Project Appendix

library("dynlm")

## Loading required package: zoo

##   
## Attaching package: 'zoo'

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

library("forecast")  
library("tseries")  
library("quantmod")

## Loading required package: xts

## Loading required package: TTR

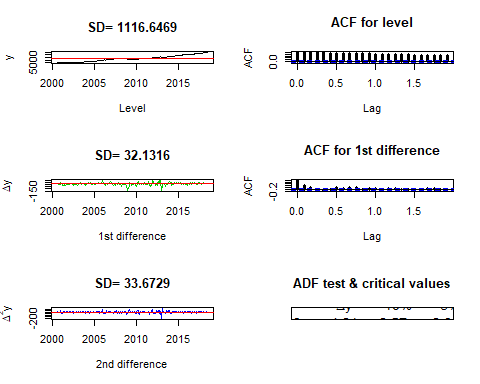
## Version 0.4-0 included new data defaults. See ?getSymbols.

library("stats")  
library("urca")  
library(lmtest)

source(file="intord.R")  
df1<-read.csv("wage and salary.csv")  
df2<-read.csv("consumer loans.csv")  
df3<-read.csv("PCE.csv")  
wage<-ts(df1[,2],frequency = 12,start = c(2000,07))  
loans<-ts(df2[,2],frequency = 12,start = c(2000,07))  
PCE<-ts(df3[,2],frequency = 12,start = c(2000,07))  
#stationarity  
waget=ur.df(wage,type="trend",selectlags = "BIC")  
summary(waget)

##   
## ###############################################   
## # Augmented Dickey-Fuller Test Unit Root Test #   
## ###############################################   
##   
## Test regression trend   
##   
##   
## Call:  
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -191.626 -11.053 1.795 14.489 76.490   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 56.435157 42.270077 1.335 0.183   
## z.lag.1 -0.011168 0.009149 -1.221 0.224   
## tt 0.245370 0.162735 1.508 0.133   
## z.diff.lag 0.443634 0.062300 7.121 1.66e-11 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 28.61 on 211 degrees of freedom  
## Multiple R-squared: 0.2181, Adjusted R-squared: 0.2069   
## F-statistic: 19.61 on 3 and 211 DF, p-value: 2.965e-11  
##   
##   
## Value of test-statistic is: -1.2207 8.2514 2.0006   
##   
## Critical values for test statistics:   
## 1pct 5pct 10pct  
## tau3 -3.99 -3.43 -3.13  
## phi2 6.22 4.75 4.07  
## phi3 8.43 6.49 5.47

intord(wage)



## ADF t-value lags

## $adf.stat  
## round1 round2  
## [1,] 1.08 -4.21  
##   
## $critvals  
## [1] -2.57 -2.88 -3.46

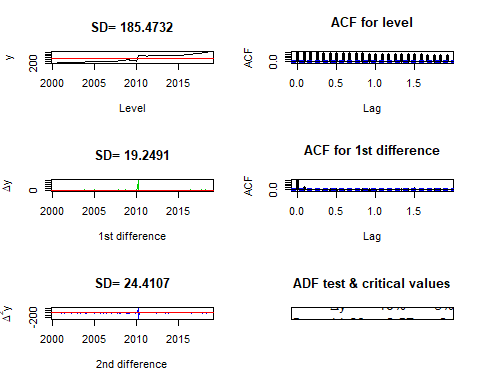
wage1<-diff(wage)  
wage1t=ur.df(wage1,type="trend",selectlags = "BIC")  
summary(wage1t)

##   
## ###############################################   
## # Augmented Dickey-Fuller Test Unit Root Test #   
## ###############################################   
##   
## Test regression trend   
##   
##   
## Call:  
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -187.845 -11.599 0.524 14.838 75.932   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 5.22413 4.01774 1.300 0.1949   
## z.lag.1 -0.60684 0.07319 -8.291 1.34e-14 \*\*\*  
## tt 0.05591 0.03240 1.726 0.0859 .   
## z.diff.lag 0.07217 0.06880 1.049 0.2954   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 28.69 on 210 degrees of freedom  
## Multiple R-squared: 0.287, Adjusted R-squared: 0.2768   
## F-statistic: 28.17 on 3 and 210 DF, p-value: 2.374e-15  
##   
##   
## Value of test-statistic is: -8.2907 22.9144 34.3711   
##   
## Critical values for test statistics:   
## 1pct 5pct 10pct  
## tau3 -3.99 -3.43 -3.13  
## phi2 6.22 4.75 4.07  
## phi3 8.43 6.49 5.47

loanst<-ur.df(loans,type="trend",selectlags = "BIC")  
summary(loanst)

##   
## ###############################################   
## # Augmented Dickey-Fuller Test Unit Root Test #   
## ###############################################   
##   
## Test regression trend   
##   
##   
## Call:  
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -58.029 -3.550 -0.600 2.073 242.131   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.90201 4.22281 2.819 0.005284 \*\*   
## z.lag.1 -0.07382 0.02287 -3.228 0.001444 \*\*   
## tt 0.21858 0.06770 3.229 0.001443 \*\*   
## z.diff.lag 0.23038 0.06684 3.447 0.000685 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 18.55 on 211 degrees of freedom  
## Multiple R-squared: 0.08467, Adjusted R-squared: 0.07166   
## F-statistic: 6.506 on 3 and 211 DF, p-value: 0.0003136  
##   
##   
## Value of test-statistic is: -3.2282 4.5103 5.3351   
##   
## Critical values for test statistics:   
## 1pct 5pct 10pct  
## tau3 -3.99 -3.43 -3.13  
## phi2 6.22 4.75 4.07  
## phi3 8.43 6.49 5.47

intord(loans)



## ADF t-value lags

## $adf.stat  
## round1 round2  
## [1,] -0.55 -11.63  
##   
## $critvals  
## [1] -2.57 -2.88 -3.46

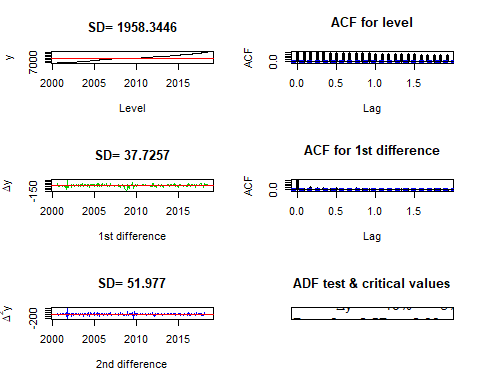
loans1<-diff(loans)  
loans1t<-ur.df(loans1,type="trend",selectlags = "BIC")  
summary(loans1t)

##   
## ###############################################   
## # Augmented Dickey-Fuller Test Unit Root Test #   
## ###############################################   
##   
## Test regression trend   
##   
##   
## Call:  
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -59.853 -3.683 -1.540 0.677 249.113   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.15894 2.61626 0.443 0.658   
## z.lag.1 -0.89780 0.08700 -10.319 <2e-16 \*\*\*  
## tt 0.01154 0.02096 0.550 0.583   
## z.diff.lag 0.11462 0.06855 1.672 0.096 .   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 18.92 on 210 degrees of freedom  
## Multiple R-squared: 0.4106, Adjusted R-squared: 0.4022   
## F-statistic: 48.76 on 3 and 210 DF, p-value: < 2.2e-16  
##   
##   
## Value of test-statistic is: -10.3193 35.496 53.244   
##   
## Critical values for test statistics:   
## 1pct 5pct 10pct  
## tau3 -3.99 -3.43 -3.13  
## phi2 6.22 4.75 4.07  
## phi3 8.43 6.49 5.47

PCEt<-ur.df(PCE,type="trend",selectlags = "BIC")  
summary(PCEt)

##   
## ###############################################   
## # Augmented Dickey-Fuller Test Unit Root Test #   
## ###############################################   
##   
## Test regression trend   
##   
##   
## Call:  
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -167.707 -15.638 0.527 22.733 173.339   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)  
## (Intercept) 37.851749 78.951863 0.479 0.632  
## z.lag.1 -0.001991 0.011795 -0.169 0.866  
## tt 0.133273 0.369612 0.361 0.719  
## z.diff.lag 0.037724 0.069711 0.541 0.589  
##   
## Residual standard error: 37.68 on 211 degrees of freedom  
## Multiple R-squared: 0.0162, Adjusted R-squared: 0.002207   
## F-statistic: 1.158 on 3 and 211 DF, p-value: 0.3269  
##   
##   
## Value of test-statistic is: -0.1688 29.6397 1.4761   
##   
## Critical values for test statistics:   
## 1pct 5pct 10pct  
## tau3 -3.99 -3.43 -3.13  
## phi2 6.22 4.75 4.07  
## phi3 8.43 6.49 5.47

intord(PCE)



## ADF t-value lags

## $adf.stat  
## round1 round2  
## [1,] 1.57 -8  
##   
## $critvals  
## [1] -2.57 -2.88 -3.46

PCE1<-diff(PCE)  
PCE1t<-ur.df(PCE1,type="trend",selectlags = "BIC")  
summary(PCE1t)

##   
## ###############################################   
## # Augmented Dickey-Fuller Test Unit Root Test #   
## ###############################################   
##   
## Test regression trend   
##   
##   
## Call:  
## lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -154.436 -18.240 1.936 22.378 171.810   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 19.28922 5.66152 3.407 0.000787 \*\*\*  
## z.lag.1 -0.80110 0.09405 -8.517 3.15e-15 \*\*\*  
## tt 0.06802 0.04146 1.641 0.102328   
## z.diff.lag -0.17065 0.06769 -2.521 0.012448 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 37 on 210 degrees of freedom  
## Multiple R-squared: 0.5005, Adjusted R-squared: 0.4934   
## F-statistic: 70.15 on 3 and 210 DF, p-value: < 2.2e-16  
##   
##   
## Value of test-statistic is: -8.5174 24.2155 36.3233   
##   
## Critical values for test statistics:   
## 1pct 5pct 10pct  
## tau3 -3.99 -3.43 -3.13  
## phi2 6.22 4.75 4.07  
## phi3 8.43 6.49 5.47

#first difference for everyone  
#dynamic regression  
Reg1<-dynlm(loans1~L(loans1,1:24)+L(wage1,0:24)+L(PCE1,0:24))  
summary(Reg1)

##   
## Time series regression with "ts" data:  
## Start = 2002(8), End = 2018(7)  
##   
## Call:  
## dynlm(formula = loans1 ~ L(loans1, 1:24) + L(wage1, 0:24) + L(PCE1,   
## 0:24))  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -34.407 -6.591 -0.658 5.129 120.051   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.194e+01 6.600e+00 1.809 0.07298 .   
## L(loans1, 1:24)1 -2.912e-02 9.121e-02 -0.319 0.75010   
## L(loans1, 1:24)2 -1.156e-01 9.267e-02 -1.248 0.21468   
## L(loans1, 1:24)3 7.107e-03 9.135e-02 0.078 0.93812   
## L(loans1, 1:24)4 -1.381e-01 9.115e-02 -1.515 0.13243   
## L(loans1, 1:24)5 -1.035e-02 9.210e-02 -0.112 0.91074   
## L(loans1, 1:24)6 -4.057e-05 9.155e-02 0.000 0.99965   
## L(loans1, 1:24)7 -3.635e-03 8.888e-02 -0.041 0.96745   
## L(loans1, 1:24)8 3.192e-02 8.463e-02 0.377 0.70674   
## L(loans1, 1:24)9 3.494e-02 8.403e-02 0.416 0.67832   
## L(loans1, 1:24)10 -1.150e-02 8.156e-02 -0.141 0.88809   
## L(loans1, 1:24)11 9.216e-03 8.030e-02 0.115 0.90882   
## L(loans1, 1:24)12 -5.882e-02 7.696e-02 -0.764 0.44622   
## L(loans1, 1:24)13 -1.294e-02 7.688e-02 -0.168 0.86659   
## L(loans1, 1:24)14 -6.515e-02 7.675e-02 -0.849 0.39767   
## L(loans1, 1:24)15 2.896e-02 7.691e-02 0.377 0.70714   
## L(loans1, 1:24)16 4.460e-02 7.828e-02 0.570 0.56997   
## L(loans1, 1:24)17 4.063e-02 7.721e-02 0.526 0.59973   
## L(loans1, 1:24)18 2.903e-02 7.478e-02 0.388 0.69857   
## L(loans1, 1:24)19 -6.030e-02 7.435e-02 -0.811 0.41904   
## L(loans1, 1:24)20 -1.165e-02 7.446e-02 -0.156 0.87593   
## L(loans1, 1:24)21 -6.300e-02 7.459e-02 -0.845 0.40007   
## L(loans1, 1:24)22 -4.101e-02 7.526e-02 -0.545 0.58686   
## L(loans1, 1:24)23 6.602e-02 7.569e-02 0.872 0.38483   
## L(loans1, 1:24)24 1.023e-01 7.522e-02 1.361 0.17627   
## L(wage1, 0:24)0 1.762e-01 6.581e-02 2.677 0.00848 \*\*  
## L(wage1, 0:24)1 -2.800e-02 7.035e-02 -0.398 0.69129   
## L(wage1, 0:24)2 -7.498e-02 7.082e-02 -1.059 0.29195   
## L(wage1, 0:24)3 -7.144e-02 7.037e-02 -1.015 0.31205   
## L(wage1, 0:24)4 1.559e-01 7.227e-02 2.157 0.03303 \*   
## L(wage1, 0:24)5 5.032e-02 7.366e-02 0.683 0.49583   
## L(wage1, 0:24)6 -5.274e-02 7.292e-02 -0.723 0.47103   
## L(wage1, 0:24)7 -3.859e-02 7.281e-02 -0.530 0.59712   
## L(wage1, 0:24)8 6.932e-02 7.163e-02 0.968 0.33513   
## L(wage1, 0:24)9 2.709e-02 7.084e-02 0.382 0.70287   
## L(wage1, 0:24)10 1.448e-02 7.153e-02 0.202 0.83989   
## L(wage1, 0:24)11 -2.924e-02 7.136e-02 -0.410 0.68272   
## L(wage1, 0:24)12 8.311e-02 7.090e-02 1.172 0.24347   
## L(wage1, 0:24)13 4.476e-03 6.990e-02 0.064 0.94906   
## L(wage1, 0:24)14 -1.453e-02 6.902e-02 -0.211 0.83361   
## L(wage1, 0:24)15 -1.559e-01 6.822e-02 -2.285 0.02410 \*   
## L(wage1, 0:24)16 1.864e-04 6.806e-02 0.003 0.99782   
## L(wage1, 0:24)17 -2.979e-02 6.817e-02 -0.437 0.66287   
## L(wage1, 0:24)18 1.237e-01 6.706e-02 1.845 0.06755 .   
## L(wage1, 0:24)19 -2.515e-03 6.700e-02 -0.038 0.97012   
## L(wage1, 0:24)20 2.197e-02 6.639e-02 0.331 0.74130   
## L(wage1, 0:24)21 -4.192e-02 6.428e-02 -0.652 0.51560   
## L(wage1, 0:24)22 8.156e-02 6.474e-02 1.260 0.21021   
## L(wage1, 0:24)23 2.875e-02 6.534e-02 0.440 0.66079   
## L(wage1, 0:24)24 -2.107e-02 6.314e-02 -0.334 0.73919   
## L(PCE1, 0:24)0 3.063e-02 4.376e-02 0.700 0.48530   
## L(PCE1, 0:24)1 -2.389e-02 4.510e-02 -0.530 0.59738   
## L(PCE1, 0:24)2 -1.486e-01 4.762e-02 -3.120 0.00228 \*\*  
## L(PCE1, 0:24)3 -3.673e-02 4.813e-02 -0.763 0.44686   
## L(PCE1, 0:24)4 6.333e-02 4.814e-02 1.316 0.19086   
## L(PCE1, 0:24)5 4.690e-02 4.855e-02 0.966 0.33597   
## L(PCE1, 0:24)6 7.747e-03 4.882e-02 0.159 0.87420   
## L(PCE1, 0:24)7 -1.243e-01 5.087e-02 -2.443 0.01608 \*   
## L(PCE1, 0:24)8 1.417e-01 5.135e-02 2.760 0.00670 \*\*  
## L(PCE1, 0:24)9 2.139e-02 5.298e-02 0.404 0.68711   
## L(PCE1, 0:24)10 1.895e-02 4.810e-02 0.394 0.69426   
## L(PCE1, 0:24)11 -3.246e-03 4.704e-02 -0.069 0.94510   
## L(PCE1, 0:24)12 -2.359e-02 4.698e-02 -0.502 0.61658   
## L(PCE1, 0:24)13 -4.106e-02 4.716e-02 -0.871 0.38568   
## L(PCE1, 0:24)14 -4.861e-03 4.718e-02 -0.103 0.91811   
## L(PCE1, 0:24)15 4.630e-02 4.667e-02 0.992 0.32320   
## L(PCE1, 0:24)16 -8.698e-02 4.628e-02 -1.879 0.06269 .   
## L(PCE1, 0:24)17 -1.571e-01 4.730e-02 -3.321 0.00120 \*\*  
## L(PCE1, 0:24)18 -1.066e-01 4.989e-02 -2.136 0.03473 \*   
## L(PCE1, 0:24)19 -6.720e-02 5.054e-02 -1.329 0.18627   
## L(PCE1, 0:24)20 -6.740e-02 5.028e-02 -1.341 0.18265   
## L(PCE1, 0:24)21 -4.892e-02 5.057e-02 -0.967 0.33539   
## L(PCE1, 0:24)22 5.189e-02 5.101e-02 1.017 0.31106   
## L(PCE1, 0:24)23 3.353e-02 4.976e-02 0.674 0.50181   
## L(PCE1, 0:24)24 5.470e-02 4.804e-02 1.139 0.25716   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 17.61 on 117 degrees of freedom  
## Multiple R-squared: 0.541, Adjusted R-squared: 0.2508   
## F-statistic: 1.864 on 74 and 117 DF, p-value: 0.00127

#0 #18 #18 #2002,8  
Reg2<-dynlm(loans1~L(wage1,0:18)+L(PCE1,0:18),start = c(2002,8))  
summary(Reg2)

##   
## Time series regression with "ts" data:  
## Start = 2002(8), End = 2018(7)  
##   
## Call:  
## dynlm(formula = loans1 ~ L(wage1, 0:18) + L(PCE1, 0:18), start = c(2002,   
## 8))  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -32.508 -8.254 -1.370 6.563 144.342   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.9320407 4.5629155 2.396 0.01779 \*   
## L(wage1, 0:18)0 0.1504371 0.0554424 2.713 0.00742 \*\*   
## L(wage1, 0:18)1 -0.0246804 0.0577573 -0.427 0.66975   
## L(wage1, 0:18)2 -0.0423681 0.0582083 -0.728 0.46781   
## L(wage1, 0:18)3 -0.0526044 0.0589693 -0.892 0.37376   
## L(wage1, 0:18)4 0.1006132 0.0614967 1.636 0.10388   
## L(wage1, 0:18)5 0.0438416 0.0606690 0.723 0.47101   
## L(wage1, 0:18)6 -0.0623024 0.0614527 -1.014 0.31227   
## L(wage1, 0:18)7 -0.0312957 0.0625244 -0.501 0.61742   
## L(wage1, 0:18)8 0.0785837 0.0616867 1.274 0.20462   
## L(wage1, 0:18)9 0.0241954 0.0607440 0.398 0.69095   
## L(wage1, 0:18)10 -0.0044364 0.0610378 -0.073 0.94215   
## L(wage1, 0:18)11 -0.0331759 0.0614543 -0.540 0.59009   
## L(wage1, 0:18)12 0.0782382 0.0599657 1.305 0.19395   
## L(wage1, 0:18)13 0.0038111 0.0593555 0.064 0.94889   
## L(wage1, 0:18)14 0.0004121 0.0589296 0.007 0.99443   
## L(wage1, 0:18)15 -0.1444220 0.0565842 -2.552 0.01168 \*   
## L(wage1, 0:18)16 -0.0255046 0.0552019 -0.462 0.64472   
## L(wage1, 0:18)17 0.0031157 0.0550242 0.057 0.95492   
## L(wage1, 0:18)18 0.0987216 0.0504059 1.959 0.05199 .   
## L(PCE1, 0:18)0 0.0054789 0.0393954 0.139 0.88957   
## L(PCE1, 0:18)1 -0.0148906 0.0409359 -0.364 0.71654   
## L(PCE1, 0:18)2 -0.1157046 0.0424979 -2.723 0.00723 \*\*   
## L(PCE1, 0:18)3 -0.0286817 0.0424380 -0.676 0.50016   
## L(PCE1, 0:18)4 0.0709475 0.0433765 1.636 0.10397   
## L(PCE1, 0:18)5 0.0432506 0.0438253 0.987 0.32526   
## L(PCE1, 0:18)6 0.0004395 0.0437823 0.010 0.99200   
## L(PCE1, 0:18)7 -0.1137567 0.0449693 -2.530 0.01243 \*   
## L(PCE1, 0:18)8 0.1403715 0.0448754 3.128 0.00211 \*\*   
## L(PCE1, 0:18)9 0.0230298 0.0450315 0.511 0.60980   
## L(PCE1, 0:18)10 -0.0019488 0.0416375 -0.047 0.96273   
## L(PCE1, 0:18)11 -0.0018727 0.0410894 -0.046 0.96371   
## L(PCE1, 0:18)12 -0.0430723 0.0406349 -1.060 0.29082   
## L(PCE1, 0:18)13 -0.0279008 0.0404158 -0.690 0.49102   
## L(PCE1, 0:18)14 0.0159582 0.0407506 0.392 0.69589   
## L(PCE1, 0:18)15 0.0433896 0.0402918 1.077 0.28323   
## L(PCE1, 0:18)16 -0.0958020 0.0401495 -2.386 0.01825 \*   
## L(PCE1, 0:18)17 -0.1595518 0.0395282 -4.036 8.55e-05 \*\*\*  
## L(PCE1, 0:18)18 -0.0884847 0.0392268 -2.256 0.02551 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 16.97 on 153 degrees of freedom  
## Multiple R-squared: 0.4422, Adjusted R-squared: 0.3036   
## F-statistic: 3.192 on 38 and 153 DF, p-value: 2.366e-07

AIC(Reg1)

## [1] 1703.166

BIC(Reg1)

## [1] 1950.736

AIC(Reg2)

## [1] 1668.623

BIC(Reg2)

## [1] 1798.923

#seasonality  
seawage<-seasonaldummy(wage1)  
s1<-dynlm(wage1~seawage)  
sealoans<-seasonaldummy(loans1)  
s2<-dynlm(loans1~sealoans)  
seapce<-seasonaldummy(PCE1)  
s3<-dynlm(PCE1~seapce)  
summary(s1)

##   
## Time series regression with "ts" data:  
## Start = 2000(8), End = 2018(7)  
##   
## Call:  
## dynlm(formula = wage1 ~ seawage)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -162.794 -15.747 2.381 15.579 87.306   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 23.889 7.733 3.089 0.00229 \*\*  
## seawageJan -8.294 10.936 -0.758 0.44907   
## seawageFeb -7.867 10.936 -0.719 0.47277   
## seawageMar -5.778 10.936 -0.528 0.59786   
## seawageApr -4.561 10.936 -0.417 0.67707   
## seawageMay -8.083 10.936 -0.739 0.46068   
## seawageJun -5.717 10.936 -0.523 0.60174   
## seawageJul -5.961 10.936 -0.545 0.58630   
## seawageAug -8.317 10.936 -0.760 0.44786   
## seawageSep -2.972 10.936 -0.272 0.78607   
## seawageOct -4.244 10.936 -0.388 0.69834   
## seawageNov -1.972 10.936 -0.180 0.85707   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 32.81 on 204 degrees of freedom  
## Multiple R-squared: 0.006473, Adjusted R-squared: -0.0471   
## F-statistic: 0.1208 on 11 and 204 DF, p-value: 0.9998

summary(s2)

##   
## Time series regression with "ts" data:  
## Start = 2000(8), End = 2018(7)  
##   
## Call:  
## dynlm(formula = loans1 ~ sealoans)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -30.698 -3.976 -0.479 1.751 249.543   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.8600 4.5269 0.632 0.5282   
## sealoansJan -1.5081 6.4020 -0.236 0.8140   
## sealoansFeb -4.5699 6.4020 -0.714 0.4762   
## sealoansMar -0.6528 6.4020 -0.102 0.9189   
## sealoansApr 13.5422 6.4020 2.115 0.0356 \*  
## sealoansMay -1.0174 6.4020 -0.159 0.8739   
## sealoansJun -2.3341 6.4020 -0.365 0.7158   
## sealoansJul -2.0421 6.4020 -0.319 0.7501   
## sealoansAug -1.0180 6.4020 -0.159 0.8738   
## sealoansSep -1.5958 6.4020 -0.249 0.8034   
## sealoansOct -1.7186 6.4020 -0.268 0.7886   
## sealoansNov 1.0078 6.4020 0.157 0.8751   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 19.21 on 204 degrees of freedom  
## Multiple R-squared: 0.05105, Adjusted R-squared: -0.0001238   
## F-statistic: 0.9976 on 11 and 204 DF, p-value: 0.4498

summary(s3)

##   
## Time series regression with "ts" data:  
## Start = 2000(8), End = 2018(7)  
##   
## Call:  
## dynlm(formula = PCE1 ~ seapce)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -162.500 -16.383 1.472 21.268 156.172   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 26.500 8.947 2.962 0.00342 \*\*  
## seapceJan 7.494 12.654 0.592 0.55432   
## seapceFeb 1.389 12.654 0.110 0.91271   
## seapceMar 10.878 12.654 0.860 0.39098   
## seapceApr 12.411 12.654 0.981 0.32783   
## seapceMay 7.061 12.654 0.558 0.57743   
## seapceJun 9.494 12.654 0.750 0.45392   
## seapceJul 17.678 12.654 1.397 0.16391   
## seapceAug 13.839 12.654 1.094 0.27539   
## seapceSep -5.322 12.654 -0.421 0.67448   
## seapceOct 12.928 12.654 1.022 0.30815   
## seapceNov -3.500 12.654 -0.277 0.78237   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 37.96 on 204 degrees of freedom  
## Multiple R-squared: 0.03483, Adjusted R-squared: -0.01722   
## F-statistic: 0.6692 on 11 and 204 DF, p-value: 0.7667

Regx<-dynlm(loans1~L(wage1,0:18)+L(PCE1,0:18)+sealoans,start = c(2002,8))  
summary(Regx)

##   
## Time series regression with "ts" data:  
## Start = 2002(8), End = 2018(7)  
##   
## Call:  
## dynlm(formula = loans1 ~ L(wage1, 0:18) + L(PCE1, 0:18) + sealoans,   
## start = c(2002, 8))  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -32.129 -7.224 -0.841 7.078 139.074   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 9.617493 6.456317 1.490 0.13854   
## L(wage1, 0:18)0 0.138823 0.058245 2.383 0.01847 \*   
## L(wage1, 0:18)1 -0.026993 0.060933 -0.443 0.65844   
## L(wage1, 0:18)2 -0.035384 0.061404 -0.576 0.56536   
## L(wage1, 0:18)3 -0.046403 0.062016 -0.748 0.45554   
## L(wage1, 0:18)4 0.077445 0.064820 1.195 0.23417   
## L(wage1, 0:18)5 0.046965 0.063926 0.735 0.46375   
## L(wage1, 0:18)6 -0.059224 0.064949 -0.912 0.36339   
## L(wage1, 0:18)7 -0.030190 0.066113 -0.457 0.64862   
## L(wage1, 0:18)8 0.079882 0.064961 1.230 0.22084   
## L(wage1, 0:18)9 0.011903 0.063718 0.187 0.85208   
## L(wage1, 0:18)10 0.003898 0.063979 0.061 0.95150   
## L(wage1, 0:18)11 -0.017669 0.064510 -0.274 0.78456   
## L(wage1, 0:18)12 0.074759 0.062935 1.188 0.23687   
## L(wage1, 0:18)13 -0.010119 0.062305 -0.162 0.87121   
## L(wage1, 0:18)14 0.003170 0.061837 0.051 0.95919   
## L(wage1, 0:18)15 -0.115451 0.059613 -1.937 0.05477 .   
## L(wage1, 0:18)16 -0.044628 0.057781 -0.772 0.44119   
## L(wage1, 0:18)17 -0.003168 0.057733 -0.055 0.95632   
## L(wage1, 0:18)18 0.107114 0.052718 2.032 0.04404 \*   
## L(PCE1, 0:18)0 -0.003737 0.041011 -0.091 0.92752   
## L(PCE1, 0:18)1 -0.013321 0.042723 -0.312 0.75565   
## L(PCE1, 0:18)2 -0.101704 0.044721 -2.274 0.02445 \*   
## L(PCE1, 0:18)3 -0.034042 0.044644 -0.763 0.44702   
## L(PCE1, 0:18)4 0.075405 0.045468 1.658 0.09944 .   
## L(PCE1, 0:18)5 0.043711 0.045856 0.953 0.34210   
## L(PCE1, 0:18)6 0.001675 0.045696 0.037 0.97082   
## L(PCE1, 0:18)7 -0.099038 0.047004 -2.107 0.03687 \*   
## L(PCE1, 0:18)8 0.134632 0.046878 2.872 0.00470 \*\*   
## L(PCE1, 0:18)9 0.014595 0.047080 0.310 0.75701   
## L(PCE1, 0:18)10 0.001055 0.043474 0.024 0.98068   
## L(PCE1, 0:18)11 0.004590 0.043298 0.106 0.91573   
## L(PCE1, 0:18)12 -0.052290 0.042845 -1.220 0.22432   
## L(PCE1, 0:18)13 -0.035254 0.042736 -0.825 0.41080   
## L(PCE1, 0:18)14 0.022159 0.043436 0.510 0.61073   
## L(PCE1, 0:18)15 0.037023 0.042983 0.861 0.39050   
## L(PCE1, 0:18)16 -0.089501 0.042744 -2.094 0.03805 \*   
## L(PCE1, 0:18)17 -0.154396 0.041853 -3.689 0.00032 \*\*\*  
## L(PCE1, 0:18)18 -0.097658 0.041677 -2.343 0.02051 \*   
## sealoansJan 2.893853 6.676375 0.433 0.66535   
## sealoansFeb -2.056421 6.674021 -0.308 0.75844   
## sealoansMar 0.073498 6.591936 0.011 0.99112   
## sealoansApr 10.735479 6.664038 1.611 0.10941   
## sealoansMay -0.839286 6.631545 -0.127 0.89947   
## sealoansJun -0.391387 6.742498 -0.058 0.95379   
## sealoansJul 1.854588 6.657971 0.279 0.78099   
## sealoansAug 2.202555 6.692659 0.329 0.74256   
## sealoansSep -0.225632 6.583368 -0.034 0.97271   
## sealoansOct 0.844601 6.676265 0.127 0.89951   
## sealoansNov 1.062327 6.649964 0.160 0.87331   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 17.3 on 142 degrees of freedom  
## Multiple R-squared: 0.4622, Adjusted R-squared: 0.2766   
## F-statistic: 2.491 on 49 and 142 DF, p-value: 1.554e-05

anova(Regx,Reg2,test="F") #cannot reject the null dummy avoid

## Analysis of Variance Table  
##   
## Model 1: loans1 ~ L(wage1, 0:18) + L(PCE1, 0:18) + sealoans  
## Model 2: loans1 ~ L(wage1, 0:18) + L(PCE1, 0:18)  
## Res.Df RSS Df Sum of Sq F Pr(>F)  
## 1 142 42494   
## 2 153 44077 -11 -1582.9 0.4809 0.9127

bgtest(Reg2,order=1)

##   
## Breusch-Godfrey test for serial correlation of order up to 1  
##   
## data: Reg2  
## LM test = 0.2401, df = 1, p-value = 0.6241

bgtest(Reg2,order=2)

##   
## Breusch-Godfrey test for serial correlation of order up to 2  
##   
## data: Reg2  
## LM test = 2.2336, df = 2, p-value = 0.3273

bgtest(Reg2,order=3)

##   
## Breusch-Godfrey test for serial correlation of order up to 3  
##   
## data: Reg2  
## LM test = 2.3926, df = 3, p-value = 0.495

bgtest(Reg2,order=4)

##   
## Breusch-Godfrey test for serial correlation of order up to 4  
##   
## data: Reg2  
## LM test = 8.1742, df = 4, p-value = 0.0854

bgtest(Reg2,order=5)

##   
## Breusch-Godfrey test for serial correlation of order up to 5  
##   
## data: Reg2  
## LM test = 8.4374, df = 5, p-value = 0.1337

bgtest(Reg2,order=6)

##   
## Breusch-Godfrey test for serial correlation of order up to 6  
##   
## data: Reg2  
## LM test = 8.4565, df = 6, p-value = 0.2065

RegY<-dynlm(loans1~L(wage1,0:22)+L(PCE1,0:20),start = c(2002,8))  
summary(RegY)

##   
## Time series regression with "ts" data:  
## Start = 2002(8), End = 2018(7)  
##   
## Call:  
## dynlm(formula = loans1 ~ L(wage1, 0:22) + L(PCE1, 0:20), start = c(2002,   
## 8))  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -35.967 -7.926 -0.227 6.553 139.476   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.973086 4.884087 2.451 0.015400 \*   
## L(wage1, 0:22)0 0.159605 0.057018 2.799 0.005811 \*\*   
## L(wage1, 0:22)1 -0.038084 0.058555 -0.650 0.516451   
## L(wage1, 0:22)2 -0.041882 0.058699 -0.714 0.476665   
## L(wage1, 0:22)3 -0.045093 0.059840 -0.754 0.452322   
## L(wage1, 0:22)4 0.115313 0.062459 1.846 0.066873 .   
## L(wage1, 0:22)5 0.048619 0.062170 0.782 0.435458   
## L(wage1, 0:22)6 -0.057415 0.062777 -0.915 0.361905   
## L(wage1, 0:22)7 -0.037239 0.062990 -0.591 0.555302   
## L(wage1, 0:22)8 0.074508 0.062707 1.188 0.236678   
## L(wage1, 0:22)9 0.034015 0.062692 0.543 0.588241   
## L(wage1, 0:22)10 0.005475 0.063282 0.087 0.931174   
## L(wage1, 0:22)11 -0.055023 0.062878 -0.875 0.382957   
## L(wage1, 0:22)12 0.095050 0.062014 1.533 0.127497   
## L(wage1, 0:22)13 -0.005191 0.061455 -0.084 0.932798   
## L(wage1, 0:22)14 -0.008374 0.060347 -0.139 0.889827   
## L(wage1, 0:22)15 -0.127510 0.060124 -2.121 0.035617 \*   
## L(wage1, 0:22)16 -0.011306 0.059124 -0.191 0.848619   
## L(wage1, 0:22)17 0.014088 0.058252 0.242 0.809239   
## L(wage1, 0:22)18 0.119303 0.057038 2.092 0.038193 \*   
## L(wage1, 0:22)19 0.019111 0.055510 0.344 0.731126   
## L(wage1, 0:22)20 0.038495 0.054880 0.701 0.484137   
## L(wage1, 0:22)21 -0.011774 0.054871 -0.215 0.830401   
## L(wage1, 0:22)22 0.086576 0.050356 1.719 0.087669 .   
## L(PCE1, 0:20)0 0.008718 0.039564 0.220 0.825899   
## L(PCE1, 0:20)1 -0.018942 0.041146 -0.460 0.645931   
## L(PCE1, 0:20)2 -0.118058 0.042938 -2.749 0.006719 \*\*   
## L(PCE1, 0:20)3 -0.030820 0.042811 -0.720 0.472730   
## L(PCE1, 0:20)4 0.061683 0.043582 1.415 0.159089   
## L(PCE1, 0:20)5 0.041671 0.043914 0.949 0.344220   
## L(PCE1, 0:20)6 -0.004716 0.044239 -0.107 0.915241   
## L(PCE1, 0:20)7 -0.118018 0.045622 -2.587 0.010656 \*   
## L(PCE1, 0:20)8 0.141425 0.045320 3.121 0.002173 \*\*   
## L(PCE1, 0:20)9 0.027004 0.045696 0.591 0.555457   
## L(PCE1, 0:20)10 0.003158 0.042017 0.075 0.940190   
## L(PCE1, 0:20)11 -0.001309 0.041530 -0.032 0.974898   
## L(PCE1, 0:20)12 -0.046264 0.041518 -1.114 0.266959   
## L(PCE1, 0:20)13 -0.038641 0.041264 -0.936 0.350581   
## L(PCE1, 0:20)14 0.006991 0.041405 0.169 0.866146   
## L(PCE1, 0:20)15 0.045381 0.040866 1.110 0.268601   
## L(PCE1, 0:20)16 -0.097966 0.040716 -2.406 0.017367 \*   
## L(PCE1, 0:20)17 -0.161152 0.040908 -3.939 0.000126 \*\*\*  
## L(PCE1, 0:20)18 -0.100469 0.041145 -2.442 0.015801 \*   
## L(PCE1, 0:20)19 -0.060147 0.040904 -1.470 0.143577   
## L(PCE1, 0:20)20 -0.035305 0.039856 -0.886 0.377163   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 16.97 on 147 degrees of freedom  
## Multiple R-squared: 0.4641, Adjusted R-squared: 0.3037   
## F-statistic: 2.893 on 44 and 147 DF, p-value: 9.668e-07

AIC(RegY)

## [1] 1672.936

BIC(RegY)

## [1] 1822.78

AIC(Reg2)

## [1] 1668.623

BIC(Reg2)

## [1] 1798.923

bgtest(RegY,order=1)

##   
## Breusch-Godfrey test for serial correlation of order up to 1  
##   
## data: RegY  
## LM test = 0.027575, df = 1, p-value = 0.8681

bgtest(RegY,order=2)

##   
## Breusch-Godfrey test for serial correlation of order up to 2  
##   
## data: RegY  
## LM test = 2.3022, df = 2, p-value = 0.3163

bgtest(RegY,order=3)

##   
## Breusch-Godfrey test for serial correlation of order up to 3  
##   
## data: RegY  
## LM test = 2.6069, df = 3, p-value = 0.4563

bgtest(RegY,order=4)

##   
## Breusch-Godfrey test for serial correlation of order up to 4  
##   
## data: RegY  
## LM test = 7.4603, df = 4, p-value = 0.1135

bgtest(RegY,order=5)

##   
## Breusch-Godfrey test for serial correlation of order up to 5  
##   
## data: RegY  
## LM test = 7.5667, df = 5, p-value = 0.1818

bgtest(RegY,order=6)

##   
## Breusch-Godfrey test for serial correlation of order up to 6  
##   
## data: RegY  
## LM test = 7.7115, df = 6, p-value = 0.26

Reg11<-dynlm(loans1~L(wage1,0:22),start = c(2002,8))  
anova(Reg11,RegY,test="F")

## Analysis of Variance Table  
##   
## Model 1: loans1 ~ L(wage1, 0:22)  
## Model 2: loans1 ~ L(wage1, 0:22) + L(PCE1, 0:20)  
## Res.Df RSS Df Sum of Sq F Pr(>F)   
## 1 168 58743   
## 2 147 42347 21 16396 2.7103 0.0002563 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Reg12<-dynlm(loans1~L(PCE1,0:20),start = c(2002,8))  
anova(Reg12,RegY,test="F")

## Analysis of Variance Table  
##   
## Model 1: loans1 ~ L(PCE1, 0:20)  
## Model 2: loans1 ~ L(wage1, 0:22) + L(PCE1, 0:20)  
## Res.Df RSS Df Sum of Sq F Pr(>F)   
## 1 170 54047   
## 2 147 42347 23 11699 1.7657 0.02344 \*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1