Assignment3

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```r
library("readxl")
library('openxlsx')
library('lubridate')
```

```
##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```r
library('tidyverse')
```

```
## -- Attaching packages ---------------

## v ggplot2 3.3.2     v purrr   0.3.4
## v tibble  3.0.3     v dplyr   1.0.1
## v tidyr   1.1.1     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0

## -- Conflicts ------------------------
## x lubridate::as.difftime() masks base::as.difftime()
## x lubridate::date()        masks base::date()
## x dplyr::filter()          masks stats::filter()
## x lubridate::intersect()   masks base::intersect()
## x dplyr::lag()             masks stats::lag()
## x lubridate::setdiff()     masks base::setdiff()
## x lubridate::union()       masks base::union()
```

```r
library('zoo')
```

```
##
## Attaching package: 'zoo'

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

###Treasury

```
treasury <- read_excel("P:/Mgt_of_FI/Assignment3/ta-us-treasury-trading-volume-sifma.xls", sheet = 3, sk
                       col_types = "guess")

treasury <- head(treasury, -5)

colnames(treasury)[1] <- "Date"


treasury$Date <- convertToDate(treasury$Date)
treasury$Date[1] <- ymd(as.character('2001-01-31'))
for (i in 1:5) {
  treasury$Date[1+i] <- ymd(treasury$Date[i])%m+% months(1)
}

treasury$Date <- strftime(treasury$Date,format="%Y-%m")

names(treasury)[11] <- "Total"

treasury$`Coupon Securities Due in 3 Years or Less` <- NA
treasury$`Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years` <- NA

treasury$`Coupon Securities Due in 3 Years or Less` <- ifelse(treasury$Date<="2013-03",
                                                              treasury$`Coupon Securities Due in 2 Years

treasury$`Coupon Securities Due in 2 Years or Less`  <- ifelse(treasury$Date<="2013-03", NA, treasury$`C



treasury$`Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years`  <- ifelse(trea

treasury$`Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years`  <- ifelse(treas

treasury[-1] <- sapply(treasury[-1], as.numeric)
```

###agency

```
agency <- read_excel("P:/Mgt_of_FI/Assignment3/ta-us-agency-trading-volume-sifma.xls", sheet = 1, skip =

agency <- head(agency, -4)

colnames(agency)[1] <- "Date"

agency$Date <- convertToDate(agency$Date)

agency$Date <- strftime(agency$Date,format="%Y-%m")

names(agency)[5] <- "Other"
```

###sf

```
sf <- read_excel("P:/Mgt_of_FI/Assignment3/sf-us-sf-trading-volume-sifma.xls", sheet = 2, skip = 5)

sf <- sf[-c(1:9),]
```

```r
colnames(sf)[1] <- "Date"

sf$Date <- convertToDate(sf$Date)

sf$Date <- strftime(sf$Date,format="%Y-%m")

colnames(sf)[4] <- "Total, Agency Volume Reported by Primary Dealers"
colnames(sf)[9] <- "Total, Agency Volume"
colnames(sf)[20] <- "Total, Non-Agency Volume"

sf <- sf[,-c(5,10,21)]

sf[-1] <- sapply(sf[-1], as.numeric)

sf$Total <- sf$`Total, Agency Volume Reported by Primary Dealers`+sf$`Total, Agency Volume`+sf$`Total, N
```

###corporate

```r
corporate <- read_excel("P:/Mgt_of_FI/Assignment3/corporate-us-corporate-trading-volume-sifma.xls", shee

corporate <- corporate[,-c(5,9,13)]
corporate <- head(corporate, -4)

colnames(corporate) <- c("Date", "Investment Grade, Publicly Traded", "High Yield, Publicly Traded", "To
                         "Investment Grade, 144A", "High Yield, 144A", "Total, 144A", "Investment Grade
                         "Total, Convertible")
corporate$Date <- convertToDate(corporate$Date)
corporate$Date <- strftime(corporate$Date,format="%Y-%m")

corporate$Total <- corporate$`Total, Publicly Traded`+corporate$`Total, 144A`+corporate$`Total, Total No
```

###fixedincome

```r
fixedincome <- read_excel("P:/Mgt_of_FI/Assignment3/CM-US-Fixed-Income-Trading-Volume-SIFMA.xls", sheet
fixedincome <- fixedincome[-c(1:25),]
fixedincome <- head(fixedincome, -4)
fixedincome <- fixedincome[-c(14,28),]


colnames(fixedincome)[1] <- "Date"



for (i in 1:nrow(fixedincome)) {
  if (i>1 & i <14) {
    fixedincome$Date[i] <- as.Date(paste("2018",as.character(match(fixedincome$Date[i],month.abb)), "01
                                   format = "%Y%m%d") %>% ymd %>% strftime(format="%Y-%m")
  }
  if (i>14 & i <27) {
    fixedincome$Date[i]<- as.Date(paste("2019",as.character(match(fixedincome$Date[i],month.abb)), "01")
```

```r
                                    format = "%Y%m%d") %>% ymd %>% strftime(format="%Y-%m")
  }
  if (i>27) {
    fixedincome$Date[i]<- as.Date(paste("2020",as.character(match(fixedincome$Date[i],month.abb)), "01"
                                      format = "%Y%m%d") %>% ymd %>% strftime(format="%Y-%m")
  }
}

fixedincome <- fixedincome[-c(1,14,27),]

fixedincome[-1] <- sapply(fixedincome[-1], as.numeric)
fixedincome$Total <- rowSums(fixedincome[c(2:8)])
```

###equity

```r
equity <- read_excel("P:/Mgt_of_FI/Assignment3/CM-US-Equity-SIFMA.xls", sheet = 3, skip = 5)
names(equity)[c(3:7)] <- colnames(equity)[2]
names(equity)[c(10:14)] <- colnames(equity)[9]

equity <- equity[,-c(2:8,15:42)]
names(equity)<- paste(equity[1,], colnames(equity), sep=’, ’)
equity <- equity[-c(1:14),]


colnames(equity)[1] <- "Date"


equity$Date <- convertToDate(equity$Date)
equity$Date <- strftime(equity$Date,format="%Y-%m")

equity[-1] <- sapply(equity[-1], as.numeric)

equity$Total <- rowSums(equity[c(-1)])
```

###repo

```r
repo <- read_excel("P:/Mgt_of_FI/Assignment3/Funding-US-Repo-SIFMA.xlsx", sheet = 3, skip = 3)

colnames(repo)[3] <- "Repurchase"
colnames(repo)[7] <- "Reverse Repurchase"
colnames(repo)[13] <- "Repurchase"
colnames(repo)[22] <- "Reverse Repurchase"

names(repo)[c(4:5)] <- colnames(repo)[3]
names(repo)[c(8:9)] <- colnames(repo)[7]
names(repo)[c(14:20)] <- colnames(repo)[13]
names(repo)[c(23:29)] <- colnames(repo)[22]

repo <- repo[,-c(6,10,12,21)]

names(repo)<- paste(repo[1,], colnames(repo), sep=’, ’)

repo <- repo[-c(1:86),]
```

```r
repo[1] <- na.locf(repo[1])

repo[1] <- as.Date(paste(repo[[1]],as.character(repo[[2]]), "01"),
                                    format = "%Y%m%d") %>% ymd %>% strftime(format="%Y-%m")

repo <- repo[-2]

names(repo)[1] <- "Date"

repo[-1] <- sapply(repo[-1], as.numeric)
```

###get macroecon indicators

```r
library(quantmod)
```

```
## Loading required package: xts

##
## Attaching package: 'xts'

## The following objects are masked from 'package:dplyr':
##
##     first, last

## Loading required package: TTR

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

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

```r
#unemployment rate
unrate <- getSymbols("UNRATE", src = "FRED", auto.assign = FALSE, row.names="Date")
```

```
## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
```

```r
unrate$Date <- NA
unrate$Date <- as.character(index(unrate))
unrate$Date <- strftime(unrate$Date,format="%Y-%m")
names(unrate)[1] <- "Unemployment"

# Producer Price Index by Commodity: All Commodities
```

```r
ppi <- getSymbols("PPIACO", src = "FRED", auto.assign = FALSE)

ppi$Date <- NA
ppi$Date <- as.character(index(ppi))
ppi$Date <- strftime(ppi$Date,format="%Y-%m")
names(ppi)[1] <- "PPI"

#Interest Rates, Discount Rate for United States
r <- getSymbols("INTDSRUSM193N", src = "FRED", auto.assign = FALSE)
r$Date <- NA
r$Date <- as.character(index(r))
r$Date <- strftime(r$Date,format="%Y-%m")
names(r)[1] <- "Discount Rate"
```

###Descriptive Statistics

```r
#The function to get the descriptive statistics
describe <- function(df) {
  desnames <- names(df)[-1]
  ds <- NA
  for (c in desnames) {
    coln <- as.name(c)
    output <- df %>% summarize(n=n(),
            nnna=(sum(!is.na(eval(coln)))),
            m=mean(eval(coln), na.rm = T),
            q25=quantile(eval(coln),probs=0.25, na.rm = T),
            median=median(eval(coln), na.rm = T),
            q75=quantile(eval(coln),probs=0.75, na.rm = T),
            std=sd(eval(coln), na.rm = T))
    ds = rbind(ds, output)
  }
descriptive_table <- as.data.frame(ds[-1,])
rownames(descriptive_table) = desnames
colnames(descriptive_table) = c('N','N not NA','Mean', 'Q25', 'Q50', 'Q75', 'Standard Deviation')
print(descriptive_table)
}
```

```r
describe(fixedincome)
```

```
##                            N N not NA       Mean        Q25       Q50
## Municipal                 31       31  12.013871  11.118500  11.44400
## Treasury                  31       31 589.957958 537.124325 572.62920
## Agency MBS                31       31 245.625241 222.915901 239.22953
## Non-Agency MBS            31       31   2.852075   2.360856   2.70608
## ABS                       31       31   1.626996   1.380083   1.57203
## Corporate Debt            31       31  34.962837  31.542012  33.48581
## Federal Agency Securities 31       31   4.216898   3.579684   3.94800
## Total                     31       31 891.255876 814.393993 873.79700
##                                  Q75 Standard Deviation
## Municipal                  12.418000           2.246250
## Treasury                  628.017875          86.724390
## Agency MBS                267.990031          33.507705
## Non-Agency MBS              3.042197           0.852188
```

```
## ABS                         1.781767          0.447420
## Corporate Debt             38.271829          6.288796
## Federal Agency Securities   4.571178          1.031783
## Total                     944.125858        119.871269
```

```r
describe(corporate)
```

```
##                                          N N not NA      Mean       Q25
## Investment Grade, Publicly Traded      188      188 12.963227  9.891534
## High Yield, Publicly Traded            188      188  5.934250  4.422029
## Total, Publicly Traded                 188      188 18.897477 14.347845
## Investment Grade, 144A                 188       74  2.474192  2.102126
## High Yield, 144A                       188       74  4.151241  3.407073
## Total, 144A                            188       74  6.972227  5.534684
## Investment Grade, Total Nonconvertible 188       74 19.303626 16.553600
## High Yield, Total Nonconvertible       188       74 11.816655 10.234401
## Total, Total Nonconvertible            188       74 31.120281 27.569960
## Total, Convertible                     188      188  1.418543  1.056902
## Total                                  188       74 63.896652 56.251440
##                                              Q50       Q75 Standard Deviation
## Investment Grade, Publicly Traded      12.388727 15.254205          4.1985229
## High Yield, Publicly Traded             5.640798  7.085320          1.8073247
## Total, Publicly Traded                 18.063375 22.872982          5.8076816
## Investment Grade, 144A                  2.352286  2.866305          0.5374098
## High Yield, 144A                        4.026104  4.661748          1.0953242
## Total, 144A                             6.418513  7.658963          2.4199838
## Investment Grade, Total Nonconvertible 18.530020 21.280884          4.0351512
## High Yield, Total Nonconvertible       11.733262 12.677650          2.2500048
## Total, Total Nonconvertible            30.818605 33.766190          5.9813675
## Total, Convertible                      1.342645  1.692668          0.4451597
## Total                                  62.871517 70.664505         12.6364799
```

```r
describe(agency)
```

```
##               N N not NA     Mean       Q25       Q50      Q75
## Fannie Mae  126      126 1.792667 0.7157381 1.3127750 2.812975
## FHLB        126      126 1.849558 1.4290342 1.6830589 2.277049
## Freddie Mac 126      126 1.629467 0.8404477 1.3770455 2.365482
## Other       126      126 1.004108 0.7754343 0.9241155 1.174712
## Total       126      126 6.275216 4.2203500 5.2831024 8.322839
##             Standard Deviation
## Fannie Mae           1.2473515
## FHLB                 0.5979729
## Freddie Mac          0.9474954
## Other                0.3115845
## Total                2.6531433
```

```r
describe(sf)
```

```
##                                                      N N not NA         Mean
## Interdealer                                        230      141 7.356237e+04
## Customer                                           230      141 1.934642e+05
```

```
## Total, Agency Volume Reported by Primary Dealers 230      141 2.670266e+05
## Agency CMO                                       230      112 2.030809e+03
## Agency Specified Pool                            230      112 1.344915e+04
## Agency TBA                                       230      112 2.107587e+05
## Total, Agency Volume                             230      112 2.262387e+05
## ABS                                              230      112 1.108296e+03
## Agency CMBS (IO/PO)                              230       35 6.167087e+02
## Agency CMBS (P&I)                                230       35 5.118878e+02
## CDO                                              230      112 3.743083e+02
## Non-Agency CMBS (IO/PO)                          230      112 6.237622e+02
## Non-Agency CMBS (P&I)                            230      112 1.011457e+03
## CMO (IO/PO)                                      230      112 2.390847e+02
## CMO (P&I)                                        230      112 1.121338e+03
## Other                                            230      106 2.084852e+00
## Total, Non-Agency Volume                         230      112 4.832905e+03
## IG                                               230      112 2.392734e+03
## HY                                               230      112 2.439940e+03
## Total                                            230       23 6.004212e+05
##                                                          Q25          Q50
## Interdealer                                       58272.25000 6.681700e+04
## Customer                                         160239.75000 2.011080e+05
## Total, Agency Volume Reported by Primary Dealers 214422.00000 2.672520e+05
## Agency CMO                                         1550.10247 1.896409e+03
## Agency Specified Pool                             11058.89414 1.264840e+04
## Agency TBA                                       180763.31176 2.060647e+05
## Total, Agency Volume                             194406.11453 2.225593e+05
## ABS                                                 944.85342 1.069154e+03
## Agency CMBS (IO/PO)                                 360.46876 5.760925e+02
## Agency CMBS (P&I)                                   378.31005 4.667027e+02
## CDO                                                 262.01222 3.358073e+02
## Non-Agency CMBS (IO/PO)                             313.52516 5.610311e+02
## Non-Agency CMBS (P&I)                               732.92362 9.582406e+02
## CMO (IO/PO)                                          90.94026 1.756085e+02
## CMO (P&I)                                           679.68937 1.006908e+03
## Other                                                 0.00000 1.283095e-02
## Total, Non-Agency Volume                           3888.36054 4.579640e+03
## IG                                                 1960.42552 2.259191e+03
## HY                                                 1809.66276 2.205300e+03
## Total                                            567874.52357 6.068477e+05
##                                                          Q75
## Interdealer                                       90218.50000
## Customer                                         231802.80000
## Total, Agency Volume Reported by Primary Dealers 318339.25000
## Agency CMO                                         2345.50390
## Agency Specified Pool                             14033.03204
## Agency TBA                                       235598.57044
## Total, Agency Volume                             251815.60386
## ABS                                                1210.35339
## Agency CMBS (IO/PO)                                 731.21688
## Agency CMBS (P&I)                                   622.22012
## CDO                                                 427.77732
## Non-Agency CMBS (IO/PO)                             759.41258
## Non-Agency CMBS (P&I)                              1250.08191
## CMO (IO/PO)                                         328.53998
```

```
## CMO (P&I)                                                1469.80999
## Other                                                       1.95885
## Total, Non-Agency Volume                                  5301.74269
## IG                                                        2627.86479
## HY                                                        3022.17666
## Total                                                   642533.29517
##                                                         Standard Deviation
## Interdealer                                                  24180.697786
## Customer                                                     53269.094570
## Total, Agency Volume Reported by Primary Dealers             74512.456307
## Agency CMO                                                     611.760594
## Agency Specified Pool                                         4416.181338
## Agency TBA                                                   37703.460921
## Total, Agency Volume                                         40615.034987
## ABS                                                            245.794953
## Agency CMBS (IO/PO)                                            360.026692
## Agency CMBS (P&I)                                              179.608632
## CDO                                                            180.862256
## Non-Agency CMBS (IO/PO)                                        546.118734
## Non-Agency CMBS (P&I)                                          351.267400
## CMO (IO/PO)                                                    208.075735
## CMO (P&I)                                                      564.136703
## Other                                                            5.124871
## Total, Non-Agency Volume                                      1377.251562
## IG                                                             813.289490
## HY                                                             866.026055
## Total                                                        63293.967574
```

```r
describe(treasury)
```

```
##                                                                          N
## Treasury Bills                                                         235
## Treasury Inflation Index Securities                                    235
## Floating Rate Notes                                                    235
## Coupon Securities Due in 2 Years or Less                               235
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years  235
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years  235
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years  235
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years 235
## Coupon Securities Due in More Than 11 Years                            235
## Total                                                                  235
## Coupon Securities Due in 3 Years or Less                               235
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years 235
##                                                                        N not NA
## Treasury Bills                                                              235
## Treasury Inflation Index Securities                                         235
## Floating Rate Notes                                                          67
## Coupon Securities Due in 2 Years or Less                                     88
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years       88
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years      229
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years       88
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years      88
## Coupon Securities Due in More Than 11 Years                                 229
## Total                                                                       235
```

```
## Coupon Securities Due in 3 Years or Less                                 229
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years      229
##                                                                          Mean
## Treasury Bills                                                      72.829936
## Treasury Inflation Index Securities                                  9.992062
## Floating Rate Notes                                                  2.928040
## Coupon Securities Due in 2 Years or Less                            83.866402
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years   55.435750
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years  122.248383
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years   33.961733
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years  86.623526
## Coupon Securities Due in More Than 11 Years                         33.174972
## Total                                                              505.776469
## Coupon Securities Due in 3 Years or Less                           155.039666
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years 115.905822
##                                                                           Q25
## Treasury Bills                                                      48.527500
## Treasury Inflation Index Securities                                  6.017100
## Floating Rate Notes                                                  2.283625
## Coupon Securities Due in 2 Years or Less                            77.014412
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years   48.642950
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years  110.117225
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years   29.558687
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years  76.733913
## Coupon Securities Due in More Than 11 Years                         25.544537
## Total                                                              461.419331
## Coupon Securities Due in 3 Years or Less                           132.621100
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years 101.818913
##                                                                          Q50
## Treasury Bills                                                      67.78640
## Treasury Inflation Index Securities                                  9.34560
## Floating Rate Notes                                                  2.94275
## Coupon Securities Due in 2 Years or Less                            83.24405
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years   54.84528
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years  123.25120
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years   33.50685
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years  83.94965
## Coupon Securities Due in More Than 11 Years                         31.63400
## Total                                                              507.38440
## Coupon Securities Due in 3 Years or Less                           149.62900
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years 115.77960
##                                                                          Q75
## Treasury Bills                                                      86.60155
## Treasury Inflation Index Securities                                 13.80063
## Floating Rate Notes                                                  3.48175
## Coupon Securities Due in 2 Years or Less                            90.88656
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years   60.69894
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years  136.59225
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years   37.65475
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years  93.08360
## Coupon Securities Due in More Than 11 Years                         38.81800
## Total                                                              557.48121
## Coupon Securities Due in 3 Years or Less                           176.13156
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years 129.85343
```

```
##                                                                                                   Standard Deviation
## Treasury Bills                                                                                            31.9678320
## Treasury Inflation Index Securities                                                                        5.3777742
## Floating Rate Notes                                                                                        0.9229417
## Coupon Securities Due in 2 Years or Less                                                                  13.6185971
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years                               9.8558536
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years                              23.8434052
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years                               6.2774691
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years                             15.4520182
## Coupon Securities Due in More Than 11 Years                                                               10.9658547
## Total                                                                                                     95.4423812
## Coupon Securities Due in 3 Years or Less                                                                  34.3908696
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years                             25.5724281
```

```r
describe(equity)
```

```
##                               N N not NA       Mean        Q25        Q50
## ICE, Volumes ($B)            32       32  85.321955  74.545910  80.093918
## Nasdaq, Volumes ($B)         32       32  83.403037  70.730037  77.989572
## Cboe, Volumes ($B)           32       32  62.688815  52.463504  58.931197
## Other, Volumes ($B)          32       32   9.814077   8.826815   9.413337
## Off Exchange, Volumes ($B) 32       32 132.500626 111.571184 119.561135
## Market, Volumes ($B)         32       32 373.728510 321.087364 348.024706
## Total                        32       32 747.457019 642.174729 696.049413
##                                    Q75 Standard Deviation
## ICE, Volumes ($B)             92.97981          17.760979
## Nasdaq, Volumes ($B)          96.09389          18.132293
## Cboe, Volumes ($B)            72.85265          15.261665
## Other, Volumes ($B)           10.45850           1.931294
## Off Exchange, Volumes ($B)  142.46422          30.442833
## Market, Volumes ($B)         429.10097          80.124097
## Total                        858.20194         160.248195
```

```r
describe(repo)
```

```
##                                              N N not NA        Mean         Q25
## Overnight, Repurchase                      103      103 1595.550750 1463.928600
## Term, Repurchase                           103      103  810.622029  727.859875
## Total, Repurchase                          103      103 2406.172780 2215.397875
## Overnight, Reverse Repurchase              103      103  799.525292  748.495375
## Term, Reverse Repurchase                   103      103 1081.421269  994.390900
## Total, Reverse Repurchase                  103      103 1880.946561 1766.554625
## Total, Total                               103      103 4287.119341 3961.510392
## ABS, Repurchase                            103       67   21.711304   18.036583
## Corporate, Repurchase                      103       88   68.165665   63.646437
## Equities, Repurchase                       103       88   59.809227   50.050979
## Federal Agency & GSE, Repurchase           103       88   49.719804   27.040750
## MBS, Repurchase                            103       88  446.314495  383.454675
## Other, Repurchase                          103       88   66.074311   44.234062
## US Treasuries, Repurchase                  103       88 1488.410956 1390.345963
## TIPS, Repurchase                           103       88  157.834268  150.824400
## ABS, Reverse Repurchase                    103       67   12.741239    9.116625
## Corporate, Reverse Repurchase              103       88   17.981032   14.958113
```

```
## Equities, Reverse Repurchase             103       88    0.313768    0.000000
## Federal Agency & GSE, Reverse Repurchase 103       88   22.143634    8.915750
## MBS, Reverse Repurchase                  103       88  271.672327  217.879375
## Other, Reverse Repurchase                103       88   39.096389   24.376812
## US Treasuries, Reverse Repurchase        103       88 1320.846005 1237.284688
## TIPS, Reverse Repurchase                 103       88  154.398570  144.059463
##                                                 Q50        Q75
## Overnight, Repurchase                    1505.70433 1782.66580
## Term, Repurchase                          787.58300  897.97180
## Total, Repurchase                        2368.22547 2598.33315
## Overnight, Reverse Repurchase             769.77320  857.15275
## Term, Reverse Repurchase                 1054.87800 1146.61912
## Total, Reverse Repurchase                1835.90825 1965.97750
## Total, Total                             4196.03600 4579.46587
## ABS, Repurchase                            19.12125   23.71088
## Corporate, Repurchase                      68.52265   72.29794
## Equities, Repurchase                       56.61525   70.78944
## Federal Agency & GSE, Repurchase           32.50955   72.31606
## MBS, Repurchase                           419.12675  500.29555
## Other, Repurchase                          62.38880   86.66906
## US Treasuries, Repurchase                1449.49050 1560.67387
## TIPS, Repurchase                          160.05340  165.68381
## ABS, Reverse Repurchase                    10.72650   16.27958
## Corporate, Reverse Repurchase              16.44160   21.67162
## Equities, Reverse Repurchase                0.00000    0.31000
## Federal Agency & GSE, Reverse Repurchase   11.88845   32.41950
## MBS, Reverse Repurchase                   243.48552  308.38650
## Other, Reverse Repurchase                  37.53787   53.96462
## US Treasuries, Reverse Repurchase        1286.06682 1380.13236
## TIPS, Reverse Repurchase                  157.11212  162.44335
##                                          Standard Deviation
## Overnight, Repurchase                           170.8014071
## Term, Repurchase                                107.4065757
## Total, Repurchase                               226.4218396
## Overnight, Reverse Repurchase                    69.6727236
## Term, Reverse Repurchase                        119.7401118
## Total, Reverse Repurchase                       159.3161138
## Total, Total                                    380.9874761
## ABS, Repurchase                                   5.4811831
## Corporate, Repurchase                             5.4395625
## Equities, Repurchase                             14.6531557
## Federal Agency & GSE, Repurchase                 29.9771302
## MBS, Repurchase                                  87.6004896
## Other, Repurchase                                24.0936360
## US Treasuries, Repurchase                       146.8776999
## TIPS, Repurchase                                 11.2221779
## ABS, Reverse Repurchase                           4.5188332
## Corporate, Reverse Repurchase                     3.4621792
## Equities, Reverse Repurchase                      0.5697574
## Federal Agency & GSE, Reverse Repurchase         17.5030748
## MBS, Reverse Repurchase                          76.6880416
## Other, Reverse Repurchase                        15.3479848
## US Treasuries, Reverse Repurchase               122.6854806
## TIPS, Reverse Repurchase                         13.4041179
```

###corporate_issuance

```
corporate_issuance <- read_excel(paste("P:/Mgt_of_FI/Assignment3/Corporate-US-Corporate-Issuance-SIFMA.x

corporate_issuance <- corporate_issuance[,-c(5,10,12)]
corporate_issuance <- corporate_issuance[-c(1:2,27:54),]


colnames(corporate_issuance) <- c("Date", "Investment Grade, Non-Convertible", "High Yield, Non-Converti
                         "Fixed Rate, Callable, Non-Convertible", "Floating Rate, Callable, Non-Converti

corporate_issuance[-1] <- sapply(corporate_issuance[-1], as.numeric)
```

###municipal_issuance

```
municipal_issuance <- read_excel(paste("P:/Mgt_of_FI/Assignment3/municipal-us-municipal-issuance-sifma.x

municipal_issuance <- municipal_issuance[c(1:25),-c(2,5,8,10,13,16)]

names(municipal_issuance)[3] <- colnames(municipal_issuance)[2]
names(municipal_issuance)[5] <- colnames(municipal_issuance)[4]
names(municipal_issuance)[8] <- colnames(municipal_issuance)[7]
names(municipal_issuance)[10] <- colnames(municipal_issuance)[9]

names(municipal_issuance)<- paste(municipal_issuance[1,], colnames(municipal_issuance), sep=', ')

names(municipal_issuance)[1] <- "Date"
names(municipal_issuance)[11] <- "Total"
municipal_issuance <- municipal_issuance[-1,]

municipal_issuance[-1] <- sapply(municipal_issuance[-1], as.numeric)
```

###MBSissuance

```
MBSissuance <- read_excel(paste("P:/Mgt_of_FI/Assignment3/SF-US-MBS-SIFMA.xls"),sheet=2,skip=2)
MBSissuance <- MBSissuance[,-c(2,5,8)]
MBSissuance <- MBSissuance[c(1:25),]

names(MBSissuance)[3] <- colnames(MBSissuance)[2]
names(MBSissuance)[5] <- colnames(MBSissuance)[4]
names(MBSissuance)[7] <- colnames(MBSissuance)[6]
names(MBSissuance)[8] <- colnames(MBSissuance)[6]

names(MBSissuance)<- paste(MBSissuance[1,], colnames(MBSissuance), sep=', ')
names(MBSissuance)[1] <- "Date"

MBSissuance <- MBSissuance[-1,]
MBSissuance[-1] <- sapply(MBSissuance[-1], as.numeric)

MBSissuance$Total <- rowSums(MBSissuance[c(2:6)])
```

###ABSissuance

```r
ABSissuance <- read_excel(paste("P:/Mgt_of_FI/Assignment3/sf-us-abs-sifma.xls"),sheet=2,skip=3)
ABSissuance <- ABSissuance[c(1:35),-c(2)]
ABSissuance[-1] <- sapply(ABSissuance[-1], as.numeric)
names(ABSissuance)[1] <- "Date"
```

###fixedincome_issuance

```r
fixedincome_issuance <- read_excel(paste("P:/Mgt_of_FI/Assignment3/CM-US-Fixed-Income-SIFMA.xls"),sheet
fixedincome_issuance <- fixedincome_issuance[c(1:24),-c(2,10:13)]
fixedincome_issuance[-1] <- sapply(fixedincome_issuance[-1], as.numeric)

names(fixedincome_issuance)[1] <- "Date"
```

###treasury_issuance

```r
treasury_issuance <- read_excel(paste("P:/Mgt_of_FI/Assignment3/ta-us-treasury-sifma.xls"),sheet=2,skip

names(treasury_issuance)[c(3:4)] <- colnames(treasury_issuance)[2]
names(treasury_issuance)[c(7:8)] <- colnames(treasury_issuance)[6]
names(treasury_issuance)[c(11:12)] <- colnames(treasury_issuance)[10]
names(treasury_issuance)[c(15:16)] <- colnames(treasury_issuance)[14]

treasury_issuance <- treasury_issuance[,-c(5,9,13)]

names(treasury_issuance)<- paste(treasury_issuance[1,], colnames(treasury_issuance), sep=', ')

treasury_issuance <- treasury_issuance[-c(1),]

colnames(treasury_issuance)[1] <- "Date"


treasury_issuance$Date <- ymd(treasury_issuance$Date) %>% strftime(treasury_issuance$Date,format="%Y-%m
treasury_issuance[-1] <- sapply(treasury_issuance[-1], as.numeric)


###transform the monthly data of treasury_issuance to annual data
desnames <- names(treasury_issuance)[-1]
ds <- NA

for (c in desnames) {
    coln <- as.name(c)
    output <- treasury_issuance %>% mutate(year = format(Date, "%Y")) %>%
      group_by(year) %>% summarize(s=sum(eval(coln)))
    ds <- cbind(ds,output$s)
  }

annual <- as.data.frame(ds)
colnames(annual)[-1] = desnames
colnames(annual)[1] = "Date"
annual[1] <- format(treasury_issuance$Date, "%Y") %>% unique()
treasury_issuance <- annual
colnames(treasury_issuance)[11] <- "Total"
```

###commercialpaper__issuance

```r
commercialpaper_issuance <- read_excel(paste("P:/Mgt_of_FI/Assignment3/funding-us-commercial-paper-sifma
commercialpaper_issuance <- commercialpaper_issuance[c(1:18),]
colnames(commercialpaper_issuance)[1] <- "Date"


commercialpaper_issuance[-1] <- sapply(commercialpaper_issuance[-1], as.numeric)
```

```r
library("reshape2")
```

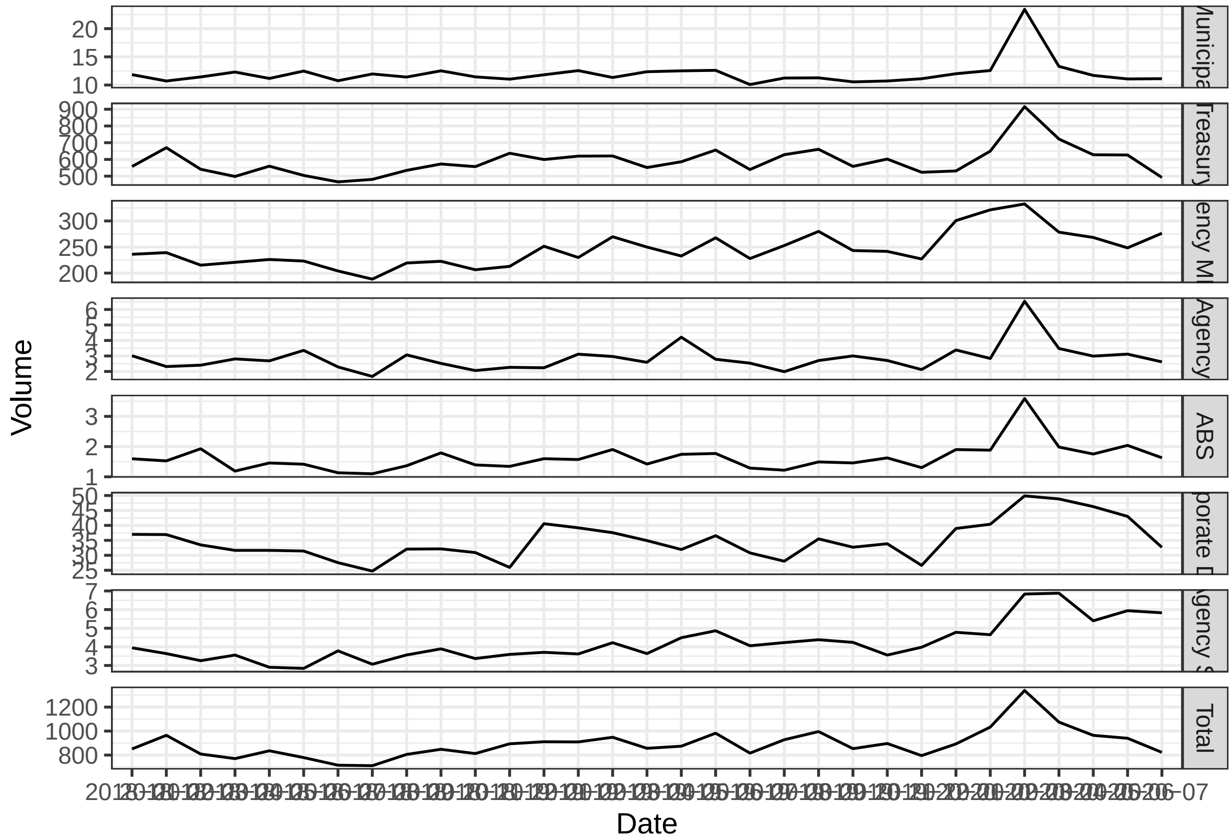
```
##
## Attaching package: 'reshape2'

## The following object is masked from 'package:tidyr':
##
##     smiths
```

###the function to plot the time-series data

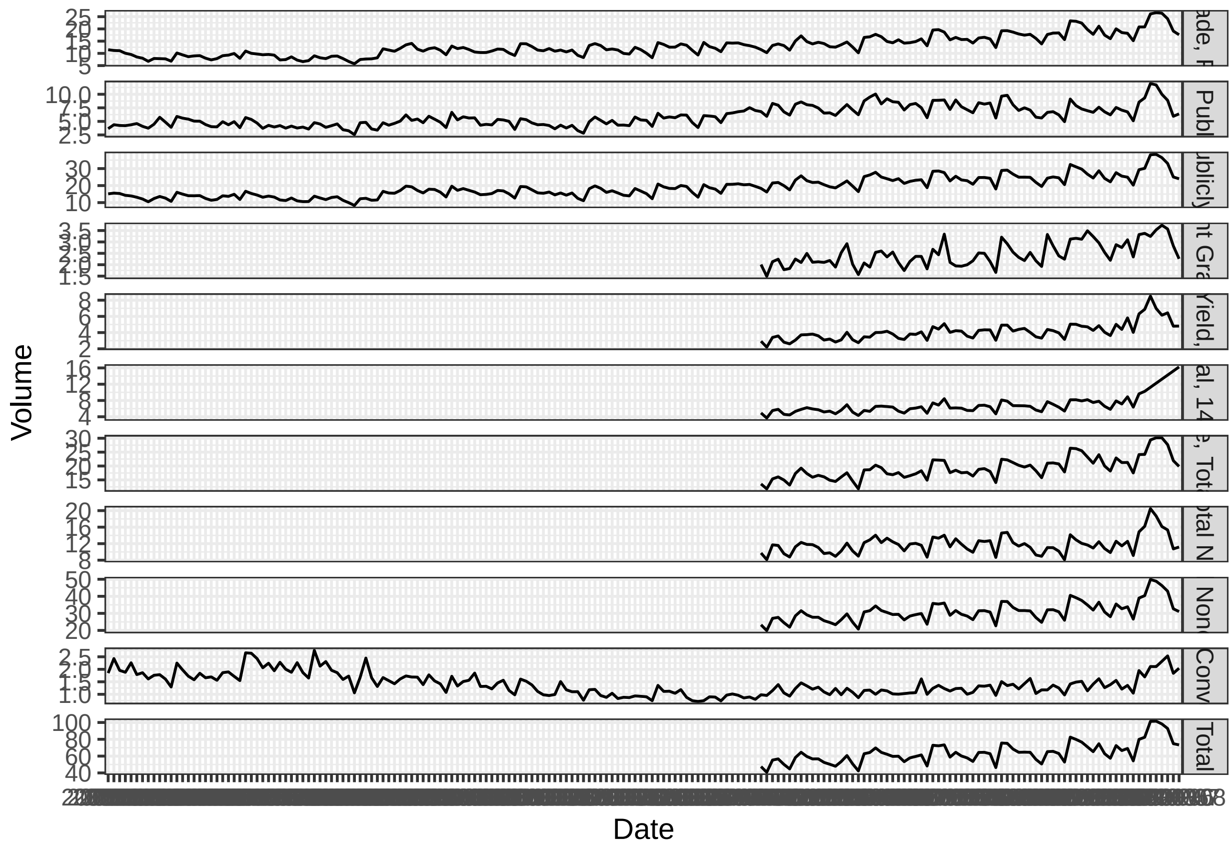
```r
toplot <- function(df) {
melted_df <- melt(df,id="Date")
melted_df %>% ggplot(aes(x = Date,y = value, group = variable)) + geom_line() +
  facet_grid(variable~., scales = "free") + ylab("Volume") + xlab("Date") +
  theme(legend.title = element_text(size = 1), legend.text = element_text( size = 1)
  )+theme_bw()
}
```

```r
toplot(fixedincome)
```

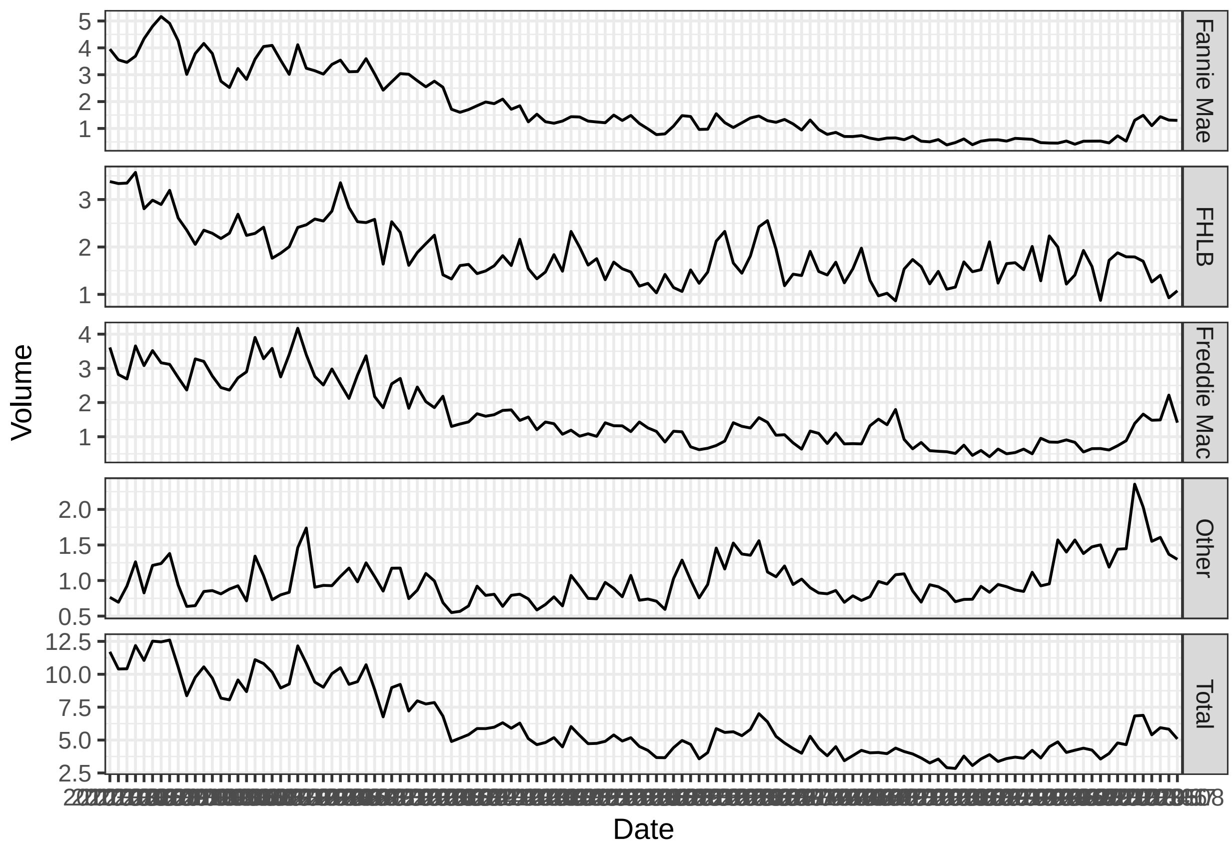


```
toplot(corporate)
```

```
## Warning: Removed 798 row(s) containing missing values (geom_path).
```

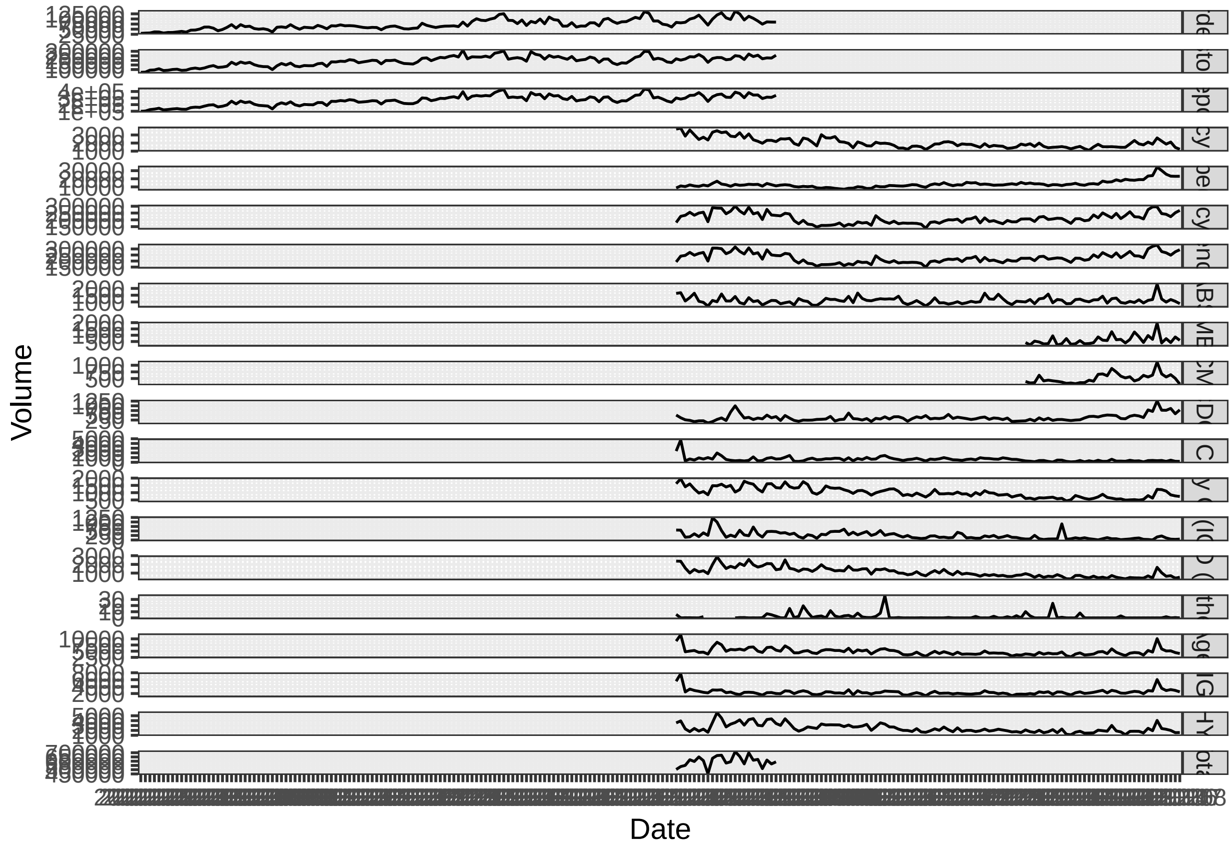


```r
toplot(agency)
```



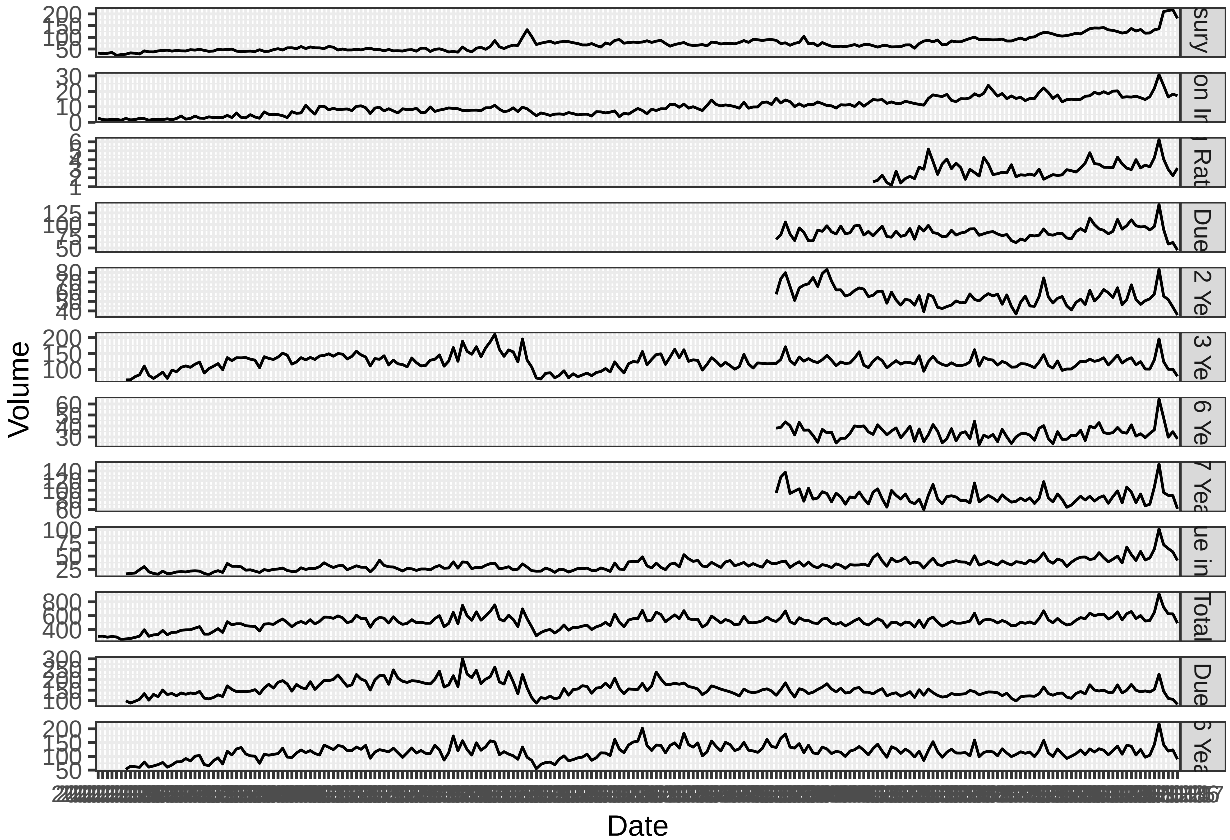

```r
toplot(sf)
```

```
## Warning: Removed 2516 row(s) containing missing values (geom_path).
```

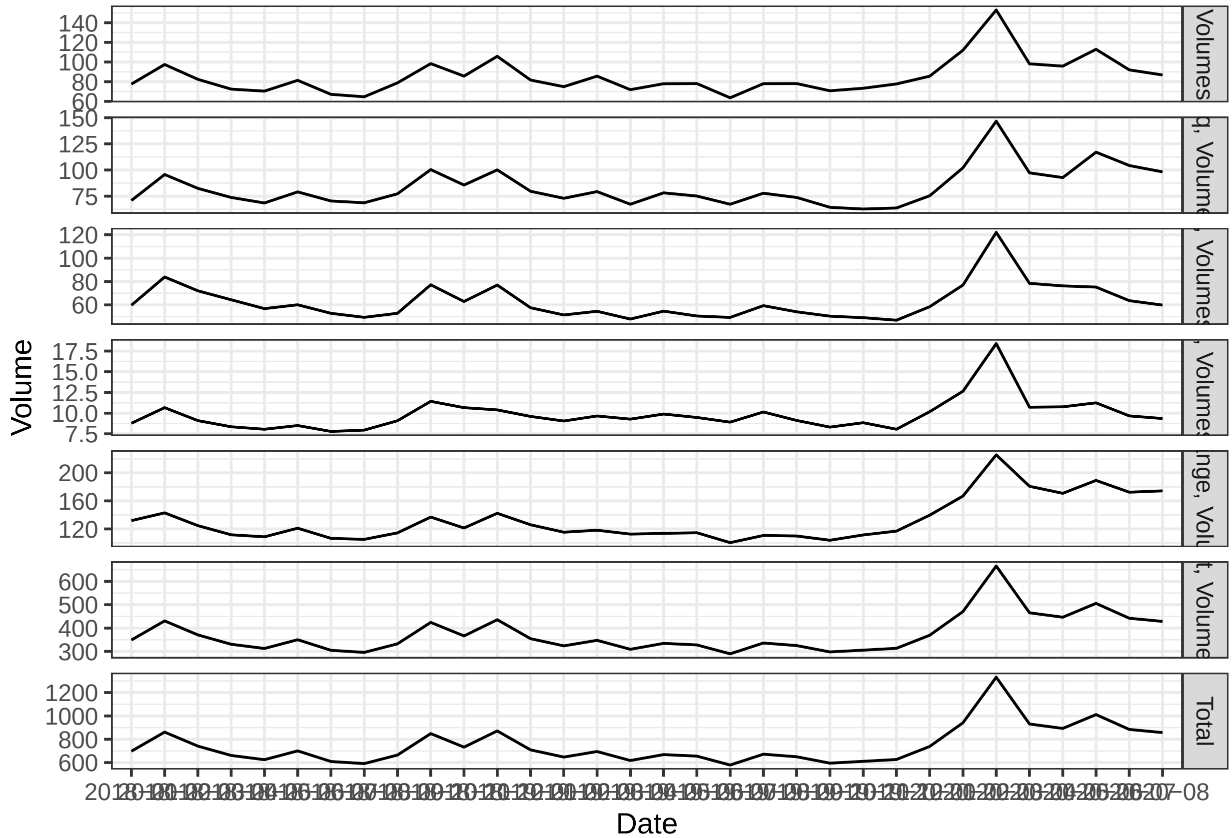


```
toplot(treasury)
```

```
## Warning: Removed 780 row(s) containing missing values (geom_path).
```

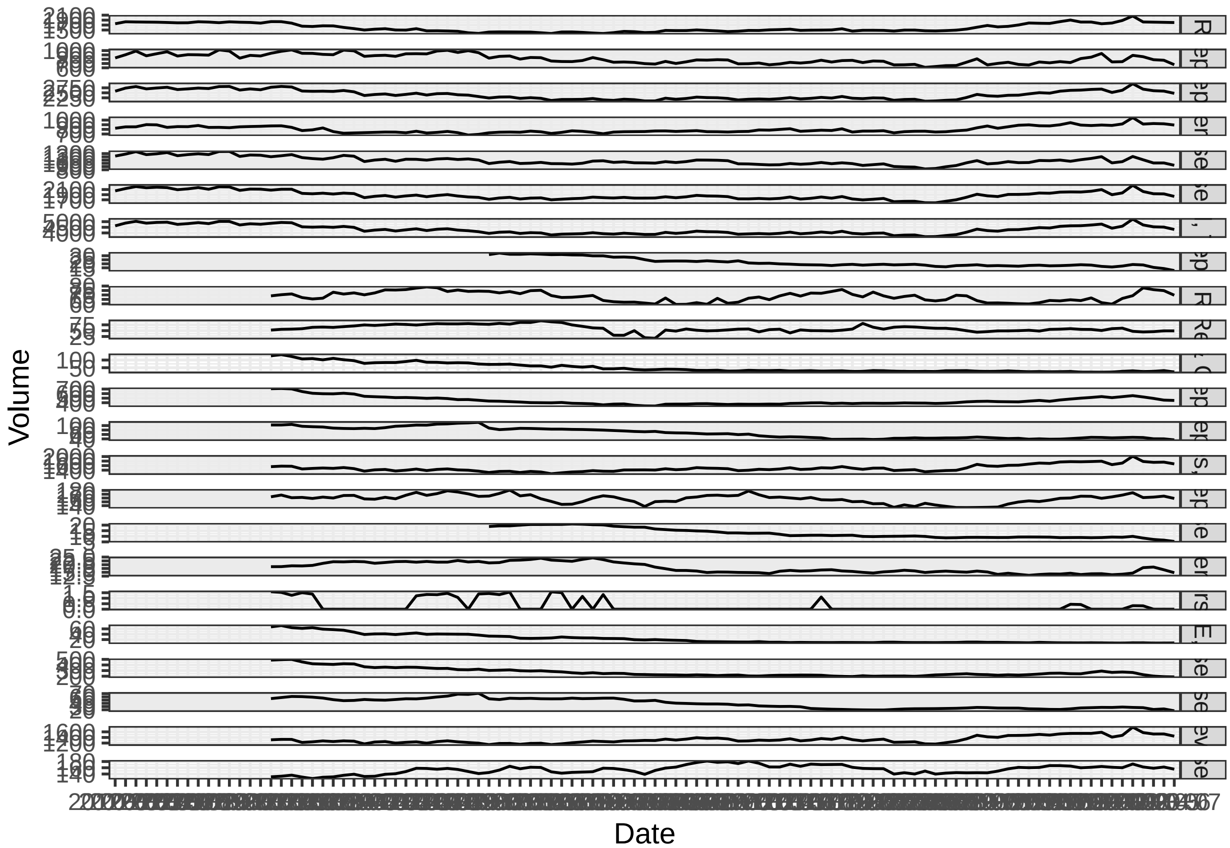



```r
toplot(equity)
```



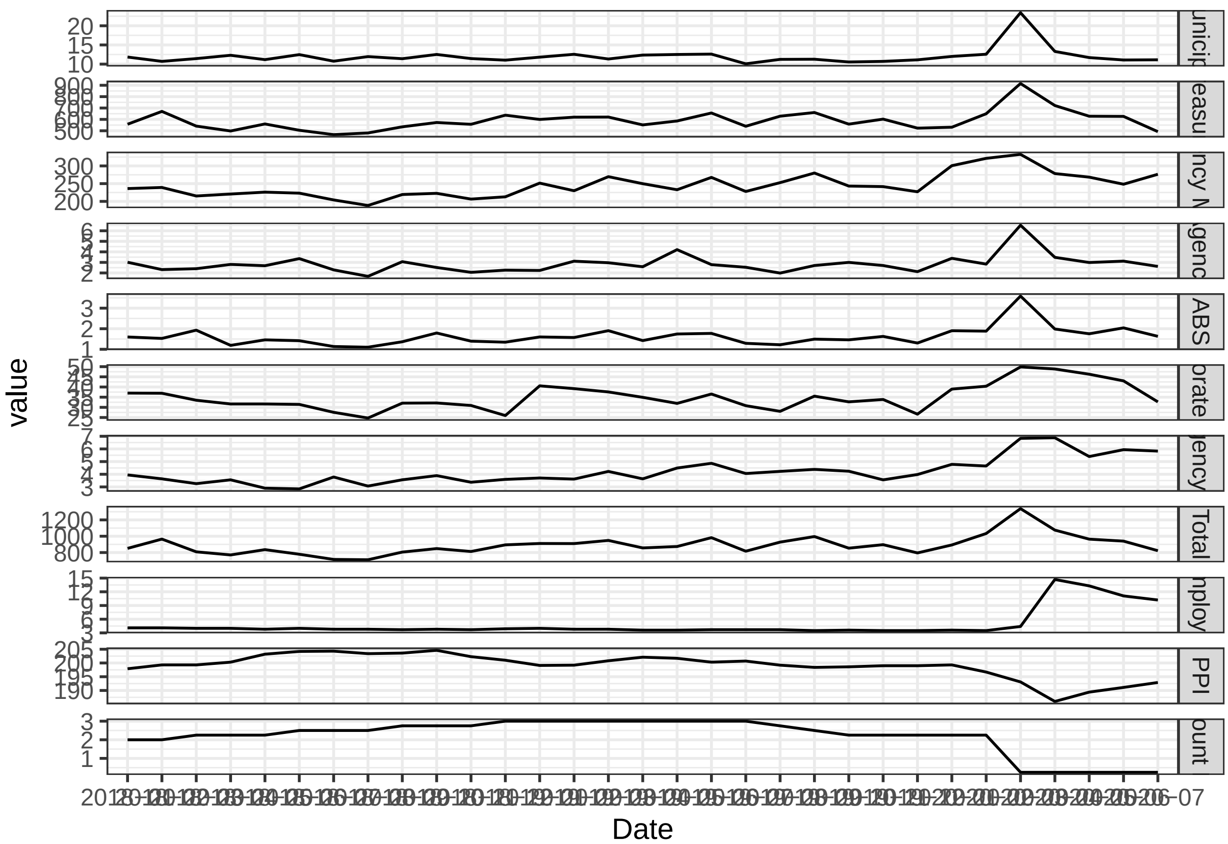

```r
toplot(repo)
```

```
## Warning: Removed 282 row(s) containing missing values (geom_path).
```



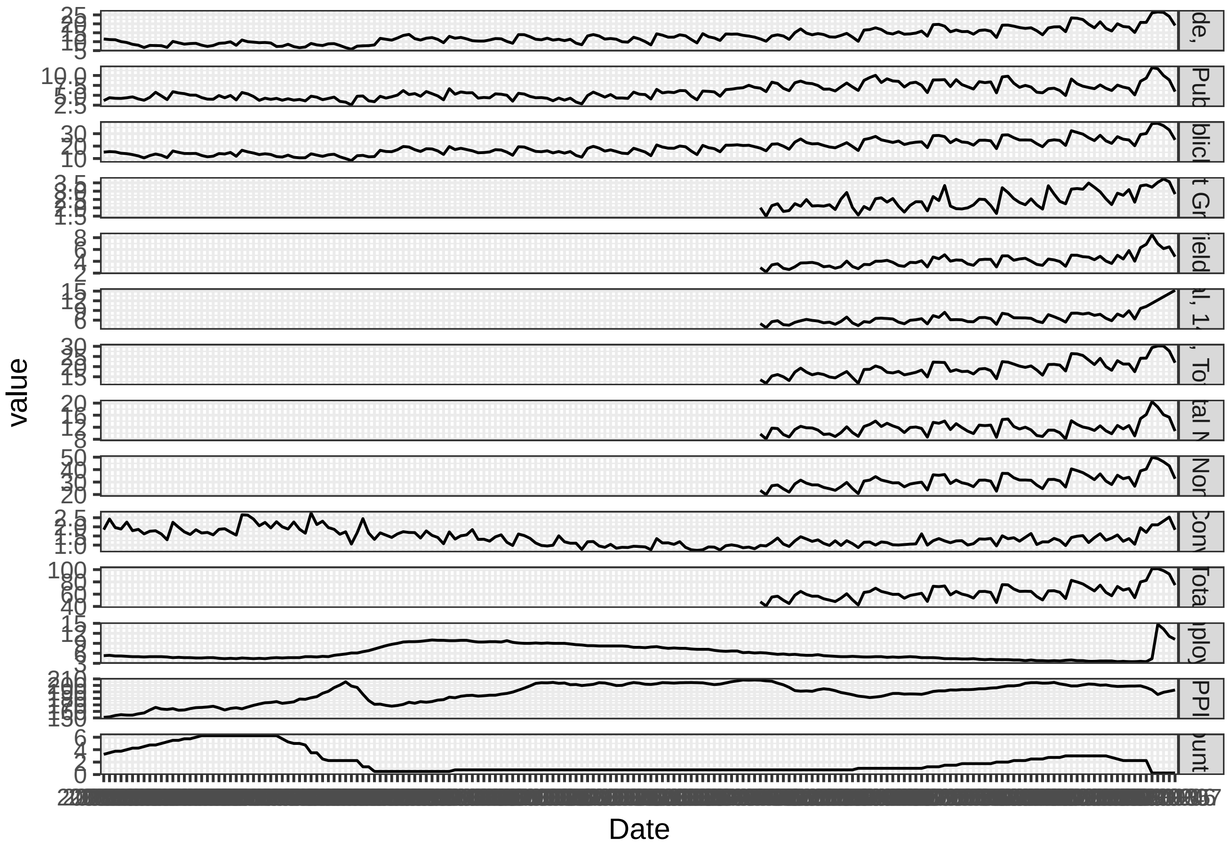

```r
#plot all the variables together with macroecon indicators
allwithmacros <- function(df) {
combined <- df %>% merge(unrate, by = "Date") %>% merge(ppi, by = "Date") %>% merge(r, by = "Date")
melted_df <- melt(combined,id = "Date")
melted_df$value <-as.numeric(melted_df$value)
melted_df %>% ggplot(aes(x = Date,y = value, group = variable)) +
  geom_line()+
  facet_grid(variable~., scales = "free")+theme_bw()
}
```

```r
allwithmacros(fixedincome)
```

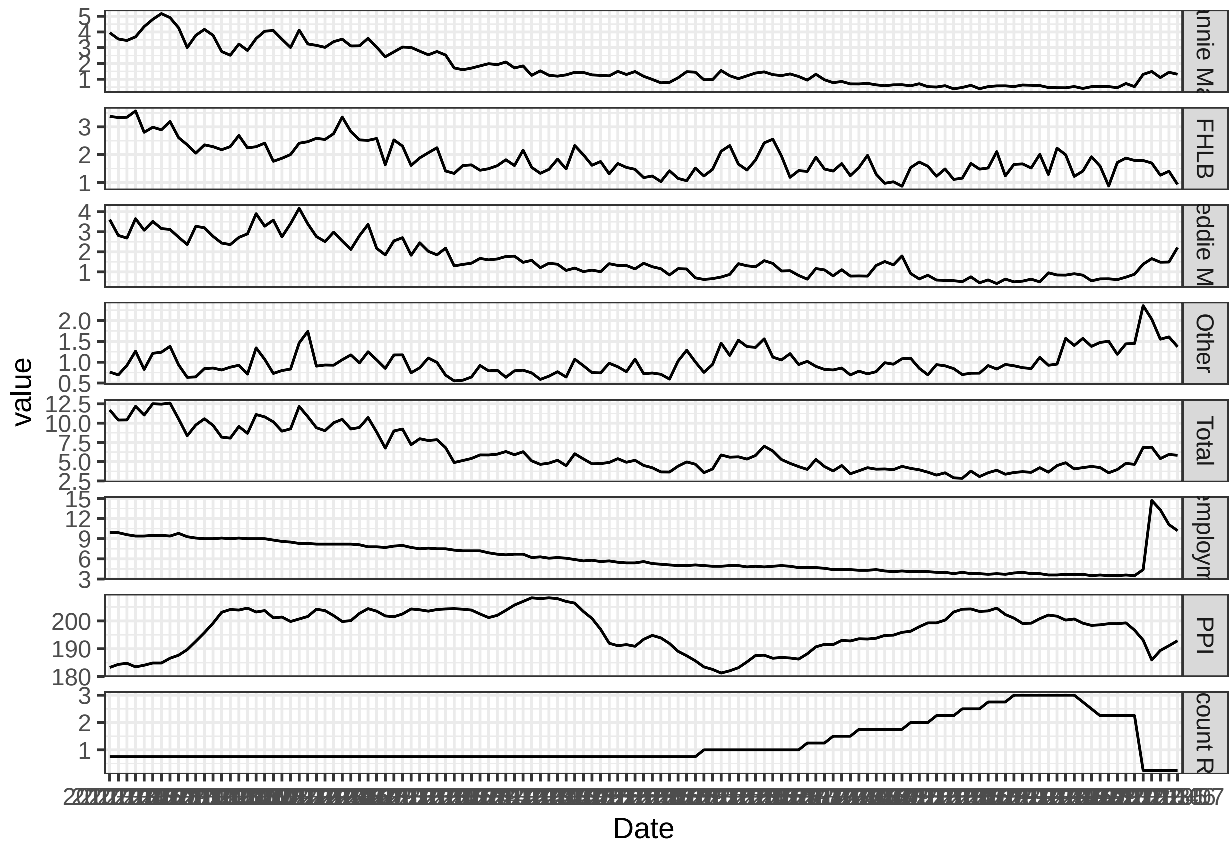



```r
allwithmacros(corporate)
```

```
## Warning: Removed 798 row(s) containing missing values (geom_path).
```

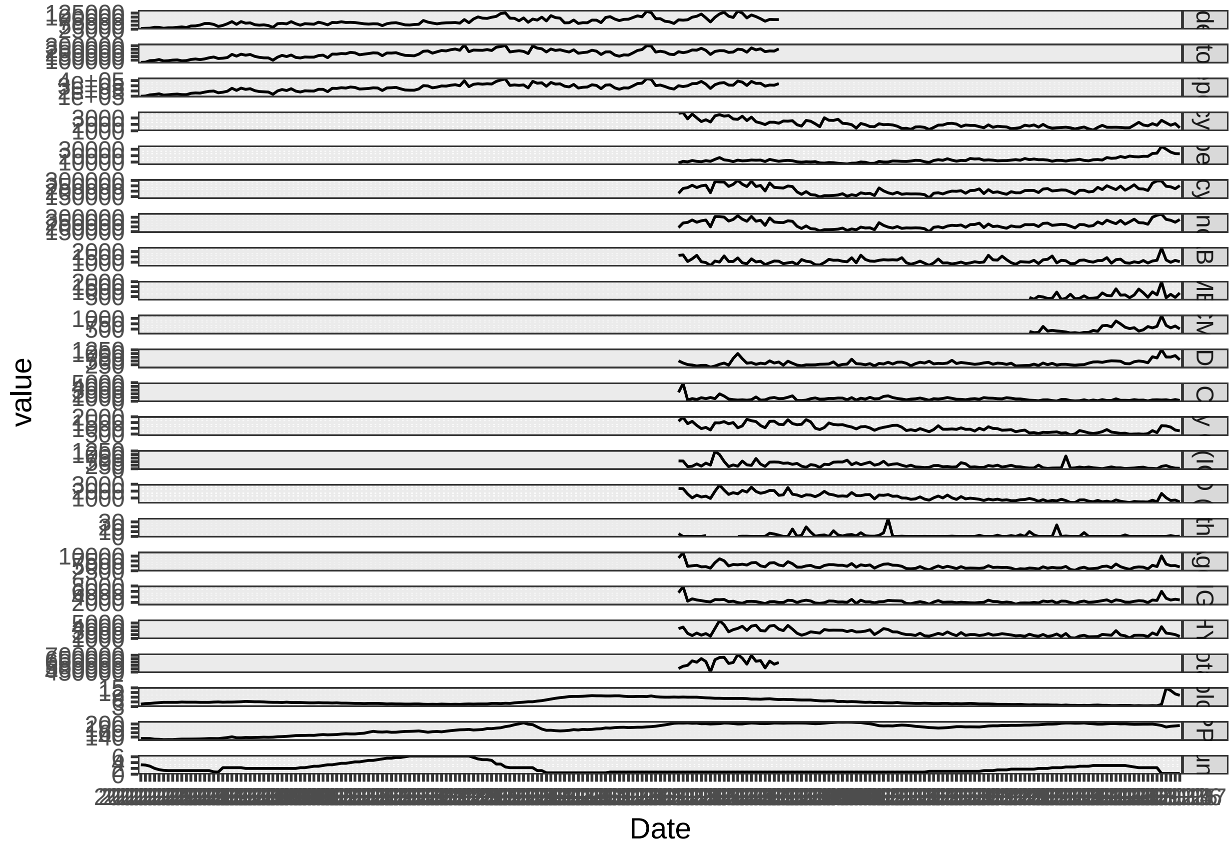



```
allwithmacros(agency)
```



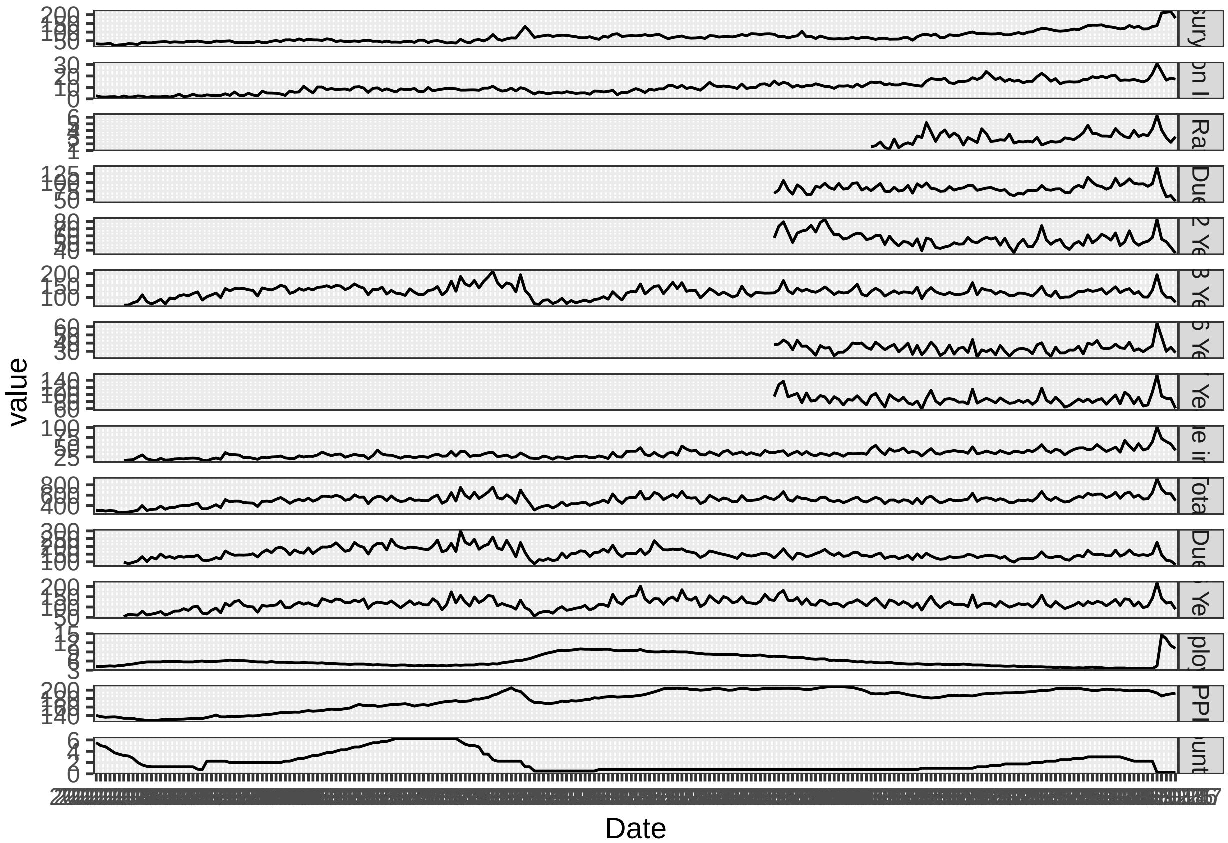

```
allwithmacros(sf)
```

```
## Warning: Removed 2512 row(s) containing missing values (geom_path).
```

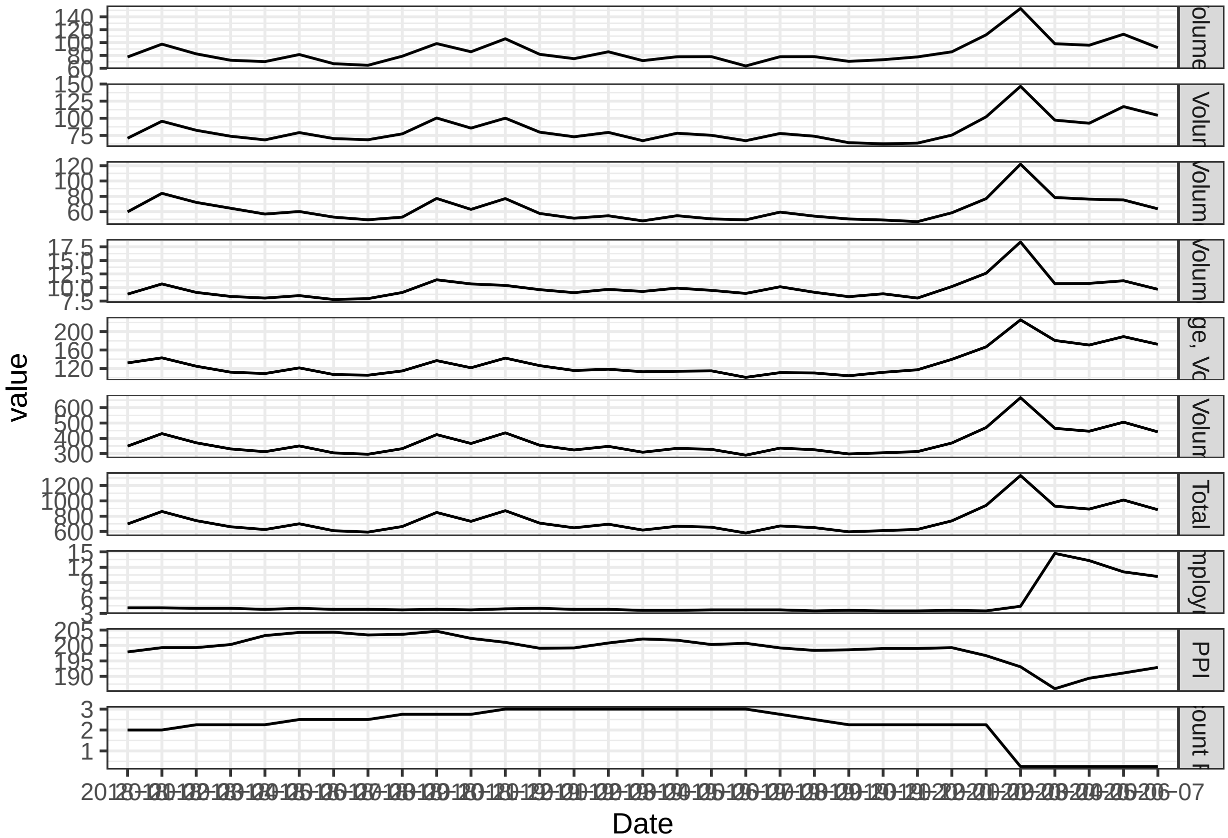



```r
allwithmacros(treasury)
```

```
## Warning: Removed 780 row(s) containing missing values (geom_path).
```

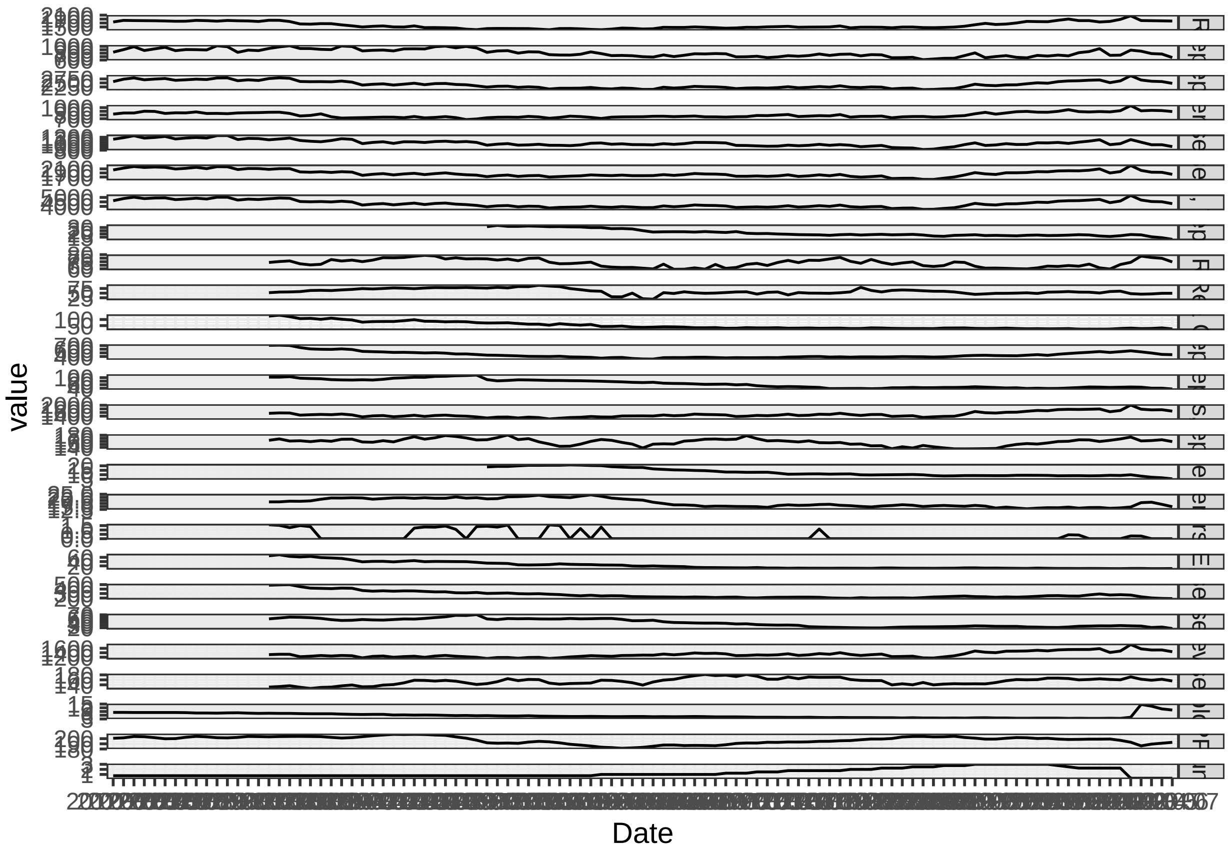



```r
allwithmacros(equity)
```



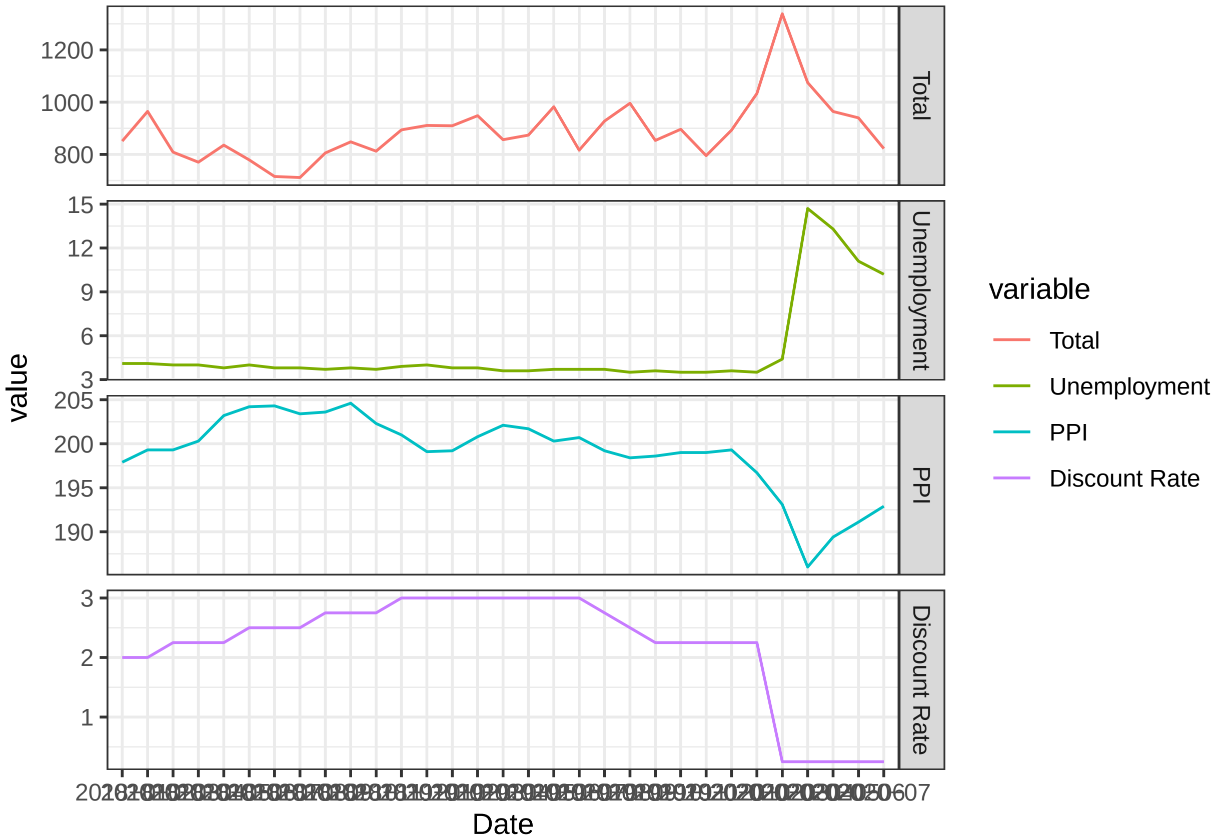

```r
allwithmacros(repo)
```

```
## Warning: Removed 282 row(s) containing missing values (geom_path).
```



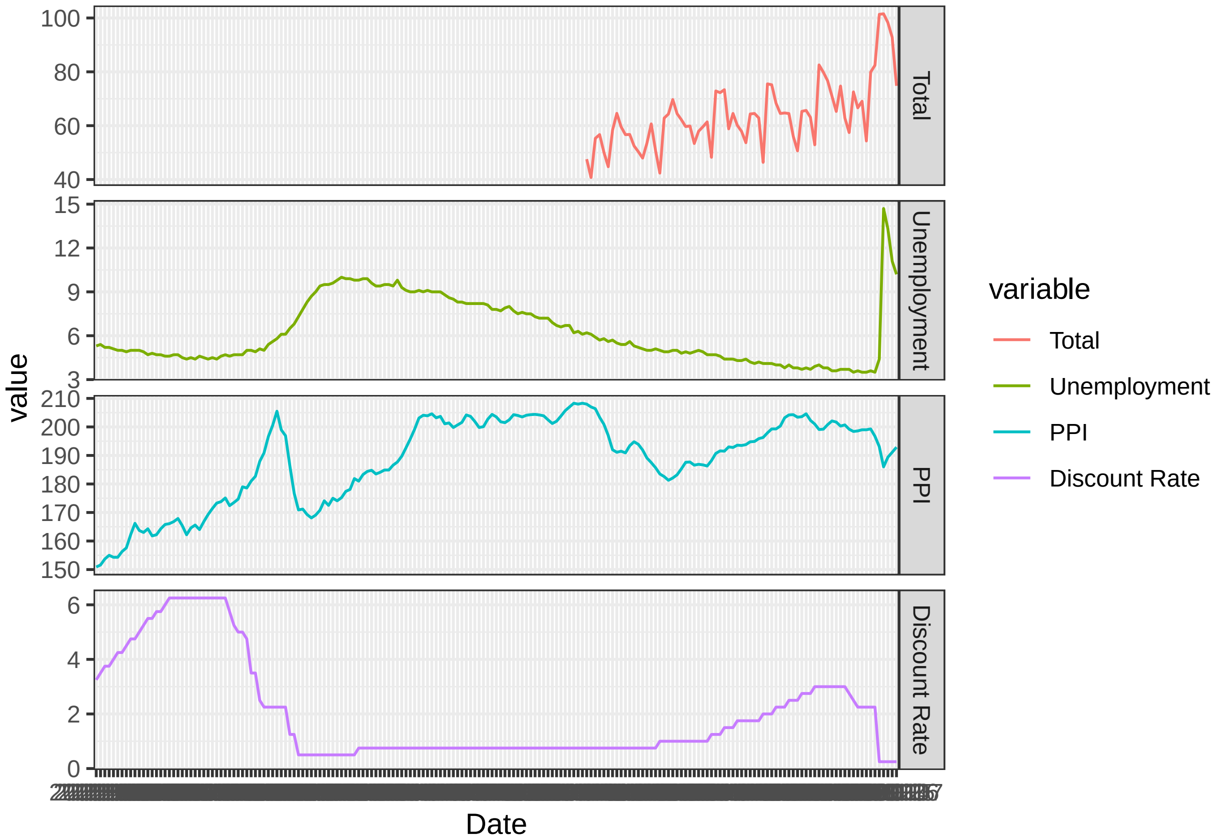

```
### plot the aggregate volume together with macroecon indicators
plot_macro_aggregate <- function(df) {
combined <- df %>% merge(unrate, by = "Date") %>% merge(ppi, by = "Date") %>% merge(r, by = "Date")
melted_df <- melt(combined,id = "Date")
melted_df$value <-as.numeric(melted_df$value)
melted_df %>% filter (Date >= df$Date[[1]]) %>%  filter(variable %in% c('Total', 'Total, Total', 'Unempl
  geom_line()+
  facet_grid(variable~., scales = "free")+theme_bw()
}
```

```
plot_macro_aggregate(fixedincome)
```

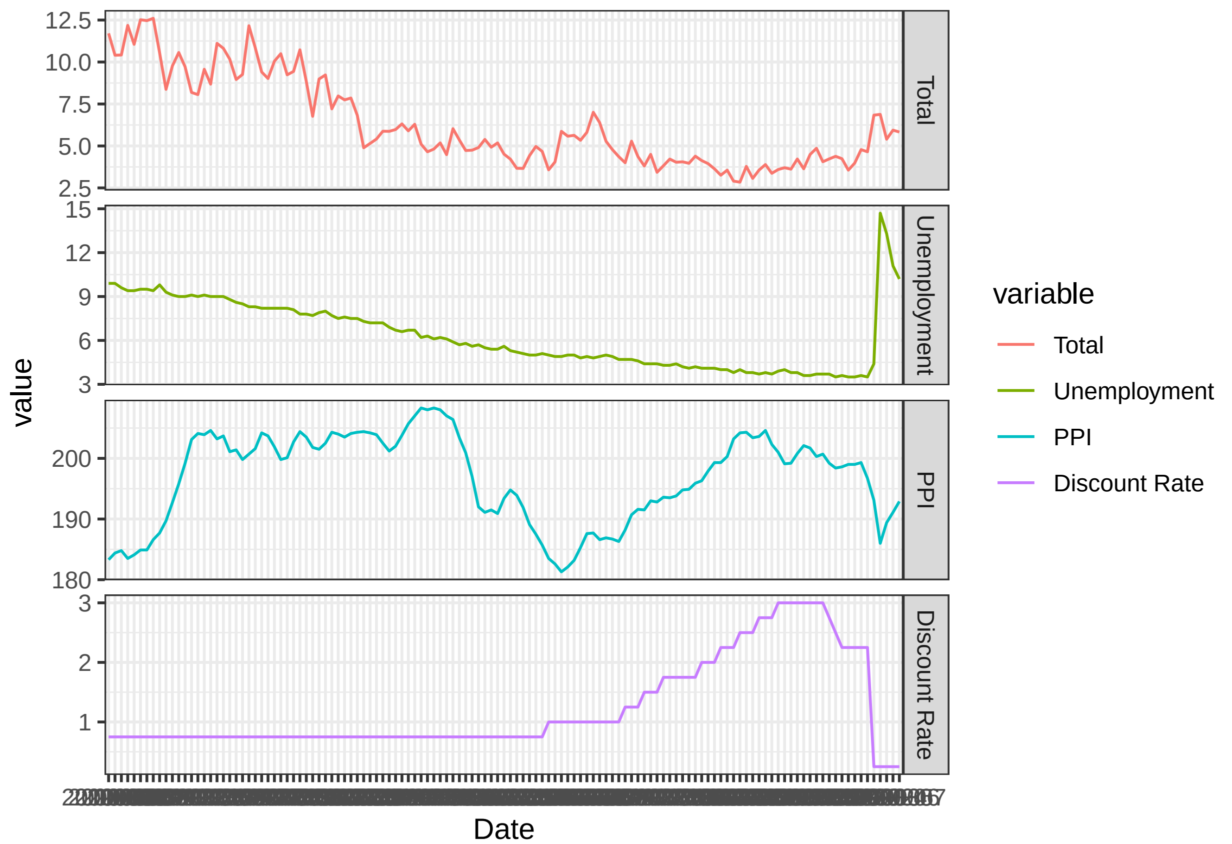



```r
plot_macro_aggregate(corporate)
```

```
## Warning: Removed 114 row(s) containing missing values (geom_path).
```

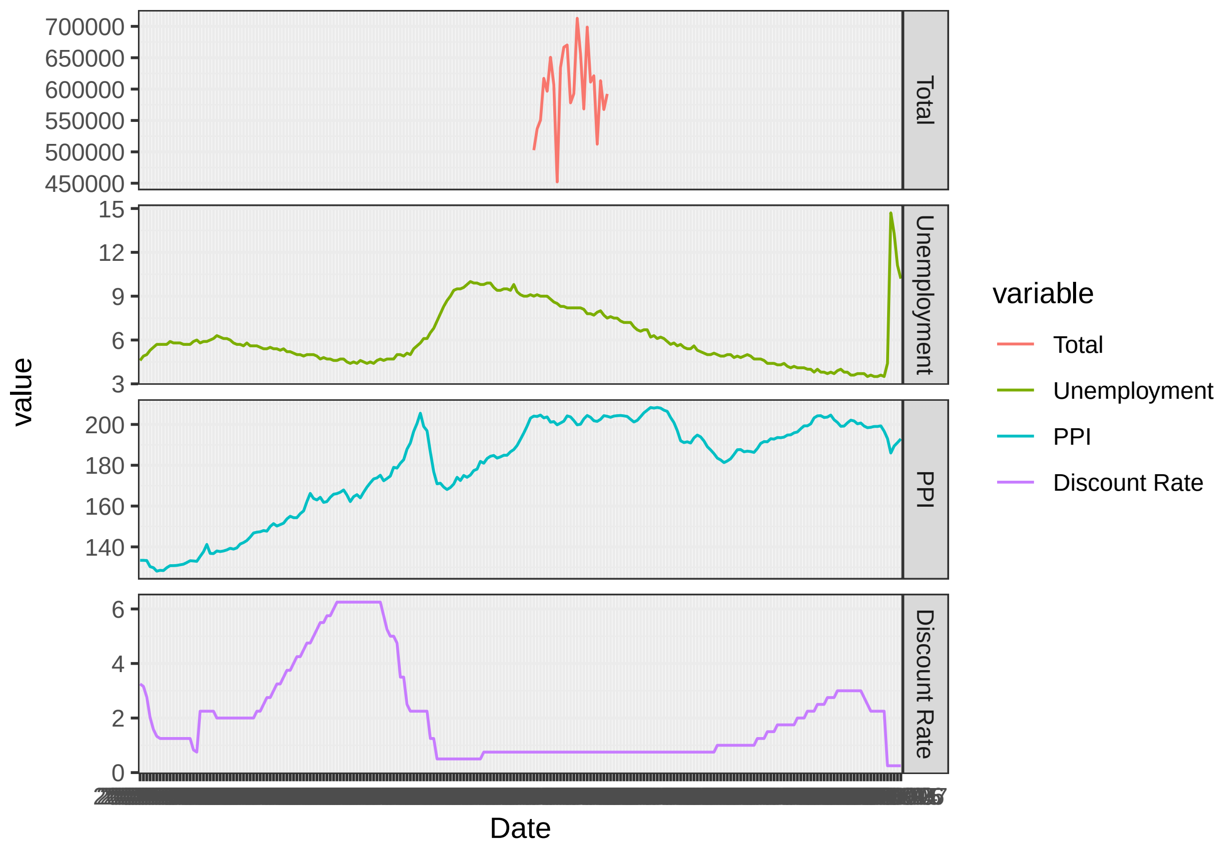



```r
plot_macro_aggregate(agency)
```

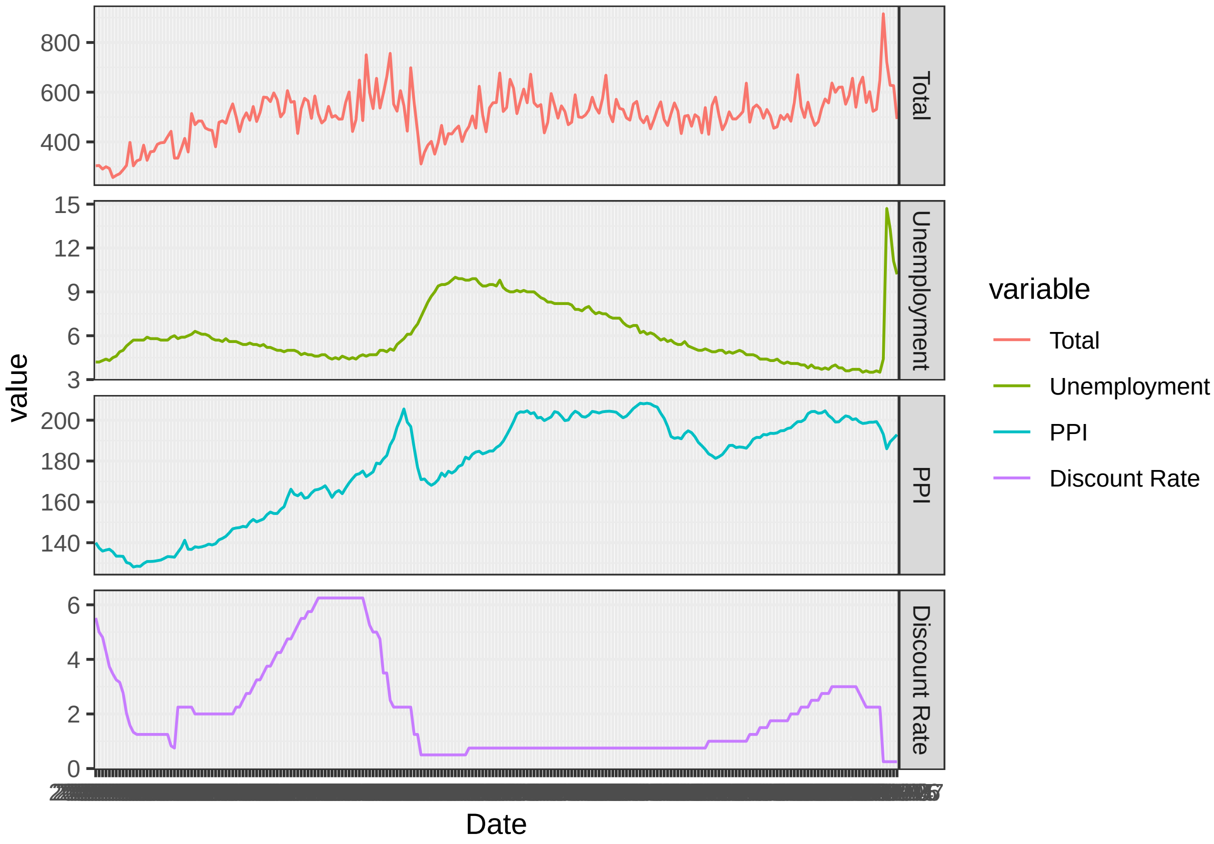



```r
plot_macro_aggregate(sf)
```

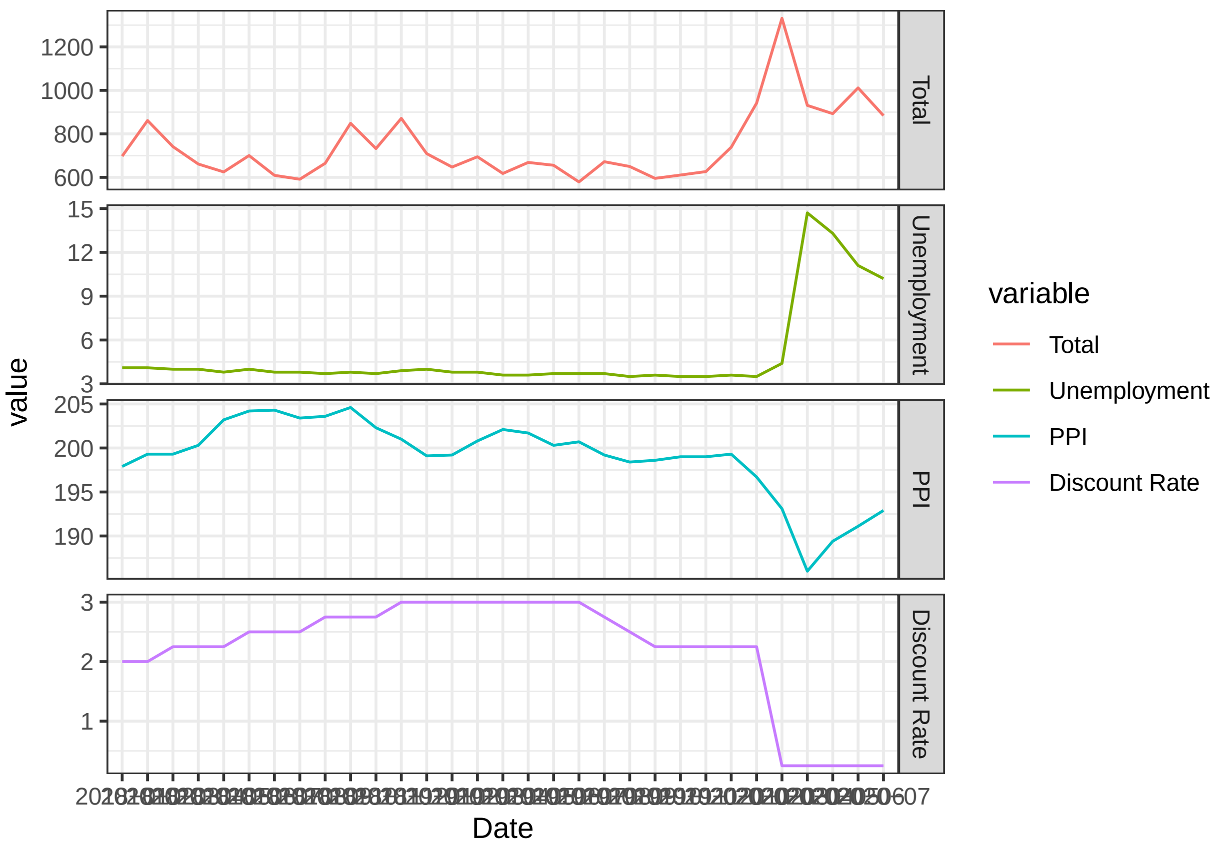
```
## Warning: Removed 206 row(s) containing missing values (geom_path).
```



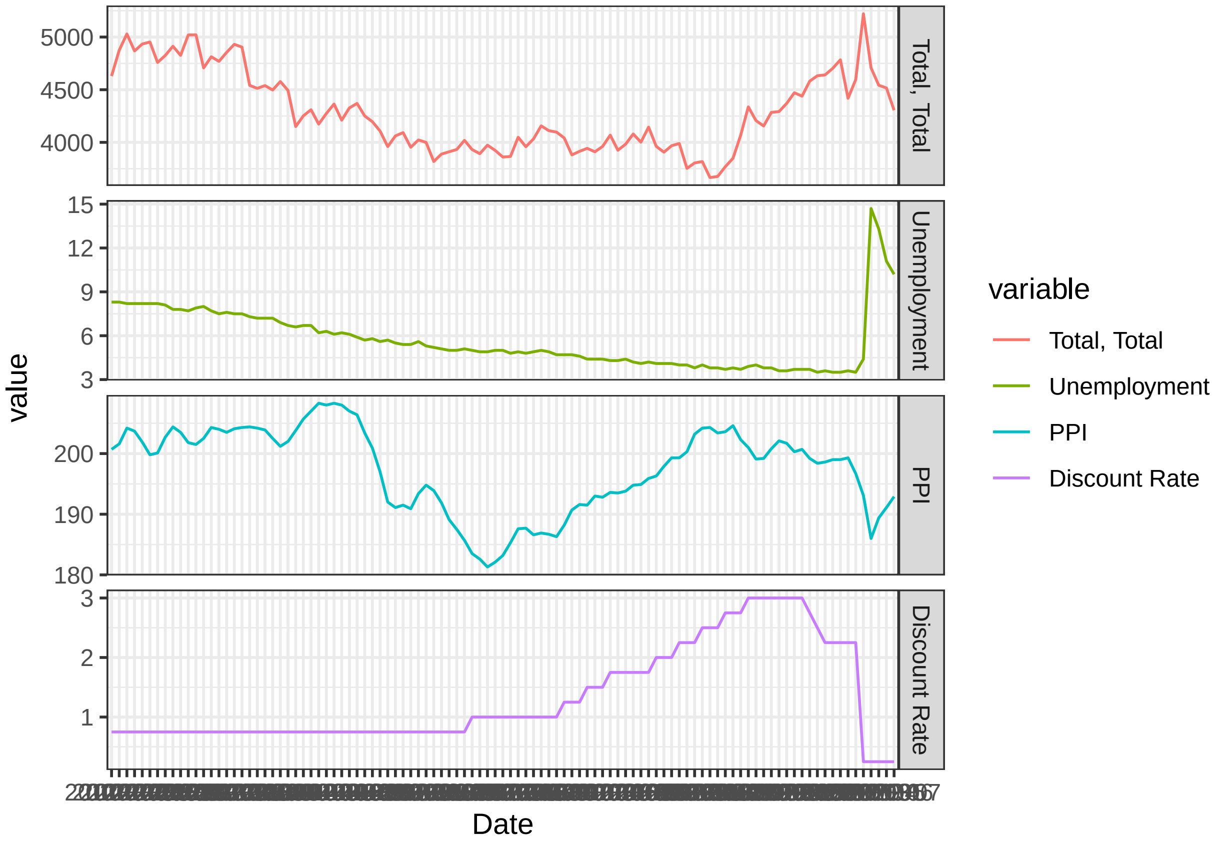

```
plot_macro_aggregate(treasury)
```




```r
plot_macro_aggregate(equity)
```




```
plot_macro_aggregate(repo)
```




```
#to see correlations of trading activities across markets
trading_aggregate <- sf[c("Date", "Total")] %>% merge(agency[c("Date", "Total")],all=T, by = "Date") %>%
  merge(corporate[c("Date", "Total")], all=T, by = "Date") %>% merge(fixedincome[c("Date", "Total")], al
  merge(equity[c("Date", "Total")], all=T, by = "Date") %>%  merge(repo[c("Date", "Total, Total")], all=
```

```
## Warning in merge.data.frame(., fixedincome[c("Date", "Total")], all = T, :
## column names 'Total.x', 'Total.y' are duplicated in the result

## Warning in merge.data.frame(., treasury[c("Date", "Total")], all = T, by =
## "Date"): column names 'Total.x', 'Total.y' are duplicated in the result

## Warning in merge.data.frame(., equity[c("Date", "Total")], all = T, by =
## "Date"): column names 'Total.x', 'Total.y', 'Total.x', 'Total.y' are duplicated
## in the result

## Warning in merge.data.frame(., repo[c("Date", "Total, Total")], all = T, :
## column names 'Total.x', 'Total.y', 'Total.x', 'Total.y' are duplicated in the
## result
```

```
colnames(trading_aggregate) <- c("Date","SF","Agency","Corporate","Fixedincome","Treasury","Equity","Rep


cor(trading_aggregate[,
            c("SF","Agency","Corporate","Fixedincome","Treasury","Equity","Repo")],
    use="pairwise",
    method="spearman")
```

```
##                     SF     Agency  Corporate Fixedincome   Treasury    Equity
## SF          1.00000000 0.47924901         NA          NA 0.02667984        NA
## Agency      0.47924901 1.00000000 0.06416883   0.6443548 0.08667896 0.4769062
## Corporate           NA 0.06416883 1.00000000   0.7391129 0.66589535 0.5894428
## Fixedincome         NA 0.64435484 0.73911290   1.0000000 0.93427419 0.4903226
## Treasury    0.02667984 0.08667896 0.66589535   0.9342742 1.00000000 0.4608871
## Equity              NA 0.47690616 0.58944282   0.4903226 0.46088710 1.0000000
## Repo        0.17142857 0.63735009 0.23988029   0.6495968 0.34885560 0.2129032
##                  Repo
## SF          0.1714286
## Agency      0.6373501
## Corporate   0.2398803
## Fixedincome 0.6495968
## Treasury    0.3488556
## Equity      0.2129032
## Repo        1.0000000
```

```
describe(fixedincome_issuance)
```

```
##                            N N not NA      Mean       Q25       Q50       Q75
## Municipal                 24       24  349.0650  292.9672  369.1951  407.7589
## Treasury                  24       24 1404.8563  632.5886  941.4105 2201.7762
## Mortgage-Related          24       24 1893.9172 1428.2246 1973.6892 2253.4209
## Corporate Debt            24       24 1029.1073  735.4863 1011.3640 1397.5411
## Federal Agency Securities 24       24  794.4476  625.3591  781.2791  953.0822
## Asset-Backed              24       24  318.8169  193.2617  278.0713  348.3868
## Total                     24       24 5790.2103 4668.4841 6383.5570 7219.6431
##                           Standard Deviation
## Municipal                           80.68615
## Treasury                           881.19874
## Mortgage-Related                   699.96146
## Corporate Debt                     381.13000
## Federal Agency Securities          280.38988
## Asset-Backed                       176.03951
## Total                             1831.49992
```

```
describe(corporate_issuance)
```

```
##                                              N N not NA       Mean       Q25
## Investment Grade, Non-Convertible           24       24  822.88903 625.38510
## High Yield, Non-Convertible                 24       24  167.71603  89.97740
## Total, Non-Convertible                      24       24  990.60498 693.41030
## Fixed Rate, Callable, Non-Convertible       24       24  524.31565 239.46025
## Floating Rate, Callable, Non-Convertible    24       24   39.48339   7.65460
## Fixed Rate, Non-Callable, Non-Convertible   24       24  276.10447 201.64075
## Floating Rate, Non-Callable, Non-Convertible 24      24  150.65195  82.63393
## Convertible                                 24       24   35.63295  22.13995
## Total                                       24       24 1026.23793 733.63585
##                                                    Q50        Q75
## Investment Grade, Non-Convertible            794.14650 1063.67490
## High Yield, Non-Convertible                  137.56190  260.99295
## Total, Non-Convertible                       982.29615 1370.80340
## Fixed Rate, Callable, Non-Convertible        411.99005  828.37030
```

```
## Floating Rate, Callable, Non-Convertible       22.31165   58.25715
## Fixed Rate, Non-Callable, Non-Convertible     252.98855  378.99770
## Floating Rate, Non-Callable, Non-Convertible  120.68280  170.59818
## Convertible                                    30.15625   39.77717
## Total                                        1009.43560 1394.83585
##                                              Standard Deviation
## Investment Grade, Non-Convertible                     301.58821
## High Yield, Non-Convertible                            97.91148
## Total, Non-Convertible                                383.17386
## Fixed Rate, Callable, Non-Convertible                 320.87952
## Floating Rate, Callable, Non-Convertible               44.49955
## Fixed Rate, Non-Callable, Non-Convertible              90.28841
## Floating Rate, Non-Callable, Non-Convertible          102.28734
## Convertible                                            19.76661
## Total                                                 380.54407
```

```r
describe(municipal_issuance)
```

```
##                                N N not NA      Mean       Q25       Q50
## GO, Competitive               24       24  49.74489  42.34360  50.00570
## Revenue, Competitive          24       24  20.17306  16.83998  20.48950
## GO, Negotiated                24       24  72.16760  60.94820  76.58045
## Revenue, Negotiated           24       24 195.24710 164.19293 207.59855
## Total, Private Placement      24       24  11.70401   3.52685   6.32990
## GO, Total - Bond Type         24       24 121.91249 104.05155 127.79270
## Revenue, Total - Bond Type    24       24 215.42016 182.21742 227.13190
## Competitive, Total - Bid Type 24       24  69.91795  59.14667  70.42585
## Negotiated, Total - Bid Type  24       24 267.41470 224.33250 288.50940
## Total                         24       24 349.03666 292.96715 369.19505
##                                     Q75 Standard Deviation
## GO, Competitive                54.11600           11.12485
## Revenue, Competitive           23.44872            5.02661
## GO, Negotiated                 88.79452           23.26011
## Revenue, Negotiated           224.08805           47.27196
## Total, Private Placement       20.20767           10.87118
## GO, Total - Bond Type         145.01317           32.28881
## Revenue, Total - Bond Type    249.05260           49.62844
## Competitive, Total - Bid Type  75.56867           15.50910
## Negotiated, Total - Bid Type  315.80275           67.22106
## Total                         407.75888           80.68710
```

```r
describe(ABSissuance)
```

```
##                N N not NA      Mean       Q25       Q50       Q75
## Auto          35       35  58288.82 24985.850  64277.68  88473.70
## CDO/CLO       35       31  91843.57  4649.833  55038.80 118174.36
## Credit Cards  35       33  38306.03 22531.400  40100.40  51506.73
## Equipment     35       35  10876.14  3366.343  11596.20  16031.04
## Other         35       35  25483.62  5736.826  23922.90  36944.32
## Student Loans 35       30  20187.99 10044.472  15716.11  24673.83
## Total         35       35 229354.99 60936.383 196293.67 315943.12
##               Standard Deviation
## Auto                   36254.746
```

```
## CDO/CLO              121601.618
## Credit Cards          21311.657
## Equipment              8324.709
## Other                 20882.394
## Student Loans         18385.892
## Total                194203.803
```

```r
describe(MBSissuance)
```

```
##                                          N N not NA       Mean        Q25
## MBS, Agency (FHLMC, FNMA, GNMA)         24        24 1197.75453  967.68542
## CMO, Agency (FHLMC, FNMA, GNMA)         24        24  311.07978  249.89727
## CMBS, Non-Agency                        24        24   80.25694   45.57663
## RMBS, Non-Agency                        24        24  304.97630   71.00047
## Agency, Mortgage-Related Securities     24        24 1508.58074 1248.70218
## Non-Agency, Mortgage-Related Securities 24        24  385.28474  115.67057
## Total, Mortgage-Related Securities      24        24 1893.86548 1428.22623
## Total                                   24        24 3402.64829 2714.64667
##                                                Q50        Q75
## MBS, Agency (FHLMC, FNMA, GNMA)         1208.06795 1474.62249
## CMO, Agency (FHLMC, FNMA, GNMA)          302.01819  363.84886
## CMBS, Non-Agency                          71.65446   98.64328
## RMBS, Non-Agency                         131.96383  309.27438
## Agency, Mortgage-Related Securities     1540.20931 1936.50099
## Non-Agency, Mortgage-Related Securities  197.38857  373.45182
## Total, Mortgage-Related Securities      1973.65199 2253.50841
## Total                                   3742.02369 4096.45681
##                                         Standard Deviation
## MBS, Agency (FHLMC, FNMA, GNMA)                  462.95562
## CMO, Agency (FHLMC, FNMA, GNMA)                  133.37563
## CMBS, Non-Agency                                  58.03502
## RMBS, Non-Agency                                 382.78435
## Agency, Mortgage-Related Securities              564.59346
## Non-Agency, Mortgage-Related Securities          429.22479
## Total, Mortgage-Related Securities               699.86593
## Total                                           1197.17086
```

```r
describe(treasury_issuance)
```

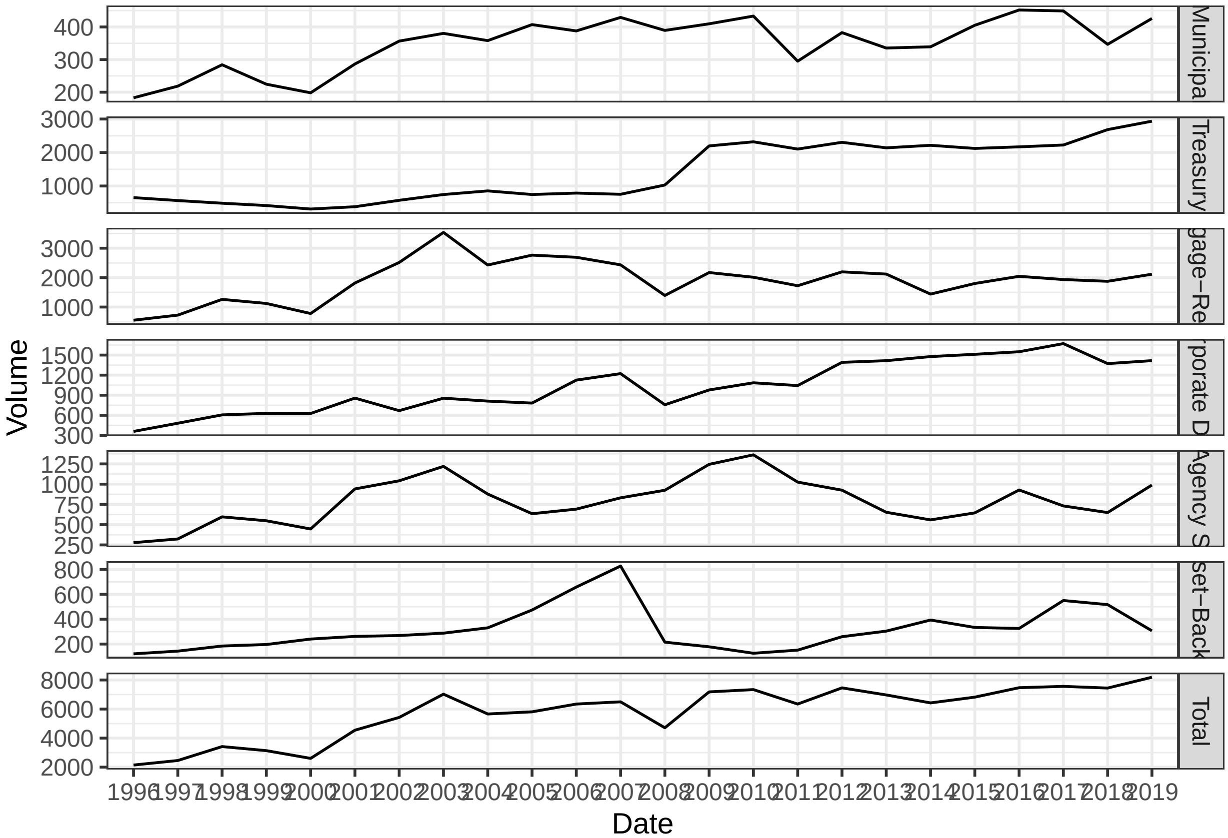
```
##                          N N not NA       Mean      Q25      Q50      Q75
## Gross Issues, Bills     21        21 5300.46081 3633.449 5401.746 6130.872
## Gross Retirement, Bills 21        21 5093.81000 3655.652 4948.982 6120.715
## Net, Bills              21        21  206.64517  -37.017   59.738  137.968
## Gross Issues, Notes     21        21 1489.77905  742.189 1930.702 2045.722
## Gross Retirement, Notes 21        21 1012.93610  539.105  713.310 1474.193
## Net, Notes              21        21  476.84295  233.794  350.898  644.860
## Gross Issues, Bonds     21        21  127.79972   22.044  187.617  191.765
## Gross Retirement, Bonds 21        21   17.94757   10.147   14.242   26.531
## Net, Bonds              21        21  109.85214   -5.926  144.575  191.030
## Total                   21        21 6918.03957 4422.035 7030.295 8419.586
## Gross Retirement, TOTAL 21        21 6124.69367 4269.394 6397.263 7137.268
## Net Cash Raised, TOTAL  21        21  793.34027  234.341  684.221 1099.961
##                         Standard Deviation
```

```
## Gross Issues, Bills             2263.37151
## Gross Retirement, Bills         1929.19941
## Net, Bills                       605.99373
## Gross Issues, Notes              768.34242
## Gross Retirement, Notes          558.05137
## Net, Notes                       437.42915
## Gross Issues, Bonds               95.29604
## Gross Retirement, Bonds           13.68404
## Net, Bonds                        98.26647
## Total                           3008.76096
## Gross Retirement, TOTAL         2381.91883
## Net Cash Raised, TOTAL           797.67963
```

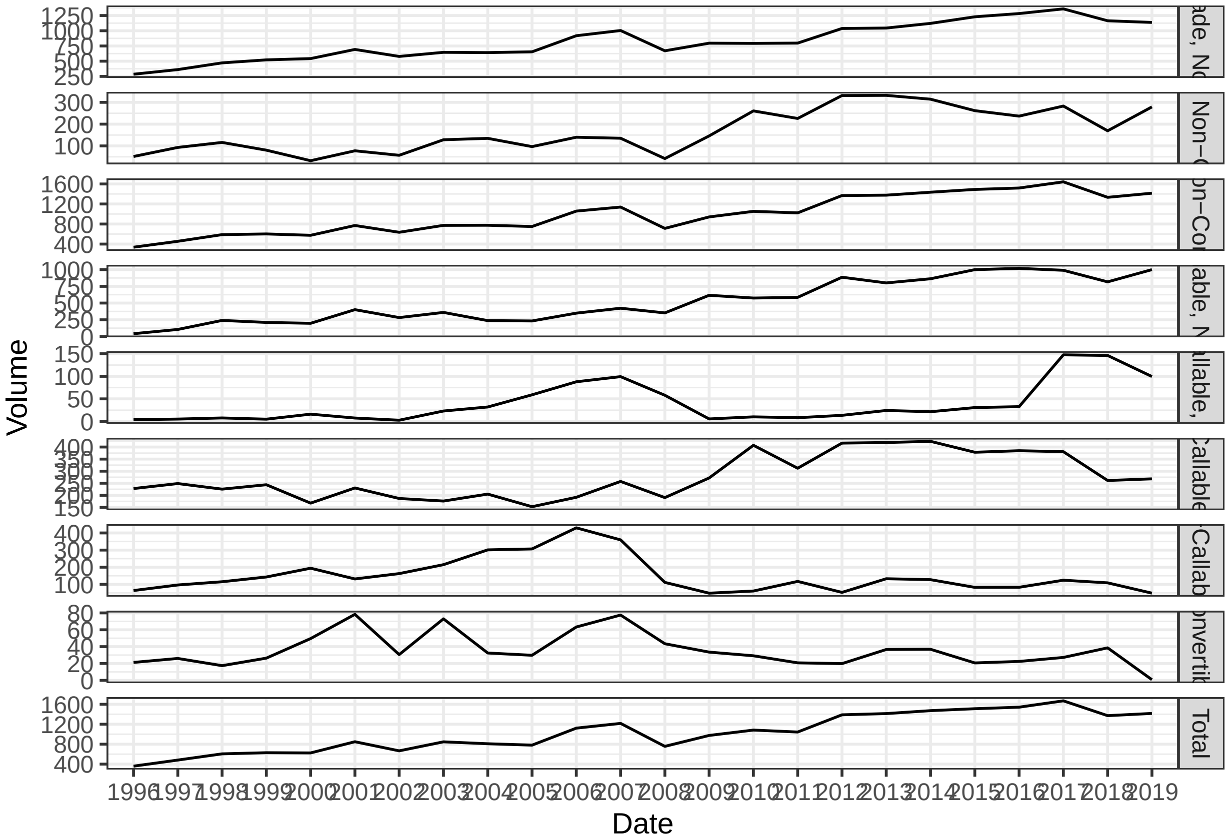
```r
describe(commercialpaper_issuance)
```

```
##                N N not NA         Mean      Q25       Q50       Q75
## Non-Financial 18       18  171.3546347 124.0691  161.7896  223.7618
## Financial     18       18  551.1812184 475.4655  520.7528  588.1537
## ABCP          18       18  492.2454695 252.0667  366.4662  703.7719
## Other         18       18    0.2656427   0.0000    0.0000    0.0000
## Total         18       18 1215.0469653 955.7430 1051.3504 1388.8495
##               Standard Deviation
## Non-Financial         55.3909943
## Financial            102.3753819
## ABCP                 278.4581812
## Other                  0.8651362
## Total                334.6044470
```

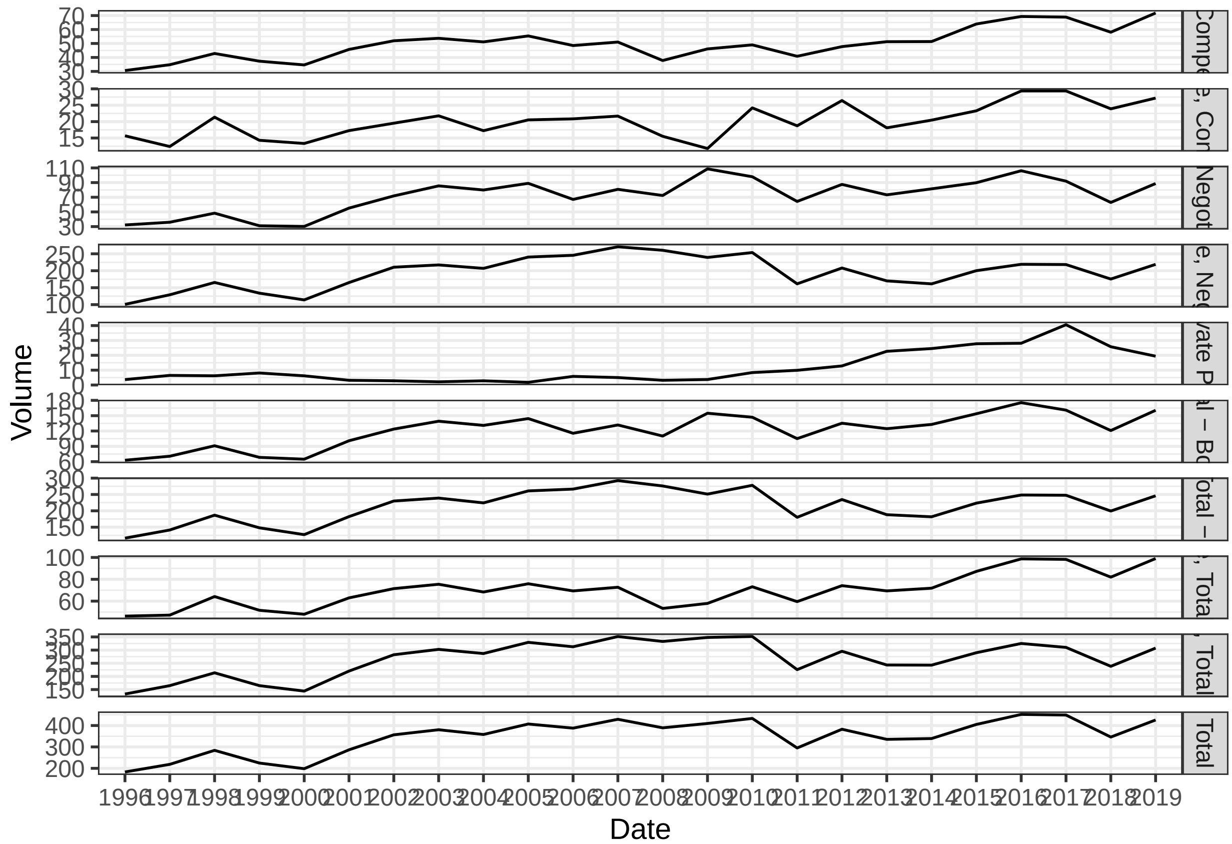
```r
toplot(fixedincome_issuance)
```




```r
toplot(corporate_issuance)
```

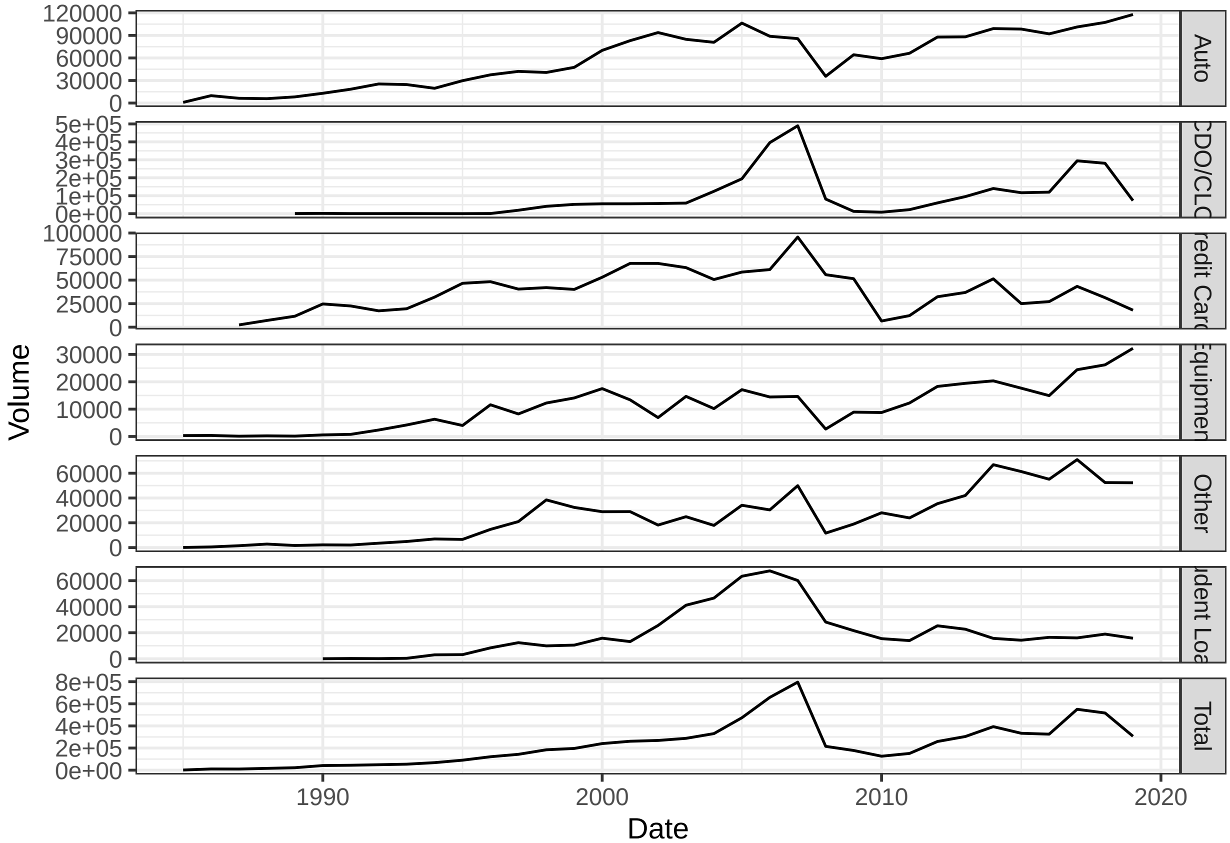



```r
toplot(municipal_issuance)
```

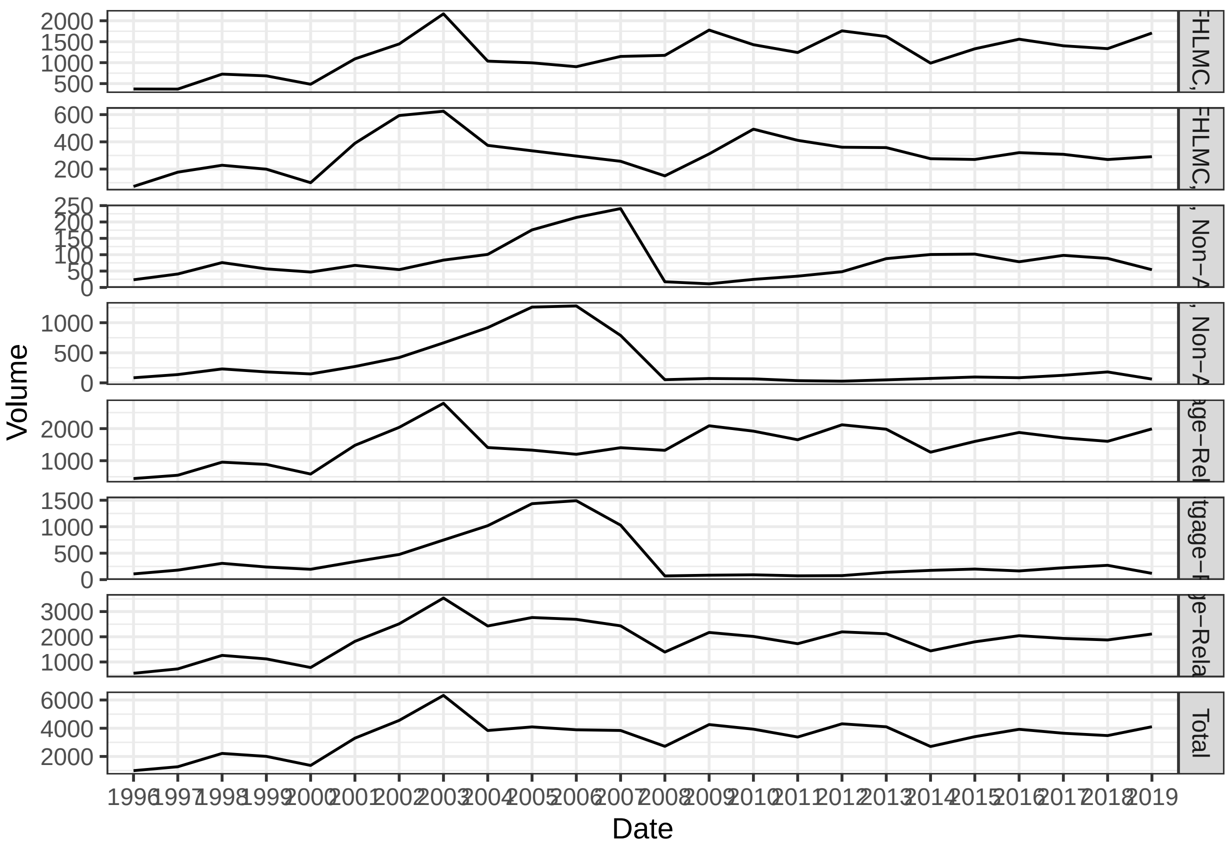



```r
toplot(ABSissuance)
```

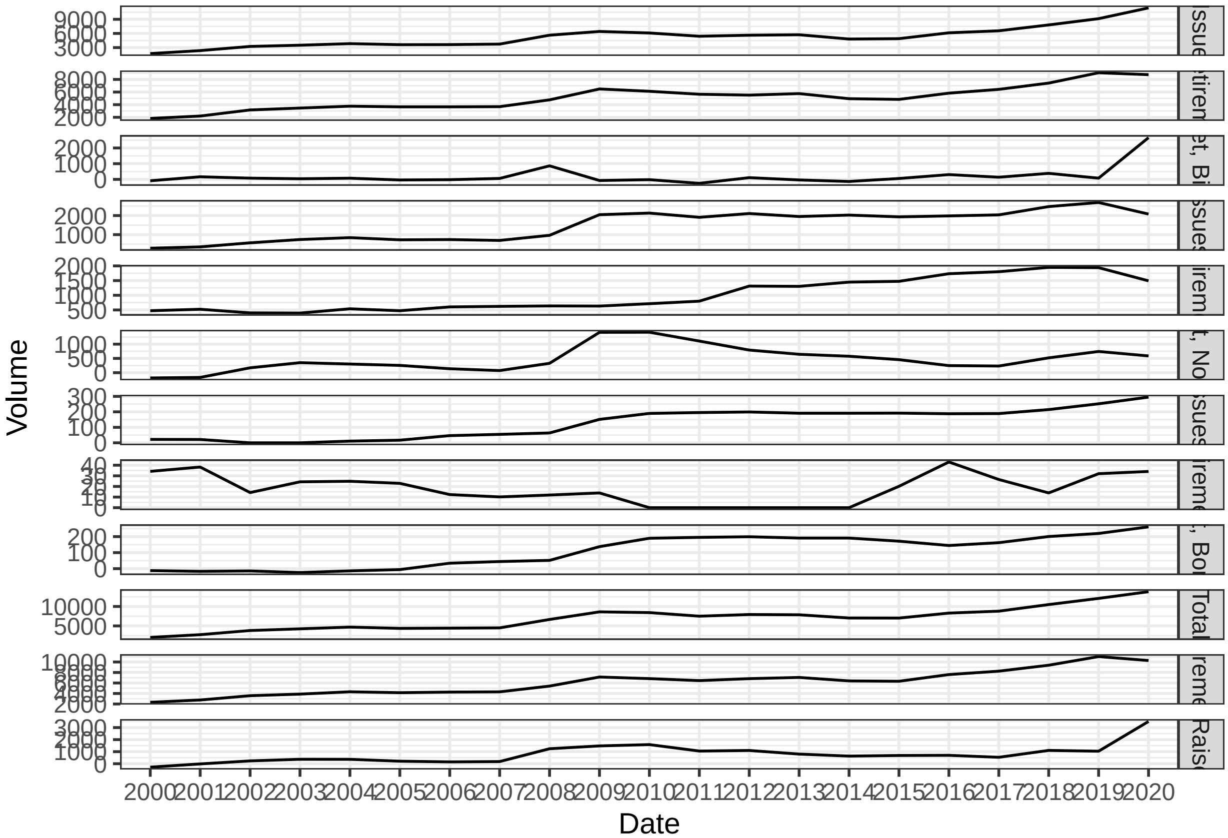
```
## Warning: Removed 11 row(s) containing missing values (geom_path).
```



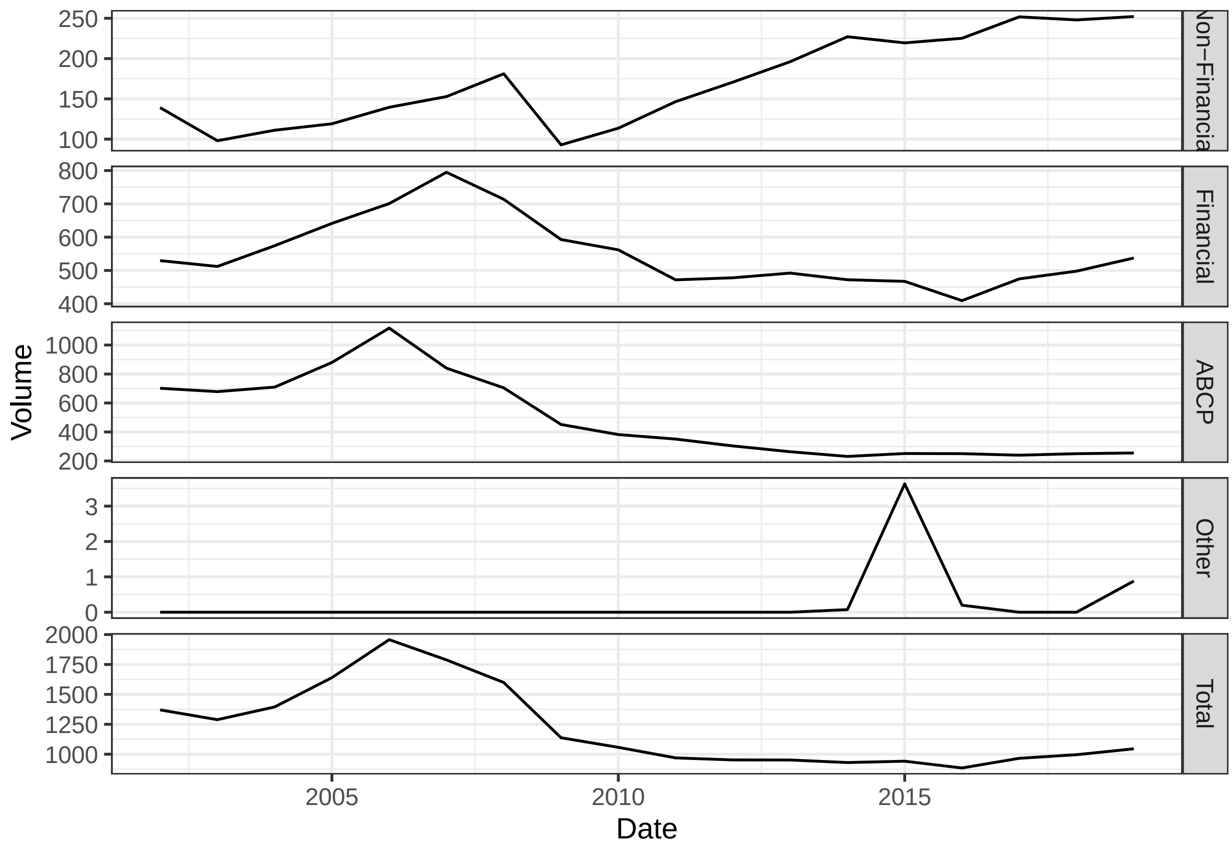

```r
toplot(MBSissuance)
```




```r
toplot(treasury_issuance)
```




```
toplot(commercialpaper_issuance)
```



###transform the monthly data of macroeconindicators to annual data

```
unrate <- read_excel(paste("P:/Mgt_of_FI/Assignment3/UNRATE.xls"),skip = 10)
colnames(unrate)[1] <- "Date"
unrate$year <- unrate$Date %>% as.character() %>% year
unrate <- unrate %>% group_by(year) %>% summarise(Unemployment = mean(UNRATE))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
colnames(unrate)[1] <- "Date"

ppi <- read_excel(paste("P:/Mgt_of_FI/Assignment3/PPIACO.xls"),skip = 10)
colnames(ppi)[1] <- "Date"
ppi$year <- ppi$Date %>% as.character() %>% year
ppi <- ppi %>% group_by(year) %>% summarise(PPI = mean(PPIACO))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

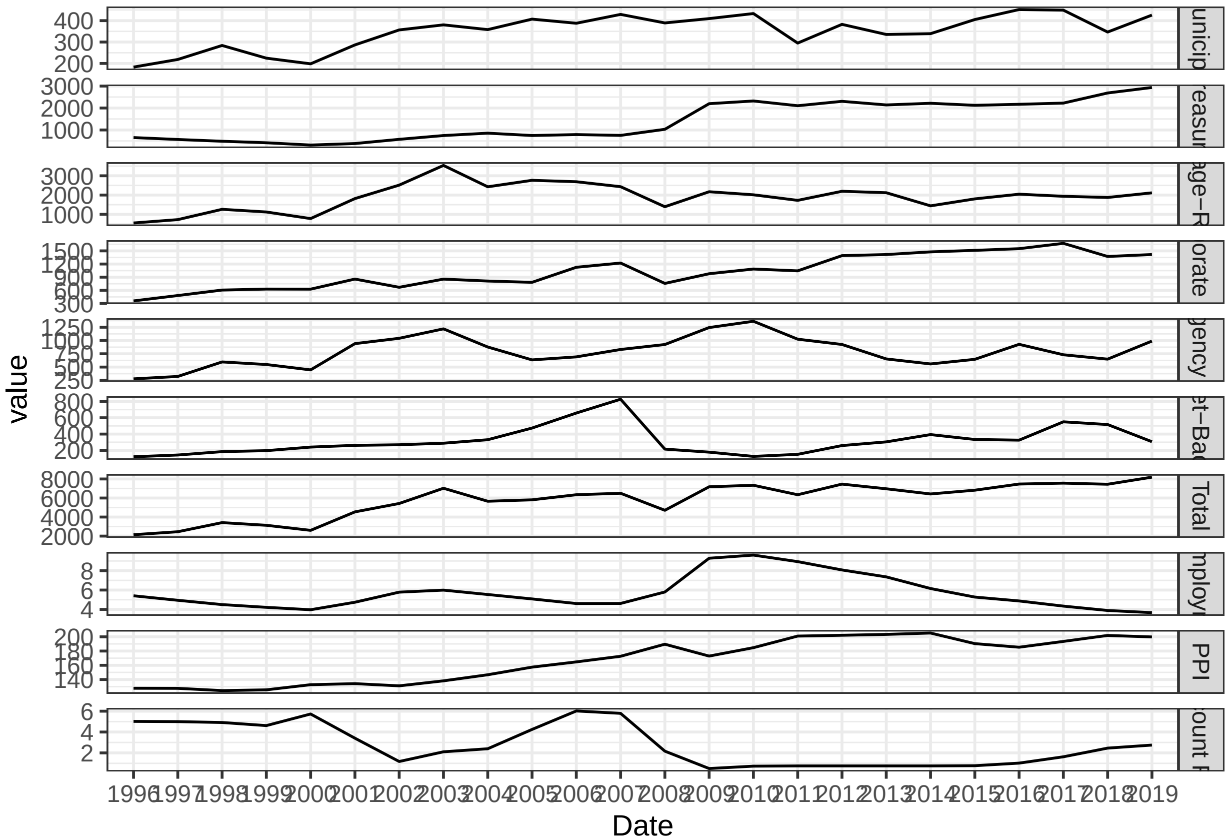
```
colnames(ppi)[1] <- "Date"

r <- read_excel(paste("P:/Mgt_of_FI/Assignment3/INTDSRUSM193N.xls"),skip = 10)
colnames(r)[1] <- "Date"
r$year <- r$Date %>% as.character() %>% year
r <- r %>% group_by(year) %>% summarise('Discount Rate' = mean(INTDSRUSM193N))
```

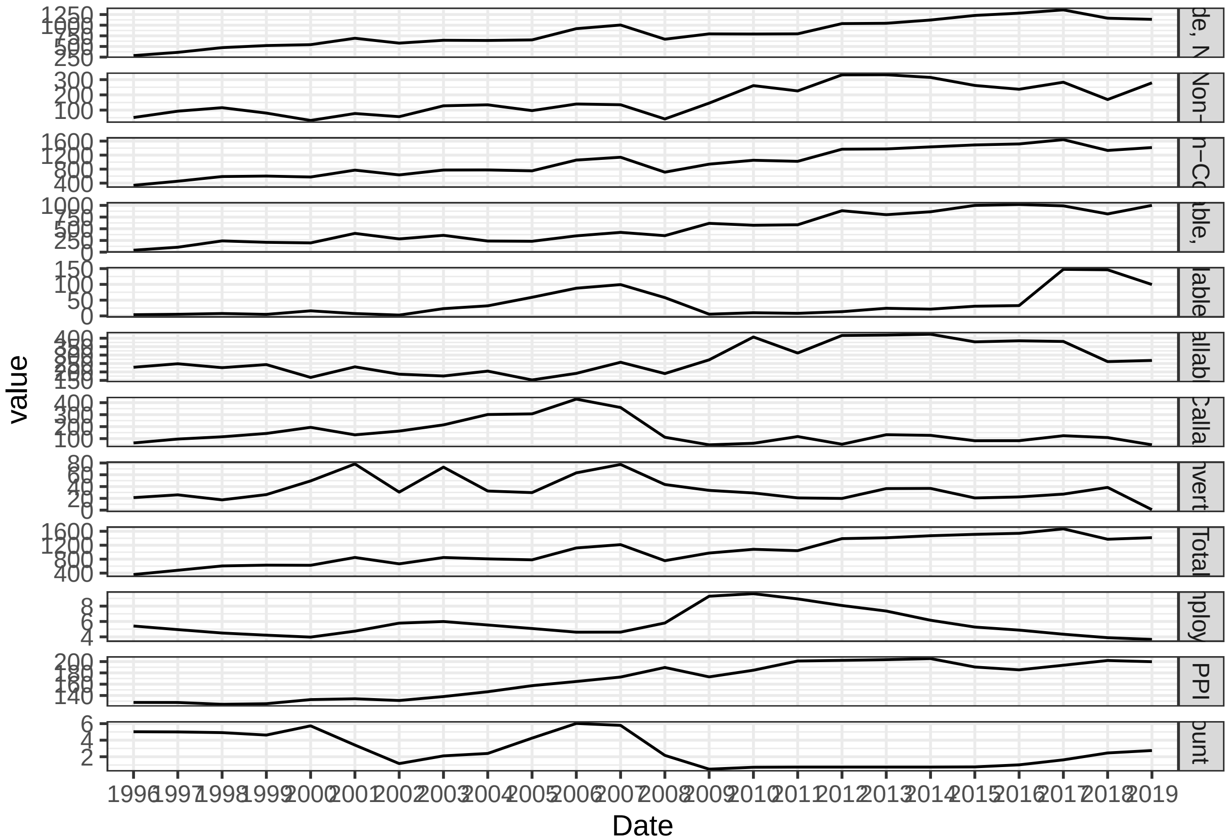
```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```r
colnames(r)[1] <- "Date"
```

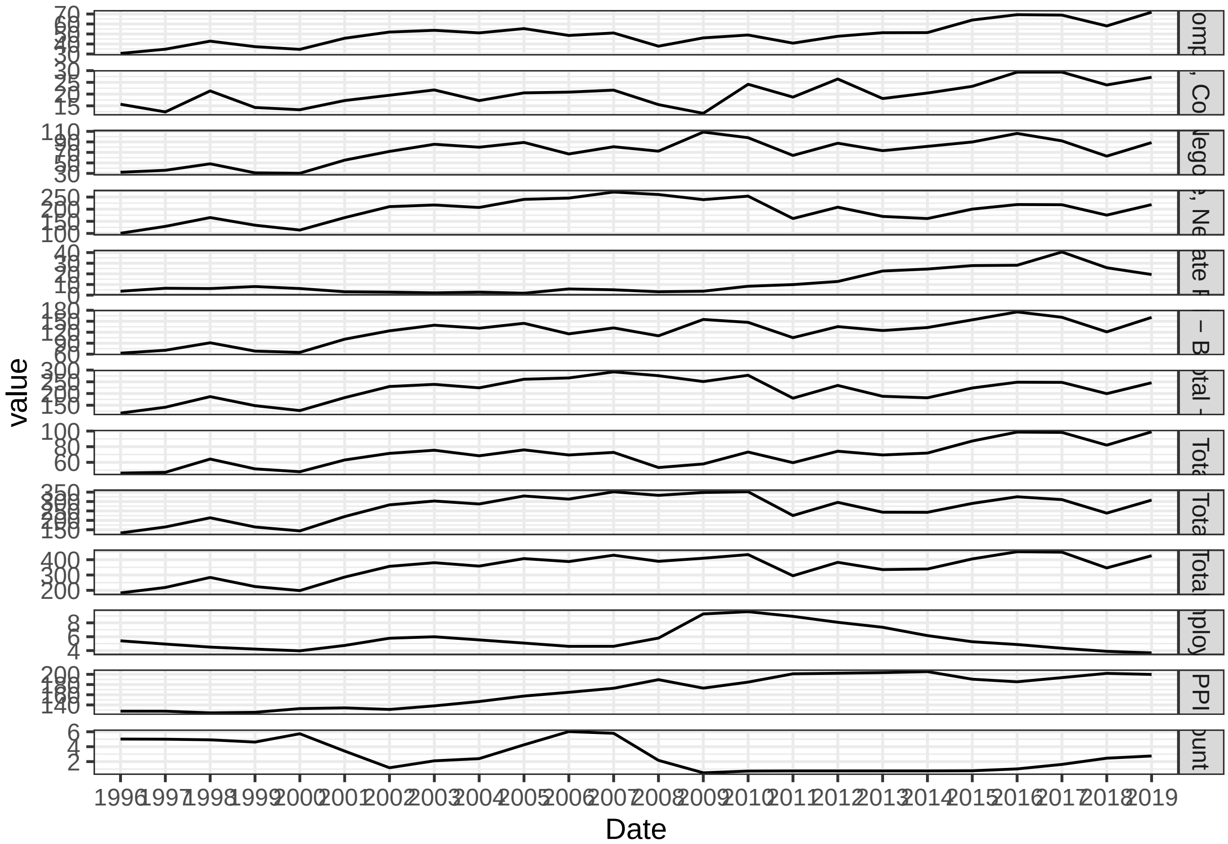
```r
allwithmacros(fixedincome_issuance)
```




```r
allwithmacros(corporate_issuance)
```

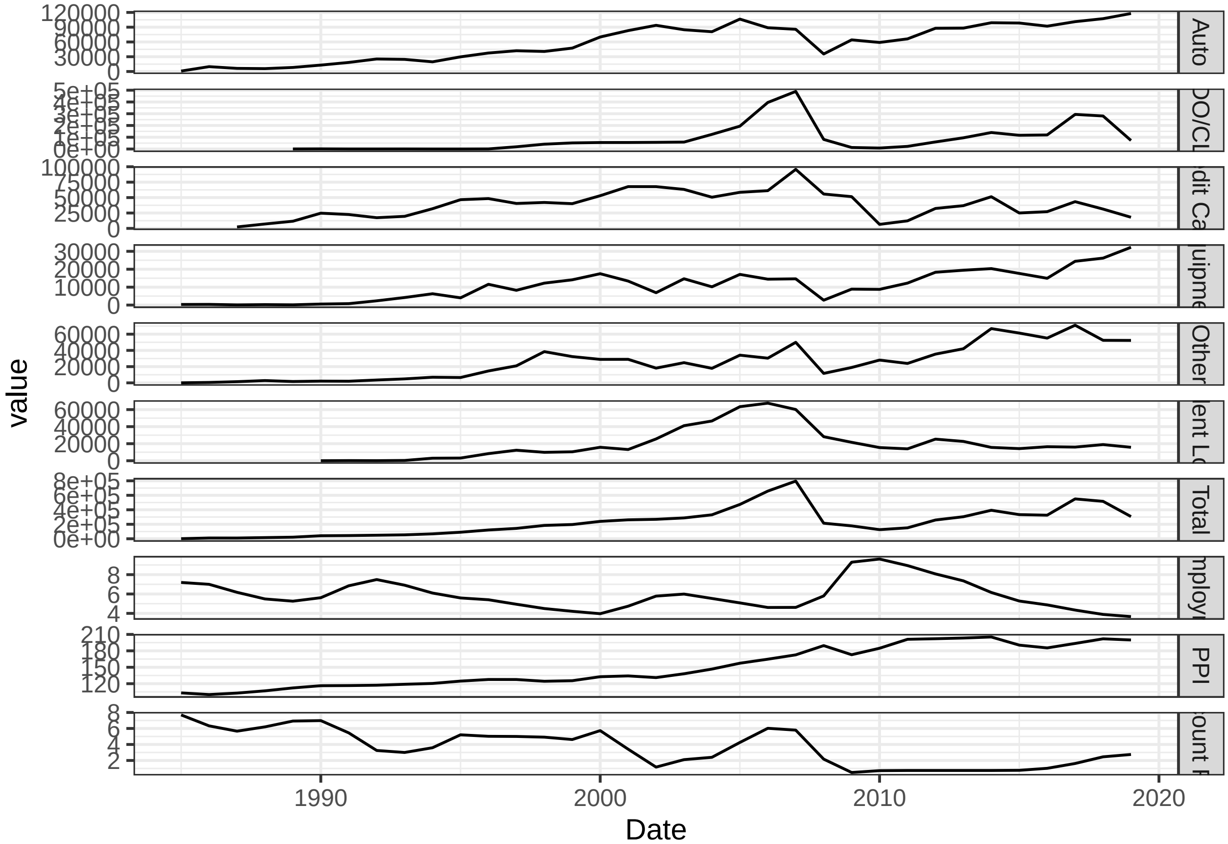



```
allwithmacros(municipal_issuance)
```

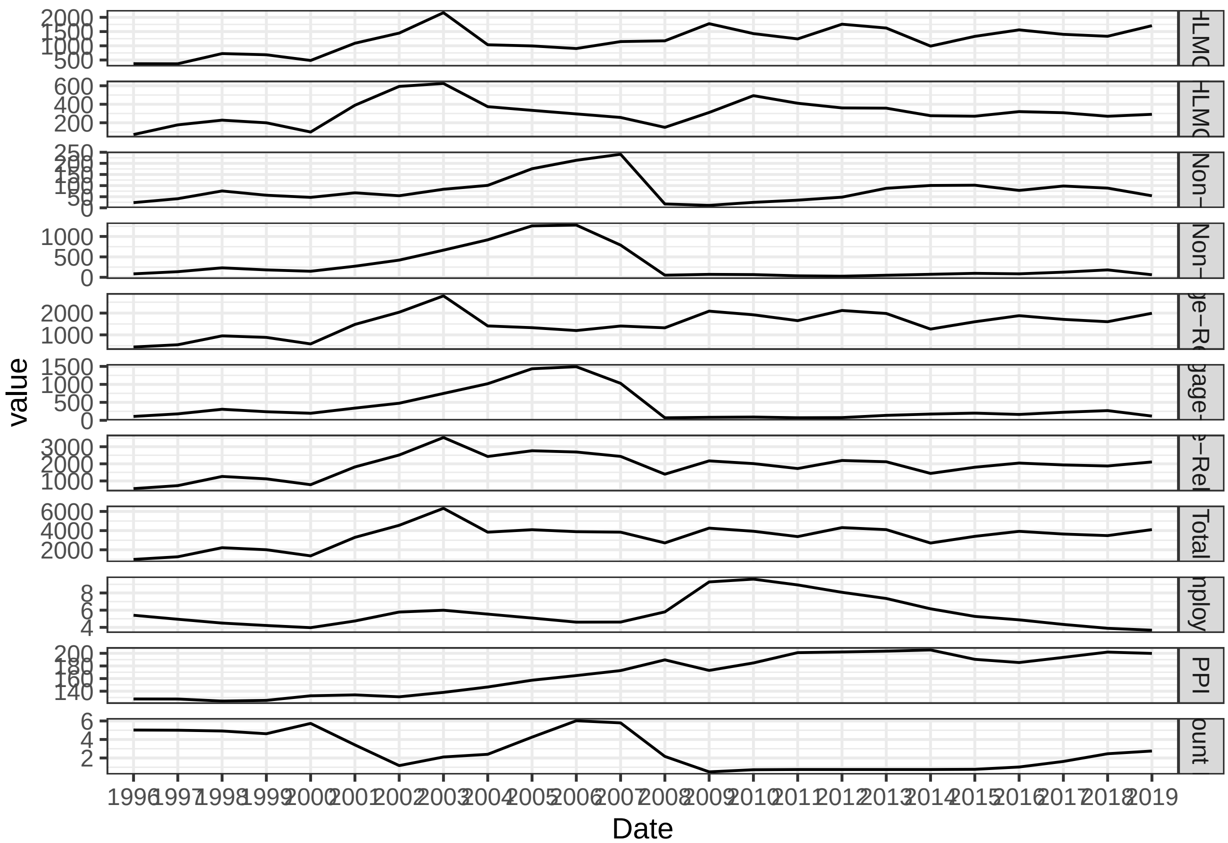


```r
allwithmacros(ABSissuance)
```

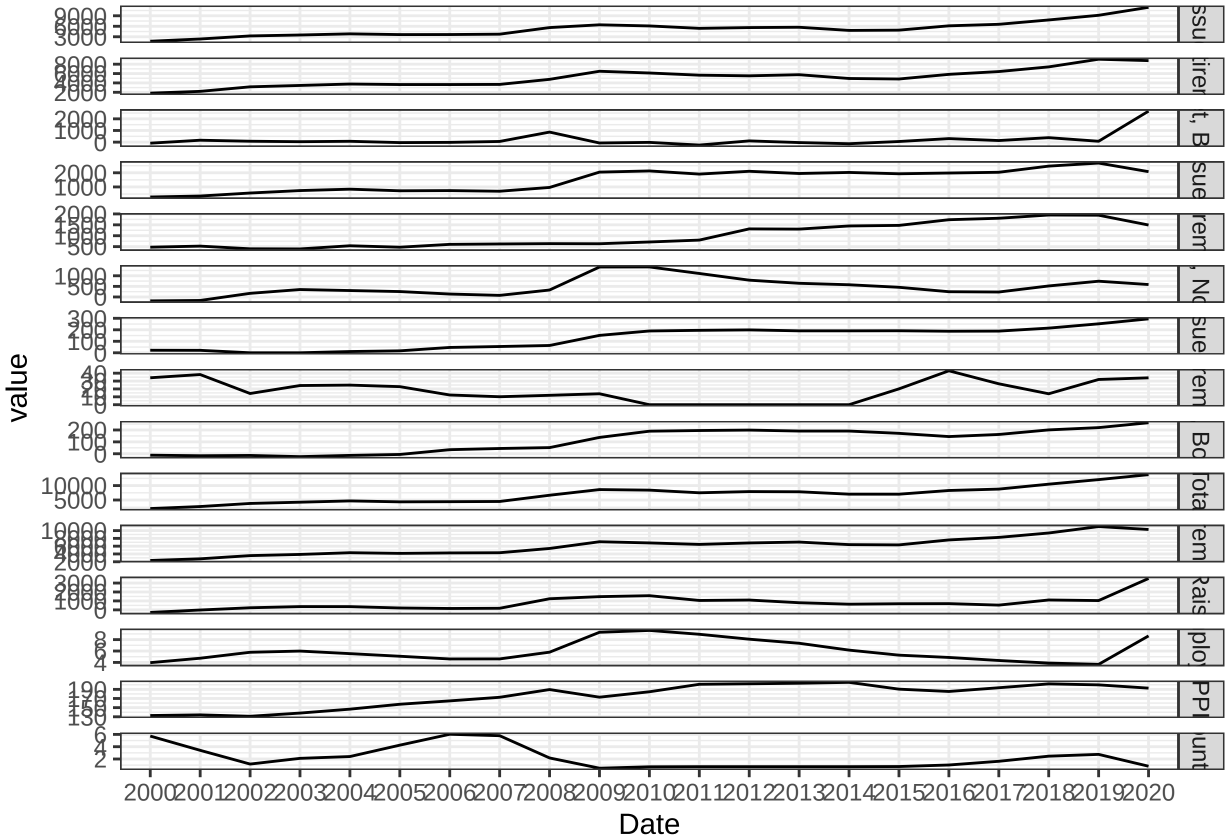
```
## Warning: Removed 11 row(s) containing missing values (geom_path).
```



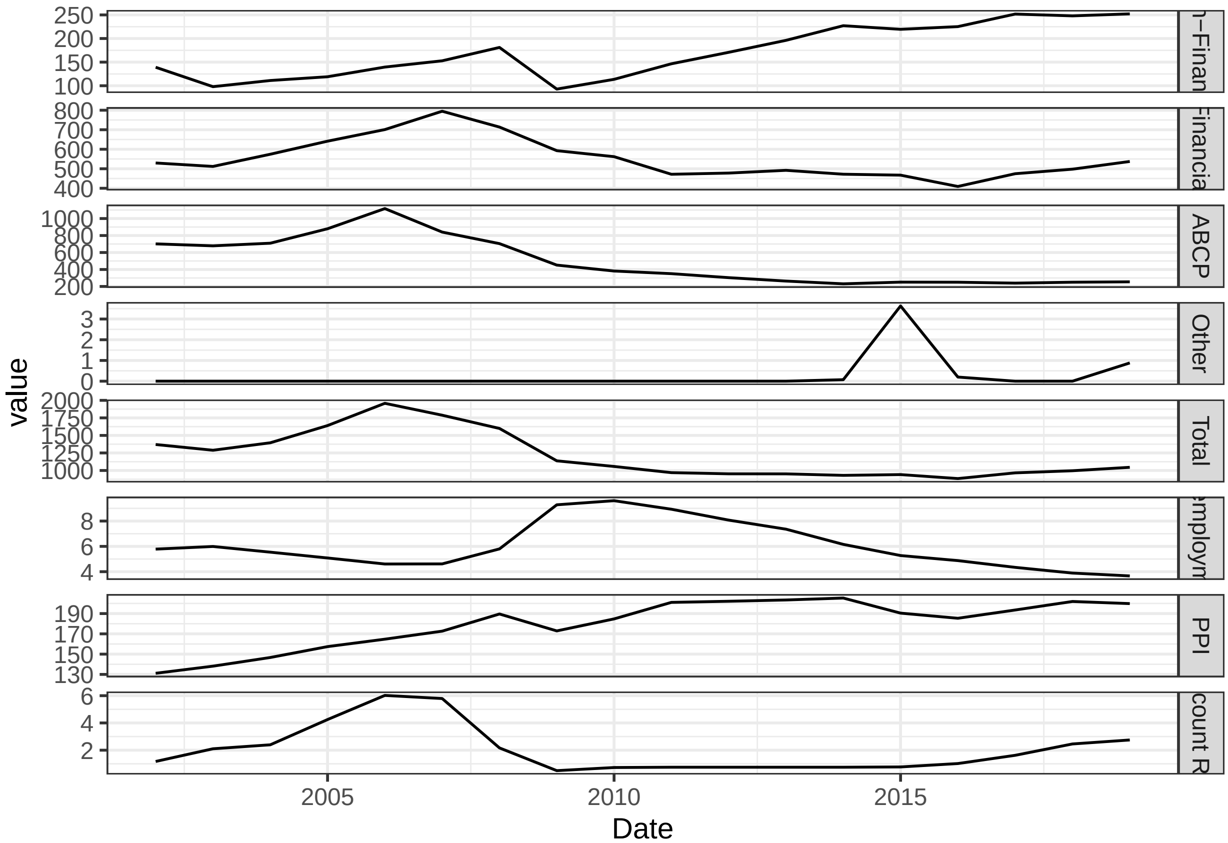

```r
allwithmacros(MBSissuance)
```



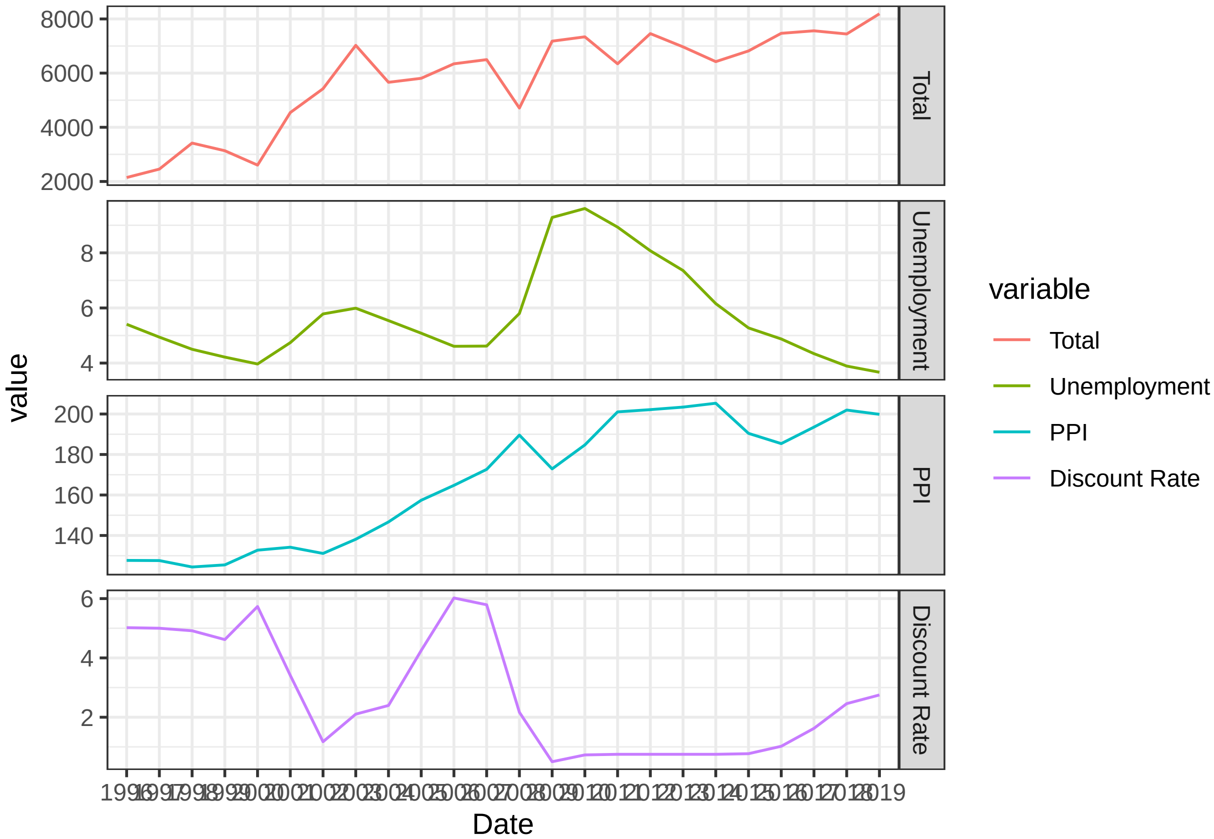

```r
allwithmacros(treasury_issuance)
```



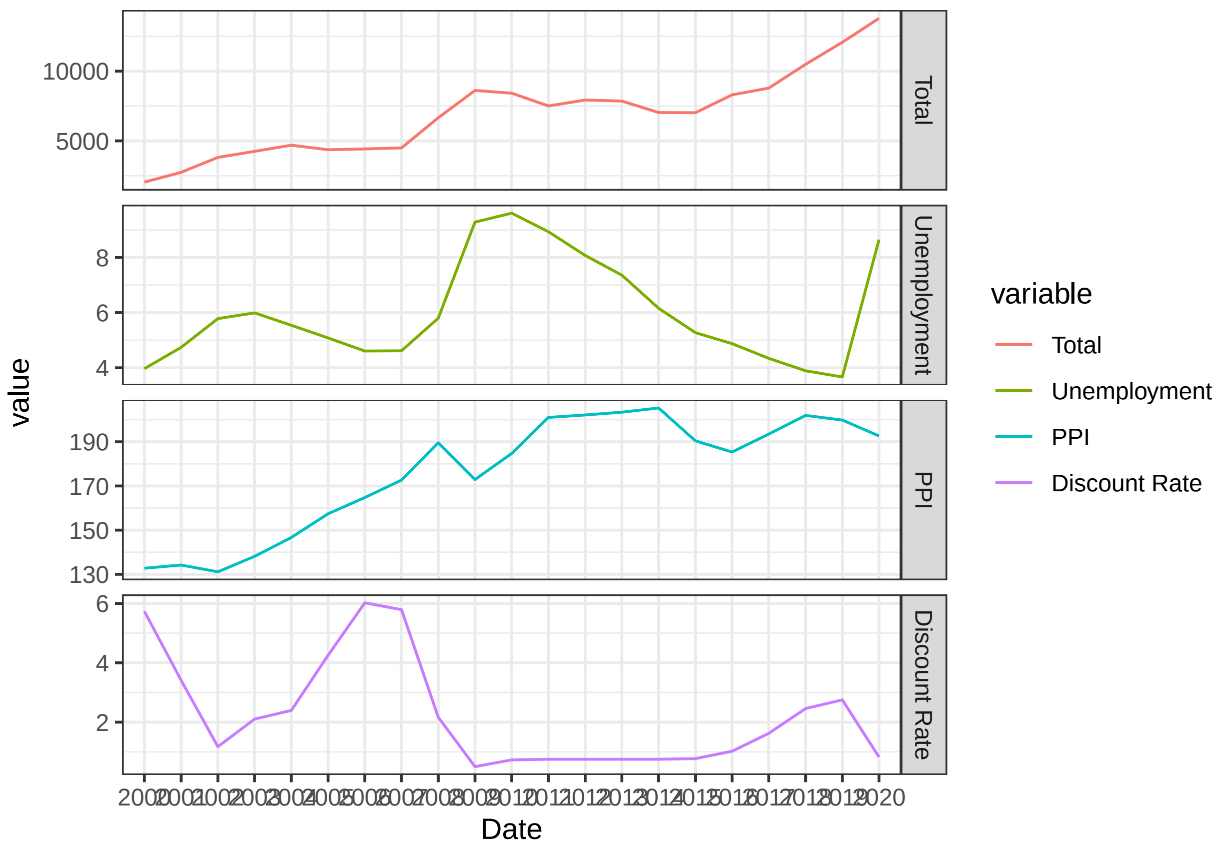

```
allwithmacros(commercialpaper_issuance)
```



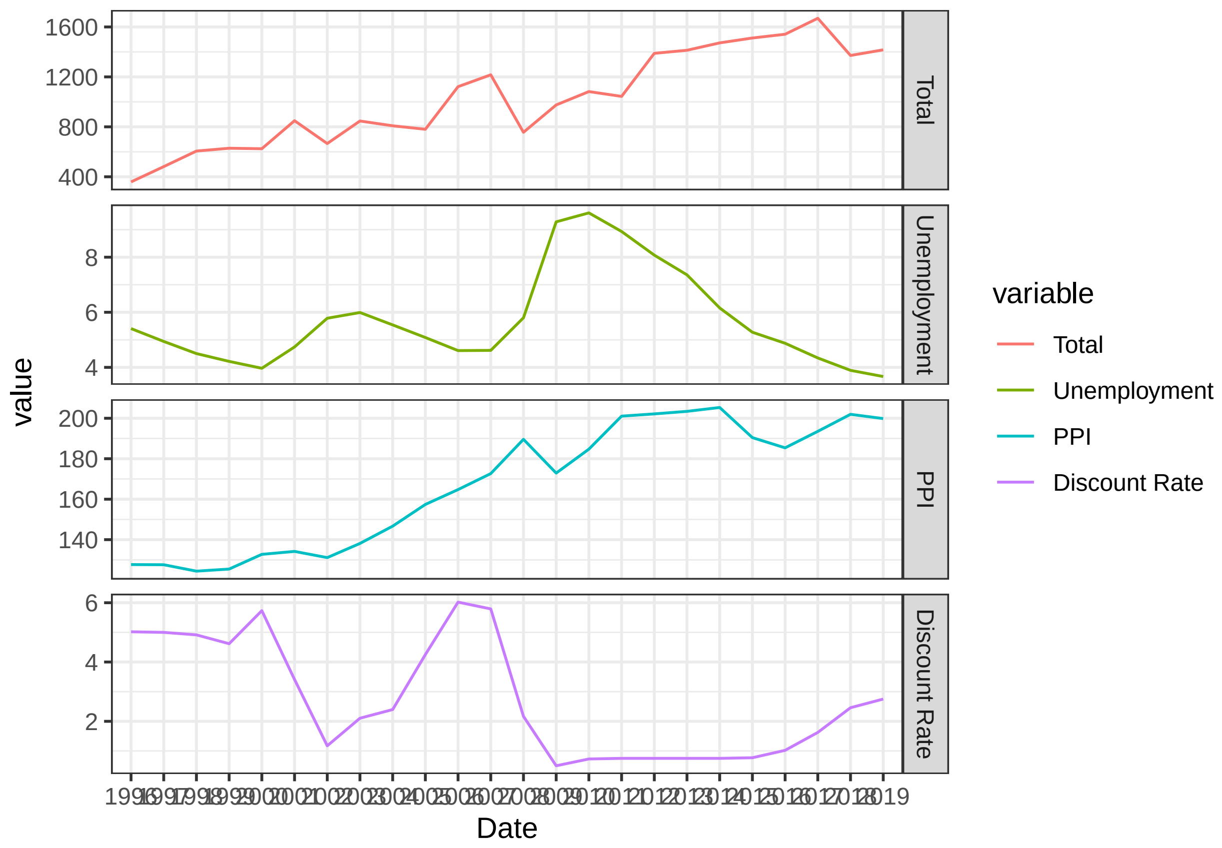

```
plot_macro_aggregate(fixedincome_issuance)
```



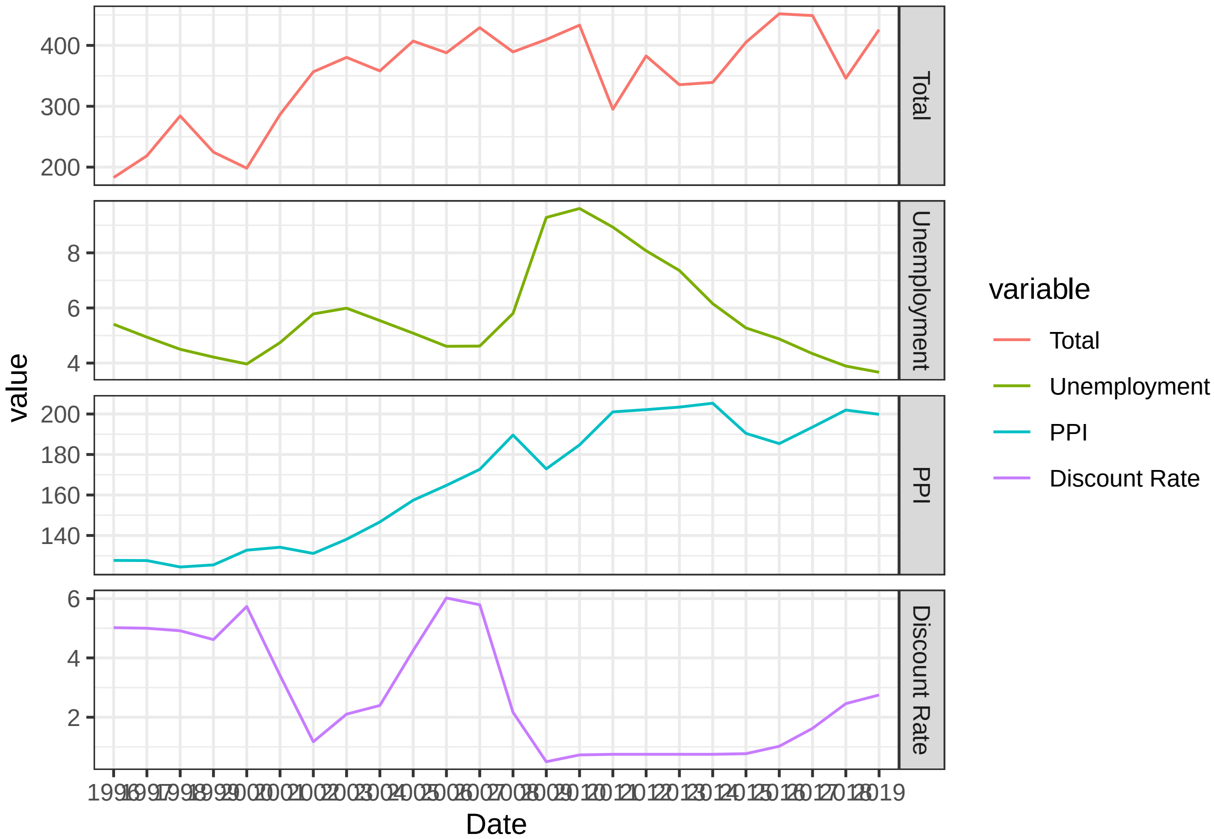

```
plot_macro_aggregate(treasury_issuance)
```



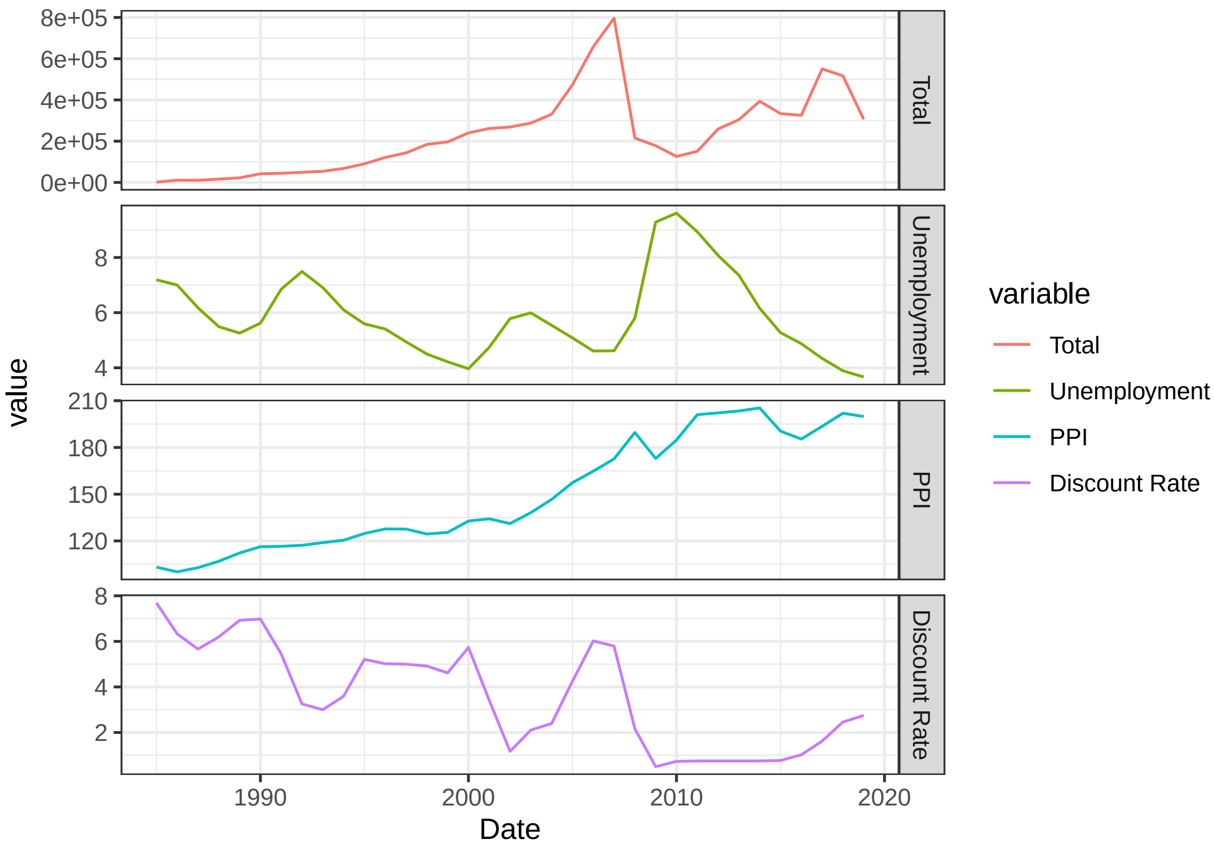

```r
plot_macro_aggregate(corporate_issuance)
```



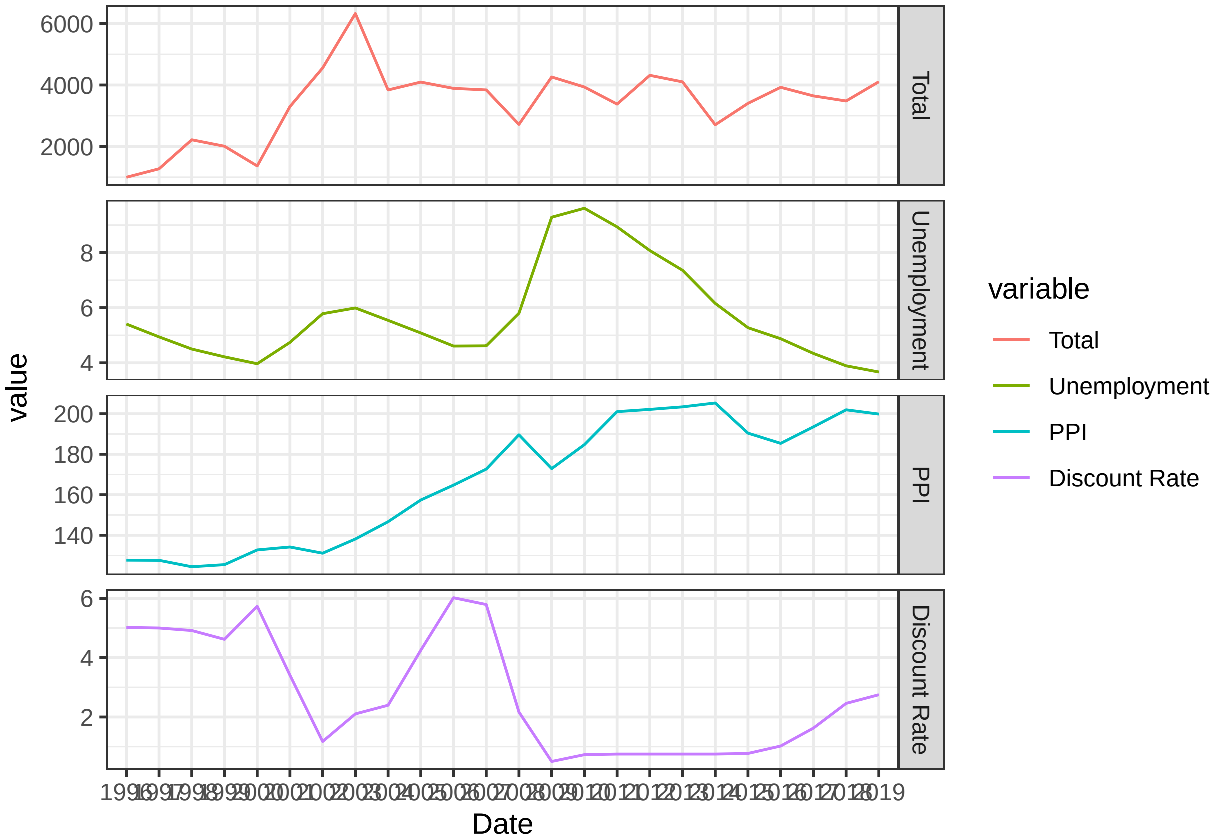

```
plot_macro_aggregate(municipal_issuance)
```



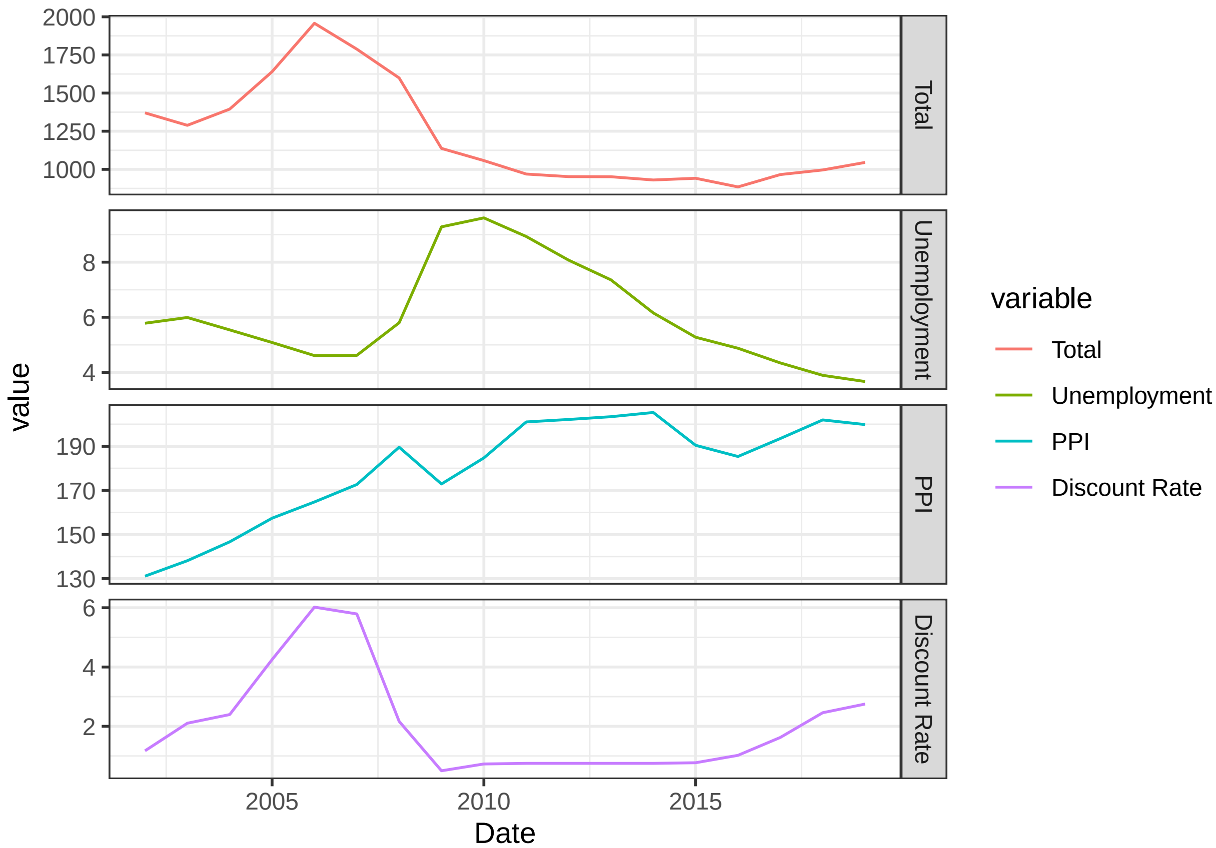

```
plot_macro_aggregate(ABSissuance)
```




```
plot_macro_aggregate(MBSissuance)
```




```
plot_macro_aggregate(commercialpaper_issuance)
```



###correlation of trading within each market

```r
#the function to see correlation
seecor <- function (df){
  cor(df[,c(-1)],
    use="pairwise",
    method="spearman") %>% print()
}

seecor(sf)
```

```
##                                               Interdealer     Customer
## Interdealer                                    1.00000000  0.839864720
## Customer                                       0.83986472  1.000000000
## Total, Agency Volume Reported by Primary Dealers  0.92217133  0.978612098
## Agency CMO                                     0.33003953 -0.196640316
## Agency Specified Pool                          0.45750988  0.278656126
## Agency TBA                                     0.77272727  0.456521739
## Total, Agency Volume                           0.77569170  0.458498024
## ABS                                            0.18873518  0.178853755
## Agency CMBS (IO/PO)                                    NA           NA
## Agency CMBS (P&I)                                      NA           NA
## CDO                                            0.06521739  0.156126482
## Non-Agency CMBS (IO/PO)                       -0.08596838 -0.138339921
## Non-Agency CMBS (P&I)                         -0.13142292 -0.224308300
## CMO (IO/PO)                                    0.04051383  0.042490119
```

```
## CMO (P&I)                                       0.13339921 -0.040513834
## Other                                          -0.40074744 -0.392115960
## Total, Non-Agency Volume                        0.19071146 -0.003952569
## IG                                              0.05335968 -0.176877470
## HY                                              0.30434783  0.148221344
## Total                                           0.86956522  0.727272727
##                                                Total, Agency Volume Reported by Primary Dealers
## Interdealer                                                                         0.92217133
## Customer                                                                            0.97861210
## Total, Agency Volume Reported by Primary Dealers                                    1.00000000
## Agency CMO                                                                          0.03458498
## Agency Specified Pool                                                               0.46047431
## Agency TBA                                                                          0.70158103
## Total, Agency Volume                                                                0.70256917
## ABS                                                                                 0.19861660
## Agency CMBS (IO/PO)                                                                         NA
## Agency CMBS (P&I)                                                                           NA
## CDO                                                                                 0.14525692
## Non-Agency CMBS (IO/PO)                                                            -0.09387352
## Non-Agency CMBS (P&I)                                                              -0.23122530
## CMO (IO/PO)                                                                         0.09288538
## CMO (P&I)                                                                           0.08003953
## Other                                                                              -0.44883714
## Total, Non-Agency Volume                                                            0.12747036
## IG                                                                                 -0.09782609
## HY                                                                                  0.30039526
## Total                                                                               0.91996047
##                                                  Agency CMO
## Interdealer                                      0.330039526
## Customer                                        -0.196640316
## Total, Agency Volume Reported by Primary Dealers 0.034584980
## Agency CMO                                       1.000000000
## Agency Specified Pool                           -0.198269382
## Agency TBA                                       0.339853760
## Total, Agency Volume                             0.330679605
## ABS                                              0.225612465
## Agency CMBS (IO/PO)                              0.331092437
## Agency CMBS (P&I)                                0.446498599
## CDO                                              0.008627464
## Non-Agency CMBS (IO/PO)                          0.419636451
## Non-Agency CMBS (P&I)                            0.736853794
## CMO (IO/PO)                                      0.540549083
## CMO (P&I)                                        0.743994943
## Other                                            0.263352208
## Total, Non-Agency Volume                         0.738083849
## IG                                               0.395317252
## HY                                               0.702275601
## Total                                            0.165019763
##                                                Agency Specified Pool
## Interdealer                                               0.45750988
## Customer                                                  0.27865613
## Total, Agency Volume Reported by Primary Dealers          0.46047431
## Agency CMO                                               -0.19826938
## Agency Specified Pool                                     1.00000000
```

```
## Agency TBA                                                      0.60019818
## Total, Agency Volume                                            0.64086685
## ABS                                                            -0.03883213
## Agency CMBS (IO/PO)                                             0.44453782
## Agency CMBS (P&I)                                               0.51316527
## CDO                                                             0.34362934
## Non-Agency CMBS (IO/PO)                                        -0.35073632
## Non-Agency CMBS (P&I)                                          -0.43015171
## CMO (IO/PO)                                                    -0.55518160
## CMO (P&I)                                                      -0.49029624
## Other                                                          -0.50248288
## Total, Non-Agency Volume                                       -0.17950251
## IG                                                              0.16777429
## HY                                                             -0.33898247
## Total                                                           0.64328063
##                                                     Agency TBA
## Interdealer                                         0.77272727
## Customer                                            0.45652174
## Total, Agency Volume Reported by Primary Dealers    0.70158103
## Agency CMO                                          0.33985376
## Agency Specified Pool                               0.60019818
## Agency TBA                                          1.00000000
## Total, Agency Volume                                0.99685653
## ABS                                                 0.15582397
## Agency CMBS (IO/PO)                                 0.41960784
## Agency CMBS (P&I)                                   0.53305322
## CDO                                                 0.32567397
## Non-Agency CMBS (IO/PO)                            -0.16524584
## Non-Agency CMBS (P&I)                               0.09487648
## CMO (IO/PO)                                        -0.10069361
## CMO (P&I)                                           0.05302047
## Other                                              -0.19688917
## Total, Non-Agency Volume                            0.33351556
## IG                                                  0.42585506
## HY                                                  0.14107186
## Total                                               0.90513834
##                                                    Total, Agency Volume
## Interdealer                                                  0.77569170
## Customer                                                     0.45849802
## Total, Agency Volume Reported by Primary Dealers             0.70256917
## Agency CMO                                                   0.33067961
## Agency Specified Pool                                        0.64086685
## Agency TBA                                                   0.99685653
## Total, Agency Volume                                         1.00000000
## ABS                                                          0.14369426
## Agency CMBS (IO/PO)                                          0.44229692
## Agency CMBS (P&I)                                            0.57591036
## CDO                                                          0.35112926
## Non-Agency CMBS (IO/PO)                                     -0.18088632
## Non-Agency CMBS (P&I)                                        0.07626337
## CMO (IO/PO)                                                 -0.12984761
## CMO (P&I)                                                    0.02911129
## Other                                                       -0.22722108
## Total, Non-Agency Volume                                     0.32059999
```

```
## IG                                                  0.42761472
## HY                                                  0.12149349
## Total                                               0.90810277
##                                                ABS
## Interdealer                                 0.18873518
## Customer                                    0.17885375
## Total, Agency Volume Reported by Primary Dealers  0.19861660
## Agency CMO                                  0.22561246
## Agency Specified Pool                      -0.03883213
## Agency TBA                                  0.15582397
## Total, Agency Volume                        0.14369426
## ABS                                         1.00000000
## Agency CMBS (IO/PO)                        -0.08263305
## Agency CMBS (P&I)                           0.45266106
## CDO                                         0.17845184
## Non-Agency CMBS (IO/PO)                     0.18104862
## Non-Agency CMBS (P&I)                       0.23683671
## CMO (IO/PO)                                 0.11266102
## CMO (P&I)                                   0.15906994
## Other                                       0.02067012
## Total, Non-Agency Volume                    0.50890935
## IG                                          0.64770902
## HY                                          0.28293812
## Total                                       0.16106719
##                                             Agency CMBS (IO/PO)
## Interdealer                                                  NA
## Customer                                                     NA
## Total, Agency Volume Reported by Primary Dealers             NA
## Agency CMO                                           0.33109244
## Agency Specified Pool                                0.44453782
## Agency TBA                                           0.41960784
## Total, Agency Volume                                 0.44229692
## ABS                                                 -0.08263305
## Agency CMBS (IO/PO)                                  1.00000000
## Agency CMBS (P&I)                                    0.45210084
## CDO                                                  0.46582633
## Non-Agency CMBS (IO/PO)                              0.11568627
## Non-Agency CMBS (P&I)                                0.11092437
## CMO (IO/PO)                                         -0.08935574
## CMO (P&I)                                           -0.15658263
## Other                                               -0.01075484
## Total, Non-Agency Volume                             0.49607843
## IG                                                   0.42801120
## HY                                                   0.49719888
## Total                                                        NA
##                                             Agency CMBS (P&I)         CDO
## Interdealer                                                NA  0.065217391
## Customer                                                   NA  0.156126482
## Total, Agency Volume Reported by Primary Dealers           NA  0.145256917
## Agency CMO                                         0.44649860  0.008627464
## Agency Specified Pool                              0.51316527  0.343629344
## Agency TBA                                         0.53305322  0.325673967
## Total, Agency Volume                               0.57591036  0.351129258
## ABS                                                0.45266106  0.178451840
```

```
## Agency CMBS (IO/PO)                                 0.45210084  0.465826331
## Agency CMBS (P&I)                                   1.00000000  0.620448179
## CDO                                                 0.62044818  1.000000000
## Non-Agency CMBS (IO/PO)                             0.40336134 -0.082926163
## Non-Agency CMBS (P&I)                               0.28627451 -0.030776984
## CMO (IO/PO)                                        -0.08207283 -0.168141593
## CMO (P&I)                                           0.03501401 -0.049765948
## Other                                              -0.28837565 -0.257907057
## Total, Non-Agency Volume                            0.64957983  0.306838760
## IG                                                  0.64145658  0.350223802
## HY                                                  0.54789916  0.152150887
## Total                                                       NA  0.165019763
##                                                Non-Agency CMBS (IO/PO)
## Interdealer                                                -0.08596838
## Customer                                                   -0.13833992
## Total, Agency Volume Reported by Primary Dealers           -0.09387352
## Agency CMO                                                  0.41963645
## Agency Specified Pool                                      -0.35073632
## Agency TBA                                                 -0.16524584
## Total, Agency Volume                                       -0.18088632
## ABS                                                         0.18104862
## Agency CMBS (IO/PO)                                         0.11568627
## Agency CMBS (P&I)                                           0.40336134
## CDO                                                        -0.08292616
## Non-Agency CMBS (IO/PO)                                     1.00000000
## Non-Agency CMBS (P&I)                                       0.52536133
## CMO (IO/PO)                                                 0.58427581
## CMO (P&I)                                                   0.53324564
## Other                                                       0.24474213
## Total, Non-Agency Volume                                    0.47820070
## IG                                                          0.20629890
## HY                                                          0.54710937
## Total                                                      -0.11857708
##                                                Non-Agency CMBS (P&I)
## Interdealer                                              -0.13142292
## Customer                                                 -0.22430830
## Total, Agency Volume Reported by Primary Dealers         -0.23122530
## Agency CMO                                                0.73685379
## Agency Specified Pool                                    -0.43015171
## Agency TBA                                                0.09487648
## Total, Agency Volume                                      0.07626337
## ABS                                                       0.23683671
## Agency CMBS (IO/PO)                                       0.11092437
## Agency CMBS (P&I)                                         0.28627451
## CDO                                                      -0.03077698
## Non-Agency CMBS (IO/PO)                                   0.52536133
## Non-Agency CMBS (P&I)                                     1.00000000
## CMO (IO/PO)                                               0.74068063
## CMO (P&I)                                                 0.87537158
## Other                                                     0.39925032
## Total, Non-Agency Volume                                  0.76284723
## IG                                                        0.34348413
## HY                                                        0.78692726
## Total                                                    -0.10573123
```

```
##                                              CMO (IO/PO)   CMO (P&I)
## Interdealer                                   0.04051383  0.13339921
## Customer                                      0.04249012 -0.04051383
## Total, Agency Volume Reported by Primary Dealers  0.09288538  0.08003953
## Agency CMO                                    0.54054908  0.74399494
## Agency Specified Pool                        -0.55518160 -0.49029624
## Agency TBA                                   -0.10069361  0.05302047
## Total, Agency Volume                         -0.12984761  0.02911129
## ABS                                           0.11266102  0.15906994
## Agency CMBS (IO/PO)                          -0.08935574 -0.15658263
## Agency CMBS (P&I)                            -0.08207283  0.03501401
## CDO                                          -0.16814159 -0.04976595
## Non-Agency CMBS (IO/PO)                       0.58427581  0.53324564
## Non-Agency CMBS (P&I)                         0.74068063  0.87537158
## CMO (IO/PO)                                   1.00000000  0.75062357
## CMO (P&I)                                     0.75062357  1.00000000
## Other                                         0.39181487  0.39341891
## Total, Non-Agency Volume                      0.60156490  0.73264257
## IG                                            0.08958041  0.17395872
## HY                                            0.73367615  0.85601531
## Total                                         0.13339921  0.20750988
##                                                     Other
## Interdealer                                  -0.400747444
## Customer                                     -0.392115960
## Total, Agency Volume Reported by Primary Dealers -0.448837137
## Agency CMO                                    0.263352208
## Agency Specified Pool                        -0.502482880
## Agency TBA                                   -0.196889171
## Total, Agency Volume                         -0.227221079
## ABS                                           0.020670117
## Agency CMBS (IO/PO)                          -0.010754844
## Agency CMBS (P&I)                            -0.288375648
## CDO                                          -0.257907057
## Non-Agency CMBS (IO/PO)                       0.244742129
## Non-Agency CMBS (P&I)                         0.399250317
## CMO (IO/PO)                                   0.391814869
## CMO (P&I)                                     0.393418908
## Other                                         1.000000000
## Total, Non-Agency Volume                      0.290368744
## IG                                            0.003191985
## HY                                            0.376123176
## Total                                        -0.455002482
##                                              Total, Non-Agency Volume
## Interdealer                                               0.190711462
## Customer                                                 -0.003952569
## Total, Agency Volume Reported by Primary Dealers          0.127470356
## Agency CMO                                                0.738083849
## Agency Specified Pool                                    -0.179502511
## Agency TBA                                                0.333515564
## Total, Agency Volume                                      0.320599993
## ABS                                                       0.508909352
## Agency CMBS (IO/PO)                                       0.496078431
## Agency CMBS (P&I)                                         0.649579832
## CDO                                                       0.306838760
```

```
## Non-Agency CMBS (IO/PO)                                       0.478200704
## Non-Agency CMBS (P&I)                                         0.762847234
## CMO (IO/PO)                                                   0.601564902
## CMO (P&I)                                                     0.732642567
## Other                                                         0.290368744
## Total, Non-Agency Volume                                      1.000000000
## IG                                                            0.658805139
## HY                                                            0.888304233
## Total                                                         0.219367589
##                                                       IG         HY
## Interdealer                                  0.053359684  0.3043478
## Customer                                    -0.176877470  0.1482213
## Total, Agency Volume Reported by Primary Dealers -0.097826087  0.3003953
## Agency CMO                                   0.395317252  0.7022756
## Agency Specified Pool                        0.167774285 -0.3389825
## Agency TBA                                   0.425855059  0.1410719
## Total, Agency Volume                         0.427614720  0.1214935
## ABS                                          0.647709024  0.2829381
## Agency CMBS (IO/PO)                          0.428011204  0.4971989
## Agency CMBS (P&I)                            0.641456583  0.5478992
## CDO                                          0.350223802  0.1521509
## Non-Agency CMBS (IO/PO)                      0.206298903  0.5471094
## Non-Agency CMBS (P&I)                        0.343484129  0.7869273
## CMO (IO/PO)                                  0.089580415  0.7336762
## CMO (P&I)                                    0.173958725  0.8560153
## Other                                        0.003191985  0.3761232
## Total, Non-Agency Volume                     0.658805139  0.8883042
## IG                                           1.000000000  0.2841853
## HY                                           0.284185260  1.0000000
## Total                                        0.008893281  0.3863636
##                                                    Total
## Interdealer                                  0.869565217
## Customer                                     0.727272727
## Total, Agency Volume Reported by Primary Dealers  0.919960474
## Agency CMO                                   0.165019763
## Agency Specified Pool                        0.643280632
## Agency TBA                                   0.905138340
## Total, Agency Volume                         0.908102767
## ABS                                          0.161067194
## Agency CMBS (IO/PO)                                   NA
## Agency CMBS (P&I)                                     NA
## CDO                                          0.165019763
## Non-Agency CMBS (IO/PO)                     -0.118577075
## Non-Agency CMBS (P&I)                       -0.105731225
## CMO (IO/PO)                                  0.133399209
## CMO (P&I)                                    0.207509881
## Other                                       -0.455002482
## Total, Non-Agency Volume                     0.219367589
## IG                                           0.008893281
## HY                                           0.386363636
## Total                                        1.000000000
```

```r
seecor(corporate)
```

```
##                                       Investment Grade, Publicly Traded
## Investment Grade, Publicly Traded                              1.0000000
## High Yield, Publicly Traded                                    0.8605887
## Total, Publicly Traded                                         0.9867963
## Investment Grade, 144A                                         0.8102332
## High Yield, 144A                                               0.8991188
## Total, 144A                                                    0.8864421
## Investment Grade, Total Nonconvertible                         0.9959422
## High Yield, Total Nonconvertible                               0.7054424
## Total, Total Nonconvertible                                    0.9634210
## Total, Convertible                                            -0.2080848
## Total                                                          0.9613476
##                                       High Yield, Publicly Traded
## Investment Grade, Publicly Traded                        0.8605887
## High Yield, Publicly Traded                              1.0000000
## Total, Publicly Traded                                   0.9271004
## Investment Grade, 144A                                   0.4109737
## High Yield, 144A                                         0.5032358
## Total, 144A                                              0.4373639
## Investment Grade, Total Nonconvertible                   0.4741503
## High Yield, Total Nonconvertible                         0.9185191
## Total, Total Nonconvertible                              0.6317512
## Total, Convertible                                      -0.1596151
## Total                                                    0.6008886
##                                       Total, Publicly Traded
## Investment Grade, Publicly Traded                  0.9867963
## High Yield, Publicly Traded                        0.9271004
## Total, Publicly Traded                             1.0000000
## Investment Grade, 144A                             0.7653610
## High Yield, 144A                                   0.8710107
## Total, 144A                                        0.8408293
## Investment Grade, Total Nonconvertible             0.9503591
## High Yield, Total Nonconvertible                   0.8579489
## Total, Total Nonconvertible                        0.9844206
## Total, Convertible                                -0.1995279
## Total                                              0.9708256
##                                       Investment Grade, 144A High Yield, 144A
## Investment Grade, Publicly Traded                  0.8102332        0.8991188
## High Yield, Publicly Traded                        0.4109737        0.5032358
## Total, Publicly Traded                             0.7653610        0.8710107
## Investment Grade, 144A                             1.0000000        0.8325657
## High Yield, 144A                                   0.8325657        1.0000000
## Total, 144A                                        0.9049833        0.9688412
## Investment Grade, Total Nonconvertible             0.8424880        0.9080341
## High Yield, Total Nonconvertible                   0.6263902        0.7725879
## Total, Total Nonconvertible                        0.8369789        0.9291522
## Total, Convertible                                 0.6359867        0.7793114
## Total                                              0.8315291        0.9394891
##                                       Total, 144A
## Investment Grade, Publicly Traded       0.8864421
## High Yield, Publicly Traded             0.4373639
## Total, Publicly Traded                  0.8408293
## Investment Grade, 144A                  0.9049833
## High Yield, 144A                        0.9688412
```

```
## Total, 144A                              1.0000000
## Investment Grade, Total Nonconvertible   0.9037690
## High Yield, Total Nonconvertible         0.7073380
## Total, Total Nonconvertible              0.9112921
## Total, Convertible                       0.7679082
## Total                                    0.9340689
##                                        Investment Grade, Total Nonconvertible
## Investment Grade, Publicly Traded                                   0.9959422
## High Yield, Publicly Traded                                         0.4741503
## Total, Publicly Traded                                              0.9503591
## Investment Grade, 144A                                              0.8424880
## High Yield, 144A                                                    0.9080341
## Total, 144A                                                         0.9037690
## Investment Grade, Total Nonconvertible                              1.0000000
## High Yield, Total Nonconvertible                                    0.7115143
## Total, Total Nonconvertible                                         0.9681303
## Total, Convertible                                                  0.7534543
## Total                                                               0.9657312
##                                        High Yield, Total Nonconvertible
## Investment Grade, Publicly Traded                             0.7054424
## High Yield, Publicly Traded                                   0.9185191
## Total, Publicly Traded                                        0.8579489
## Investment Grade, 144A                                        0.6263902
## High Yield, 144A                                              0.7725879
## Total, 144A                                                   0.7073380
## Investment Grade, Total Nonconvertible                        0.7115143
## High Yield, Total Nonconvertible                              1.0000000
## Total, Total Nonconvertible                                   0.8381636
## Total, Convertible                                            0.5982525
## Total                                                         0.8167790
##                                        Total, Total Nonconvertible
## Investment Grade, Publicly Traded                        0.9634210
## High Yield, Publicly Traded                              0.6317512
## Total, Publicly Traded                                   0.9844206
## Investment Grade, 144A                                   0.8369789
## High Yield, 144A                                         0.9291522
## Total, 144A                                              0.9112921
## Investment Grade, Total Nonconvertible                   0.9681303
## High Yield, Total Nonconvertible                         0.8381636
## Total, Total Nonconvertible                              1.0000000
## Total, Convertible                                       0.7499297
## Total                                                    0.9905220
##                                        Total, Convertible     Total
## Investment Grade, Publicly Traded              -0.2080848 0.9613476
## High Yield, Publicly Traded                    -0.1596151 0.6008886
## Total, Publicly Traded                         -0.1995279 0.9708256
## Investment Grade, 144A                          0.6359867 0.8315291
## High Yield, 144A                                0.7793114 0.9394891
## Total, 144A                                     0.7679082 0.9340689
## Investment Grade, Total Nonconvertible          0.7534543 0.9657312
## High Yield, Total Nonconvertible                0.5982525 0.8167790
## Total, Total Nonconvertible                     0.7499297 0.9905220
## Total, Convertible                              1.0000000 0.7854720
## Total                                           0.7854720 1.0000000
```

```r
seecor(fixedincome)
```

```
##                           Municipal  Treasury Agency MBS Non-Agency MBS
## Municipal                 1.0000000 0.1988104  0.2595020      0.4351245
## Treasury                  0.1988104 1.0000000  0.5713710      0.2330645
## Agency MBS                0.2595020 0.5713710  1.0000000      0.4491935
## Non-Agency MBS            0.4351245 0.2330645  0.4491935      1.0000000
## ABS                       0.3984273 0.5193548  0.6302419      0.5693548
## Corporate Debt            0.4060893 0.5883065  0.7427419      0.5971774
## Federal Agency Securities 0.1770340 0.4633065  0.7822581      0.4354839
## Total                     0.2526464 0.9342742  0.8036290      0.3512097
##                                 ABS Corporate Debt Federal Agency Securities
## Municipal                 0.3984273      0.4060893                 0.1770340
## Treasury                  0.5193548      0.5883065                 0.4633065
## Agency MBS                0.6302419      0.7427419                 0.7822581
## Non-Agency MBS            0.5693548      0.5971774                 0.4354839
## ABS                       1.0000000      0.8161290                 0.5745968
## Corporate Debt            0.8161290      1.0000000                 0.5665323
## Federal Agency Securities 0.5745968      0.5665323                 1.0000000
## Total                     0.6431452      0.7576613                 0.6443548
##                               Total
## Municipal                 0.2526464
## Treasury                  0.9342742
## Agency MBS                0.8036290
## Non-Agency MBS            0.3512097
## ABS                       0.6431452
## Corporate Debt            0.7576613
## Federal Agency Securities 0.6443548
## Total                     1.0000000
```

```r
seecor(agency)
```

```
##               Fannie Mae      FHLB Freddie Mac       Other     Total
## Fannie Mae    1.00000000 0.6477540  0.89129359 -0.02680765 0.9346802
## FHLB          0.64775403 1.0000000  0.55340382  0.14731459 0.7579903
## Freddie Mac   0.89129359 0.5534038  1.00000000  0.03142107 0.9149126
## Other        -0.02680765 0.1473146  0.03142107  1.00000000 0.1904612
## Total         0.93468016 0.7579903  0.91491264  0.19046119 1.0000000
```

```r
seecor(treasury)
```

```
##                                                                          Treasury Bills
## Treasury Bills                                                               1.00000000
## Treasury Inflation Index Securities                                          0.73654244
## Floating Rate Notes                                                          0.41292202
## Coupon Securities Due in 2 Years or Less                                     0.17000106
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years    -0.19116974
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years    -0.06028551
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years     0.05584516
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years   -0.03789933
## Coupon Securities Due in More Than 11 Years                                  0.65471023
## Total                                                                        0.45581580
```

```
## Coupon Securities Due in 3 Years or Less                                          -0.22446170
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years     0.24983119
##                                                                                  Treasury Inflation Inde
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
##                                                                                  Floating Rate Notes
## Treasury Bills                                                                            0.41292202
## Treasury Inflation Index Securities                                                       0.44967675
## Floating Rate Notes                                                                       1.00000000
## Coupon Securities Due in 2 Years or Less                                                  0.46520073
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years              0.14007503
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years              0.25616570
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years              0.10695187
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years             0.07438742
## Coupon Securities Due in More Than 11 Years                                               0.15727512
## Total                                                                                     0.40258600
## Coupon Securities Due in 3 Years or Less                                                  0.38790007
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years             0.09242557
##                                                                                  Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
##                                                                                  Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
```

```
##                                                                                                Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
##                                                                                                Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
##                                                                                                Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
##                                                                                                Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
##                                                                                                    Total
## Treasury Bills                                                                                 0.4558158
```

```
## Treasury Inflation Index Securities                                       0.5737859
## Floating Rate Notes                                                       0.4025860
## Coupon Securities Due in 2 Years or Less                                  0.5982706
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years  0.4204149
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years  0.7595835
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years  0.6375788
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years 0.6257969
## Coupon Securities Due in More Than 11 Years                               0.6994234
## Total                                                                     1.0000000
## Coupon Securities Due in 3 Years or Less                                  0.6089445
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years 0.8344279
##                                                                           Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
##                                                                           Coupon Securities Due i
## Treasury Bills
## Treasury Inflation Index Securities
## Floating Rate Notes
## Coupon Securities Due in 2 Years or Less
## Coupon Securities Due in More Than 2 Years but Less Than or Equal to 3 Years
## Coupon Securities Due in More Than 3 Years but Less Than or Equal to 6 Years
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 7 Years
## Coupon Securities Due in More Than 7 Years but Less Than or Equal to 11 Years
## Coupon Securities Due in More Than 11 Years
## Total
## Coupon Securities Due in 3 Years or Less
## Coupon Securities Due in More Than 6 Years but Less Than or Equal to 11 Years
```

```r
seecor(equity)
```

```
##                            ICE, Volumes ($B) Nasdaq, Volumes ($B)
## ICE, Volumes ($B)                  1.0000000            0.9299853
## Nasdaq, Volumes ($B)               0.9299853            1.0000000
## Cboe, Volumes ($B)                 0.8207478            0.8669355
## Other, Volumes ($B)                0.8753666            0.8273460
## Off Exchange, Volumes ($B)         0.9035924            0.8442082
## Market, Volumes ($B)               0.9530792            0.9362170
## Total                              0.9530792            0.9362170
##                            Cboe, Volumes ($B) Other, Volumes ($B)
## ICE, Volumes ($B)                   0.8207478           0.8753666
## Nasdaq, Volumes ($B)                0.8669355           0.8273460
## Cboe, Volumes ($B)                  1.0000000           0.7144428
## Other, Volumes ($B)                 0.7144428           1.0000000
## Off Exchange, Volumes ($B)          0.7730938           0.7474340
```

```
## Market, Volumes ($B)              0.8962610          0.8328446
## Total                             0.8962610          0.8328446
##                            Off Exchange, Volumes ($B) Market, Volumes ($B)
## ICE, Volumes ($B)                           0.9035924            0.9530792
## Nasdaq, Volumes ($B)                        0.8442082            0.9362170
## Cboe, Volumes ($B)                          0.7730938            0.8962610
## Other, Volumes ($B)                         0.7474340            0.8328446
## Off Exchange, Volumes ($B)                  1.0000000            0.9464809
## Market, Volumes ($B)                        0.9464809            1.0000000
## Total                                       0.9464809            1.0000000
##                                Total
## ICE, Volumes ($B)          0.9530792
## Nasdaq, Volumes ($B)       0.9362170
## Cboe, Volumes ($B)         0.8962610
## Other, Volumes ($B)        0.8328446
## Off Exchange, Volumes ($B) 0.9464809
## Market, Volumes ($B)       1.0000000
## Total                      1.0000000
```

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```
##                                          Overnight, Repurchase Term, Repurchase
## Overnight, Repurchase                              1.000000000       0.25135088
## Term, Repurchase                                   0.251350876       1.00000000
## Total, Repurchase                                  0.837005228       0.70078636
## Overnight, Reverse Repurchase                      0.838707552      -0.04401880
## Term, Reverse Repurchase                           0.521020955       0.84744981
## Total, Reverse Repurchase                          0.801421166       0.63368185
## Total, Total                                       0.826560647       0.69173659
## ABS, Repurchase                                   -0.786854498       0.36575146
## Corporate, Repurchase                             -0.067979289       0.55390793
## Equities, Repurchase                              -0.373322532       0.41453277
## Federal Agency & GSE, Repurchase                  -0.319995773       0.65386918
## MBS, Repurchase                                    0.609136698       0.64106583
## Other, Repurchase                                 -0.349336057       0.69821422
## US Treasuries, Repurchase                          0.863477863       0.04996302
## TIPS, Repurchase                                   0.002536015       0.59994364
## ABS, Reverse Repurchase                           -0.835940618       0.25009977
## Corporate, Reverse Repurchase                     -0.560336022       0.54318270
## Equities, Reverse Repurchase                      -0.070016953       0.49745769
## Federal Agency & GSE, Reverse Repurchase          -0.366577437       0.61443767
## MBS, Reverse Repurchase                            0.034905428       0.73097108
## Other, Reverse Repurchase                         -0.417878905       0.63391568
## US Treasuries, Reverse Repurchase                  0.692015075      -0.15159734
## TIPS, Reverse Repurchase                           0.042654362      -0.24495439
##                                          Total, Repurchase
## Overnight, Repurchase                           0.83700523
## Term, Repurchase                                0.70078636
## Total, Repurchase                               1.00000000
## Overnight, Reverse Repurchase                   0.61257304
## Term, Reverse Repurchase                        0.83009709
## Total, Reverse Repurchase                       0.94055045
## Total, Total                                    0.98989588
## ABS, Repurchase                                -0.46009259
```

```
## Corporate, Repurchase                          0.25592617
## Equities, Repurchase                          -0.03365503
## Federal Agency & GSE, Repurchase               0.07505900
## MBS, Repurchase                                0.85465464
## Other, Repurchase                              0.11743158
## US Treasuries, Repurchase                      0.71638900
## TIPS, Repurchase                               0.40548061
## ABS, Reverse Repurchase                       -0.54122436
## Corporate, Reverse Repurchase                 -0.14178789
## Equities, Reverse Repurchase                   0.25654649
## Federal Agency & GSE, Reverse Repurchase       0.02447959
## MBS, Reverse Repurchase                        0.45797964
## Other, Reverse Repurchase                      0.05473566
## US Treasuries, Reverse Repurchase              0.48099750
## TIPS, Reverse Repurchase                      -0.04644077
##                                          Overnight, Reverse Repurchase
## Overnight, Repurchase                                        0.8387076
## Term, Repurchase                                            -0.0440188
## Total, Repurchase                                            0.6125730
## Overnight, Reverse Repurchase                                1.0000000
## Term, Reverse Repurchase                                     0.2569081
## Total, Reverse Repurchase                                    0.6375917
## Total, Total                                                 0.6243355
## ABS, Repurchase                                             -0.6979009
## Corporate, Repurchase                                       -0.2908140
## Equities, Repurchase                                        -0.5972315
## Federal Agency & GSE, Repurchase                            -0.5494699
## MBS, Repurchase                                              0.2006622
## Other, Repurchase                                           -0.5481491
## US Treasuries, Repurchase                                    0.8057659
## TIPS, Repurchase                                            -0.1397098
## ABS, Reverse Repurchase                                     -0.7170564
## Corporate, Reverse Repurchase                               -0.6706174
## Equities, Reverse Repurchase                                -0.1259713
## Federal Agency & GSE, Reverse Repurchase                    -0.6011412
## MBS, Reverse Repurchase                                     -0.2792786
## Other, Reverse Repurchase                                   -0.5025360
## US Treasuries, Reverse Repurchase                            0.8052728
## TIPS, Reverse Repurchase                                     0.3207178
##                                          Term, Reverse Repurchase
## Overnight, Repurchase                                 0.521020955
## Term, Repurchase                                      0.847449809
## Total, Repurchase                                     0.830097087
## Overnight, Reverse Repurchase                         0.256908140
## Term, Reverse Repurchase                              1.000000000
## Total, Reverse Repurchase                             0.887273207
## Total, Total                                          0.865933752
## ABS, Repurchase                                       0.075025940
## Corporate, Repurchase                                 0.159064492
## Equities, Repurchase                                  0.078933465
## Federal Agency & GSE, Repurchase                      0.450019372
## MBS, Repurchase                                       0.638177591
## Other, Repurchase                                     0.548624564
## US Treasuries, Repurchase                             0.351361347
```

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## TIPS, Repurchase                                    0.519759783
## ABS, Reverse Repurchase                            -0.006624631
## Corporate, Reverse Repurchase                       0.227713008
## Equities, Reverse Repurchase                        0.368500684
## Federal Agency & GSE, Reverse Repurchase            0.464125955
## MBS, Reverse Repurchase                             0.714839210
## Other, Reverse Repurchase                           0.507132542
## US Treasuries, Reverse Repurchase                   0.187911662
## TIPS, Reverse Repurchase                           -0.139833046
##                                          Total, Reverse Repurchase Total, Total
## Overnight, Repurchase                                   0.80142117  0.826560647
## Term, Repurchase                                        0.63368185  0.691736590
## Total, Repurchase                                       0.94055045  0.989895884
## Overnight, Reverse Repurchase                           0.63759171  0.624335545
## Term, Reverse Repurchase                                0.88727321  0.865933752
## Total, Reverse Repurchase                               1.00000000  0.975464570
## Total, Total                                            0.97546457  1.000000000
## ABS, Repurchase                                        -0.34751377 -0.404900631
## Corporate, Repurchase                                  -0.01407136  0.163062238
## Equities, Repurchase                                   -0.24470783 -0.111461379
## Federal Agency & GSE, Repurchase                        0.04744461  0.077295622
## MBS, Repurchase                                         0.67792610  0.798827093
## Other, Repurchase                                       0.12618435  0.132841393
## US Treasuries, Repurchase                               0.75191082  0.736677116
## TIPS, Repurchase                                        0.36284386  0.403825156
## ABS, Reverse Repurchase                                -0.39791683 -0.472024902
## Corporate, Reverse Repurchase                          -0.16873305 -0.141470889
## Equities, Reverse Repurchase                            0.19742410  0.240888405
## Federal Agency & GSE, Reverse Repurchase                0.03451798  0.036631327
## MBS, Reverse Repurchase                                 0.43165088  0.462646613
## Other, Reverse Repurchase                               0.11077454  0.089447360
## US Treasuries, Reverse Repurchase                       0.60438167  0.533743088
## TIPS, Reverse Repurchase                                0.03191152 -0.009721391
##                                          ABS, Repurchase Corporate, Repurchase
## Overnight, Repurchase                       -0.786854498           -0.06797929
## Term, Repurchase                             0.365751457            0.55390793
## Total, Repurchase                           -0.460092585            0.25592617
## Overnight, Reverse Repurchase               -0.697900870           -0.29081399
## Term, Reverse Repurchase                     0.075025940            0.15906449
## Total, Reverse Repurchase                   -0.347513768           -0.01407136
## Total, Total                                -0.404900631            0.16306224
## ABS, Repurchase                              1.000000000            0.12766382
## Corporate, Repurchase                        0.127663820            1.00000000
## Equities, Repurchase                         0.327160987            0.48450213
## Federal Agency & GSE, Repurchase             0.830233857            0.45065338
## MBS, Repurchase                             -0.502354537            0.40083125
## Other, Repurchase                            0.842724878            0.35225952
## US Treasuries, Repurchase                   -0.704166334           -0.18849283
## TIPS, Repurchase                             0.287931998            0.36212180
## ABS, Reverse Repurchase                      0.932117487            0.05539149
## Corporate, Reverse Repurchase                0.678186607            0.56116375
## Equities, Reverse Repurchase                 0.339858198            0.31090536
## Federal Agency & GSE, Reverse Repurchase     0.875768218            0.31513508
## MBS, Reverse Repurchase                      0.358927289            0.28038815
```

```
## Other, Reverse Repurchase                    0.801021630           0.24104470
## US Treasuries, Reverse Repurchase           -0.618684652          -0.35470748
## TIPS, Reverse Repurchase                    -0.008380557          -0.16410130
##                                          Equities, Repurchase
## Overnight, Repurchase                             -0.37332253
## Term, Repurchase                                   0.41453277
## Total, Repurchase                                 -0.03365503
## Overnight, Reverse Repurchase                     -0.59723152
## Term, Reverse Repurchase                           0.07893346
## Total, Reverse Repurchase                         -0.24470783
## Total, Total                                      -0.11146138
## ABS, Repurchase                                    0.32716099
## Corporate, Repurchase                              0.48450213
## Equities, Repurchase                               1.00000000
## Federal Agency & GSE, Repurchase                   0.48603431
## MBS, Repurchase                                    0.28739741
## Other, Repurchase                                  0.49721743
## US Treasuries, Repurchase                         -0.57329788
## TIPS, Repurchase                                   0.25606706
## ABS, Reverse Repurchase                            0.32827839
## Corporate, Reverse Repurchase                      0.54584199
## Equities, Reverse Repurchase                       0.33337825
## Federal Agency & GSE, Reverse Repurchase           0.48846465
## MBS, Reverse Repurchase                            0.49837977
## Other, Reverse Repurchase                          0.44959670
## US Treasuries, Reverse Repurchase                 -0.72380332
## TIPS, Reverse Repurchase                          -0.35905745
##                                          Federal Agency & GSE, Repurchase
## Overnight, Repurchase                                         -0.31999577
## Term, Repurchase                                               0.65386918
## Total, Repurchase                                              0.07505900
## Overnight, Reverse Repurchase                                 -0.54946990
## Term, Reverse Repurchase                                       0.45001937
## Total, Reverse Repurchase                                      0.04744461
## Total, Total                                                   0.07729562
## ABS, Repurchase                                                0.83023386
## Corporate, Repurchase                                          0.45065338
## Equities, Repurchase                                           0.48603431
## Federal Agency & GSE, Repurchase                               1.00000000
## MBS, Repurchase                                                0.26374555
## Other, Repurchase                                              0.88617872
## US Treasuries, Repurchase                                     -0.46965588
## TIPS, Repurchase                                               0.40308548
## ABS, Reverse Repurchase                                        0.83047330
## Corporate, Reverse Repurchase                                  0.78612941
## Equities, Reverse Repurchase                                   0.41923562
## Federal Agency & GSE, Reverse Repurchase                       0.94082632
## MBS, Reverse Repurchase                                        0.69150435
## Other, Reverse Repurchase                                      0.84097073
## US Treasuries, Reverse Repurchase                             -0.60612518
## TIPS, Reverse Repurchase                                      -0.48994400
##                                          MBS, Repurchase Other, Repurchase
## Overnight, Repurchase                         0.60913670        -0.3493361
## Term, Repurchase                              0.64106583         0.6982142
```

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## Total, Repurchase                             0.85465464         0.1174316
## Overnight, Reverse Repurchase                 0.20066218        -0.5481491
## Term, Reverse Repurchase                      0.63817759         0.5486246
## Total, Reverse Repurchase                     0.67792610         0.1261844
## Total, Total                                  0.79882709         0.1328414
## ABS, Repurchase                              -0.50235454         0.8427249
## Corporate, Repurchase                         0.40083125         0.3522595
## Equities, Repurchase                          0.28739741         0.4972174
## Federal Agency & GSE, Repurchase              0.26374555         0.8861787
## MBS, Repurchase                               1.00000000         0.3079497
## Other, Repurchase                             0.30794970         1.0000000
## US Treasuries, Repurchase                     0.37543588        -0.4695854
## TIPS, Repurchase                              0.28852453         0.5059878
## ABS, Reverse Repurchase                      -0.58560140         0.8103600
## Corporate, Reverse Repurchase                 0.09663274         0.7596950
## Equities, Reverse Repurchase                  0.36437534         0.4808423
## Federal Agency & GSE, Reverse Repurchase      0.23172836         0.9019055
## MBS, Reverse Repurchase                       0.67632348         0.7946004
## Other, Reverse Repurchase                     0.21041879         0.9579973
## US Treasuries, Reverse Repurchase             0.05882146        -0.5805537
## TIPS, Reverse Repurchase                     -0.41955197        -0.4279701
##                                           US Treasuries, Repurchase
## Overnight, Repurchase                                   0.863477863
## Term, Repurchase                                        0.049963016
## Total, Repurchase                                       0.716388997
## Overnight, Reverse Repurchase                           0.805765912
## Term, Reverse Repurchase                                0.351361347
## Total, Reverse Repurchase                               0.751910817
## Total, Total                                            0.736677116
## ABS, Repurchase                                        -0.704166334
## Corporate, Repurchase                                  -0.188492832
## Equities, Repurchase                                   -0.573297876
## Federal Agency & GSE, Repurchase                       -0.469655877
## MBS, Repurchase                                         0.375435878
## Other, Repurchase                                      -0.469585432
## US Treasuries, Repurchase                               1.000000000
## TIPS, Repurchase                                        0.005829312
## ABS, Reverse Repurchase                                -0.750618565
## Corporate, Reverse Repurchase                          -0.648444930
## Equities, Reverse Repurchase                           -0.129891477
## Federal Agency & GSE, Reverse Repurchase               -0.498820049
## MBS, Reverse Repurchase                                -0.166848649
## Other, Reverse Repurchase                              -0.494029798
## US Treasuries, Reverse Repurchase                       0.922493044
## TIPS, Reverse Repurchase                                0.284051284
##                                           TIPS, Repurchase
## Overnight, Repurchase                          0.002536015
## Term, Repurchase                               0.599943644
## Total, Repurchase                              0.405480610
## Overnight, Reverse Repurchase                 -0.139709767
## Term, Reverse Repurchase                       0.519759783
## Total, Reverse Repurchase                      0.362843859
## Total, Total                                   0.403825156
## ABS, Repurchase                                0.287931998
```

```
## Corporate, Repurchase                              0.362121799
## Equities, Repurchase                               0.256067064
## Federal Agency & GSE, Repurchase                   0.403085485
## MBS, Repurchase                                    0.288524532
## Other, Repurchase                                  0.505987813
## US Treasuries, Repurchase                          0.005829312
## TIPS, Repurchase                                   1.000000000
## ABS, Reverse Repurchase                            0.228749302
## Corporate, Reverse Repurchase                      0.241872424
## Equities, Reverse Repurchase                       0.351087613
## Federal Agency & GSE, Reverse Repurchase           0.315857138
## MBS, Reverse Repurchase                            0.393223205
## Other, Reverse Repurchase                          0.491687507
## US Treasuries, Reverse Repurchase                 -0.059913353
## TIPS, Reverse Repurchase                           0.301503998
##                                          ABS, Reverse Repurchase
## Overnight, Repurchase                              -0.8359406178
## Term, Repurchase                                    0.2500997685
## Total, Repurchase                                  -0.5412243595
## Overnight, Reverse Repurchase                      -0.7170564291
## Term, Reverse Repurchase                           -0.0066246309
## Total, Reverse Repurchase                          -0.3979168329
## Total, Total                                       -0.4720249022
## ABS, Repurchase                                     0.9321174874
## Corporate, Repurchase                               0.0553914917
## Equities, Repurchase                                0.3282783941
## Federal Agency & GSE, Repurchase                    0.8304733019
## MBS, Repurchase                                    -0.5856014047
## Other, Repurchase                                   0.8103599649
## US Treasuries, Repurchase                          -0.7506185649
## TIPS, Repurchase                                    0.2287493016
## ABS, Reverse Repurchase                             1.0000000000
## Corporate, Reverse Repurchase                       0.6897597574
## Equities, Reverse Repurchase                        0.2671465719
## Federal Agency & GSE, Reverse Repurchase            0.8764865512
## MBS, Reverse Repurchase                             0.3146300583
## Other, Reverse Repurchase                           0.7914039429
## US Treasuries, Reverse Repurchase                  -0.6642589193
## TIPS, Reverse Repurchase                           -0.0002394445
##                                          Corporate, Reverse Repurchase
## Overnight, Repurchase                                      -0.56033602
## Term, Repurchase                                            0.54318270
## Total, Repurchase                                          -0.14178789
## Overnight, Reverse Repurchase                              -0.67061745
## Term, Reverse Repurchase                                    0.22771301
## Total, Reverse Repurchase                                  -0.16873305
## Total, Total                                               -0.14147089
## ABS, Repurchase                                             0.67818661
## Corporate, Repurchase                                       0.56116375
## Equities, Repurchase                                        0.54584199
## Federal Agency & GSE, Repurchase                            0.78612941
## MBS, Repurchase                                             0.09663274
## Other, Repurchase                                           0.75969497
## US Treasuries, Repurchase                                  -0.64844493
```

```
## TIPS, Repurchase                                            0.24187242
## ABS, Reverse Repurchase                                     0.68975976
## Corporate, Reverse Repurchase                               1.00000000
## Equities, Reverse Repurchase                                0.38058043
## Federal Agency & GSE, Reverse Repurchase                    0.75145293
## MBS, Reverse Repurchase                                     0.54652883
## Other, Reverse Repurchase                                   0.75157620
## US Treasuries, Reverse Repurchase                          -0.71026029
## TIPS, Reverse Repurchase                                   -0.43809658
##                                          Equities, Reverse Repurchase
## Overnight, Repurchase                                     -0.07001695
## Term, Repurchase                                           0.49745769
## Total, Repurchase                                          0.25654649
## Overnight, Reverse Repurchase                             -0.12597126
## Term, Reverse Repurchase                                   0.36850068
## Total, Reverse Repurchase                                  0.19742410
## Total, Total                                               0.24088840
## ABS, Repurchase                                            0.33985820
## Corporate, Repurchase                                      0.31090536
## Equities, Repurchase                                       0.33337825
## Federal Agency & GSE, Repurchase                           0.41923562
## MBS, Repurchase                                            0.36437534
## Other, Repurchase                                          0.48084234
## US Treasuries, Repurchase                                 -0.12989148
## TIPS, Repurchase                                           0.35108761
## ABS, Reverse Repurchase                                    0.26714657
## Corporate, Reverse Repurchase                              0.38058043
## Equities, Reverse Repurchase                               1.00000000
## Federal Agency & GSE, Reverse Repurchase                   0.40982254
## MBS, Reverse Repurchase                                    0.48355458
## Other, Reverse Repurchase                                  0.50030669
## US Treasuries, Reverse Repurchase                         -0.23915621
## TIPS, Reverse Repurchase                                  -0.19343551
##                                          Federal Agency & GSE, Reverse Repurchase
## Overnight, Repurchase                                                 -0.36657744
## Term, Repurchase                                                       0.61443767
## Total, Repurchase                                                      0.02447959
## Overnight, Reverse Repurchase                                         -0.60114121
## Term, Reverse Repurchase                                               0.46412596
## Total, Reverse Repurchase                                              0.03451798
## Total, Total                                                           0.03663133
## ABS, Repurchase                                                        0.87576822
## Corporate, Repurchase                                                  0.31513508
## Equities, Repurchase                                                   0.48846465
## Federal Agency & GSE, Repurchase                                       0.94082632
## MBS, Repurchase                                                        0.23172836
## Other, Repurchase                                                      0.90190553
## US Treasuries, Repurchase                                             -0.49882005
## TIPS, Repurchase                                                       0.31585714
## ABS, Reverse Repurchase                                                0.87648655
## Corporate, Reverse Repurchase                                          0.75145293
## Equities, Reverse Repurchase                                           0.40982254
## Federal Agency & GSE, Reverse Repurchase                               1.00000000
## MBS, Reverse Repurchase                                                0.71888979
```

```
## Other, Reverse Repurchase                                                  0.85389736
## US Treasuries, Reverse Repurchase                                         -0.62833292
## TIPS, Reverse Repurchase                                                  -0.54675778
##                                          MBS, Reverse Repurchase
## Overnight, Repurchase                                 0.03490543
## Term, Repurchase                                      0.73097108
## Total, Repurchase                                     0.45797964
## Overnight, Reverse Repurchase                        -0.27927864
## Term, Reverse Repurchase                              0.71483921
## Total, Reverse Repurchase                             0.43165088
## Total, Total                                          0.46264661
## ABS, Repurchase                                       0.35892729
## Corporate, Repurchase                                 0.28038815
## Equities, Repurchase                                  0.49837977
## Federal Agency & GSE, Repurchase                      0.69150435
## MBS, Repurchase                                       0.67632348
## Other, Repurchase                                     0.79460040
## US Treasuries, Repurchase                            -0.16684865
## TIPS, Repurchase                                      0.39322320
## ABS, Reverse Repurchase                               0.31463006
## Corporate, Reverse Repurchase                         0.54652883
## Equities, Reverse Repurchase                          0.48355458
## Federal Agency & GSE, Reverse Repurchase              0.71888979
## MBS, Reverse Repurchase                               1.00000000
## Other, Reverse Repurchase                             0.75960692
## US Treasuries, Reverse Repurchase                    -0.37717939
## TIPS, Reverse Repurchase                             -0.52618788
##                                          Other, Reverse Repurchase
## Overnight, Repurchase                                  -0.41787891
## Term, Repurchase                                        0.63391568
## Total, Repurchase                                       0.05473566
## Overnight, Reverse Repurchase                          -0.50253601
## Term, Reverse Repurchase                                0.50713254
## Total, Reverse Repurchase                               0.11077454
## Total, Total                                            0.08944736
## ABS, Repurchase                                         0.80102163
## Corporate, Repurchase                                   0.24104470
## Equities, Repurchase                                    0.44959670
## Federal Agency & GSE, Repurchase                        0.84097073
## MBS, Repurchase                                         0.21041879
## Other, Repurchase                                       0.95799725
## US Treasuries, Repurchase                              -0.49402980
## TIPS, Repurchase                                        0.49168751
## ABS, Reverse Repurchase                                 0.79140394
## Corporate, Reverse Repurchase                           0.75157620
## Equities, Reverse Repurchase                            0.50030669
## Federal Agency & GSE, Reverse Repurchase                0.85389736
## MBS, Reverse Repurchase                                 0.75960692
## Other, Reverse Repurchase                               1.00000000
## US Treasuries, Reverse Repurchase                      -0.56000141
## TIPS, Reverse Repurchase                               -0.36546793
##                                          US Treasuries, Reverse Repurchase
## Overnight, Repurchase                                           0.69201508
## Term, Repurchase                                               -0.15159734
```

```
## Total, Repurchase                                              0.48099750
## Overnight, Reverse Repurchase                                  0.80527280
## Term, Reverse Repurchase                                       0.18791166
## Total, Reverse Repurchase                                      0.60438167
## Total, Total                                                   0.53374309
## ABS, Repurchase                                               -0.61868465
## Corporate, Repurchase                                         -0.35470748
## Equities, Repurchase                                          -0.72380332
## Federal Agency & GSE, Repurchase                              -0.60612518
## MBS, Repurchase                                                0.05882146
## Other, Repurchase                                             -0.58055370
## US Treasuries, Repurchase                                      0.92249304
## TIPS, Repurchase                                              -0.05991335
## ABS, Reverse Repurchase                                       -0.66425892
## Corporate, Reverse Repurchase                                 -0.71026029
## Equities, Reverse Repurchase                                  -0.23915621
## Federal Agency & GSE, Reverse Repurchase                      -0.62833292
## MBS, Reverse Repurchase                                       -0.37717939
## Other, Reverse Repurchase                                     -0.56000141
## US Treasuries, Reverse Repurchase                              1.00000000
## TIPS, Reverse Repurchase                                       0.49646015
##                                          TIPS, Reverse Repurchase
## Overnight, Repurchase                                0.0426543623
## Term, Repurchase                                    -0.2449543870
## Total, Repurchase                                   -0.0464407735
## Overnight, Reverse Repurchase                        0.3207178331
## Term, Reverse Repurchase                            -0.1398330457
## Total, Reverse Repurchase                            0.0319115213
## Total, Total                                        -0.0097213906
## ABS, Repurchase                                     -0.0083805571
## Corporate, Repurchase                               -0.1641012997
## Equities, Repurchase                                -0.3590574478
## Federal Agency & GSE, Repurchase                    -0.4899439963
## MBS, Repurchase                                     -0.4195519707
## Other, Repurchase                                   -0.4279701314
## US Treasuries, Repurchase                            0.2840512839
## TIPS, Repurchase                                     0.3015039977
## ABS, Reverse Repurchase                             -0.0002394445
## Corporate, Reverse Repurchase                       -0.4380965799
## Equities, Reverse Repurchase                        -0.1934355086
## Federal Agency & GSE, Reverse Repurchase            -0.5467577754
## MBS, Reverse Repurchase                             -0.5261878764
## Other, Reverse Repurchase                           -0.3654679300
## US Treasuries, Reverse Repurchase                    0.4964601458
## TIPS, Reverse Repurchase                             1.0000000000
```

###correlations of issuance activities across markets

```r
issuance_aggregate <- fixedincome_issuance[c("Date", "Total")] %>% merge(corporate_issuance[c("Date", "
  merge(municipal_issuance[c("Date", "Total")], all=T, by = "Date") %>% merge(ABSissuance[c("Date", "To
  merge(treasury_issuance[c("Date", "Total")], all=T, by = "Date") %>%  merge(commercialpaper_issuance[


colnames(issuance_aggregate) <- c("Date","FixedIncome","Corporate","Municipal","ABS","MBS", "Treasury",
```

```r
cor(issuance_aggregate[,c("FixedIncome","Corporate","Municipal","ABS","MBS", "Treasury","Commercial")],
    use="pairwise",
    method="spearman")
```

```
##              FixedIncome  Corporate Municipal         ABS       MBS     Treasury
## FixedIncome    1.0000000  0.8573913 0.7678261 0.424347826 0.6808696  0.851127820
## Corporate      0.8573913  1.0000000 0.6565217 0.609565217 0.4173913  0.678195489
## Municipal      0.7678261  0.6565217 1.0000000 0.469565217 0.6243478  0.475187970
## ABS            0.4243478  0.6095652 0.4695652 1.000000000 0.2973913  0.007518797
## MBS            0.6808696  0.4173913 0.6243478 0.297391304 1.0000000  0.163909774
## Treasury       0.8511278  0.6781955 0.4751880 0.007518797 0.1639098  1.000000000
## Commercial    -0.5521156 -0.7461300 0.0877193 0.145510836 0.1744066 -0.547987616
##              Commercial
## FixedIncome -0.5521156
## Corporate   -0.7461300
## Municipal    0.0877193
## ABS          0.1455108
## MBS          0.1744066
## Treasury    -0.5479876
## Commercial   1.0000000
```

```r
###to annualize the monthly data
corporate_trading <- corporate %>% mutate (year = as.numeric(substr((str_split(Date,"-")),4,7))) %>%
  group_by(year) %>% summarize(trading = sum(`Total`) )
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```r
agency_trading <- agency %>% mutate (year = as.numeric(substr((str_split(Date,"-")),4,7))) %>%
  group_by(year) %>% summarize(trading = sum(`Total`) )
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```r
sf_trading <- sf %>% mutate (year = as.numeric(substr((str_split(Date,"-")),4,7))) %>%
  group_by(year) %>% summarize(trading = sum(`Total`) )
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```r
treasury_trading <- treasury %>% mutate (year = as.numeric(substr((str_split(Date,"-")),4,7))) %>%
  group_by(year) %>% summarize(trading = sum(`Total`) )
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```r
equity_trading <- equity %>% mutate (year = as.numeric(substr((str_split(Date,"-")),4,7))) %>%
  group_by(year) %>% summarize(trading = sum(`Total`) )
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
repo_trading <- repo %>% mutate (year = as.numeric(substr((str_split(Date,"-")),4,7))) %>%
  group_by(year) %>% summarize(trading = sum(`Total, Total`) )
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
fixedincome_trading <- fixedincome %>% mutate (year = as.numeric(substr((str_split(Date,"-")),4,7))) %>%
  group_by(year) %>% summarize(trading = sum(`Total`) )
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
treasury_outstanding <- read_excel(paste("P:/Mgt_of_FI/Assignment3/ta-us-treasury-sifma.xls"),sheet=4,sk
```

```
## New names:
## * `` -> ...1
```

```
colnames(treasury_outstanding)[1] <- "Date"
treasury_outstanding <- treasury_outstanding[c(1:24),]

fixedincome_outstanding <- read_excel(paste("P:/Mgt_of_FI/Assignment3/CM-US-Fixed-Income-SIFMA.xls"),she
```

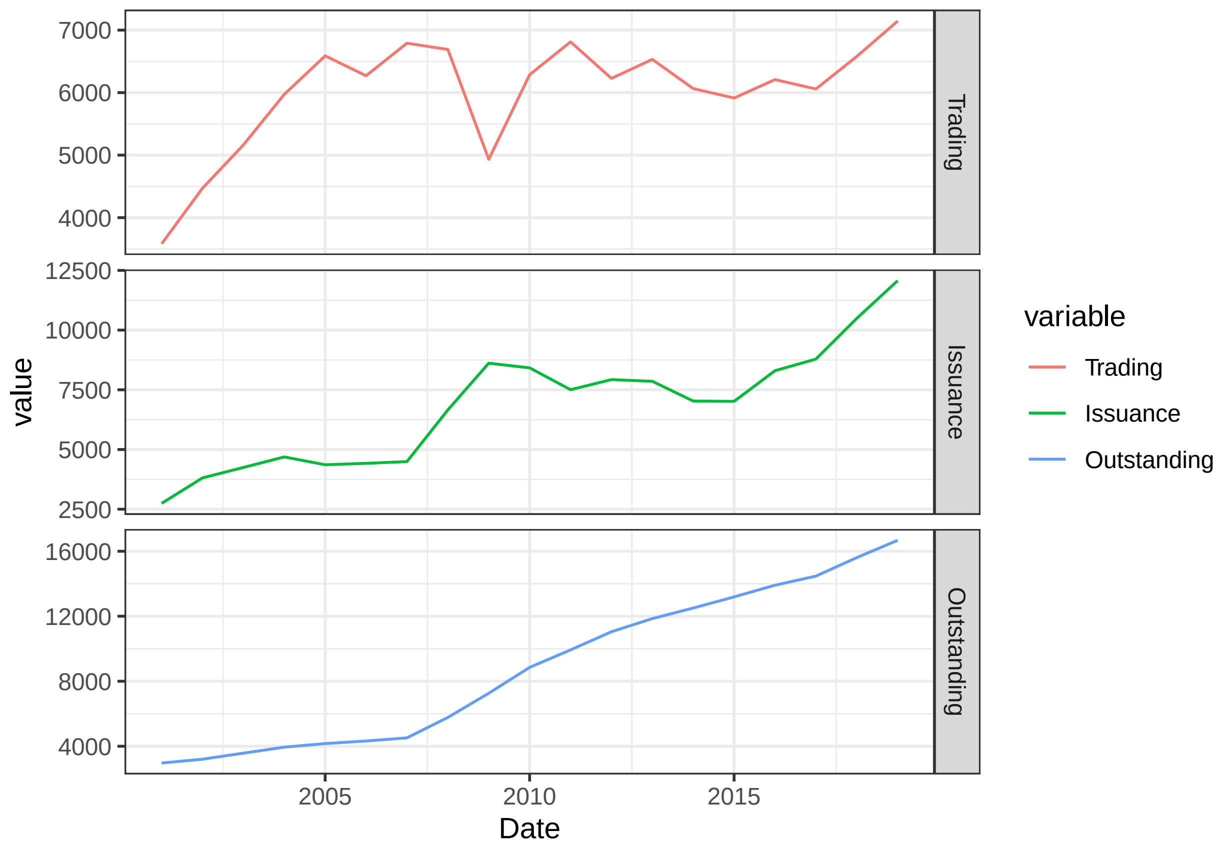
```
## New names:
## * `` -> ...1
```

```
names(fixedincome_outstanding)[1] <- "Date"
```

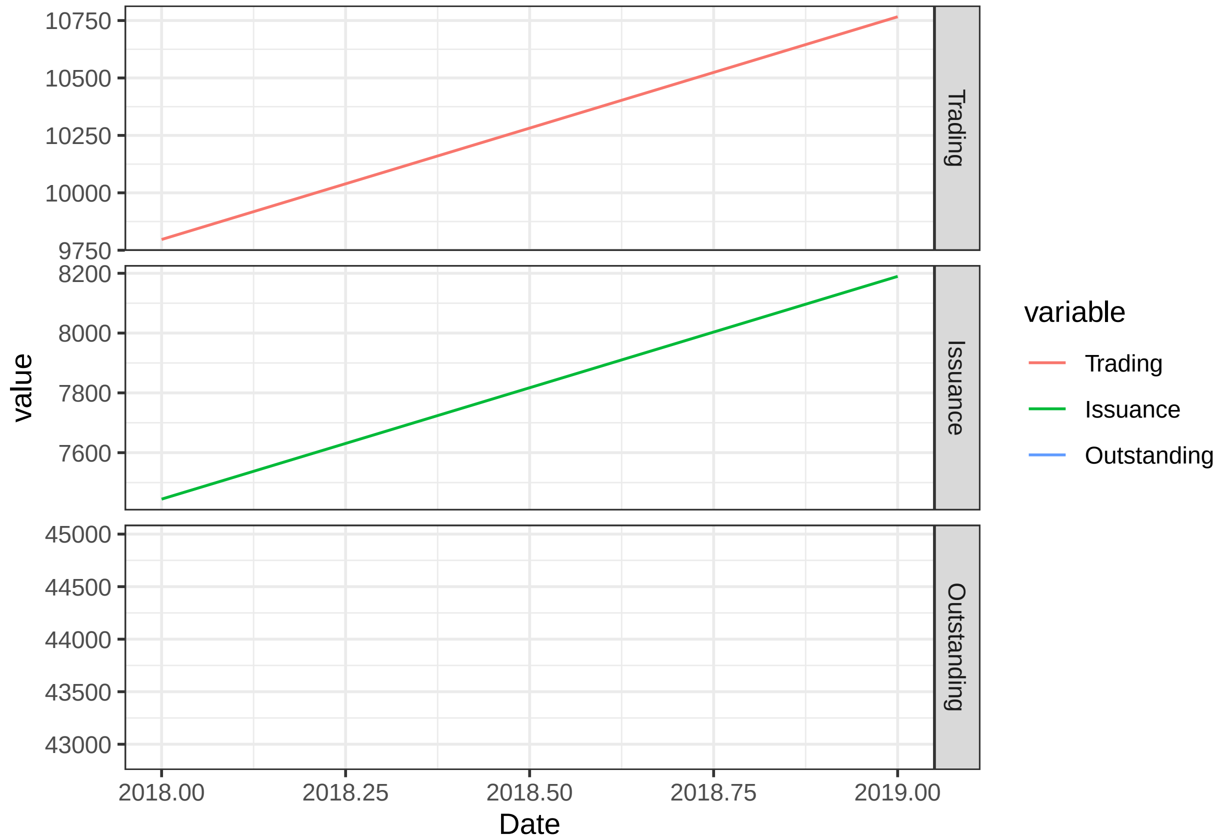
```
colnames(treasury_trading)[1] <- "Date"
treasury_all <- treasury_trading %>% merge(treasury_issuance[c("Date", "Total")], by = "Date") %>%
  merge(treasury_outstanding[c("Date", "Total")], by = "Date")
colnames(treasury_all) <- c("Date","Trading", "Issuance", "Outstanding")


colnames(fixedincome_trading)[1] <- "Date"
fixedincome_all <- fixedincome_trading %>% merge(fixedincome_issuance[c("Date", "Total")], by = "Date")
colnames(fixedincome_all) <- c("Date","Trading", "Issuance", "Outstanding")

colnames(corporate_trading)[1] <- "Date"
corporate_all <- corporate_trading %>% merge(corporate_issuance[c("Date", "Total")],by="Date")
colnames(corporate_all) <- c("Date", "Trading", "Issuance")
```

```
plotthemarket <- function(df) {
melted_df <- melt(df,id = "Date")
melted_df$value <-as.numeric(melted_df$value)
melted_df %>% filter (Date >= df$Date[[1]])  %>% ggplot(aes(x = Date,y = value, color = variable, group
  geom_line()+
  facet_grid(variable~., scales = "free")+theme_bw()
}
```

```r
plotthemarket(treasury_all)
```

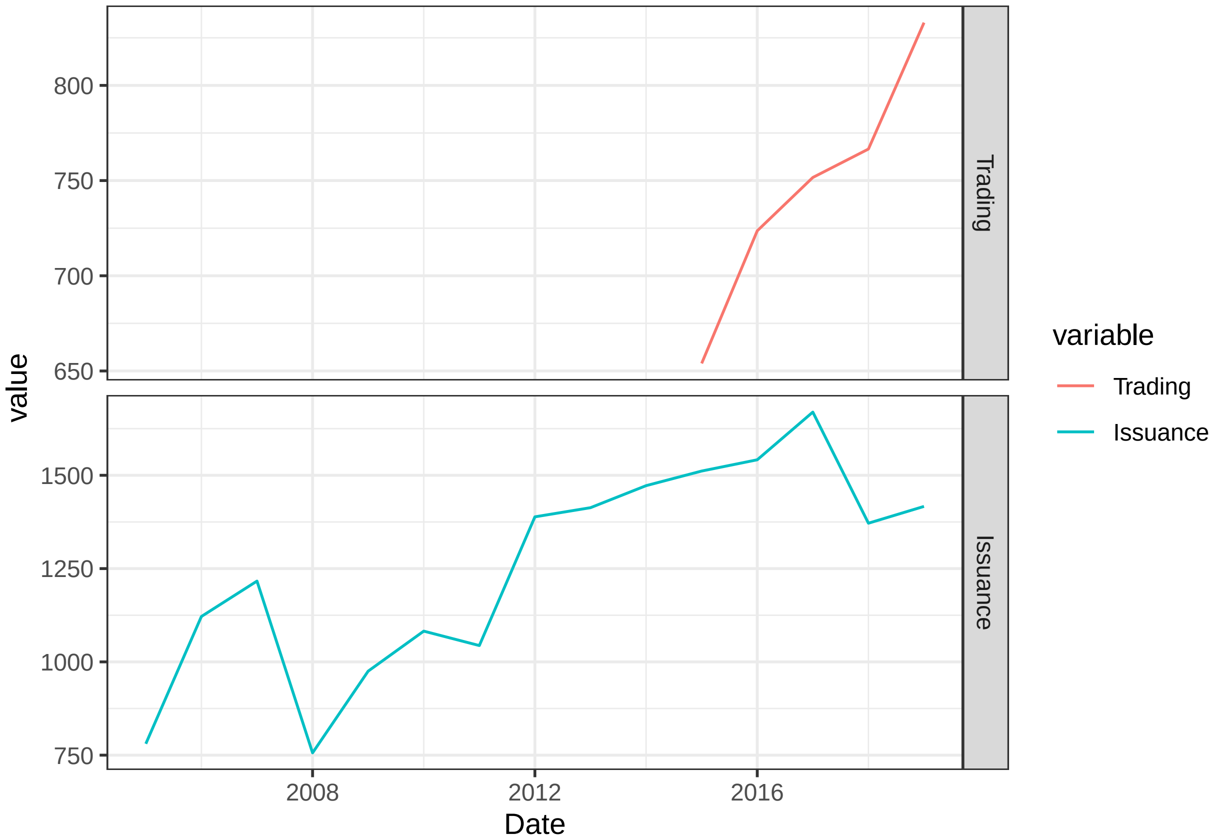



```r
plotthemarket(fixedincome_all)
```




```r
plotthemarket(corporate_all)
```

```
## Warning: Removed 10 row(s) containing missing values (geom_path).
```


800
750
700
650
1500
1250
1000
750
value
Trading
Issuance
2008
2012
2016
Date
variable
Trading
Issuance