

# Thesis

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## Chapter 1

# Opening Comments



## Chapter 2

# Introduction





## Chapter 3

# Literature Review



## Chapter 4

# Data Collection and Summary Statistics



## Chapter 5

# Data Analysis

### 5.1 Sector Weights

First, sector weights were calculated over time for both EUSA and USMV. Plots were made by sector and displayed to compare the relative weights of EUSA and USMV.

*Sector Weight Summary Statistics:*

```
data(usa_percent)
data(minvol_percent)

## Summary statistics of EUSA sector weights
head(usa_percent)

##           sector_name sector_count total    percent    date
## 1 Cash and/or Derivatives          2   631 0.003169572 2017-01-05
## 2 Consumer Discretionary        106   631 0.167987322 2017-01-05
## 3 Consumer Staples              43   631 0.068145800 2017-01-05
## 4 Energy                        44   631 0.069730586 2017-01-05
## 5 Financials                    84   631 0.133122029 2017-01-05
## 6 Health Care                   71   631 0.112519810 2017-01-05

tail(usa_percent)

##           sector_name sector_count total    percent    date
## 827 Information Technology          79   585 0.135042735 2011-10-31
## 828 Materials                    33   585 0.056410256 2011-10-31
## 829 Real Estate                    0   585 0.000000000 2011-10-31
## 830 S-T Securities                  1   585 0.001709402 2011-10-31
## 831 Telecommunications            12   585 0.020512821 2011-10-31
## 832 Utilities                     35   585 0.059829060 2011-10-31

summary(usa_percent)

##           sector_name sector_count    total
## Cash and/or Derivatives: 64 Length:832 Length:832
## Consumer Discretionary : 64 Class :character Class :character
## Consumer Staples       : 64 Mode  :character Mode  :character
## Energy                  : 64
## Financials              : 64
## Health Care             : 64
```

```
## (Other) :448
## percent date
## Min. :0.00000 Min. :2011-10-31
## 1st Qu.:0.01426 1st Qu.:2013-02-21
## Median :0.06820 Median :2014-06-14
## Mean :0.07692 Mean :2014-06-14
## 3rd Qu.:0.12236 3rd Qu.:2015-10-07
## Max. :0.19293 Max. :2017-01-05
##
```

```
## Summary statistics of USMV sector weights
head(minvol_percent)
```

```
##          sector_name sector_count total    percent    date
## 1 Cash and/or Derivatives          2   186 0.01075269 2017-01-05
## 2 Consumer Discretionary         18   186 0.09677419 2017-01-05
## 3 Consumer Staples              24   186 0.12903226 2017-01-05
## 4 Energy                        4   186 0.02150538 2017-01-05
## 5 Financials                    21   186 0.11290323 2017-01-05
## 6 Health Care                   33   186 0.17741935 2017-01-05
```

```
tail(minvol_percent)
```

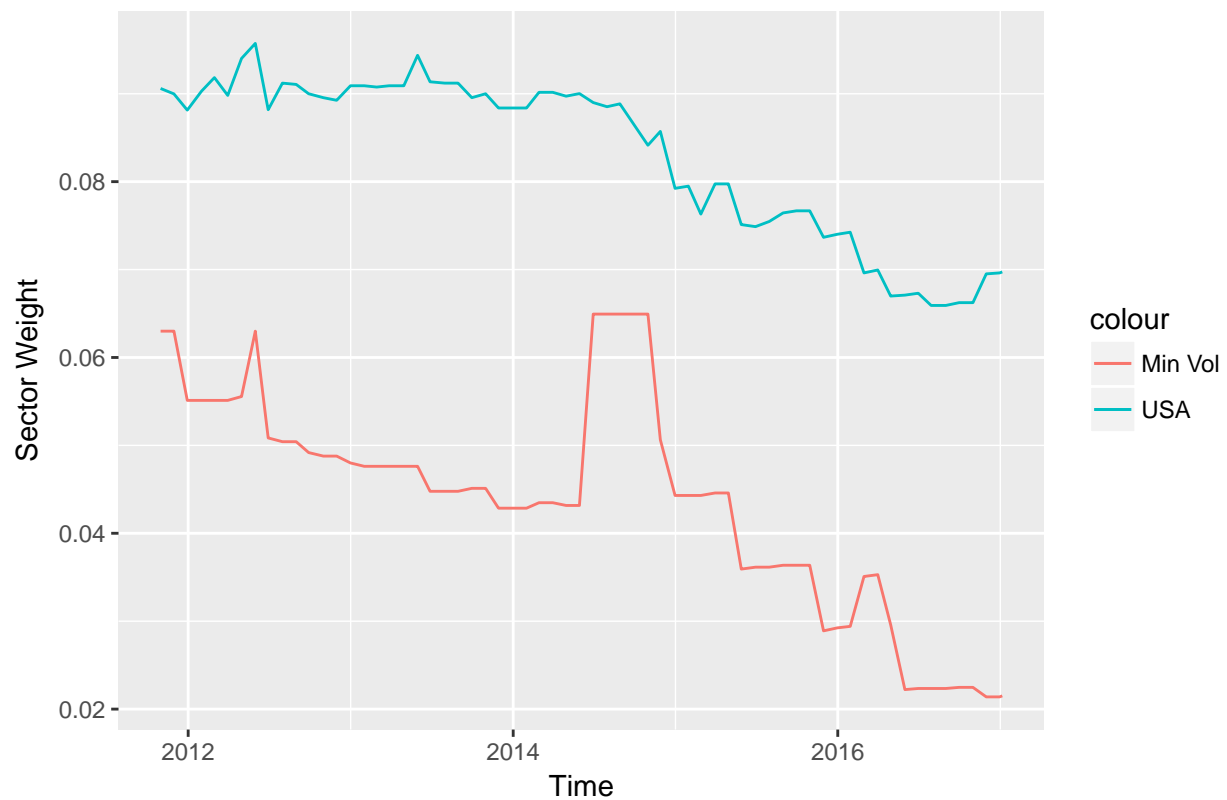
```
##          sector_name sector_count total    percent    date
## 827 Information Technology         19   127 0.149606299 2011-10-31
## 828 Materials                     4   127 0.031496063 2011-10-31
## 829 Real Estate                   0   127 0.000000000 2011-10-31
## 830 S-T Securities                 1   127 0.007874016 2011-10-31
## 831 Telecommunications             7   127 0.055118110 2011-10-31
## 832 Utilities                     9   127 0.070866142 2011-10-31
```

```
summary(minvol_percent)
```

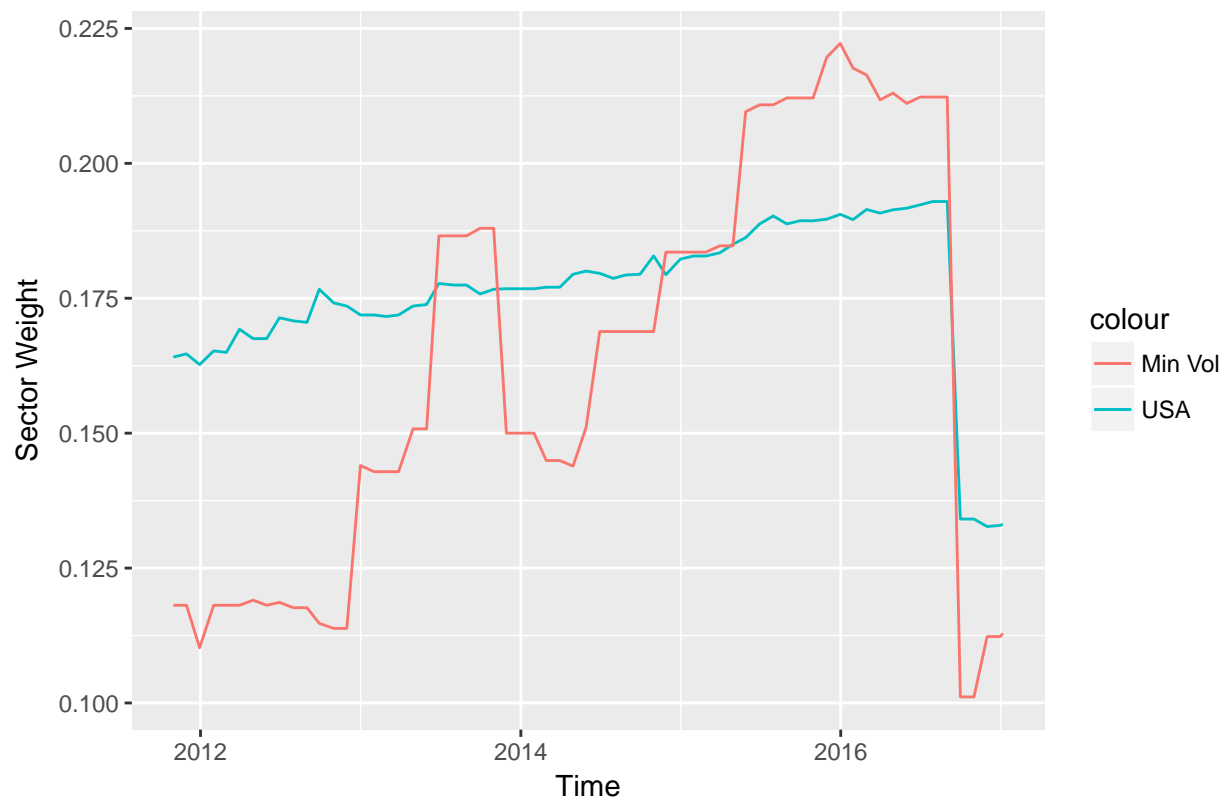
```
##          sector_name sector_count    total
## Cash and/or Derivatives: 64 Length:832 Length:832
## Consumer Discretionary : 64 Class :character Class :character
## Consumer Staples      : 64 Mode :character Mode :character
## Energy                 : 64
## Financials             : 64
## Health Care            : 64
## (Other)                :448
## percent date
## Min. :0.00000 Min. :2011-10-31
## 1st Qu.:0.02235 1st Qu.:2013-02-21
## Median :0.06349 Median :2014-06-14
## Mean :0.07692 Mean :2014-06-14
## 3rd Qu.:0.13043 3rd Qu.:2015-10-07
## Max. :0.22222 Max. :2017-01-05
##
```

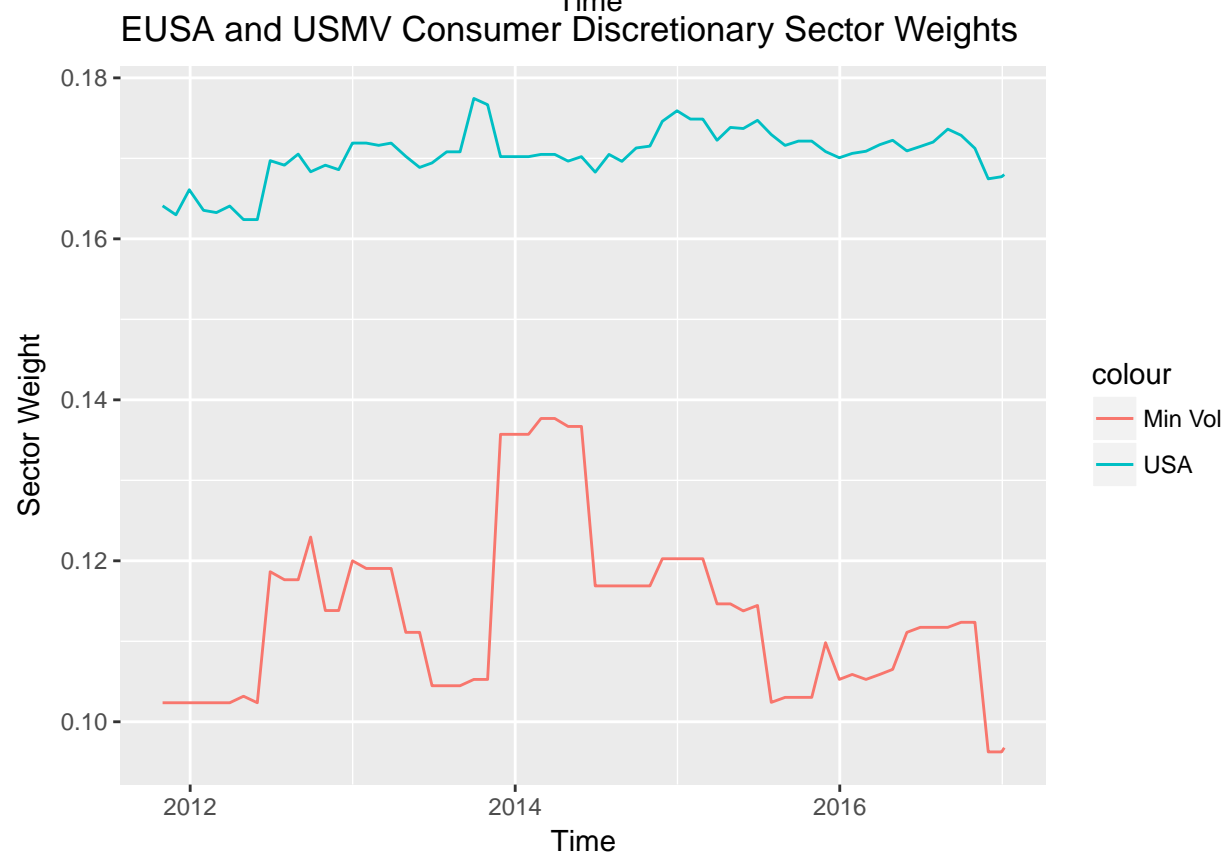
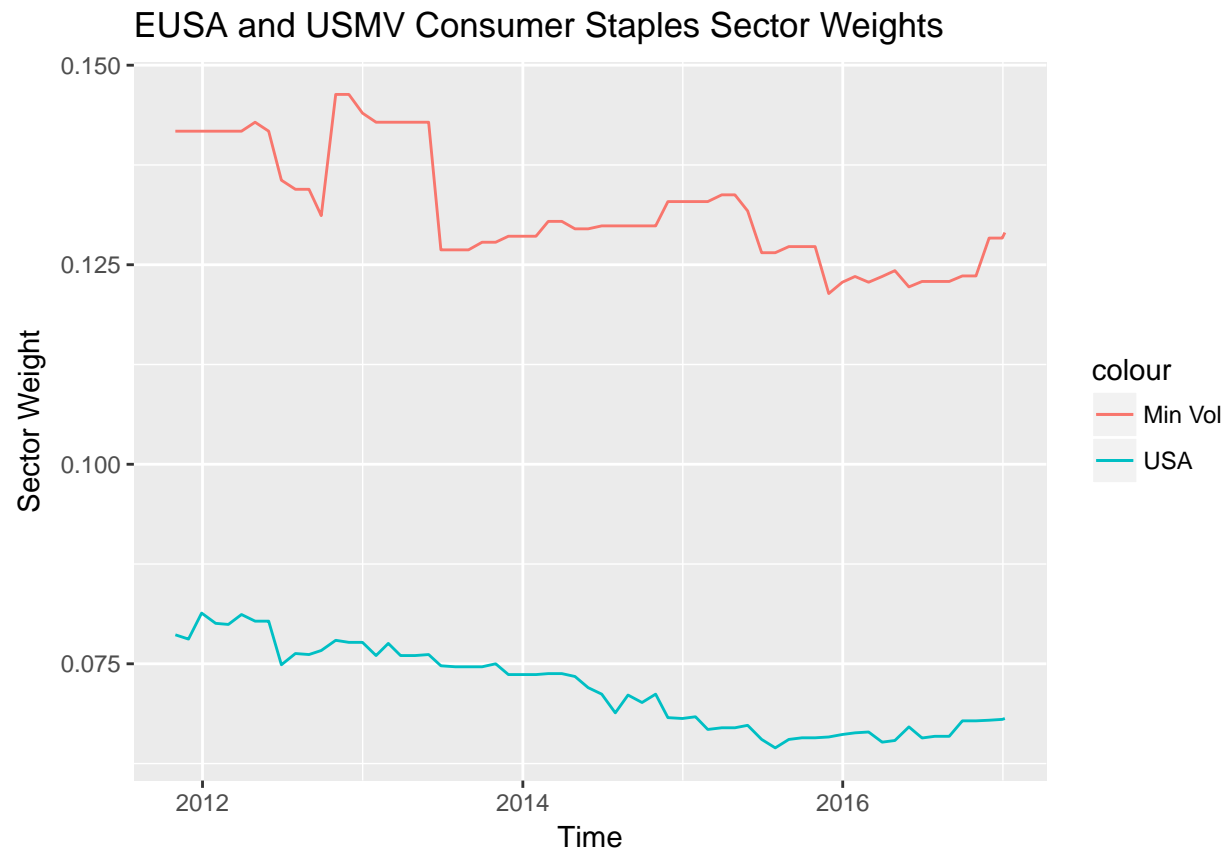
*Sector Weights for EUSA and USMV:*

EUSA and USMV Energy Sector Weights

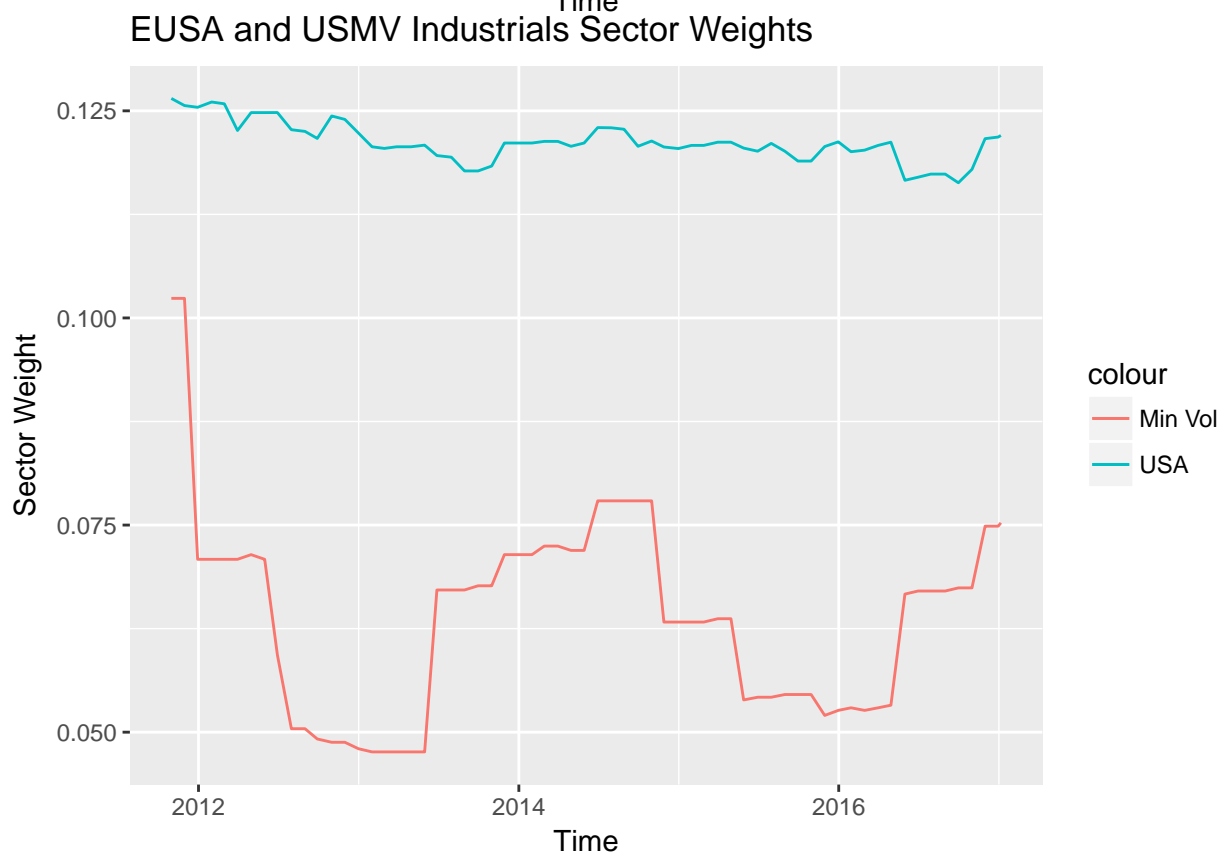
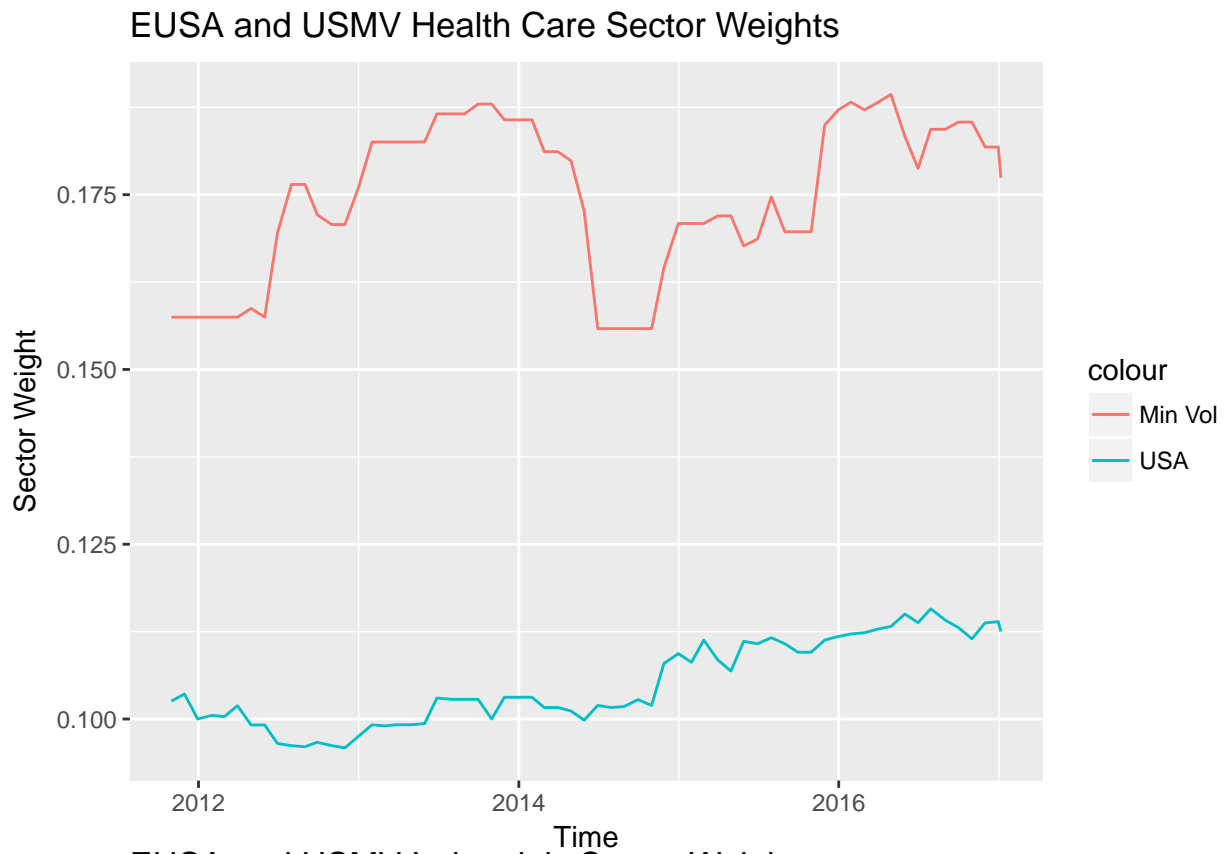


EUSA and USMV Financial Sector Weights

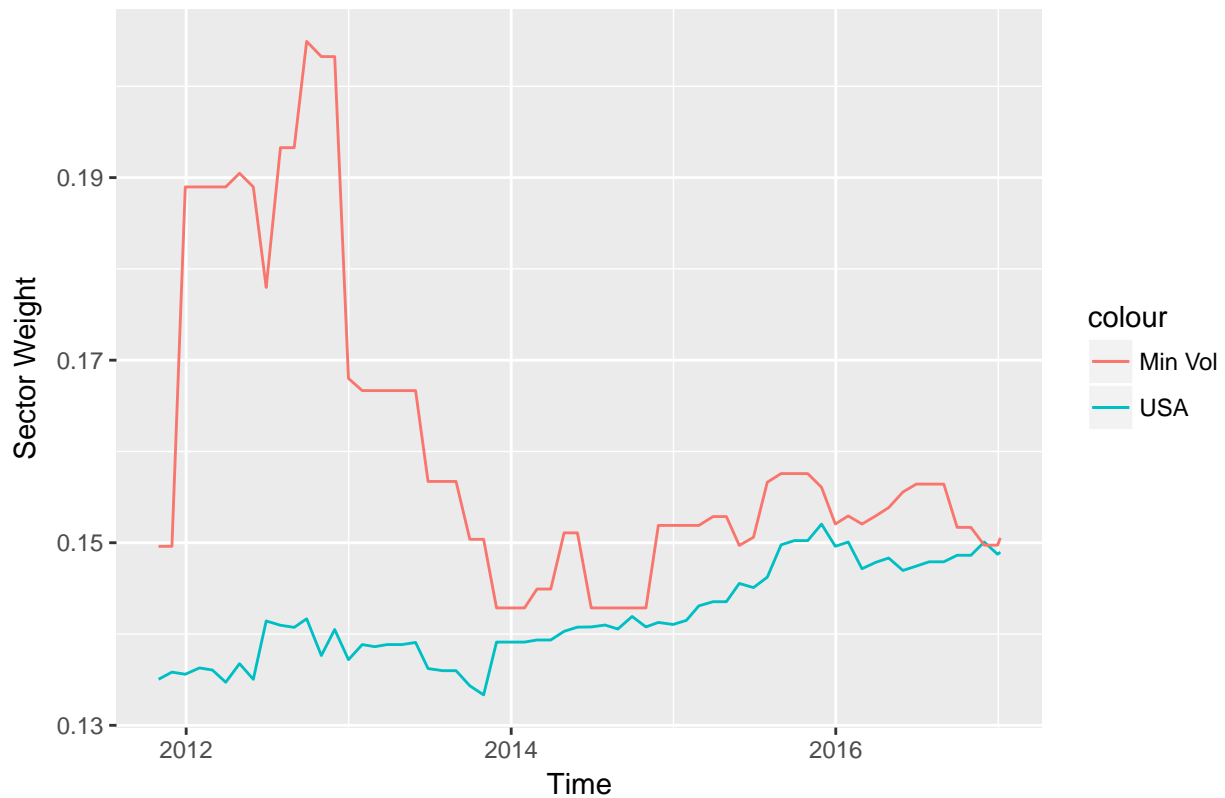




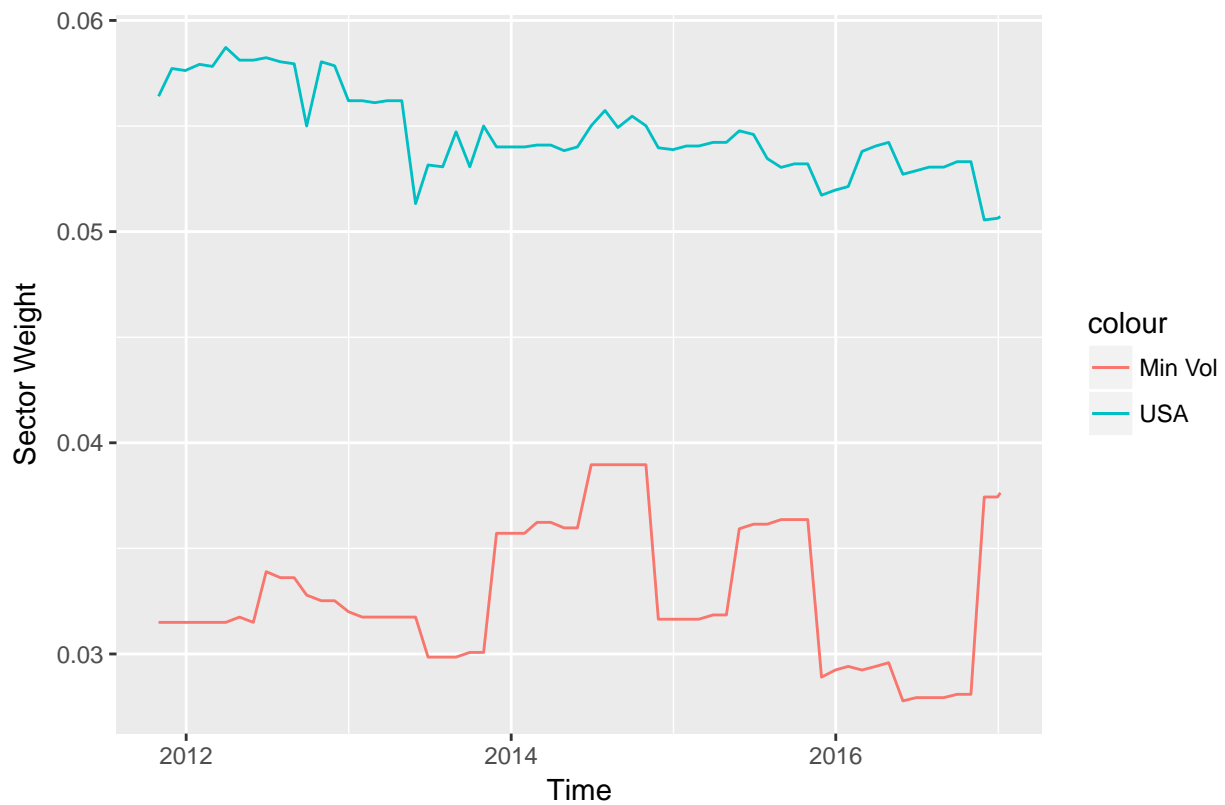


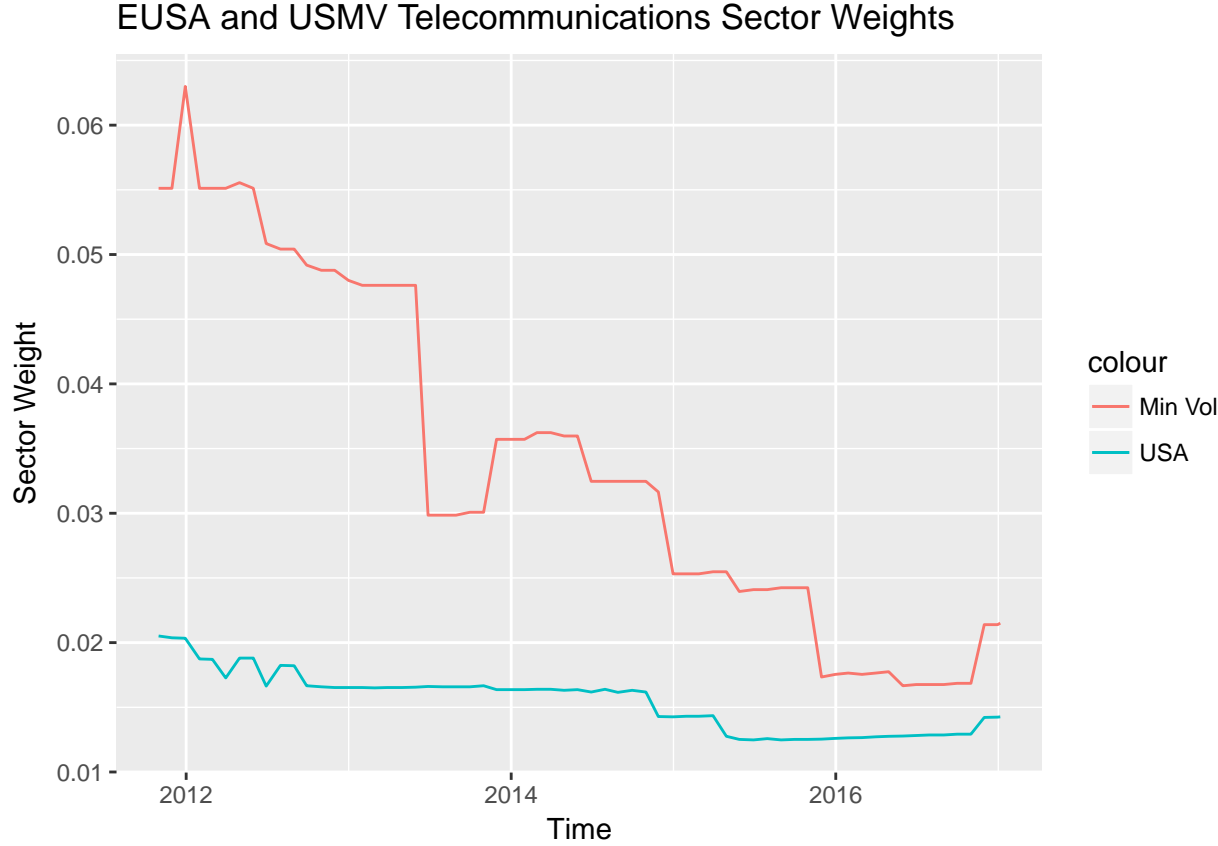
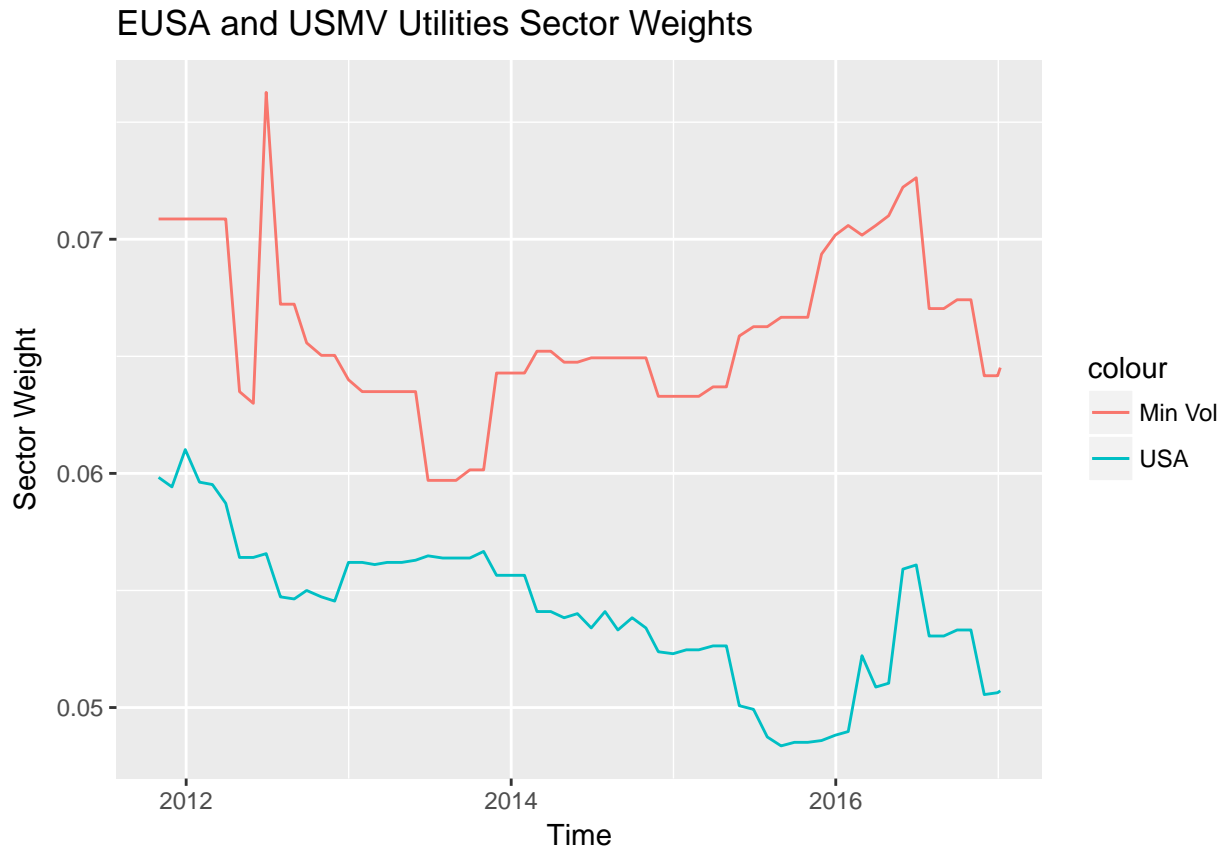


EUSA and USMV Information Technology Sector Weights



EUSA and USMV Materials Sector Weights





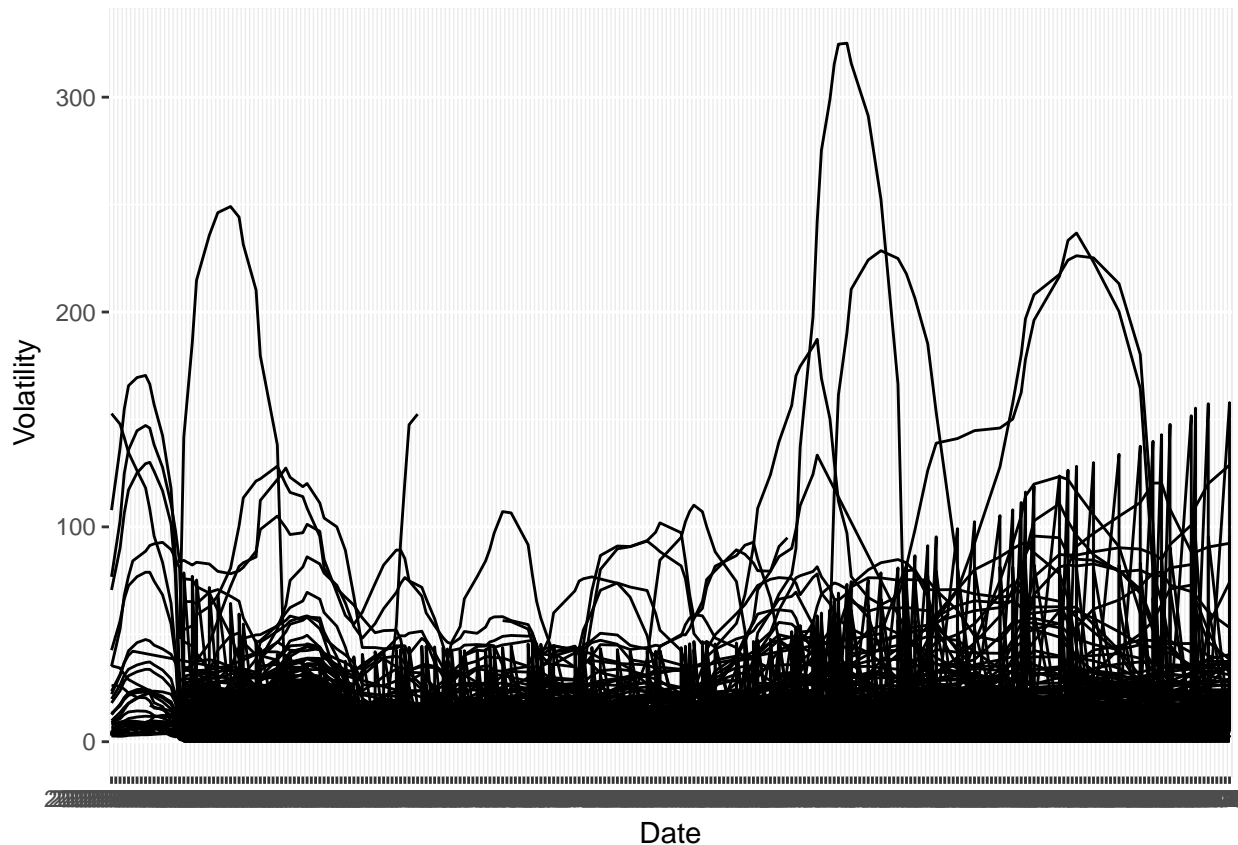
## 5.2 EUSA Constituent Trailing Volatilities

Data was collected from the past 10 years of the EUSA index. The data was collected from 12/31/2006 to 12/30/2016, was collected from WRDS for the 908 historical constituents of the USA Equal Weight (EUSA) index, of which USMV is derived. Each tickers' 252-day (annual) trailing volatility was calculated and a month end spaghetti plot was produced.

```
##          Date Ticker Volatility
## 1 2008-01-31      A   2.289449
## 2 2008-02-29      A   2.357208
## 3 2008-03-31      A   2.660299
## 4 2008-04-30      A   3.017754
## 5 2008-05-30      A   3.028868
## 6 2008-06-30      A   2.921781
```

```
##          Date Ticker Volatility
## 82257 2016-07-29    ZTS  2.718338
## 82258 2016-08-31    ZTS  3.150629
## 82259 2016-09-30    ZTS  3.363564
## 82260 2016-10-31    ZTS  3.372530
## 82261 2016-11-30    ZTS  3.436391
## 82262 2016-12-30    ZTS  3.664053
```

```
##          Date          Ticker          Volatility
## 2014-09-30: 774    GE      : 432    Min.      : 0.0492
## 2014-10-31: 774    LSI      : 246    1st Qu.: 2.4407
## 2014-11-28: 774    UA       : 234    Median   : 4.3057
## 2014-12-31: 773    CBS      : 228    Mean     : 6.9432
## 2014-06-30: 771    LEN      : 228    3rd Qu.: 7.4648
## 2014-07-31: 771    MKC      : 228    Max.     :325.1242
## (Other)      :77625    (Other):80666
```



### 5.3 EUSA Constituent Trailing Betas

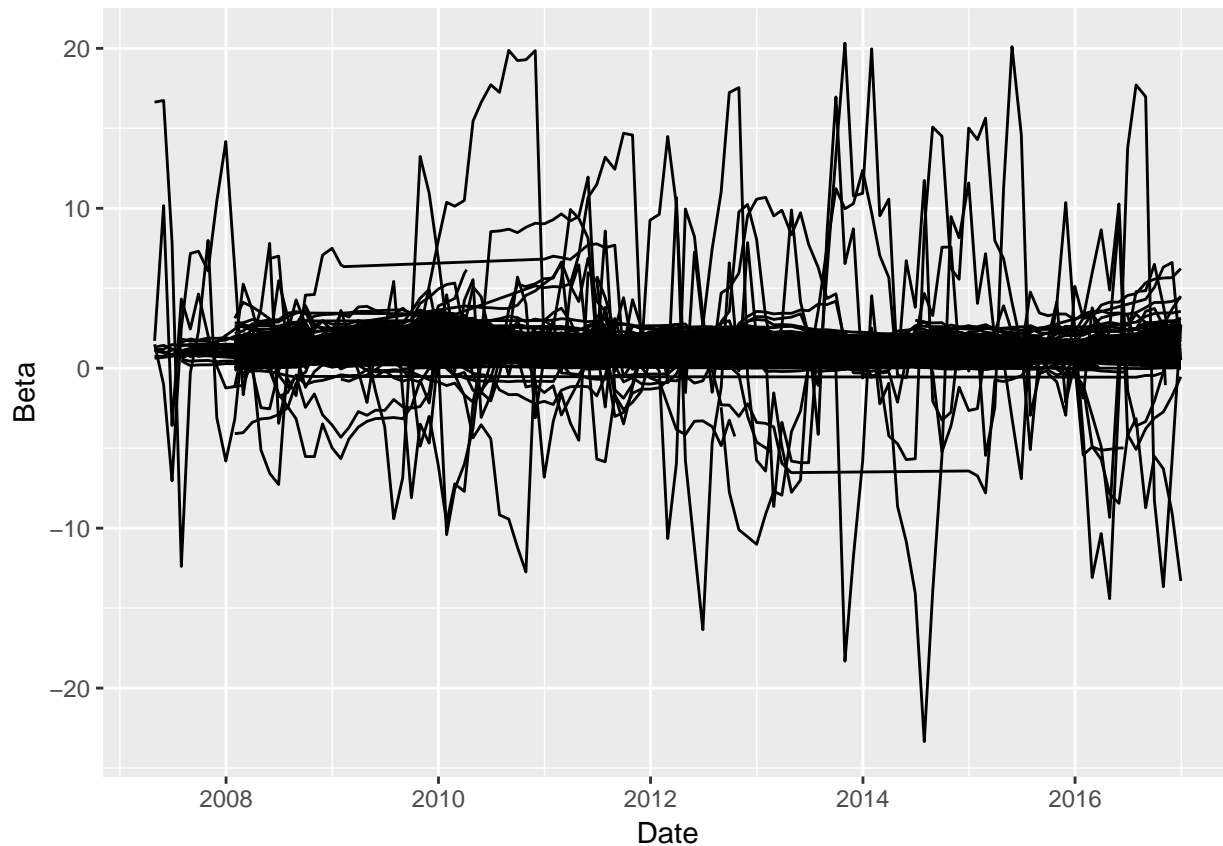
Data was collected from the past 10 years of the EUSA index. The data was collected from 12/31/2006 to 12/30/2016, was collected from WRDS for the 908 historical constituents of the USA Equal Weight (EUSA) index, of which USMV is derived. Each tickers' 252-day (annual) trailing beta was calculated and a month end spaghetti plot was produced.

```
##          Date Ticker      Beta
## 271 2008-01-31      A 0.9538067
## 291 2008-02-29      A 0.9473060
## 311 2008-03-31      A 0.9376670
## 333 2008-04-30      A 0.9588268
## 354 2008-05-30      A 0.9680630
## 375 2008-06-30      A 0.9611418
```

```
##          Date Ticker      Beta
## 879842 2016-07-29    ZTS 1.0224673
## 902837 2016-08-31    ZTS 1.0302957
## 923836 2016-09-30    ZTS 0.9779760
## 944833 2016-10-31    ZTS 0.9830767
## 965832 2016-11-30    ZTS 0.9220281
## 986829 2016-12-30    ZTS 0.9549808
```

```
##          Date          Ticker          Beta
## Min.      :2007-04-30  Length:80200    Min.      : -23.3438
## 1st Qu.:2010-04-30    Class :character 1st Qu.:  0.8184
```

```
## Median :2012-07-31   Mode  :character   Median : 1.0516
## Mean   :2012-07-23                               Mean  : 1.0982
## 3rd Qu.:2014-10-31                               3rd Qu.: 1.3297
## Max.   :2016-12-30                               Max.   : 20.3256
```



## 5.4 EUSA Constituent Price to Book Ratios

Data was collected from the past 10 years of the EUSA index. The data was collected from 12/31/2006 to 12/30/2016, was collected from WRDS for the 908 historical constituents of the USA Equal Weight (EUSA) index, of which USMV is derived. Each tickers' Price to Book ratio was calculated in two ways, to ensure accuracy.

```
##      gvkey      Date Year Ticker Total_Assets BV_per_share
## 1 126554 2007-10-31 2007      A    7.554e+09      8.7405
## 2 126554 2008-10-31 2008      A    7.437e+09      7.3114
## 3 126554 2009-10-31 2009      A    7.612e+09      7.2397
## 4 126554 2010-10-31 2010      A    9.696e+09      9.3256
## 5 126554 2011-10-31 2011      A    9.057e+09     12.4371
## 6 126554 2011-10-31 2011      A    9.049e+09         NA
##      Shares_Outstanding Total_Liabilities Market_Value Share_Price Book_Value
## 1          370000000      4.320e+09 13634500000      36.85 3233985000
## 2          350000000      4.878e+09  7766500000      22.19 2558990000
## 3          346148000      5.106e+09  8563701500      24.74 2506007676
## 4          346144000      6.460e+09 12045811200      34.80 3228000486
## 5          346382000      4.741e+09 12840380700      37.07 4307987572
## 6              NA              NA 12840380700         NA         NA
```

```
##      PBR1      PBR2
## 1 4.216006 4.216006
## 2 3.034986 3.034986
## 3 3.417269 3.417269
## 4 3.731663 3.731663
## 5 2.980598 2.980598
## 6      NA      NA
```

```
##      gvkey      Date Year Ticker Total_Assets BV_per_share
## 17182 13721 2014-12-31 2014   ZTS   6.607e+09   2.6151
## 17183 13721 2014-12-31 2014   ZTS   6.588e+09      NA
## 17184 13721 2015-12-31 2015   ZTS   7.913e+09   2.1472
## 17185 13721 2015-12-31 2015   ZTS   7.913e+09      NA
## 17186 13721 2016-12-31 2016   ZTS   7.649e+09   3.0171
## 17187 13721 2016-12-31 2016   ZTS   7.649e+09      NA
##      Shares_Outstanding Total_Liabilities Market_Value Share_Price
## 17182      501328000      5.270e+09 21572143800      43.03
## 17183      NA      NA      NA 21572143800      NA
## 17184      497400000      6.822e+09 23835408000      47.92
## 17185      NA      NA      NA 23835408000      NA
## 17186      492855000      6.150e+09 26382528200      53.53
## 17187      NA      NA      NA 26382528200      NA
##      Book_Value      PBR1      PBR2
## 17182 1311022853 16.45444 16.45444
## 17183      NA      NA      NA
## 17184 1068017280 22.31744 22.31744
## 17185      NA      NA      NA
## 17186 1486992820 17.74220 17.74220
## 17187      NA      NA      NA
```

```
##      gvkey      Date      Year      Ticker
## Min. : 1045 2013-12-31:1283 Min. :2006 ACGL : 33
## 1st Qu.: 7146 2012-12-31:1277 1st Qu.:2009 AET : 33
## Median : 14824 2014-12-31:1275 Median :2011 AFL : 33
## Mean : 50895 2011-12-31:1265 Mean :2011 AIZ : 33
## 3rd Qu.: 65556 2015-12-31:1253 3rd Qu.:2014 AMG : 33
## Max. :294524 2010-12-31:1222 Max. :2016 ANTM : 33
##      (Other) :9612 NA's :33 (Other):16989
##      Total_Assets      BV_per_share      Shares_Outstanding
## Min. :0.000e+00 Min. : -1489600 Min. :0.000e+00
## 1st Qu.:3.912e+09 1st Qu.: 8 1st Qu.:1.010e+08
## Median :9.538e+09 Median : 15 Median :1.973e+08
## Mean :4.725e+10 Mean : 5311 Mean :4.654e+08
## 3rd Qu.:2.632e+10 3rd Qu.: 27 3rd Qu.:4.344e+08
## Max. :2.573e+12 Max. :16297416 Max. :2.906e+10
## NA's :2568 NA's :9284 NA's :9188
##      Total_Liabilities      Market_Value      Share_Price
## Min. :0.000e+00 Min. :3.545e+06 Min. : 0.027
## 1st Qu.:2.135e+09 1st Qu.:4.445e+09 1st Qu.: 25.985
## Median :6.310e+09 Median :8.851e+09 Median : 43.180
## Mean :4.451e+10 Mean :2.166e+10 Mean : 57.339
## 3rd Qu.:1.865e+10 3rd Qu.:1.942e+10 3rd Qu.: 67.955
## Max. :2.341e+12 Max. :6.266e+11 Max. :1466.060
## NA's :7785 NA's :2764 NA's :10064
##      Book_Value      PBR1      PBR2
```

##	Min.	:-8.615e+10	Min.	:-687.634	Min.	:-687.634
##	1st Qu.:	1.313e+09	1st Qu.:	1.595	1st Qu.:	1.595
##	Median :	3.121e+09	Median :	2.626	Median :	2.626
##	Mean :	8.170e+09	Mean :	4.503	Mean :	4.503
##	3rd Qu.:	7.376e+09	3rd Qu.:	4.416	3rd Qu.:	4.416
##	Max.	: 2.416e+11	Max.	:1575.000	Max.	:1575.000
##	NA's	:9284	NA's	:10079	NA's	:10079



## Chapter 6

# Bibliography