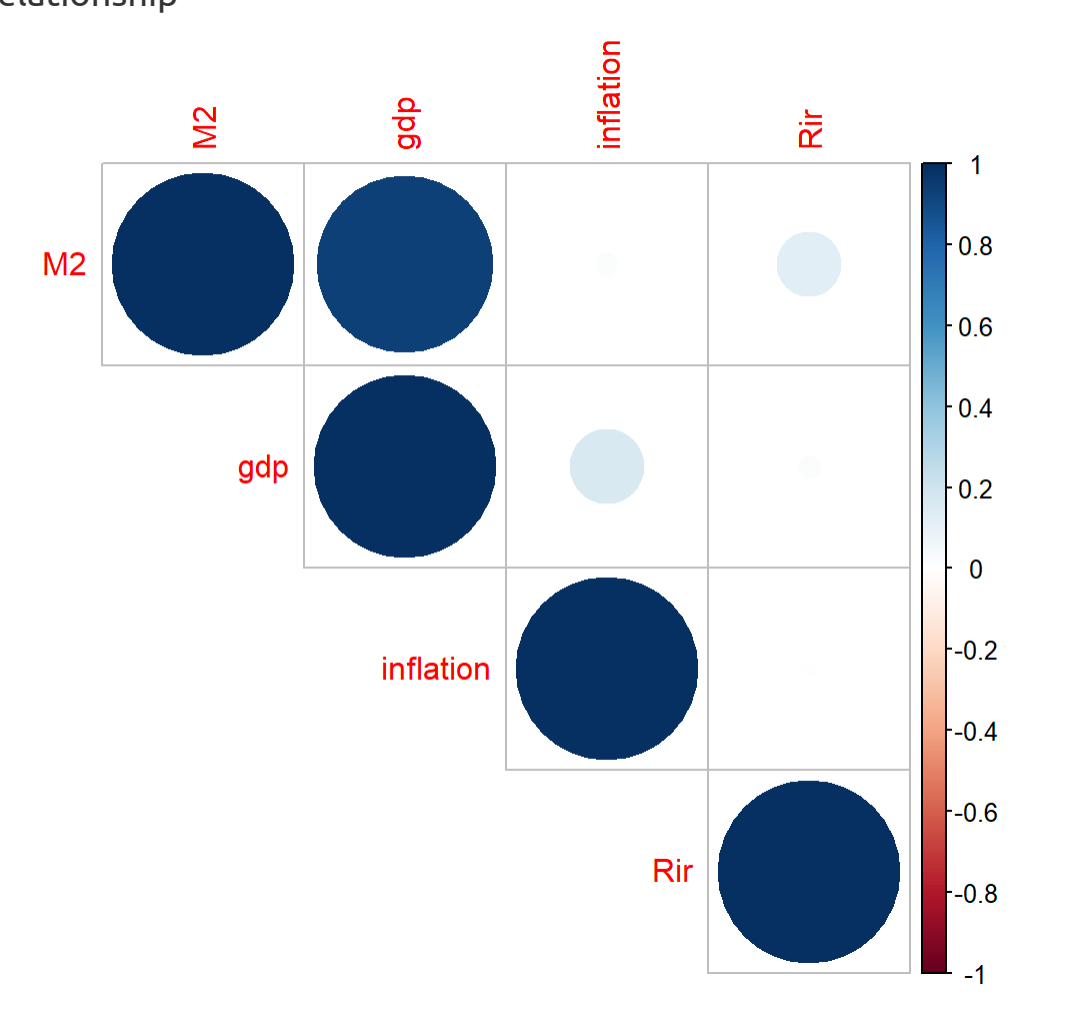
Comment : M2 and GDP: Strong positive correlation (approximately 0.98) indicates that as the money supply (M2) increases, so does the Gross Domestic Product (GDP) in Algeria during the specified period.

M2 and Inflation: Negative correlation (approximately -0.39) suggests that as the money supply (M2) goes up, inflation tends to decrease.

GDP and Inflation: Negative correlation (approximately -0.33) implies that as the GDP in Algeria increases, inflation rates tend to decrease.

Inflation and Interest Rate: Strong negative correlation (approximately -1.00) indicates that when inflation rates rise, interest rates tend to decrease

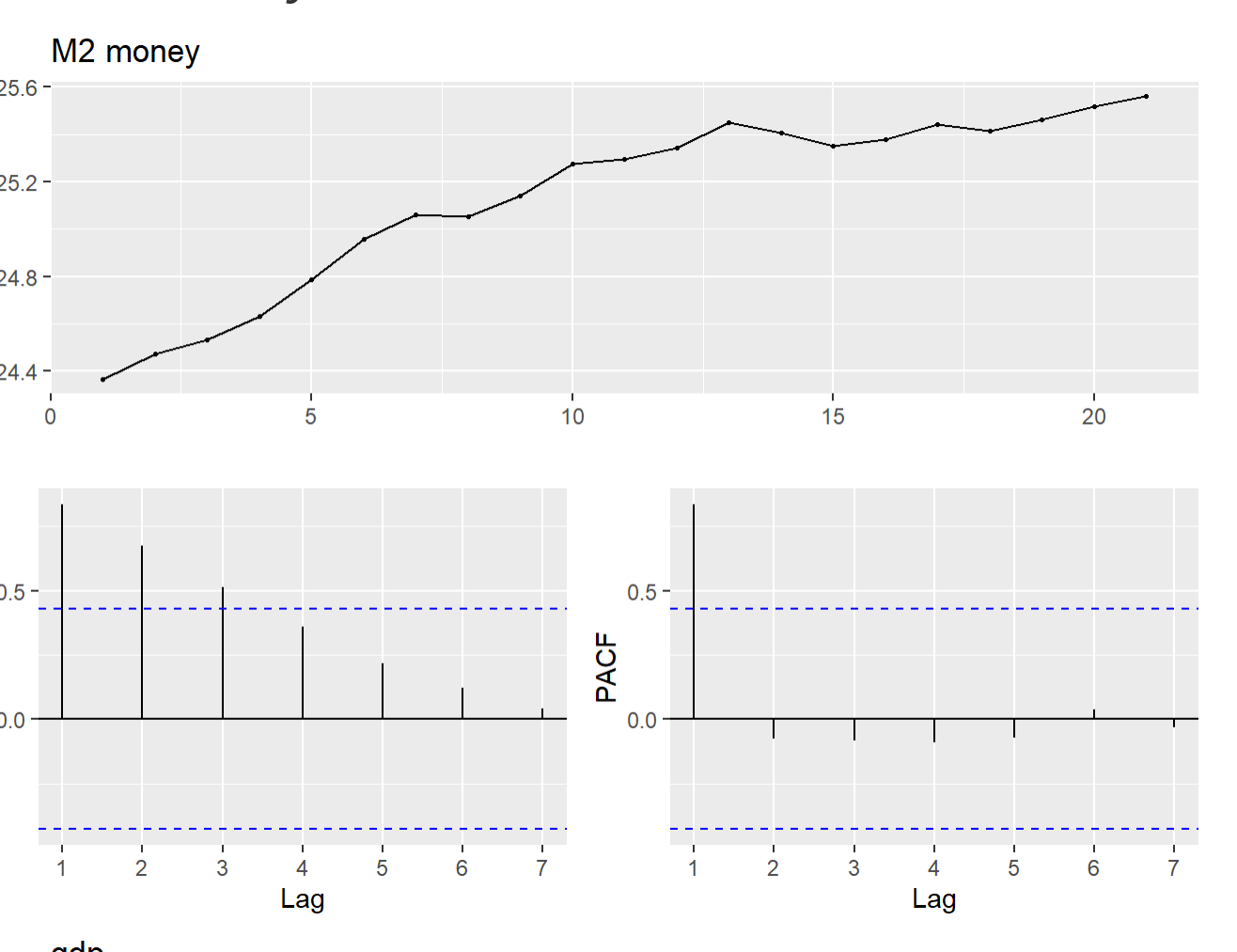
nonlinear relationship

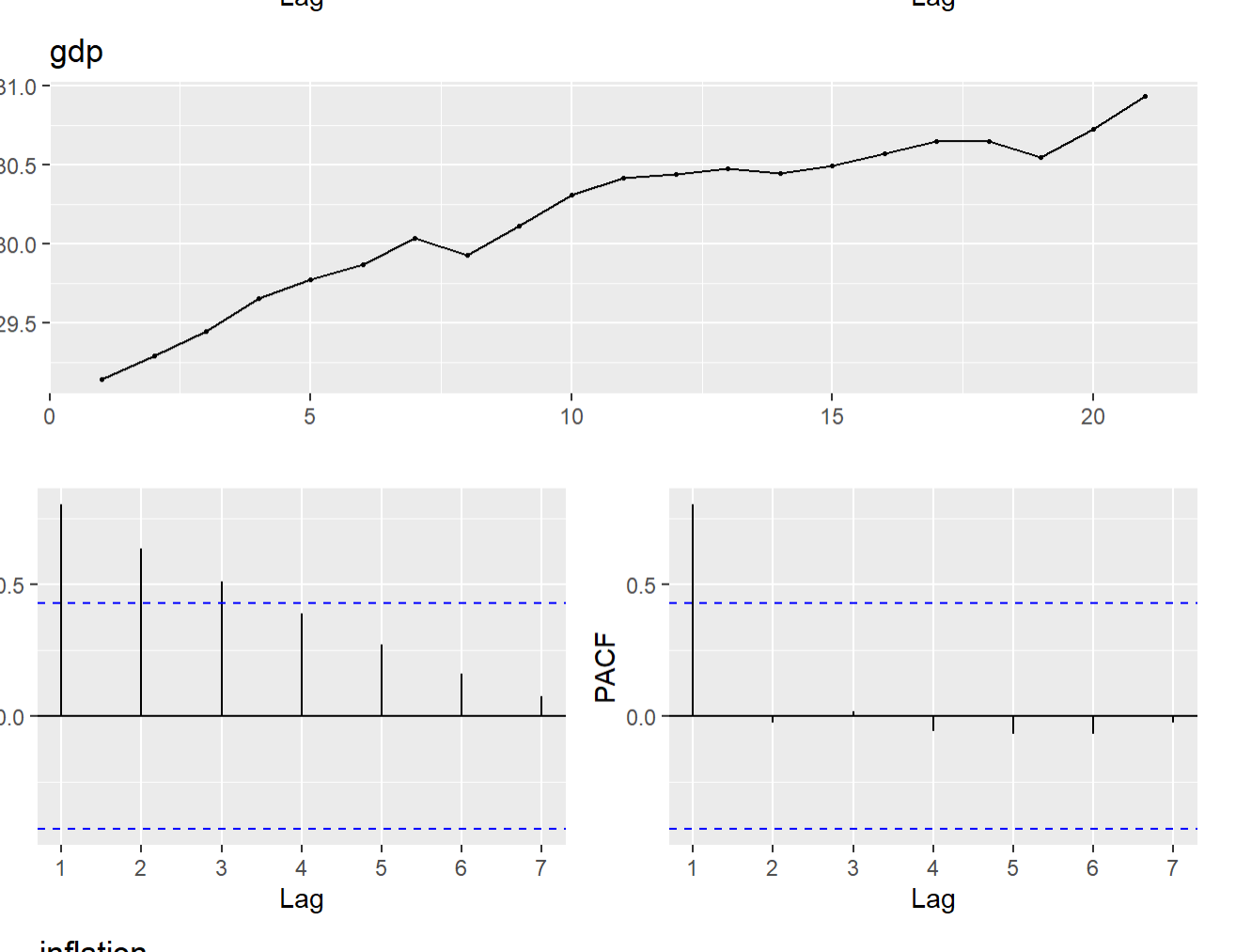


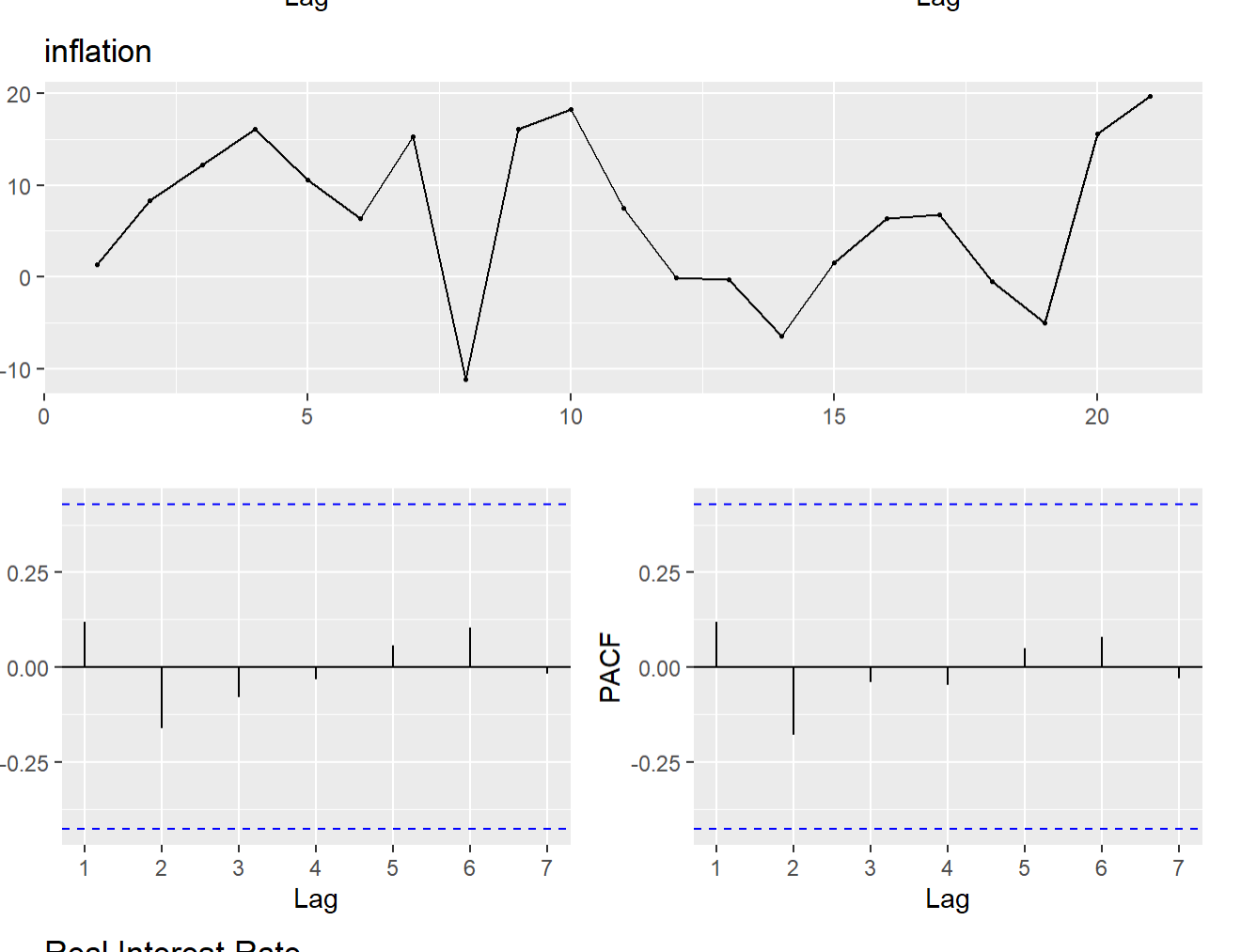
Summary Statistics

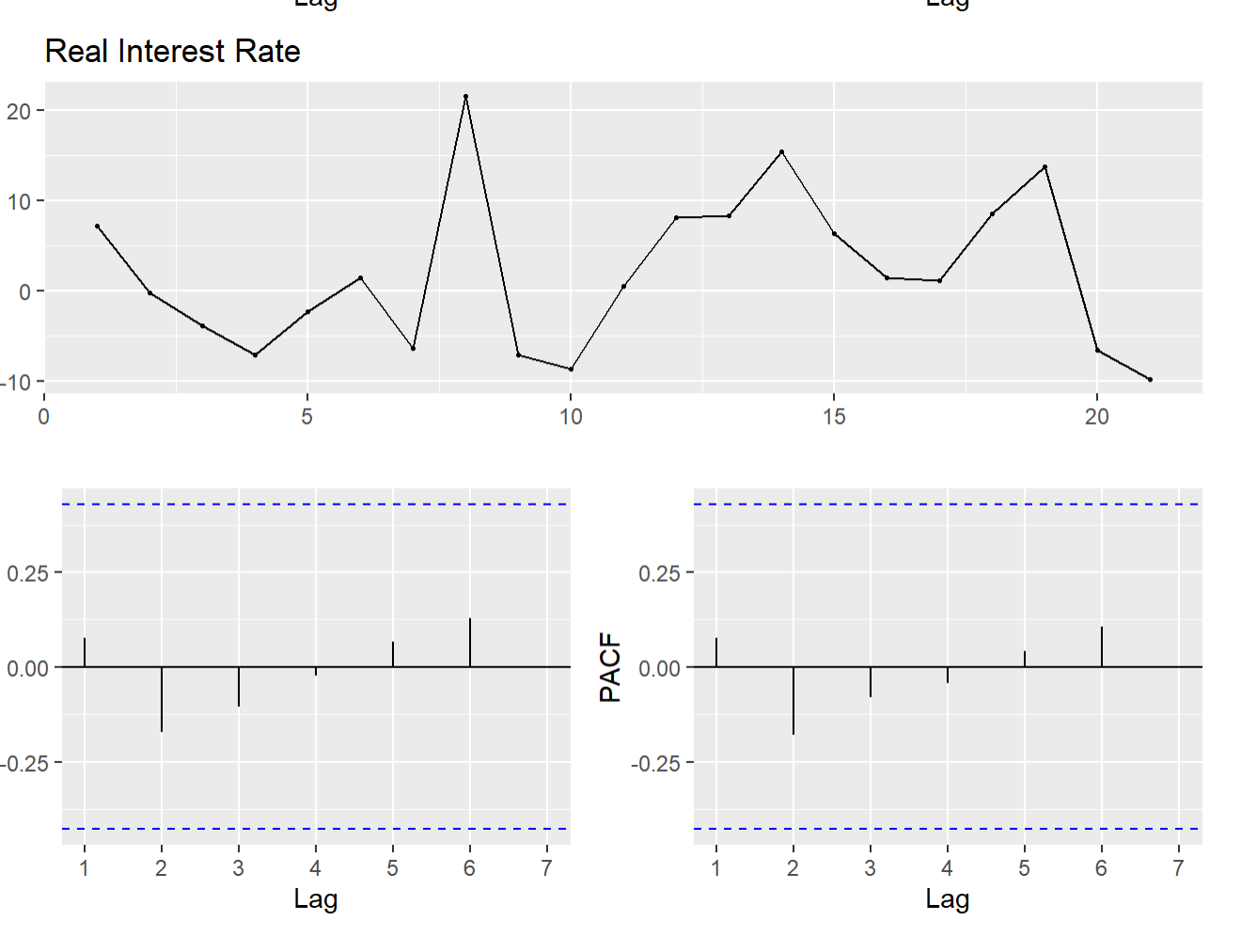
Variable	gdp	inflation	M2	Rir
Jarque	5.840000e-01	0.909	1.918000e+00	1.228
Kurtosis	2.197000e+00	2.136	1.899000e+00	2.487
Max	2.725067e+13	19.711	1.263923e+11	21.569
Mean	1.432489e+13	6.598	8.774456e+10	2.014
Median	1.620960e+13	6.757	9.677854e+10	1.164
Min	4.522773e+12	-11.162	3.810131e+10	-9.783
Skewness	7.600000e-02	-0.270	-4.950000e-01	0.534
std	6.157295e+12	8.698	2.786799e+10	8.612

Time Series Analysis









Stationarity Tests

pp test

```
## $M2
##
##  Phillips-Perron Unit Root Test
##
## data:  newX[, i]
## Dickey-Fuller Z(alpha) = -2.3468, Truncation lag parameter = 2, p-value
## = 0.9542
## alternative hypothesis: stationary
##
##
## $gdp
##
##  Phillips-Perron Unit Root Test
##
## data:  newX[, i]
## Dickey-Fuller Z(alpha) = -5.6079, Truncation lag parameter = 2, p-value
## = 0.7695
## alternative hypothesis: stationary
##
##
## $inflation
##
##  Phillips-Perron Unit Root Test
##
## data:  newX[, i]
## Dickey-Fuller Z(alpha) = -16.903, Truncation lag parameter = 2, p-value
## = 0.07167
## alternative hypothesis: stationary
##
##
## $Rir
##
##  Phillips-Perron Unit Root Test
##
## data:  newX[, i]
## Dickey-Fuller Z(alpha) = -17.676, Truncation lag parameter = 2, p-value
## = 0.05488
## alternative hypothesis: stationary
```

kpss test

```
## $M2
##
##  KPSS Test for Level Stationarity
##
## data:  newX[, i]
## KPSS Level = 0.73032, Truncation lag parameter = 2, p-value = 0.01079
##
##
## $gdp
##
##  KPSS Test for Level Stationarity
##
## data:  newX[, i]
## KPSS Level = 0.7746, Truncation lag parameter = 2, p-value = 0.01
##
##
## $inflation
##
##  KPSS Test for Level Stationarity
##
## data:  newX[, i]
## KPSS Level = 0.13762, Truncation lag parameter = 2, p-value = 0.1
##
##
## $Rir
##
##  KPSS Test for Level Stationarity
##
## data:  newX[, i]
## KPSS Level = 0.13718, Truncation lag parameter = 2, p-value = 0.1
```

Comment : `M2` : The KPSS Test for Level Stationarity indicates a KPSS Level of 0.69525 and a p-value of 0.01398. The p-value is below the typical significance level of 0.05, suggesting that M2 is not level stationary.

`GDP` : reveals a KPSS Level of 0.71113 and a p-value of 0.01253. The p-value is less than the 0.05 significance level, implying that GDP is not level stationary.

`Inflation` : shows a KPSS Level of 0.36082 and a p-value of 0.09405. The p-value is above the 0.05 threshold, indicating that Inflation is likely level stationary.

`Interest Rate` : reports a KPSS Level of 0.34339 and a p-value of 0.1. The p-value exceeds the 0.05 threshold, implying that Interest Rate is likely level stationary.

results in the table :

Serie	pp test	kpss test
M2	I(1)	I(1)
gdp	I(1)	I(1)
inflation	I(1)	I(0)
Rir	I(1)	I(0)

Modeling

VECM (lag order)

```
## AIC(n)  HQ(n)  SC(n) FPE(n)
##      3      3      3      4
```

Johanson cointegration test

```
##
## ######################
## # Johansen-Procedure #
## ######################
##
## Test type: trace statistic , without linear trend and constant in cointegration
##
## Eigenvalues (lambda):
## [1]  7.785481e-01  5.580526e-01  3.894117e-01  2.400304e-01 -2.531308e-14
##
## Values of teststatistic and critical values of test:
##
##           test 10pct  5pct  1pct
## r <= 3 |  5.22  7.52  9.24 12.97
## r <= 2 | 14.59 17.85 19.96 24.60
## r <= 1 | 30.10 32.00 34.91 41.07
## r = 0  | 58.75 49.65 53.12 60.16
##
## Eigenvectors, normalised to first column:
## (These are the cointegration relations)
##
##                     ts.df.M2..l2 ts.df.gdp..l2 ts.df.inflation..l2
## ts.df.M2..l2          1.00000000    1.00000000           1.0000000
## ts.df.gdp..l2        -0.72842655   -1.02839150          -0.9036115
## ts.df.inflation..l2  -0.08290995    0.01817141          -0.1409932
## ts.df.Rir..l2        -0.09703803   -0.09909136          -0.1508293
## constant             -2.37523697    6.97181264           3.5537647
##                     ts.df.Rir..l2    constant
## ts.df.M2..l2           1.00000000  1.00000000
## ts.df.gdp..l2         -0.74598869 -1.02571995
## ts.df.inflation..l2    0.02614693 -0.04682223
## ts.df.Rir..l2          0.02096265 -0.06413402
## constant              -2.79395831  6.36321121
##
## Weights W:
## (This is the loading matrix)
##
##                    ts.df.M2..l2 ts.df.gdp..l2 ts.df.inflation..l2 ts.df.Rir..l2
## ts.df.M2..d          -0.9390886    0.09834172          0.03813141    -0.1469773
## ts.df.gdp..d         -1.4089662    0.09557980          0.22999176     0.5148924
## ts.df.inflation..d -143.9455458    1.47330354         25.80158536    40.1490136
## ts.df.Rir..d        148.9605810   -1.20848211        -22.21614538   -43.1893765
##                         constant
## ts.df.M2..d         1.122539e-12
## ts.df.gdp..d       -2.951615e-12
## ts.df.inflation..d -3.661458e-10
## ts.df.Rir..d        4.008478e-10
```

VECM estimation

```
## #############
## ###Model VECM
## #############
## Full sample size: 21     End sample size: 18
## Number of variables: 4   Number of estimated slope parameters 40
## AIC -151.6426    BIC -113.3566    SSR 1934.799
## Cointegrating vector (estimated by 2OLS):
##    M2        gdp   inflation         Rir
## r1  1 -0.8255958 -0.02412713 -0.02805824
##
##
##                    ECT                   Intercept
## Equation M2        -0.0811(0.4405)       0.0011(0.0325)
## Equation gdp       0.9155(0.8326)        0.1193(0.0615).
## Equation inflation 75.6578(76.5072)      10.9606(5.6517).
## Equation Rir       -83.2334(77.3290)     -11.2427(5.7124).
##                    M2 -1                gdp -1
## Equation M2        0.2473(0.4030)      0.5242(0.7410)
## Equation gdp       0.1703(0.7616)      0.8679(1.4005)
## Equation inflation 2.5513(69.9854)     38.4844(128.6967)
## Equation Rir       2.6874(70.7373)     -48.5294(130.0793)
##                    inflation -1        Rir -1
## Equation M2        0.0134(0.0244)      0.0164(0.0251)
## Equation gdp       0.0140(0.0462)      0.0231(0.0474)
## Equation inflation 0.9141(4.2424)      2.2175(4.3587)
## Equation Rir       -1.1058(4.2880)     -2.5107(4.4055)
##                    M2 -2                 gdp -2
## Equation M2        -0.6756(0.4462)       0.5111(0.6516)
## Equation gdp       -0.9416(0.8434)       -0.7261(1.2314)
## Equation inflation -85.6132(77.4987)     -105.2321(113.1610)
## Equation Rir       96.5434(78.3312)      107.4010(114.3767)
##                    inflation -2        Rir -2
## Equation M2        0.0213(0.0217)      0.0255(0.0213)
## Equation gdp       0.0486(0.0409)      0.0464(0.0403)
## Equation inflation 4.4395(3.7624)      4.2966(3.6993)
## Equation Rir       -4.7906(3.8028)     -4.6144(3.7391)
```

ARDL Modeling

using auto ardl

```
##    M2 gdp inflation Rir        AIC
## 1   2   2         5   4       -Inf
## 2   2   2         5   3       -Inf
## 3   2   1         5   4       -Inf
## 4   3   4         3   3       -Inf
## 5   3   4         4   3       -Inf
## 6   3   4         3   4       -Inf
## 7   3   5         3   3       -Inf
## 8   4   4         4   4       -Inf
## 9   4   3         4   4       -Inf
## 10  4   4         3   4       -Inf
## 11  4   4         4   3       -Inf
## 12  5   5         5   5       -Inf
## 13  2   2         4   4 -210.36030
## 14  2   1         4   4 -153.32328
## 15  2   1         4   3 -104.92864
## 16  3   3         3   3 -103.87288
## 17  2   1         3   3  -86.29605
## 18  2   2         3   3  -84.47745
## 19  2   1         3   2  -58.38620
## 20  1   0         0   0  -58.18445
```

selecting best model

```
##        M2       gdp inflation       Rir
##         2         2         5         4
```

Validation of the model

```
##
## Time series regression with "ts" data:
## Start = 6, End = 21
##
## Call:
## dynlm::dynlm(formula = full_formula, data = data, start = start,
##     end = end)
##
## Residuals:
## ALL 16 residuals are 0: no residual degrees of freedom!
##
## Coefficients: (1 not defined because of singularities)
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)      6.5544406        NaN     NaN      NaN
## L(M2, 1)        -0.2317711        NaN     NaN      NaN
## L(M2, 2)        -0.7169764        NaN     NaN      NaN
## gdp              0.5245282        NaN     NaN      NaN
## L(gdp, 1)        0.7427232        NaN     NaN      NaN
## L(gdp, 2)        0.0896854        NaN     NaN      NaN
## inflation        0.0375906        NaN     NaN      NaN
## L(inflation, 1)  0.0184128        NaN     NaN      NaN
## L(inflation, 2)  0.0361110        NaN     NaN      NaN
## L(inflation, 3)  0.0744735        NaN     NaN      NaN
## L(inflation, 4)  0.0003900        NaN     NaN      NaN
## L(inflation, 5)  0.0009349        NaN     NaN      NaN
## Rir              0.0423231        NaN     NaN      NaN
## L(Rir, 1)        0.0291711        NaN     NaN      NaN
## L(Rir, 2)        0.0401171        NaN     NaN      NaN
## L(Rir, 3)        0.0736694        NaN     NaN      NaN
## L(Rir, 4)               NA         NA      NA       NA
##
## Residual standard error: NaN on 0 degrees of freedom
## Multiple R-squared:      1,  Adjusted R-squared:    NaN
## F-statistic:   NaN on 15 and 0 DF,  p-value: NA
```

Choosing another model manually

```
##
## Time series regression with "ts" data:
## Start = 5, End = 21
##
## Call:
## dynlm::dynlm(formula = full_formula, data = data, start = start,
##     end = end)
##
## Residuals:
##          5          6          7          8          9         10         11
## -1.549e-04 -1.622e-05  2.479e-05  8.400e-05  2.146e-04  3.259e-05 -2.922e-06
##         12         13         14         15         16         17         18
## -2.164e-04  2.080e-04 -1.770e-04 -2.376e-04  2.232e-04 -9.748e-05  4.519e-04
##         19         20         21
## -1.150e-04 -1.852e-04 -3.647e-05
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)      5.4203520  0.0496832 109.098  0.00584 **
## L(M2, 1)         0.0048971  0.0100473   0.487  0.71128
## L(M2, 2)        -0.7098114  0.0140312 -50.588  0.01258 *
## gdp              0.9010145  0.0234002  38.505  0.01653 *
## L(gdp, 1)        0.3838517  0.0199196  19.270  0.03301 *
## L(gdp, 2)       -0.0919256  0.0164505  -5.588  0.11273
## inflation        0.0493598  0.0008685  56.832  0.01120 *
## L(inflation, 1)  0.0028289  0.0006222   4.546  0.13784
## L(inflation, 2)  0.0484152  0.0005853  82.722  0.00770 **
## L(inflation, 3)  0.0745919  0.0008906  83.753  0.00760 **
## L(inflation, 4) -0.0205836  0.0009326 -22.071  0.02882 *
## Rir              0.0588308  0.0010895  53.998  0.01179 *
## L(Rir, 1)        0.0154259  0.0007102  21.721  0.02929 *
## L(Rir, 2)        0.0509568  0.0005962  85.473  0.00745 **
## L(Rir, 3)        0.0743909  0.0009257  80.365  0.00792 **
## L(Rir, 4)       -0.0199863  0.0008793 -22.731  0.02799 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0007545 on 1 degrees of freedom
## Multiple R-squared:      1,  Adjusted R-squared:      1
## F-statistic: 8.728e+04 on 15 and 1 DF,  p-value: 0.002656
```