ECON436 Lab 4

Abdulla Almansoori, Alexander Firth, Nathan Seto

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Load required libraries (to read excel files, to manipulate dataframes, to plot time series using ts.plot, to test for stationarity)

```r
# clean existing variables
rm(list=ls())

library(knitr)
library(formatR)
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ----------------------- tidyverse 2.0.0 --
## v dplyr     1.1.4      v readr     2.1.5
## v forcats   1.0.0      v stringr   1.5.1
## v ggplot2   3.5.1      v tibble    3.2.1
## v lubridate 1.9.4      v tidyr     1.3.1
## v purrr     1.0.4
## -- Conflicts ----------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
library(readxl)
library(graphics)
library(lubridate)
library(tseries)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```r
library(urca) # For ca.jo
library(tsDyn) # For VECM
opts_chunk$set(include = TRUE, message = FALSE, warning = FALSE, tidy = TRUE)
```

A. Monthly sales taxes modeling Input project data and create VECM data

```r
# Input the sheet 'Monthly' of the file 'FinalData.xlsx
FinalData <- read_excel("~/coursework/Data Raw/FinalData.xlsx", sheet = 1)

Manufacturing <- read_excel("~/coursework/Data Raw/Manufacturing.xlsx")
Food_accomidation <- read_excel("~/coursework/Data Raw/Food and accomidation.xlsx")
retailemployees <- read_excel("~/coursework/Data Raw/retail employees.xlsx")
Transportation <- read_excel("~/coursework/Data Raw/Transportation.xlsx")

TrafficVolume <- read_excel("~/coursework/Data Raw/TrafficVolume.xlsx")
```

```r
# Data from
# https://dtdapps.coloradodot.info/otis/TrafficData#ui/0/0/1/station/000127/criteria/27425//false/true/
TrafficVolume_clean <- TrafficVolume[TrafficVolume$Year >= 2012 & TrafficVolume$Year <=
    2024, ]
TrafficVolume_clean <- TrafficVolume_clean[, -c(1, 15)] |>
    arrange(Year)

long_Trans <- Transportation |>
    pivot_longer(cols = -Year, names_to = "Month", values_to = "transportation_employment") |>
    mutate(Month = match(Month, month.abb), .before = Month)

long_Retail <- retailemployees |>
    pivot_longer(cols = -Year, names_to = "Month", values_to = "RT_employment") |>
    mutate(Month = match(Month, month.abb), .before = Month)

long_Food <- Food_accomidation |>
    pivot_longer(cols = -Year, names_to = "Month", values_to = "AFS_employment") |>
    mutate(Month = match(Month, month.abb), .before = Month)

long_Manf <- Manufacturing |>
    pivot_longer(cols = -Year, names_to = "Month", values_to = "MAN_employment") |>
    mutate(Month = match(Month, month.abb), .before = Month)

long_Traffic <- TrafficVolume_clean %>%
    pivot_longer(cols = -Year, names_to = "Month", values_to = "Value") %>%
    mutate(Month = match(Month, month.abb), Month = as.Date(paste(Year, Month, "01",
        sep = "-")), ) %>%
    select(Month, Year, Value, )
long_Traffic <- long_Traffic |>
    mutate(Date = Month, .before = Month)
long_Traffic <- long_Traffic |>
    mutate(Month = lubridate::month(long_Traffic$Date))


# The number of cointegrating vectors depends on number of distinct BLS
# categories that you think are determined by the economic conditions of
# Larimer county.  These variables should go first in the dataframe df. They
# should be followed by the variables that are driven state or country-level
# conditions.  Then add additional data you want to add (licenses and/or data
# you think is cointegrated with the sales tax data).  Then add the sales tax
# data.  Log all variables
df <- cbind(FinalData, transportation_employment = long_Trans$transportation_employment,
    MAN_employment = long_Manf$MAN_employment, AFS_employment = long_Food$AFS_employment,
    RT_employment = long_Retail$RT_employment, long_Traffic$Value)
df <- df |>
    mutate(month = month(df$Month), .before = year)
df <- df |>
    select(-Month)
new_df <- df %>%
    select("TP", "GP", "SP", "PSP", "MAN_employment", "AFS_employment", "RT_employment",
        "long_Traffic$Value")
ldf <- log(new_df)
CombinedTS <- ts(as.matrix(ldf), start = c(2012, 1), frequency = 12)
```

```
#=============================================================== # Coin-
tegrating vectors (long run) #===============================================================
# Conduct the Johansen procedure
Johansen <- ca.jo(ldf, ecdet = "none", type = "eigen", K = 12)  # K = number of periods in a year (4 if

summary(Johansen)
```

```
##
## ######################
## # Johansen-Procedure #
## ######################
##
## Test type: maximal eigenvalue statistic (lambda max) , with linear trend
##
## Eigenvalues (lambda):
## [1] 0.86981378 0.55108634 0.36158113 0.35206639 0.25150182 0.14565971 0.04107195
## [8] 0.01560044
##
## Values of teststatistic and critical values of test:
##
##           test 10pct  5pct  1pct
## r <= 7 |   2.26  6.50  8.18 11.65
## r <= 6 |   6.04 12.91 14.90 19.19
## r <= 5 |  22.67 18.90 21.07 25.75
## r <= 4 |  41.71 24.78 27.14 32.14
## r <= 3 |  62.49 30.84 33.32 38.78
## r <= 2 |  64.62 36.25 39.43 44.59
## r <= 1 | 115.33 42.06 44.91 51.30
## r = 0  | 293.59 48.43 51.07 57.07
##
## Eigenvectors, normalised to first column:
## (These are the cointegration relations)
##
##                           TP.l12          GP.l12          SP.l12         PSP.l12
## TP.l12                 1.000000000   1.000000000   1.0000000000   1.000000000
## GP.l12                -0.199785180  -0.185247669  -0.1882537953  -0.202909787
## SP.l12                -0.009052707  -0.005225913   0.0129814375  -0.003160597
## PSP.l12               -0.797916870  -0.815014657  -0.8152135487  -0.834676542
## MAN_employment.l12     0.004084488   0.002968693  -0.0074110855   0.030116982
## AFS_employment.l12     0.002588595   0.006951945   0.0013297925   0.007009526
## RT_employment.l12      0.003739574  -0.003769467  -0.0020816111   0.006988804
## long_Traffic.Value.l12 -0.002213387  -0.004482580  -0.0006068694  -0.003116506
##                        MAN_employment.l12 AFS_employment.l12 RT_employment.l12
## TP.l12                        1.00000000         1.000000000        1.000000000
## GP.l12                       -0.18747273        -0.194014893       -0.183899780
## SP.l12                        0.06122036         0.016253404        0.068311985
## PSP.l12                      -0.82367126        -0.832229317       -0.822196918
## MAN_employment.l12           -0.05019263         0.003619808       -0.072581795
## AFS_employment.l12            0.02601414         0.004783147       -0.004763270
## RT_employment.l12             0.05116228         0.005049789        0.033192392
## long_Traffic.Value.l12       -0.03632711        -0.003005952        0.007571171
##                        long_Traffic.Value.l12
## TP.l12                            1.000000000
## GP.l12                           -0.193800887
```

```
## SP.l12                              0.015458049
## PSP.l12                             -0.826852658
## MAN_employment.l12                   0.002886761
## AFS_employment.l12                   0.003409542
## RT_employment.l12                   -0.004412468
## long_Traffic.Value.l12               0.001661878
##
## Weights W:
## (This is the loading matrix)
##
##                              TP.l12       GP.l12      SP.l12      PSP.l12
## TP.d                     -10.8358426  -16.056378   14.083314   24.9087427
## GP.d                      17.3960088  -27.793247  -12.194333   -0.1880327
## SP.d                      -0.3625584   -3.640920   13.335651   29.0499653
## PSP.d                    -16.7346903  -13.520979   21.096701   31.4920393
## MAN_employment.d          14.7164972   -5.677078    6.456317   -3.3199019
## AFS_employment.d          38.8817890 -108.200213  107.281632   95.9491354
## RT_employment.d           16.5560034   13.869857   14.502366   18.9124521
## long_Traffic.Value.d     114.3730716  -43.113673   64.170315  -24.5387423
##                        MAN_employment.l12 AFS_employment.l12 RT_employment.l12
## TP.d                            -3.295069         12.6261564        -1.8630839
## GP.d                            -1.753635          5.0778127        -0.3853445
## SP.d                            -2.050889          0.7672668        -1.6390403
## PSP.d                           -3.731276         14.7104688        -2.2454536
## MAN_employment.d                -1.276182          4.2056698         0.2165493
## AFS_employment.d               -11.735783         22.9548917        -6.2192383
## RT_employment.d                 -4.701520         -7.3838662        -2.1821988
## long_Traffic.Value.d             1.763667         27.1899530        -8.6796995
##                        long_Traffic.Value.l12
## TP.d                                -7.674965
## GP.d                                -3.249800
## SP.d                                -7.121618
## PSP.d                               -8.862571
## MAN_employment.d                    -5.060713
## AFS_employment.d                   -23.156194
## RT_employment.d                     -7.883619
## long_Traffic.Value.d               -19.000083
```

1. Coefficients

```
Beta <- round(coefB(Johansen, r = 8), 3)  # r = number of cointegrating vectors
Beta
```

```
##                      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8]
## TP.l12                  1    0    0    0    0    0    0    0
## GP.l12                  0    1    0    0    0    0    0    0
## SP.l12                  0    0    1    0    0    0    0    0
## PSP.l12                 0    0    0    1    0    0    0    0
## MAN_employment.l12      0    0    0    0    1    0    0    0
## AFS_employment.l12      0    0    0    0    0    1    0    0
## RT_employment.l12       0    0    0    0    0    0    1    0
## long_Traffic.Value.l12  0    0    0    0    0    0    0    1
```
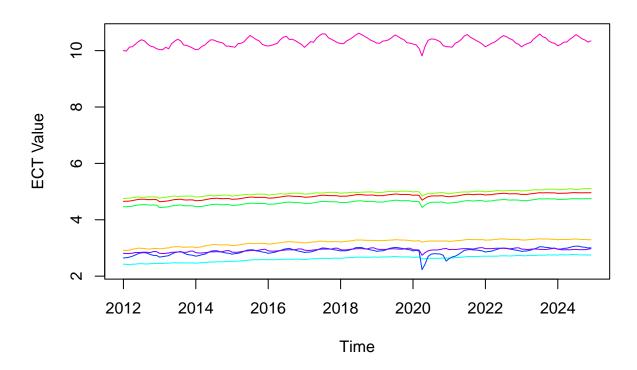
2. Error correction term

For each cointegrating vector, - create the corresponding error correction term by multiplying the cointegrating

vector with the time series in your model. - test if the error correction term is stationary - plot the error correction term

```r
ECT <- as.matrix(ldf) %*% Beta

ECT_df <- as.data.frame(ECT)
colnames(ECT_df) <- paste0("ECT_", 1:ncol(ECT_df))

stationarity_results <- sapply(ECT_df, function(x) adf.test(x)$p.value)

print(stationarity_results)
```

```
##      ECT_1      ECT_2      ECT_3      ECT_4      ECT_5      ECT_6      ECT_7
## 0.06611129 0.88011227 0.43203588 0.02615000 0.66270304 0.05623413 0.26211951
##      ECT_8
## 0.01000000
```

```r
ECT_ts <- ts(ECT, start = c(2012, 1), frequency = 12)

ts.plot(ECT_ts, col = rainbow(ncol(ECT_ts)), main = "Error Correction Terms", ylab = "ECT Value",
    xlab = "Time")
```


Error Correction Terms

```r
#================================================================  #
```
Short run adjustment coefficients #===

```r
vecm <- VECM(ldf, lag = 11, r = 7, estim = "ML", include = "const")  # lag = K-1
summary(vecm)
```

```
## #############
```

```
## ###Model VECM
## #############
## Full sample size: 156    End sample size: 144
## Number of variables: 8    Number of estimated slope parameters 768
## AIC -12298.02    BIC -9996.417    SSR 0.3193605
## Cointegrating vector (estimated by ML):
##                TP             GP             SP            PSP MAN_employment
## r1  1.000000e+00 -3.719247e-15 -8.465451e-16  3.996803e-15  -9.436896e-16
## r2  1.776357e-14  1.000000e+00 -2.442491e-15 -1.065814e-14  -1.776357e-15
## r3  3.197442e-14 -8.437695e-15  1.000000e+00 -5.329071e-15  -2.220446e-16
## r4  3.552714e-15  1.110223e-15  0.000000e+00  1.000000e+00  -8.881784e-16
## r5  2.198242e-14 -9.992007e-16  6.661338e-16 -3.586020e-14   1.000000e+00
## r6 -4.263256e-14  1.065814e-14  0.000000e+00 -2.131628e-14   2.664535e-15
## r7  1.421085e-14 -3.552714e-15  0.000000e+00  2.842171e-14  -8.881784e-16
##     AFS_employment RT_employment long_Traffic$Value
## r1  -2.255141e-16 -2.012279e-16        -0.14351997
## r2   1.942890e-16 -5.551115e-16         0.24728325
## r3   2.081668e-16 -3.330669e-16        -0.28854055
## r4   7.632783e-17 -6.106227e-16        -0.23991402
## r5   2.029626e-16 -1.505740e-15        -0.03936596
## r6   1.000000e+00  4.440892e-16        -1.59745380
## r7  -8.326673e-17  1.000000e+00         0.25775868
##
##
##                                 ECT1                ECT2
## Equation TP                     19.5672(50.5921)     -4.0554(9.7159)
## Equation GP                     -19.8402(21.0298)    3.4213(4.0387)
## Equation SP                     35.4578(45.3809)     -7.1207(8.7152)
## Equation PSP                    31.0658(59.9081)     -6.2549(11.5050)
## Equation MAN_employment         15.3228(23.9625)     -3.0470(4.6019)
## Equation AFS_employment         138.9134(175.3135)   -28.4994(33.6680)
## Equation RT_employment          49.5708(55.7045)     -9.7289(10.6977)
## Equation long_Traffic$Value     131.1696(141.5459)   -25.9751(27.1831)
##                                 ECT3                ECT4
## Equation TP                     0.1624(0.6237)       -16.8008(41.4461)
## Equation GP                     -0.2211(0.2592)      16.4042(17.2281)
## Equation SP                     -0.1214(0.5594)      -29.4624(37.1770)
## Equation PSP                    0.2538(0.7385)       -26.4335(49.0780)
## Equation MAN_employment         -0.0042(0.2954)      -12.2356(19.6306)
## Equation AFS_employment         0.5330(2.1612)       -114.7086(143.6204)
## Equation RT_employment          -0.6507(0.6867)      -40.3092(45.6343)
## Equation long_Traffic$Value     0.0578(1.7449)       -104.9011(115.9573)
##                                 ECT5                ECT6
## Equation TP                     0.9002(0.4973).      0.0372(0.2648)
## Equation GP                     0.2076(0.2067)       -0.1852(0.1101).
## Equation SP                     0.9885(0.4460)*      0.1532(0.2376)
## Equation PSP                    1.0871(0.5888).      0.0955(0.3136)
## Equation MAN_employment         -0.0410(0.2355)      -0.0302(0.1254)
## Equation AFS_employment         3.0558(1.7232).      -0.0022(0.9177)
## Equation RT_employment          0.9385(0.5475).      0.1439(0.2916)
## Equation long_Traffic$Value     -0.2355(1.3913)      0.1269(0.7409)
##                                 ECT7                Intercept
## Equation TP                     -0.0019(0.2567)      -8.1130(23.0554)
## Equation GP                     0.1170(0.1067)       8.5360(9.5835)
```

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```
## Equation SP               0.0321(0.2303)      -14.9008(20.6806)
## Equation PSP             -0.0266(0.3040)      -13.0601(27.3008)
## Equation MAN_employment   0.0029(0.1216)       -7.9798(10.9200)
## Equation AFS_employment   0.3094(0.8895)      -65.8585(79.8923)
## Equation RT_employment   -0.2387(0.2826)      -21.4555(25.3852)
## Equation long_Traffic$Value 0.2244(0.7182)    -64.9282(64.5040)
##                            TP -1                GP -1
## Equation TP               -7.1831(48.5539)      1.4016(9.4605)
## Equation GP               19.8792(20.1826)     -3.6747(3.9325)
## Equation SP              -28.1630(43.5526)      5.6199(8.4860)
## Equation PSP             -13.9541(57.4946)      2.6694(11.2026)
## Equation MAN_employment   -7.0785(22.9971)      1.3414(4.4809)
## Equation AFS_employment  -50.4016(168.2505)     9.9472(32.7829)
## Equation RT_employment    15.0954(53.4603)     -3.1762(10.4165)
## Equation long_Traffic$Value -37.1387(135.8433)  6.2637(26.4685)
##                            SP -1                PSP -1
## Equation TP                0.4210(0.7698)       6.6121(39.8122)
## Equation GP                0.6228(0.3200).    -16.2323(16.5489)
## Equation SP               -0.2224(0.6905)      23.9970(35.7114)
## Equation PSP               0.3755(0.9115)      12.3435(47.1432)
## Equation MAN_employment    0.4045(0.3646)       5.9296(18.8567)
## Equation AFS_employment    0.9046(2.6675)      44.7884(137.9586)
## Equation RT_employment     0.8784(0.8476)     -11.6717(43.8353)
## Equation long_Traffic$Value 1.3174(2.1537)     30.8835(111.3861)
##                            MAN_employment -1   AFS_employment -1
## Equation TP               -0.8188(0.5783)      -0.2406(0.2834)
## Equation GP               -0.2122(0.2404)      -0.0025(0.1178)
## Equation SP               -1.0117(0.5188).     -0.2969(0.2542)
## Equation PSP              -0.9783(0.6848)      -0.3032(0.3355)
## Equation MAN_employment   -0.1186(0.2739)      -0.0910(0.1342)
## Equation AFS_employment   -2.6861(2.0041)      -1.0284(0.9819)
## Equation RT_employment    -0.5861(0.6368)      -0.1034(0.3120)
## Equation long_Traffic$Value 0.8570(1.6181)     -0.5781(0.7928)
##                            RT_employment -1    long_Traffic$Value -1
## Equation TP               -0.2528(0.3490)       0.2424(0.1835)
## Equation GP               -0.2188(0.1451)      -0.0461(0.0763)
## Equation SP               -0.3385(0.3130)       0.2934(0.1646).
## Equation PSP              -0.2673(0.4132)       0.3193(0.2173)
## Equation MAN_employment   -0.3028(0.1653).      0.0724(0.0869)
## Equation AFS_employment   -1.1704(1.2093)       0.8417(0.6358)
## Equation RT_employment    -0.3881(0.3842)       0.3379(0.2020)
## Equation long_Traffic$Value -1.5267(0.9763)     0.4504(0.5134)
##                            TP -2                GP -2
## Equation TP                0.4601(48.1901)      0.4998(9.4426)
## Equation GP               40.8336(20.0314)*    -7.5830(3.9250).
## Equation SP              -22.3226(43.2263)      4.9031(8.4700)
## Equation PSP              -9.8488(57.0638)      2.5678(11.1813)
## Equation MAN_employment   18.1367(22.8248)     -3.3992(4.4724)
## Equation AFS_employment  -45.8133(166.9900)    10.9106(32.7208)
## Equation RT_employment    17.9447(53.0598)     -3.2307(10.3968)
## Equation long_Traffic$Value 120.0916(134.8256) -21.9437(26.4183)
##                            SP -2                PSP -2
## Equation TP               -0.4827(0.7728)       0.2203(39.4568)
## Equation GP                0.0192(0.3212)     -33.0630(16.4011)*
```

```
## Equation SP                    -0.9276(0.6932)       18.9257(35.3926)
## Equation PSP                   -0.6166(0.9151)       8.7283(46.7223)
## Equation MAN_employment        -0.1283(0.3660)       -14.6940(18.6883)
## Equation AFS_employment        -1.8142(2.6780)       39.9387(136.7269)
## Equation RT_employment         -0.1324(0.8509)       -14.3383(43.4439)
## Equation long_Traffic$Value    -0.7003(2.1622)       -98.0138(110.3916)
##                                MAN_employment -2      AFS_employment -2
## Equation TP                    -1.2858(0.5428)*      0.0613(0.2563)
## Equation GP                    -0.4289(0.2256).      0.2163(0.1066)*
## Equation SP                    -1.2955(0.4869)*      -0.0100(0.2299)
## Equation PSP                   -1.5143(0.6428)*      0.0221(0.3035)
## Equation MAN_employment        -0.3556(0.2571)       0.1666(0.1214)
## Equation AFS_employment        -4.2943(1.8811)*      -0.1813(0.8883)
## Equation RT_employment         -0.8292(0.5977)       0.1622(0.2822)
## Equation long_Traffic$Value    -0.4549(1.5188)       0.6633(0.7172)
##                                RT_employment -2       long_Traffic$Value -2
## Equation TP                    0.1335(0.3606)        0.1618(0.1766)
## Equation GP                    -0.0665(0.1499)       -0.0529(0.0734)
## Equation SP                    -0.0059(0.3235)       0.2346(0.1584)
## Equation PSP                   0.1811(0.4271)        0.2183(0.2092)
## Equation MAN_employment        0.0906(0.1708)        0.0305(0.0837)
## Equation AFS_employment        0.1542(1.2497)        0.5413(0.6121)
## Equation RT_employment         0.1133(0.3971)        0.2010(0.1945)
## Equation long_Traffic$Value    0.7707(1.0090)        0.1866(0.4942)
##                                TP -3                 GP -3
## Equation TP                    1.9353(46.1413)        -0.4767(8.9743)
## Equation GP                    48.2802(19.1797)*      -9.7371(3.7304)*
## Equation SP                    -24.6661(41.3885)      4.7706(8.0499)
## Equation PSP                   -9.6035(54.6377)       1.8300(10.6268)
## Equation MAN_employment        13.4758(21.8544)       -2.8902(4.2506)
## Equation AFS_employment        -16.0777(159.8902)     3.6432(31.0979)
## Equation RT_employment         -7.6642(50.8039)       1.1993(9.8811)
## Equation long_Traffic$Value    224.8544(129.0933).    -43.1930(25.1080).
##                                SP -3                 PSP -3
## Equation TP                    -0.8939(0.7624)       -0.5501(37.6957)
## Equation GP                    -0.3200(0.3169)       -38.8344(15.6691)*
## Equation SP                    -1.1322(0.6839)       21.0896(33.8129)
## Equation PSP                   -1.0555(0.9028)       9.0013(44.6369)
## Equation MAN_employment        -0.1923(0.3611)       -10.6182(17.8542)
## Equation AFS_employment        -3.5912(2.6420)       16.8489(130.6243)
## Equation RT_employment         -0.9670(0.8395)       7.1996(41.5049)
## Equation long_Traffic$Value    -0.7809(2.1331)       -180.7224(105.4644).
##                                MAN_employment -3     AFS_employment -3
## Equation TP                    -0.2477(0.5188)       0.0429(0.2438)
## Equation GP                    0.2823(0.2156)        0.2597(0.1014)*
## Equation SP                    -0.3871(0.4653)       -0.0410(0.2187)
## Equation PSP                   -0.3851(0.6143)       -0.0105(0.2887)
## Equation MAN_employment        0.3570(0.2457)        0.0221(0.1155)
## Equation AFS_employment        -1.2385(1.7976)       -0.0232(0.8450)
## Equation RT_employment         -0.3384(0.5712)       -0.0520(0.2685)
## Equation long_Traffic$Value    0.8935(1.4514)        0.4543(0.6822)
##                                RT_employment -3      long_Traffic$Value -3
## Equation TP                    0.2056(0.3370)        0.0750(0.1541)
## Equation GP                    -0.0765(0.1401)       -0.0991(0.0641)
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## Equation SP               0.1485(0.3023)        0.1550(0.1383)
## Equation PSP              0.2766(0.3990)        0.1203(0.1825)
## Equation MAN_employment   0.0695(0.1596)        0.0028(0.0730)
## Equation AFS_employment   1.0405(1.1677)        0.2027(0.5341)
## Equation RT_employment    0.3599(0.3710)        0.0808(0.1697)
## Equation long_Traffic$Value 1.1057(0.9428)      0.0802(0.4312)
##                           TP -4                  GP -4
## Equation TP               -46.8629(39.0900)       9.2789(7.6461)
## Equation GP               6.6619(16.2487)        -0.9738(3.1783)
## Equation SP               -57.0457(35.0635)      11.2462(6.8585)
## Equation PSP              -60.6406(46.2880)      11.9185(9.0540)
## Equation MAN_employment   -4.2678(18.5146)        0.9703(3.6215)
## Equation AFS_employment   -157.9602(135.4558)    30.9002(26.4955)
## Equation RT_employment    -65.6125(43.0400)      12.7116(8.4187)
## Equation long_Traffic$Value -40.8577(109.3653)    7.2879(21.3921)
##                           SP -4                  PSP -4
## Equation TP               -0.5715(0.7379)        38.4066(31.9077)
## Equation GP               -0.0766(0.3067)        -5.5687(13.2632)
## Equation SP               -0.7919(0.6619)        46.6954(28.6210)
## Equation PSP              -0.7089(0.8738)        49.7330(37.7831)
## Equation MAN_employment   -0.3030(0.3495)        3.5582(15.1128)
## Equation AFS_employment   -2.4815(2.5570)        130.2289(110.5675)
## Equation RT_employment    -0.8282(0.8125)        53.7478(35.1320)
## Equation long_Traffic$Value -2.3510(2.0645)      33.8880(89.2708)
##                           MAN_employment -4      AFS_employment -4
## Equation TP               -0.2899(0.5368)        -0.0037(0.2070)
## Equation GP               -0.1914(0.2232)        0.0859(0.0860)
## Equation SP               -0.4219(0.4816)        0.0185(0.1857)
## Equation PSP              -0.3183(0.6357)        -0.0249(0.2451)
## Equation MAN_employment   -0.0151(0.2543)        0.0348(0.0980)
## Equation AFS_employment   -0.8836(1.8603)        0.0467(0.7173)
## Equation RT_employment    -0.2369(0.5911)        -0.0511(0.2279)
## Equation long_Traffic$Value 0.6566(1.5020)       -0.2707(0.5792)
##                           RT_employment -4       long_Traffic$Value -4
## Equation TP               -0.4882(0.3628)        -0.0019(0.1442)
## Equation GP               -0.2326(0.1508)        -0.1046(0.0599).
## Equation SP               -0.4551(0.3255)        0.0747(0.1293)
## Equation PSP              -0.5602(0.4297)        0.0243(0.1708)
## Equation MAN_employment   -0.0945(0.1719)        -0.0211(0.0683)
## Equation AFS_employment   -1.9045(1.2573)        -0.0790(0.4997)
## Equation RT_employment    -0.6445(0.3995)        0.0369(0.1588)
## Equation long_Traffic$Value -0.3736(1.0152)      -0.2417(0.4034)
##                           TP -5                  GP -5
## Equation TP               -30.7114(34.8181)       6.1469(6.7782)
## Equation GP               0.9187(14.4730)        -0.0505(2.8175)
## Equation SP               -37.2904(31.2317)       7.3457(6.0800)
## Equation PSP              -39.1476(41.2295)       7.8042(8.0264)
## Equation MAN_employment   -17.2502(16.4913)       3.3357(3.2104)
## Equation AFS_employment   -125.2316(120.6527)    25.5296(23.4881)
## Equation RT_employment    -32.2249(38.3365)       6.6247(7.4632)
## Equation long_Traffic$Value -105.7282(97.4135)   21.5443(18.9640)
##                           SP -5                  PSP -5
## Equation TP               -0.1190(0.7379)        25.6835(28.4432)
## Equation GP               -0.2568(0.3067)        -0.3148(11.8231)
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## Equation SP               -0.0214(0.6619)      30.7201(25.5134)
## Equation PSP              -0.0903(0.8737)      32.6271(33.6807)
## Equation MAN_employment   -0.0275(0.3495)      14.3520(13.4718)
## Equation AFS_employment   -0.5835(2.5568)     104.4650(98.5621)
## Equation RT_employment    -0.5011(0.8124)      26.9211(31.3174)
## Equation long_Traffic$Value -0.8481(2.0644)    87.7917(79.5778)
##                            MAN_employment -5    AFS_employment -5
## Equation TP               -0.1465(0.5018)      -0.1528(0.1916)
## Equation GP               -0.1298(0.2086)      -0.0028(0.0797)
## Equation SP               -0.0680(0.4501)      -0.1156(0.1719)
## Equation PSP              -0.1571(0.5942)      -0.1933(0.2269)
## Equation MAN_employment    0.0522(0.2377)      -0.0993(0.0908)
## Equation AFS_employment   -0.7910(1.7389)      -0.5649(0.6640)
## Equation RT_employment    -0.4499(0.5525)      -0.0987(0.2110)
## Equation long_Traffic$Value 0.7480(1.4039)     -1.0038(0.5361).
##                            RT_employment -5     long_Traffic$Value -5
## Equation TP               -0.4234(0.3731)       0.1303(0.1291)
## Equation GP               -0.3581(0.1551)*     -0.0547(0.0537)
## Equation SP               -0.3438(0.3347)       0.1761(0.1158)
## Equation PSP              -0.4480(0.4418)       0.1786(0.1529)
## Equation MAN_employment   -0.3853(0.1767)*      0.0457(0.0612)
## Equation AFS_employment   -1.9369(1.2929)       0.4195(0.4475)
## Equation RT_employment    -0.3442(0.4108)       0.2014(0.1422)
## Equation long_Traffic$Value -1.7083(1.0438)     0.3132(0.3613)
##                            TP -6                GP -6
## Equation TP               -34.4260(31.4388)     7.2399(6.1328)
## Equation GP                0.6879(13.0683)      -0.0126(2.5492)
## Equation SP               -27.1530(28.2005)     5.7559(5.5011)
## Equation PSP              -43.6976(37.2280)     9.1584(7.2620)
## Equation MAN_employment   -0.3551(14.8907)      0.2858(2.9047)
## Equation AFS_employment   -128.4149(108.9429)  27.7274(21.2514)
## Equation RT_employment    -30.7445(34.6158)     6.5203(6.7525)
## Equation long_Traffic$Value -79.2755(87.9591)  18.1125(17.1581)
##                            SP -6                PSP -6
## Equation TP                0.7402(0.7043)      28.0231(25.6948)
## Equation GP                0.1555(0.2928)      -0.3753(10.6806)
## Equation SP                0.7923(0.6318)      22.0604(23.0481)
## Equation PSP               0.8848(0.8340)      35.5316(30.4262)
## Equation MAN_employment    0.0559(0.3336)       0.3796(12.1701)
## Equation AFS_employment    1.9560(2.4406)     104.8199(89.0384)
## Equation RT_employment     0.6905(0.7755)      24.5575(28.2913)
## Equation long_Traffic$Value -0.2426(1.9705)    63.9911(71.8885)
##                            MAN_employment -6    AFS_employment -6
## Equation TP               -0.6885(0.5214)      -0.0743(0.1810)
## Equation GP               -0.3130(0.2167)       0.0525(0.0752)
## Equation SP               -0.4837(0.4677)      -0.0736(0.1623)
## Equation PSP              -0.7939(0.6174)      -0.1077(0.2143)
## Equation MAN_employment   -0.1065(0.2469)       0.0094(0.0857)
## Equation AFS_employment   -2.5747(1.8067)      -0.3509(0.6271)
## Equation RT_employment    -0.5723(0.5741)       0.0213(0.1993)
## Equation long_Traffic$Value -1.8246(1.4587)    -0.1787(0.5063)
##                            RT_employment -6     long_Traffic$Value -6
## Equation TP               -0.5921(0.4248)       0.0393(0.1182)
## Equation GP               -0.4748(0.1766)**    -0.0846(0.0491).
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## Equation SP                -0.4747(0.3810)      0.1282(0.1060)
## Equation PSP               -0.6274(0.5030)      0.0714(0.1399)
## Equation MAN_employment    -0.1564(0.2012)     -3.2e-05(0.0560)
## Equation AFS_employment    -1.7715(1.4720)      0.1154(0.4095)
## Equation RT_employment     -0.2739(0.4677)      0.0798(0.1301)
## Equation long_Traffic$Value -0.6349(1.1884)    -0.1051(0.3306)
##                            TP -7                GP -7
## Equation TP                -6.9480(28.5287)     1.2605(5.5772)
## Equation GP                9.0373(11.8586)     -1.5146(2.3183)
## Equation SP                -6.4856(25.5901)     1.0878(5.0027)
## Equation PSP               -10.8504(33.7820)    1.9350(6.6042)
## Equation MAN_employment    3.7188(13.5123)     -0.7873(2.6416)
## Equation AFS_employment    -10.0789(98.8586)    1.5666(19.3262)
## Equation RT_employment     -3.2945(31.4115)     0.2973(6.1408)
## Equation long_Traffic$Value 64.8171(79.8172)   -14.5516(15.6037)
##                            SP -7                PSP -7
## Equation TP                0.3457(0.6756)       6.0298(23.2968)
## Equation GP                -0.2337(0.2808)     -7.1707(9.6839)
## Equation SP                0.4149(0.6060)       5.6305(20.8972)
## Equation PSP               0.4848(0.8000)       9.2723(27.5867)
## Equation MAN_employment    0.0806(0.3200)      -2.9693(11.0343)
## Equation AFS_employment    0.6314(2.3410)       10.5324(80.7289)
## Equation RT_employment     0.3812(0.7438)       2.9362(25.6510)
## Equation long_Traffic$Value -0.2652(1.8901)    -52.0914(65.1795)
##                            MAN_employment -7    AFS_employment -7
## Equation TP                -0.1017(0.5117)     -0.1677(0.1639)
## Equation GP                -0.2986(0.2127)     -0.0030(0.0681)
## Equation SP                -0.0298(0.4590)     -0.1763(0.1470)
## Equation PSP               -0.0533(0.6059)     -0.2116(0.1941)
## Equation MAN_employment    0.0248(0.2424)      -0.0686(0.0776)
## Equation AFS_employment    0.2445(1.7732)      -0.6237(0.5680)
## Equation RT_employment     -0.2248(0.5634)     -0.1414(0.1805)
## Equation long_Traffic$Value 2.8682(1.4316).    -0.4027(0.4586)
##                            RT_employment -7     long_Traffic$Value -7
## Equation TP                0.0151(0.3823)       0.1247(0.1226)
## Equation GP                0.0444(0.1589)      -0.0262(0.0510)
## Equation SP                0.0121(0.3429)       0.1892(0.1100).
## Equation PSP               0.0061(0.4527)       0.1645(0.1452)
## Equation MAN_employment    0.1389(0.1811)       0.0476(0.0581)
## Equation AFS_employment    -0.0300(1.3247)      0.3661(0.4250)
## Equation RT_employment     0.1720(0.4209)       0.1811(0.1350)
## Equation long_Traffic$Value 2.4328(1.0695)*    -0.0763(0.3431)
##                            TP -8                GP -8
## Equation TP                24.8011(27.5289)    -5.1143(5.4150)
## Equation GP                33.3133(11.4431)**  -6.5851(2.2509)**
## Equation SP                12.3530(24.6933)    -2.6948(4.8572)
## Equation PSP               23.1015(32.5981)    -4.8318(6.4121)
## Equation MAN_employment    16.1500(13.0388)    -3.3175(2.5648)
## Equation AFS_employment    49.0220(95.3942)    -10.3086(18.7642)
## Equation RT_employment     24.7413(30.3108)    -5.2585(5.9622)
## Equation long_Traffic$Value 104.9445(77.0200)  -21.3569(15.1500)
##                            SP -8                PSP -8
## Equation TP                0.4534(0.6760)      -19.9689(22.4996)
## Equation GP                -0.3272(0.2810)     -26.8040(9.3525)**
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## Equation SP             0.4642(0.6064)      -9.7779(20.1820)
## Equation PSP            0.6496(0.8005)      -18.5996(26.6427)
## Equation MAN_employment 0.0645(0.3202)      -13.0392(10.6567)
## Equation AFS_employment 1.4098(2.3425)      -38.7337(77.9663)
## Equation RT_employment  0.6067(0.7443)      -20.1245(24.7732)
## Equation long_Traffic$Value -0.2221(1.8913) -85.1819(62.9490)
##                         MAN_employment -8    AFS_employment -8
## Equation TP             0.0966(0.5449)      0.0625(0.1579)
## Equation GP             0.2575(0.2265)      0.1502(0.0656)*
## Equation SP             0.0312(0.4888)      -0.0112(0.1416)
## Equation PSP            0.0551(0.6452)      0.0411(0.1869)
## Equation MAN_employment 0.1473(0.2581)      0.0330(0.0748)
## Equation AFS_employment 0.0865(1.8882)      0.0698(0.5470)
## Equation RT_employment  -0.0417(0.6000)     0.1141(0.1738)
## Equation long_Traffic$Value 0.8728(1.5245)  0.2275(0.4416)
##                         RT_employment -8     long_Traffic$Value -8
## Equation TP             -0.0293(0.3934)     0.0915(0.1183)
## Equation GP             0.0805(0.1635)      -0.0498(0.0492)
## Equation SP             -0.1802(0.3529)     0.1490(0.1061)
## Equation PSP            -0.0589(0.4659)     0.1287(0.1400)
## Equation MAN_employment 0.0215(0.1863)      0.0376(0.0560)
## Equation AFS_employment -0.2543(1.3634)     0.3078(0.4098)
## Equation RT_employment  -0.1771(0.4332)     0.1621(0.1302)
## Equation long_Traffic$Value 0.8989(1.1008)  -0.1133(0.3308)
##                         TP -9                GP -9
## Equation TP             19.6498(27.6060)    -3.7030(5.4756)
## Equation GP             14.2268(11.4751)    -2.7219(2.2761)
## Equation SP             8.0720(24.7624)     -1.5595(4.9116)
## Equation PSP            21.2396(32.6893)    -3.9901(6.4839)
## Equation MAN_employment 16.5620(13.0753)    -3.1627(2.5935)
## Equation AFS_employment 43.3567(95.6611)    -7.2403(18.9744)
## Equation RT_employment  39.4647(30.3956)    -7.6883(6.0290)
## Equation long_Traffic$Value 99.2631(77.2355) -19.4058(15.3197)
##                         SP -9                PSP -9
## Equation TP             0.6148(0.6980)      -16.0691(22.5107)
## Equation GP             -0.3132(0.2901)     -11.5916(9.3571)
## Equation SP             0.4884(0.6261)      -6.5156(20.1920)
## Equation PSP            0.8466(0.8265)      -17.3721(26.6558)
## Equation MAN_employment -0.1164(0.3306)     -13.5438(10.6620)
## Equation AFS_employment 1.5712(2.4186)      -34.4431(78.0047)
## Equation RT_employment  0.6396(0.7685)      -32.2760(24.7854)
## Equation long_Traffic$Value -1.2522(1.9528) -80.4516(62.9800)
##                         MAN_employment -9    AFS_employment -9
## Equation TP             -0.6563(0.5435)     0.0352(0.1606)
## Equation GP             -0.3476(0.2259)     0.1198(0.0668).
## Equation SP             -0.6139(0.4875)     -0.0260(0.1441)
## Equation PSP            -0.7415(0.6436)     0.0132(0.1902)
## Equation MAN_employment -0.2710(0.2574)     0.0627(0.0761)
## Equation AFS_employment -2.3168(1.8833)     -0.2177(0.5566)
## Equation RT_employment  -0.6010(0.5984)     0.1584(0.1768)
## Equation long_Traffic$Value 0.1331(1.5206)  0.2346(0.4494)
##                         RT_employment -9     long_Traffic$Value -9
## Equation TP             -0.0807(0.3862)     0.1702(0.1114)
## Equation GP             0.0899(0.1605)      -0.0028(0.0463)
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## Equation SP               -0.1690(0.3464)     0.2061(0.0999)*
## Equation PSP              -0.1246(0.4573)     0.2158(0.1319)
## Equation MAN_employment    0.2317(0.1829)     0.0721(0.0528)
## Equation AFS_employment   -0.5061(1.3382)     0.5464(0.3861)
## Equation RT_employment    -0.0544(0.4252)     0.2065(0.1227).
## Equation long_Traffic$Value 0.6544(1.0805)    0.2769(0.3117)
##                            TP -10              GP -10
## Equation TP                2.1543(26.1939)     0.7862(5.2110)
## Equation GP               -0.4335(10.8881)     0.4732(2.1661)
## Equation SP               -1.1869(23.4958)     1.3708(4.6742)
## Equation PSP               2.7469(31.0173)     0.8882(6.1705)
## Equation MAN_employment    9.8992(12.4065)    -1.5185(2.4681)
## Equation AFS_employment   -1.8040(90.7681)     4.6896(18.0573)
## Equation RT_employment    -1.9636(28.8409)     1.2861(5.7376)
## Equation long_Traffic$Value 84.4117(73.2850)  -14.2720(14.5792)
##                            SP -10              PSP -10
## Equation TP                0.8569(0.6423)     -1.9177(21.3968)
## Equation GP               -0.0407(0.2670)      0.3692(8.8941)
## Equation SP                0.4832(0.5762)      1.0549(19.1929)
## Equation PSP               1.0885(0.7606)     -2.4393(25.3368)
## Equation MAN_employment    0.0745(0.3042)     -7.9844(10.1344)
## Equation AFS_employment    2.5267(2.2258)      1.9526(74.1449)
## Equation RT_employment     1.1755(0.7072)      1.1232(23.5590)
## Equation long_Traffic$Value 1.3432(1.7971)    -69.7001(59.8637)
##                            MAN_employment -10  AFS_employment -10
## Equation TP               -0.7296(0.4932)     -0.0495(0.1544)
## Equation GP               -0.0457(0.2050)      0.0063(0.0642)
## Equation SP               -0.7823(0.4424).    -0.0577(0.1385)
## Equation PSP              -0.9113(0.5840)     -0.0650(0.1828)
## Equation MAN_employment   -0.0817(0.2336)      0.0177(0.0731)
## Equation AFS_employment   -2.8562(1.7091)     -0.3151(0.5349)
## Equation RT_employment    -0.5828(0.5431)     -0.0173(0.1700)
## Equation long_Traffic$Value -0.3967(1.3799)    0.2015(0.4319)
##                            RT_employment -10   long_Traffic$Value -10
## Equation TP               -0.5768(0.3962)      0.0870(0.0926)
## Equation GP               -0.2797(0.1647).    -0.0165(0.0385)
## Equation SP               -0.5633(0.3554)      0.1198(0.0831)
## Equation PSP              -0.6614(0.4692)      0.1140(0.1097)
## Equation MAN_employment   -0.2447(0.1877)      0.0315(0.0439)
## Equation AFS_employment   -1.9229(1.3731)      0.3050(0.3209)
## Equation RT_employment    -0.7067(0.4363)      0.0814(0.1020)
## Equation long_Traffic$Value -0.4233(1.1086)    0.2211(0.2591)
##                            TP -11              GP -11
## Equation TP               -4.3647(22.8747)     0.8099(4.4548)
## Equation GP               11.6562(9.5084)     -2.0986(1.8518)
## Equation SP              -16.3648(20.5185)     3.3047(3.9960)
## Equation PSP              -8.5273(27.0868)     1.5676(5.2751)
## Equation MAN_employment   -0.7228(10.8344)     0.0597(2.1100)
## Equation AFS_employment  -41.6346(79.2661)     8.2212(15.4370)
## Equation RT_employment   -20.8521(25.1862)     3.6370(4.9050)
## Equation long_Traffic$Value -11.2032(63.9985)  2.0747(12.4637)
##                            SP -11              PSP -11
## Equation TP               -0.2861(0.5512)      4.2954(18.5898)
## Equation GP               -0.4206(0.2291).    -9.0855(7.7273)
```

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## Equation SP                  -0.5499(0.4945)     14.0577(16.6749)
## Equation PSP                 -0.2554(0.6528)     7.7840(22.0129)
## Equation MAN_employment      -0.1084(0.2611)     0.8177(8.8049)
## Equation AFS_employment      -0.6150(1.9102)     37.1358(64.4179)
## Equation RT_employment       -0.2688(0.6070)     17.7290(20.4683)
## Equation long_Traffic$Value  -0.2701(1.5423)     9.0706(52.0102)
##                               MAN_employment -11  AFS_employment -11
## Equation TP                  -0.2611(0.5085)     -0.1372(0.1330)
## Equation GP                  -0.1810(0.2114)     0.0449(0.0553)
## Equation SP                  -0.5015(0.4561)     -0.1161(0.1193)
## Equation PSP                 -0.2853(0.6021)     -0.1862(0.1575)
## Equation MAN_employment      0.0458(0.2408)      -0.0302(0.0630)
## Equation AFS_employment      -1.0295(1.7620)     -0.7925(0.4609).
## Equation RT_employment       -0.0975(0.5599)     -0.1553(0.1464)
## Equation long_Traffic$Value  -0.5578(1.4226)     -0.4460(0.3721)
##                               RT_employment -11   long_Traffic$Value -11
## Equation TP                  -0.3143(0.3990)     0.0960(0.0740)
## Equation GP                  -0.1372(0.1658)     0.0012(0.0307)
## Equation SP                  -0.3600(0.3579)     0.1006(0.0663)
## Equation PSP                 -0.3659(0.4724)     0.1208(0.0876)
## Equation MAN_employment      -0.1573(0.1890)     0.0230(0.0350)
## Equation AFS_employment      -1.3895(1.3825)     0.2981(0.2563)
## Equation RT_employment       -0.5043(0.4393)     0.0800(0.0814)
## Equation long_Traffic$Value  0.3666(1.1162)      0.1875(0.2069)
```

For each vector, we need at least one adjustment speed to have the opposite sign of the corresponding cointegrating vector coefficient and be statistically significant.

Vec 1: Vec 2: ....