# Load required libraries  
library(urca)  
library(tseries)

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

library(dynamac)   
library(forecast)   
library(tseries)   
library(nlme)

##   
## Attaching package: 'nlme'

## The following object is masked from 'package:forecast':  
##   
## getResponse

library(pdfetch)   
library(zoo)

##   
## Attaching package: 'zoo'

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

library(urca)   
library(vars)

## Loading required package: MASS

## Loading required package: strucchange

## Loading required package: sandwich

## Loading required package: lmtest

library(car)

## Loading required package: carData

library(dynlm)   
library(tsDyn)   
library(gets)

## Loading required package: parallel

##   
## Attaching package: 'gets'

## The following object is masked from 'package:car':  
##   
## logit

library(readxl)   
library(aod)   
library(egcm)

## Loading required package: xts

library(aTSA)

##   
## Attaching package: 'aTSA'

## The following object is masked from 'package:vars':  
##   
## arch.test

## The following object is masked from 'package:forecast':  
##   
## forecast

## The following objects are masked from 'package:tseries':  
##   
## adf.test, kpss.test, pp.test

## The following object is masked from 'package:graphics':  
##   
## identify

library(tidyverse)

## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.2  
## ──

## ✔ ggplot2 3.4.0 ✔ purrr 0.3.5   
## ✔ tibble 3.1.8 ✔ dplyr 1.0.10  
## ✔ tidyr 1.2.1 ✔ stringr 1.4.1   
## ✔ readr 2.1.3 ✔ forcats 0.5.2   
## ── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
## ✖ stringr::boundary() masks strucchange::boundary()  
## ✖ dplyr::collapse() masks nlme::collapse()  
## ✖ dplyr::filter() masks stats::filter()  
## ✖ dplyr::first() masks xts::first()  
## ✖ dplyr::lag() masks stats::lag()  
## ✖ dplyr::last() masks xts::last()  
## ✖ dplyr::recode() masks car::recode()  
## ✖ dplyr::select() masks MASS::select()  
## ✖ purrr::some() masks car::some()

CPI = pdfetch\_FRED("CPIAUCSL")  
names(CPI) = "CPI"  
  
Inflation = diff(log(CPI), lag = 12) \* 100   
names(Inflation) = "Inflation"  
  
Inflation = ts(Inflation, start=c(1947, 1), frequency=12)  
Inflation = na.omit(Inflation)   
TCU = pdfetch\_FRED("TCU")  
names(TCU) = "TCU"  
TCU = ts(TCU, start=c(1967, 1), frequency=12)

tcu <- TCU   
inflation <- Inflation  
  
# Run ADF test  
adf\_inflation\_none <- adf.test(inflation)

## Augmented Dickey-Fuller Test   
## alternative: stationary   
##   
## Type 1: no drift no trend   
## lag ADF p.value  
## [1,] 0 -2.01 0.0450  
## [2,] 1 -2.50 0.0135  
## [3,] 2 -2.17 0.0304  
## [4,] 3 -2.60 0.0100  
## [5,] 4 -2.73 0.0100  
## [6,] 5 -2.76 0.0100  
## [7,] 6 -3.00 0.0100  
## Type 2: with drift no trend   
## lag ADF p.value  
## [1,] 0 -2.82 0.0584  
## [2,] 1 -3.81 0.0100  
## [3,] 2 -3.53 0.0100  
## [4,] 3 -3.98 0.0100  
## [5,] 4 -4.17 0.0100  
## [6,] 5 -4.30 0.0100  
## [7,] 6 -4.68 0.0100  
## Type 3: with drift and trend   
## lag ADF p.value  
## [1,] 0 -2.74 0.2627  
## [2,] 1 -3.77 0.0199  
## [3,] 2 -3.51 0.0409  
## [4,] 3 -3.95 0.0112  
## [5,] 4 -4.13 0.0100  
## [6,] 5 -4.27 0.0100  
## [7,] 6 -4.64 0.0100  
## ----   
## Note: in fact, p.value = 0.01 means p.value <= 0.01

adf\_tcu\_none <- adf.test(tcu)

## Augmented Dickey-Fuller Test   
## alternative: stationary   
##   
## Type 1: no drift no trend   
## lag ADF p.value  
## [1,] 0 -0.683 0.435  
## [2,] 1 -0.498 0.501  
## [3,] 2 -0.479 0.506  
## [4,] 3 -0.501 0.500  
## [5,] 4 -0.415 0.525  
## [6,] 5 -0.419 0.523  
## [7,] 6 -0.383 0.534  
## Type 2: with drift no trend   
## lag ADF p.value  
## [1,] 0 -2.81 0.0599  
## [2,] 1 -3.31 0.0163  
## [3,] 2 -3.19 0.0220  
## [4,] 3 -3.47 0.0100  
## [5,] 4 -3.59 0.0100  
## [6,] 5 -3.65 0.0100  
## [7,] 6 -3.83 0.0100  
## Type 3: with drift and trend   
## lag ADF p.value  
## [1,] 0 -2.87 0.2093  
## [2,] 1 -3.69 0.0240  
## [3,] 2 -3.57 0.0345  
## [4,] 3 -3.91 0.0130  
## [5,] 4 -4.18 0.0100  
## [6,] 5 -4.28 0.0100  
## [7,] 6 -4.58 0.0100  
## ----   
## Note: in fact, p.value = 0.01 means p.value <= 0.01

adf\_tcu\_drift <- adf.test(tcu)

## Augmented Dickey-Fuller Test   
## alternative: stationary   
##   
## Type 1: no drift no trend   
## lag ADF p.value  
## [1,] 0 -0.683 0.435  
## [2,] 1 -0.498 0.501  
## [3,] 2 -0.479 0.506  
## [4,] 3 -0.501 0.500  
## [5,] 4 -0.415 0.525  
## [6,] 5 -0.419 0.523  
## [7,] 6 -0.383 0.534  
## Type 2: with drift no trend   
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## [1,] 0 -2.81 0.0599  
## [2,] 1 -3.31 0.0163  
## [3,] 2 -3.19 0.0220  
## [4,] 3 -3.47 0.0100  
## [5,] 4 -3.59 0.0100  
## [6,] 5 -3.65 0.0100  
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## Type 3: with drift and trend   
## lag ADF p.value  
## [1,] 0 -2.87 0.2093  
## [2,] 1 -3.69 0.0240  
## [3,] 2 -3.57 0.0345  
## [4,] 3 -3.91 0.0130  
## [5,] 4 -4.18 0.0100  
## [6,] 5 -4.28 0.0100  
## [7,] 6 -4.58 0.0100  
## ----   
## Note: in fact, p.value = 0.01 means p.value <= 0.01

# Run PP test  
pp\_inflation\_none <- ur.pp(inflation, type = "Z-alpha", model = "constant", lags = NULL)  
pp\_inflation\_drift <- ur.pp(inflation, type = "Z-alpha", model = "trend", lags = NULL)  
  
pp\_tcu\_none <- ur.pp(tcu, type = "Z-alpha", model = "constant", lags = NULL)  
pp\_tcu\_drift <- ur.pp(tcu, type = "Z-alpha", model = "trend", lags = NULL)  
  
# Run KPSS test  
kpss\_inflation\_drift <- kpss.test(inflation)

## KPSS Unit Root Test   
## alternative: nonstationary   
##   
## Type 1: no drift no trend   
## lag stat p.value  
## 6 0.186 0.1  
## -----   
## Type 2: with drift no trend   
## lag stat p.value  
## 6 0.0989 0.1  
## -----   
## Type 1: with drift and trend   
## lag stat p.value  
## 6 0.0866 0.1  
## -----------   
## Note: p.value = 0.01 means p.value <= 0.01   
## : p.value = 0.10 means p.value >= 0.10

kpss\_tcu\_drift <- kpss.test(tcu)

## KPSS Unit Root Test   
## alternative: nonstationary   
##   
## Type 1: no drift no trend   
## lag stat p.value  
## 5 0.0346 0.1  
## -----   
## Type 2: with drift no trend   
## lag stat p.value  
## 5 0.0738 0.1  
## -----   
## Type 1: with drift and trend   
## lag stat p.value  
## 5 0.0301 0.1  
## -----------   
## Note: p.value = 0.01 means p.value <= 0.01   
## : p.value = 0.10 means p.value >= 0.10

# Run ERS p-test  
ersp\_inflation\_drift <- ur.ers(inflation, model = "constant", lag.max = 12, type = "DF")  
  
ersp\_tcu\_drift <- ur.ers(tcu, model = "constant", lag.max = 12, type = "DF")  
  
# Run ERS DF-GLS  
ersdf\_inflation\_drift <- ur.ers(inflation, model = "constant", lag.max = 12, type = "DF-GLS")  
  
ersdf\_tcu\_drift <- ur.ers(tcu, model = "constant", lag.max = 12, type = "DF-GLS")

# Run ADF test  
# Run ADF test  
adf\_inflation\_none <- ur.df(inflation, type = "none", selectlags = "AIC")  
adf\_inflation\_drift <- ur.df(inflation, type = "drift", selectlags = "AIC")  
  
# Run PP test  
pp\_inflation\_none <- ur.pp(inflation, type = "Z-alpha", model = "constant", lags = NULL)  
pp\_inflation\_drift <- ur.pp(inflation, type = "Z-alpha", model = "trend", lags = NULL)  
  
pp\_tcu\_none <- ur.pp(tcu, type = "Z-alpha", model = "constant", lags = NULL)  
pp\_tcu\_drift <- ur.pp(tcu, type = "Z-alpha", model = "trend", lags = NULL)  
  
# Run KPSS test  
kpss\_inflation\_drift <- kpss.test(inflation)

## KPSS Unit Root Test   
## alternative: nonstationary   
##   
## Type 1: no drift no trend   
## lag stat p.value  
## 6 0.186 0.1  
## -----   
## Type 2: with drift no trend   
## lag stat p.value  
## 6 0.0989 0.1  
## -----   
## Type 1: with drift and trend   
## lag stat p.value  
## 6 0.0866 0.1  
## -----------   
## Note: p.value = 0.01 means p.value <= 0.01   
## : p.value = 0.10 means p.value >= 0.10

kpss\_tcu\_drift <- kpss.test(tcu)

## KPSS Unit Root Test   
## alternative: nonstationary   
##   
## Type 1: no drift no trend   
## lag stat p.value  
## 5 0.0346 0.1  
## -----   
## Type 2: with drift no trend   
## lag stat p.value  
## 5 0.0738 0.1  
## -----   
## Type 1: with drift and trend   
## lag stat p.value  
## 5 0.0301 0.1  
## -----------   
## Note: p.value = 0.01 means p.value <= 0.01   
## : p.value = 0.10 means p.value >= 0.10

# Run ERS p-test  
ersp\_inflation\_drift <- ur.ers(inflation, model = "constant", lag.max = 12, type = "DF")  
  
ersp\_tcu\_drift <- ur.ers(tcu, model = "constant", lag.max = 12, type = "DF")  
  
# Run ERS DF-GLS  
ersdf\_inflation\_drift <- ur.ers(inflation, model = "constant", lag.max = 12, type = "DF-GLS")  
  
ersdf\_tcu\_drift <- ur.ers(tcu, model = "constant", lag.max = 12, type = "DF-GLS")