Question 6: MSCI Funds

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```
knitr::opts_chunk$set(
    echo = FALSE,
    fig.height = 5,
    fig.pos = "H",
    fig.width = 6,
    message = FALSE,
    warning = FALSE
)
# Note: Include = FALSE implies the code is executed, but not printed in your pdf.
# warning and message = FALSE implies ugly messages and warnings are removed from your pdf.
# These should be picked up when you execute the command chunks (code sections below) in your rmd, not f


# load packages
pacman::p_load("MTS", "robustbase")
pacman::p_load("tidyverse", "devtools", "rugarch", "rmgarch",
    "forecast", "tbl2xts", "lubridate", "PerformanceAnalytics",
    "ggthemes", "ks")
pacman::p_load("tidyverse", "rugarch", "rmgarch")

#load Packages
library(tidyverse)
library(tbl2xts)
library(rugarch)

# load data, and see how this can be stored and later called from your 'data' folder.
msci <- read_rds("data/msci.rds")
bonds <- read_rds("data/bonds_10y.rds")
comms <- read_rds("data/comms.rds")
```

Introduction

This report investigates how the return profiles of different asset classes (Equities, Commodities, Real Estate and Bonds) have increased in their convergence over time by explaining co-movements between different asset classes using a multivariate GARCH model.

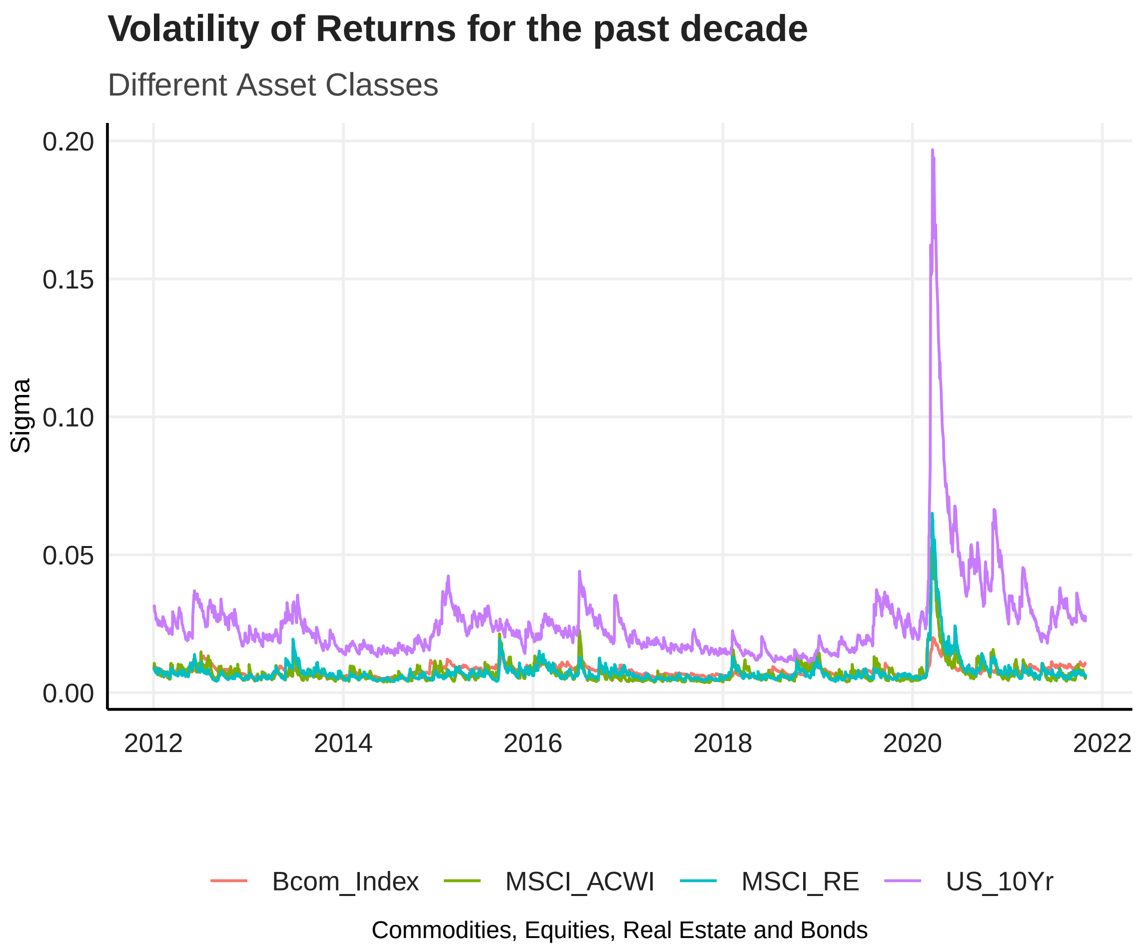
Data

I begin by selecting specific assets from the data sets provided and follow an approach similar to the practical. I select the MSCI_ACWI index to represent Equities, the BCom_Index to represent Commodities, the MSCI_RE to represent Real Estate and the US_10Yr to represent bonds. I calculate returns for the daily price data before combining the data to perform the analysis, followed by log scaling and centering the data. This was tricky to accomplish in one go so I split it up into its parts, wrangled the data and then combined the data.

DCC Model

I follow the practical code closely to render the model. I amend code and nested functions inside one another to keep the working document neat. I plot the estimates of volatility for each series from from 'dccPre'.

```
## Sample mean of the returns:  -0.0001532192 0.0006273741 -0.000122789 -0.0001327623
## Component:  1
## Estimates:  3e-06 0.183428 0.782732
## se.coef  :  0 0.021974 0.022599
## t-value  :  5.585021 8.347446 34.636
## Component:  2
## Estimates:  2e-06 0.136209 0.826154
## se.coef  :  0 0.017766 0.022081
## t-value  :  4.61807 7.666786 37.41462
## Component:  3
## Estimates:  5e-06 0.079257 0.914998
## se.coef  :  2e-06 0.010207 0.01074
## t-value  :  3.076316 7.764681 85.19931
## Component:  4
## Estimates:  1e-06 0.049531 0.936488
## se.coef  :  0 0.006571 0.008666
## t-value  :  3.466549 7.537786 108.0608
```



The 'dccPre' function is use to fit the univariate GARCH models to each series in the data and a standard univariate GARCH(1,1) is run which produces the error term and sigma, which is then used to calculate the standardized residuals used in estimate the DCC model.

The DCC model is then run and the estimates of time-varying correlation are produced.

```
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## t-value  :  3.466549 7.537786 108.0608
```
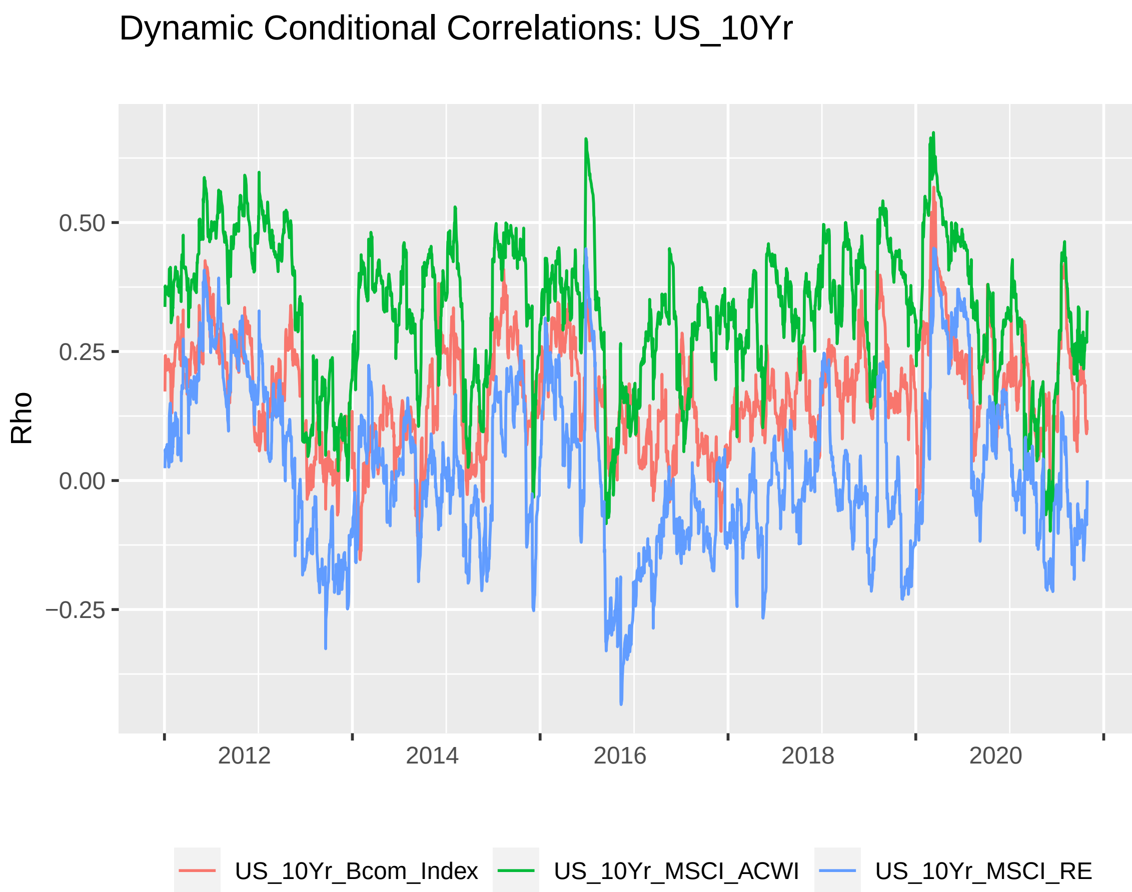

```
## Estimates:  0.9439883 0.02805751 7.628358
## st.errors:  0.009865406 0.004106348 0.4391585
## t-values:   95.68672 6.832717 17.3704
```

Co-movements of Assets

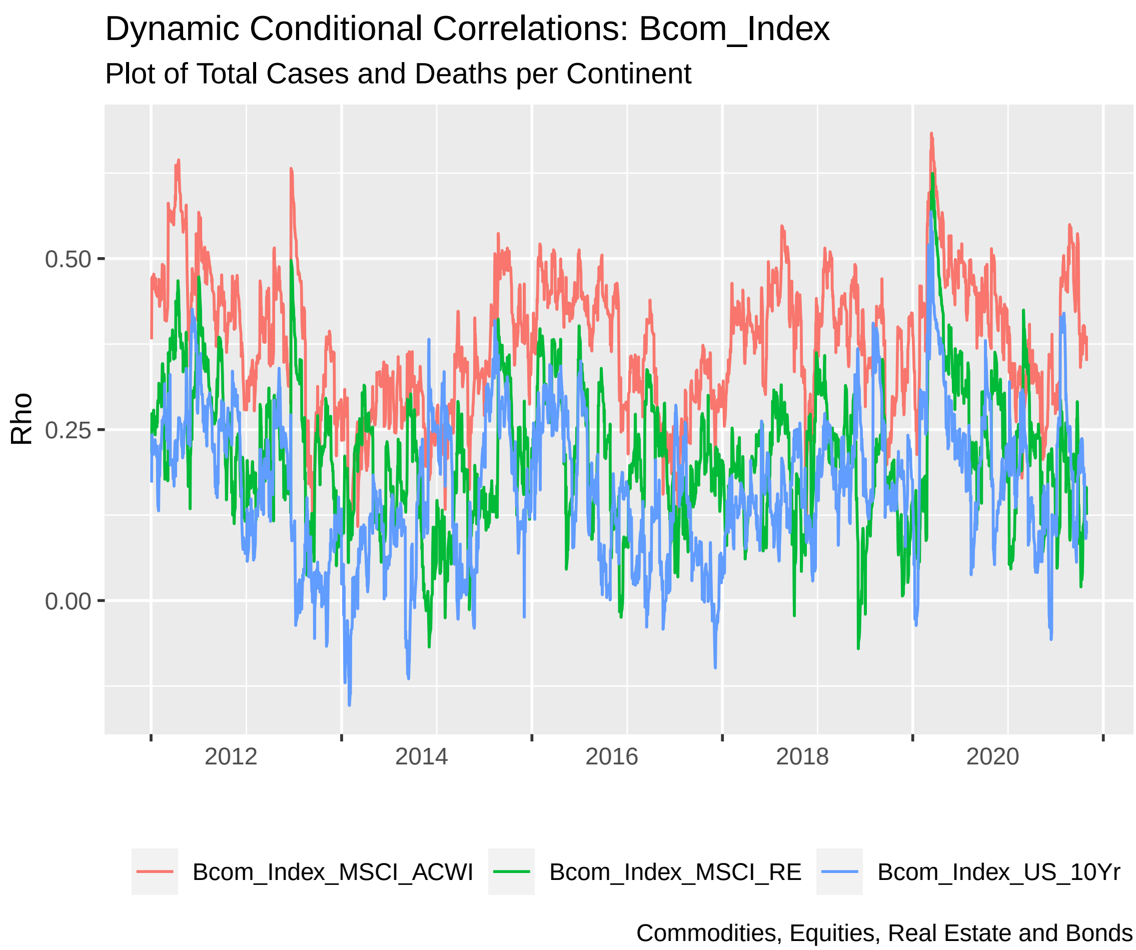
I now plot line graphs that illustrate how co-movements between different asset classes have changed over the last 10 years. I don't want to include the GFC, as all asset classes were responding similarly at the time.

To produce the Dynamic Conditional Correlations graphs for the four asset classes I nest the renaming function from the practicals inside of a graphing function, so that it can be reused simply by changing the input names.

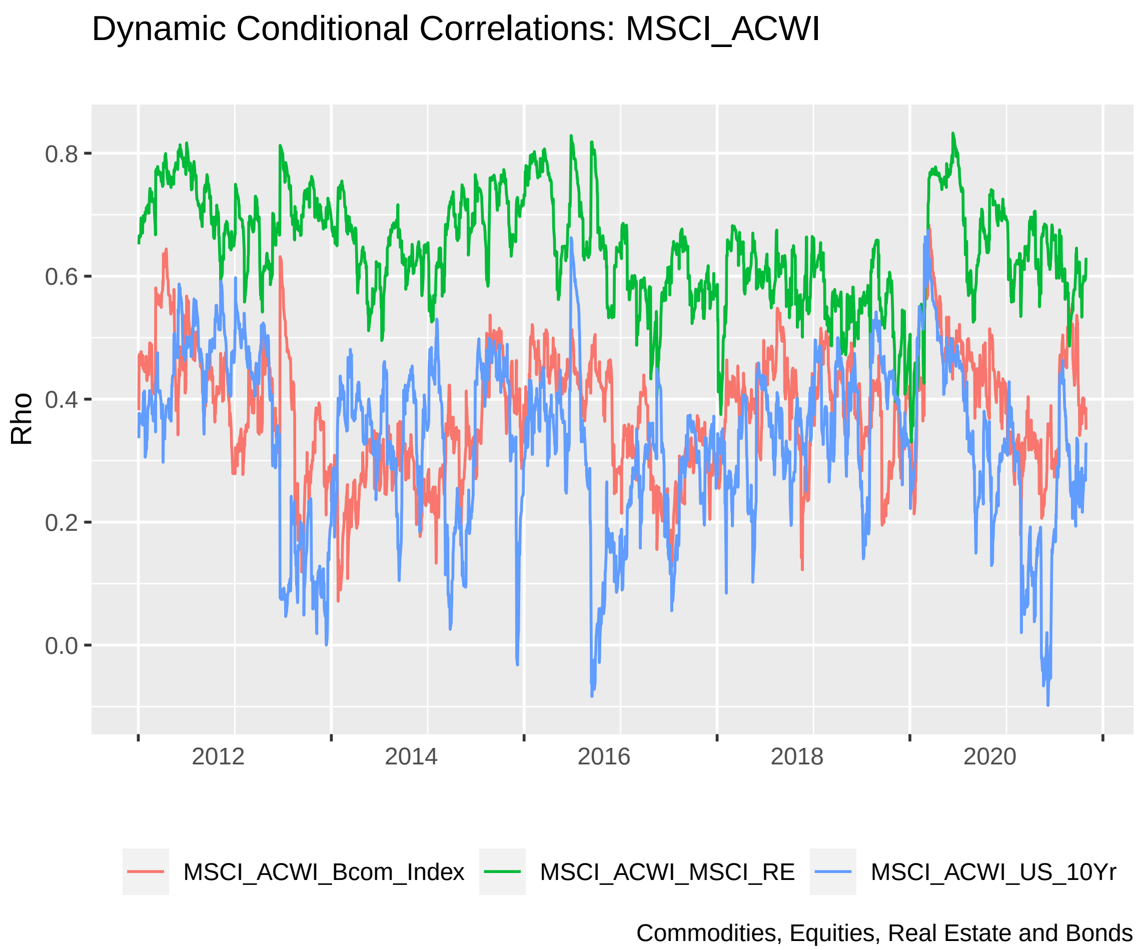


Commodities, Equities, Real Estate and Bonds

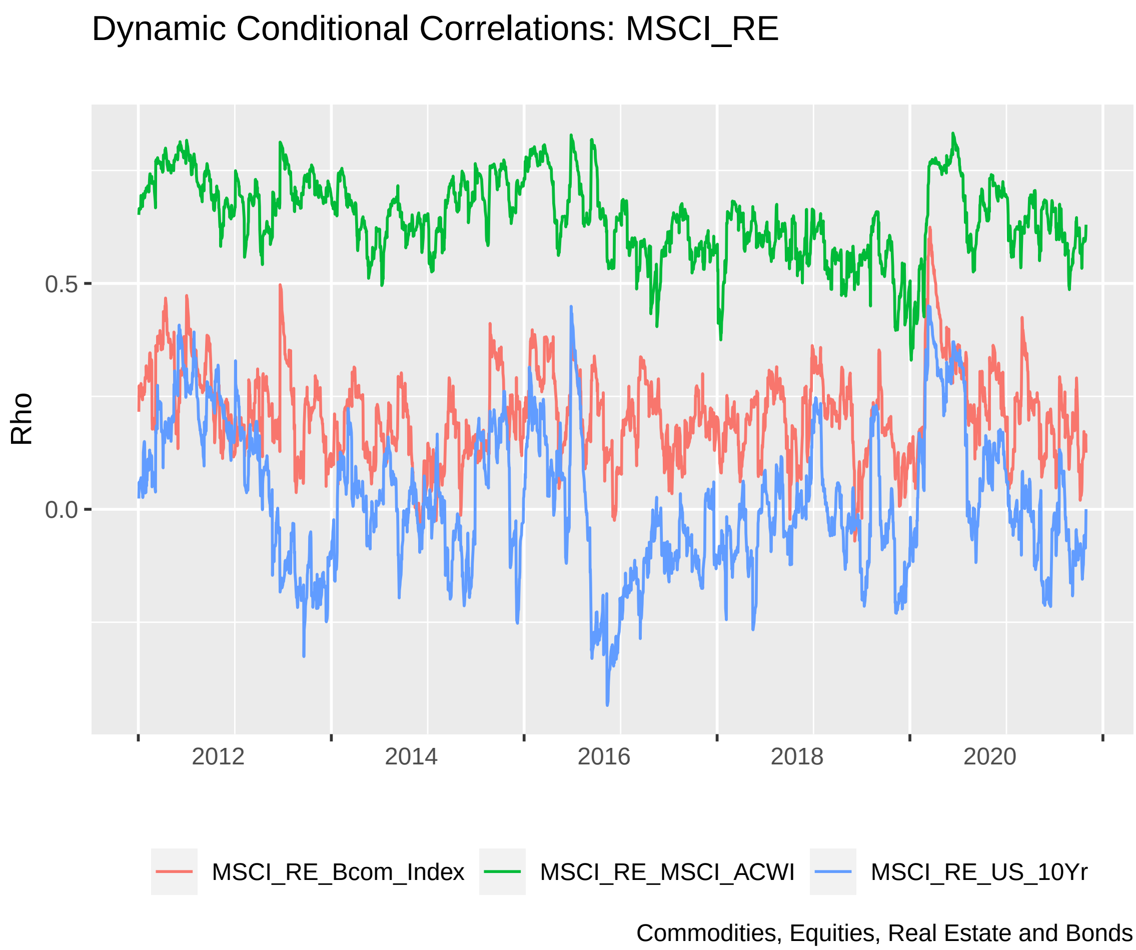
From the Dynamic Conditional Correlations: US_10Yr graph, in the last two years of the period the other three asset classes (equities, real estate and commodities) see to be moving similarly to the US 10 Year Treasury bond. This is not surprising as bond prices are underpinned by interest rates and interest rate changes have significant effects on asset classes.



From, Dynamic Conditional Correlations: Bcom_Index graph, commodities have a less correlated than other asset classes as can see the bonds-commodities relationship oscillates just above zero.



From the Dynamic Conditional Correlations: MSCI_ACWI graph, the All Country World Index and the Real Estate assets are more correlated than the other assets classes. This may be because of of common factor such as the availability of credit, would lead to incraesed housing and equity price as demand for this these asset would increase where the supply of credit facilities increase.


Dynamic Conditional Correlations: MSCI_RE
Rho
0.5
0.0
2012
2014
2016
2018
2020
MSCI_RE_Bcom_Index
MSCI_RE_MSCI_ACWI
MSCI_RE_US_10Yr
Commodities, Equities, Real Estate and Bonds