Thesis

John Gilheany

2017-05-18

Contents

Chapter 1

Opening Comments

Chapter 2

Introduction

Chapter 3

Literature Review

Chapter 4

Data Collection and Summary Statistics

Data was downloaded from www.ishares.com for EUSA (iShares MSCI USA Equal Weighted ETF) and USMV (iShares Edge MSCI Min Vol USA ETF), from Oct 31, 2011 to December 31, 2016. iShares are a type of ETF managed by BlackRock, and www.ishares.com contains the month end data for the two ETFs of interest in this dissertation. The data sets included information for the constituents of each ETF of the time, and some other characteristics of them, including: ticker, company name, asset class, weight of the stock relative to the entire index, price per share, number of shares, market value of the position, notional value of the position, sector, sedol number, isin number, exchange that the stock is listed on, and the month end date for the data. An R function was created for both ETFs that would combine each month end data set into one aggregated one. Thus, each month end data set was individually downloaded, then aggregated to create the data sets "usa" and "minvol". These were stored in the data-raw folder, for safekeeping.

However, after having a quick overview of the data, there were many issues with it that needed to be fixed before the analysis could begin. First, looking at unique exchanges of the data on R, it was seen that there were many foreign exchanges like the Swiss Exchange and the Mexican Exchange, which did not make sense, given the ETF constituents are supposed to be listed on US-based exchanges. One clear discrepancy between the company name and ticker was "AAPL*" (yes, the ticker had an asterisk) which was listed on the Mexican Exchange, instead of being listed as AAPL on the NYSE. This would cause issues for reading the data later on, because AAPL with the asterisk was not read in as "AAPL" due to the asterisk. Other tickers were very easy to notice as incorrect because they included numbers. Seeing as this is a US index with US stocks, this was a clear issue. One example was the company Aflac, Inc. which was recorded by the ticker 8686. This corresponded to Aflac, Inc. on the Tokyo exchange, but when checking the recorded price of the stock for corresponding dates, it matched up with the Aflac, Inc. stock in the US, with ticker AFL. Other tickers were read in correctly, but corresponded to non-US exchanges. One example was BAC, Bank of America, which is listed on the NYSE. Though the price for each date corresponded to the price of BAC in the NYSE, it was listed on the Swiss Exchange. BAC did not correspond to Bank of America on the Swiss Exchange either, which made me question how these companies were being read in.

Instead of looking through 800+ tickers at once, I created a subset of the usa data that looked at all of the companies not listed on the NYSE or NASDAQ exchanges. This included stocks listed on the Boerse Berlin, Bolsa Mexicana De Valores, and London Stock Exchange. There were 16 exchanges that were not the NYSE or NASDAQ, which seemed problematic. There were 74 tickers within these, that I went through and looked at by hand. These included many tickers with numbers and asterisks. In the end, I was able to figure out 67 of these tickers pretty definitively. Some of these tickers were recorded properly, just with the wrong exchange listed (i.e. F, Ford, listed on the Swiss Exchange). Thus, these tickers were kept as is. Some other tickers were harder to find because of M&A activity causing the company to no longer be traded. One example was LinkedIn, which was incorrectly listed as LKI. Before it was acquired by Microsoft, the ticker

was LNKD. Thus, the ticker was changed to show this, as we will need to get old data for companies based off their tickers at the time. Other tickers were for US companies, and included their tickers for overseas exchanges. One example was Intel Corp, which was listed as INCO. INCO is the correct ticker for Intel on the Amsterdam exchange, but not on the NYSE, which lists it as INTC. The general methodology to make sure a change in ticker was appropriate was to check the price of the stock at a specific date, in the usa data set, and then comparing it to the new ticker I was going to assign it. If the price matched, the change was made. If the price did not match up and was very different, then I looked to see if a stock-split might be the cause of this. If there was no evidence of a stock-split, then the stock was highlighted and left alone for further analysis. An entire list of what was changed and what was not is shown in the appendix. In the end, the ticker named "1015736" and Orchard Supply Hardware Stores were removed from the data set. This accounted for less than 0.2% of the data from one month-end date. I also removed cash assets as well by removing values if the sector was cash, since this is not important for our purposes.

Thus, after removing a couple tickers and cash, I wanted to check how accurate the data set was. This was accomplished by comparing the weighted returns of the constructed index we have (looking at each constituent's monthly return, multiplied by its weight), and comparing it to the ETF return. Because the iShares price data did not reflect stock splits, it was very problematic in some returns. For example, when AAPL split its stock in 2014, from 4-30-2014 to 5-30-2014, the price went from \$633.00 to \$92.93 per share. This would have been improperly recorded as an 85% decrease in the price of the stock, when in reality this was due to a stock split. Since WRDS generally gives price information adjusted for stock splits and dividends, those prices were used instead. However, this was not always the case, and for some instances, these issues were changed manually. This was done by sorting the highest deltas in the data set, with delta corresponding to the monthly change in stock price. I investigated stocks with deltas greater than 0.3 in magnitude for the given month to see if it needed to be adjusted. This same procedure was used for the minvol data set, as it is a subset of the usa data.

Shown below are some of the summary statistics of the usa and min vol data

```
# Load Packages and View the Data
devtools::install_github("johngil/gilheany.thesis")

## Skipping install of 'gilheany.thesis' from a github remote, the SHA1 (060f4bb9) has not changed since
##   Use `force = TRUE` to force installation
library(mscidata)
library(ggplot2)
data(usa)
data(minvol)

## Summary statistics of EUSA Data
head(usa)

##   X Ticker    Name Asset.Class Weight.... Price Shares Market.Value
## 1 1   <NA> 1015736        <NA>     0.1950 26.63  10991    292690000
## 2 2    MMM   3M CO      Equity     0.4706 79.02    160     12643000
## 3 3    MMM   3M CO      Equity     0.4659 81.04    154     12480000
## 4 4    MMM   3M CO      Equity     0.4626 81.73   6872    561649000
## 5 5    MMM   3M CO      Equity     0.4709 86.71   7211    625266000
## 6 6    MMM   3M CO      Equity     0.4556 87.60   6672    584467000
##   Notional.Value      Sector   SEDOL         ISIN
## 1             NA Industrials    <NA>         <NA>
## 2             NA Industrials 2595708 US88579Y1010
## 3             NA Industrials 2595708 US88579Y1010
## 4             NA Industrials 2595708 US88579Y1010
## 5             NA Industrials 2595708 US88579Y1010
## 6             NA Industrials 2595708 US88579Y1010
##                  Exchange        Date
```

```
## 1                              <NA> 2012-12-31
## 2 New York Stock Exchange Inc. 2011-10-31
## 3 New York Stock Exchange Inc. 2011-11-30
## 4 New York Stock Exchange Inc. 2011-12-30
## 5 New York Stock Exchange Inc. 2012-01-31
## 6 New York Stock Exchange Inc. 2012-02-29
```

```r
tail(usa)
```

```
##           X Ticker                Name Asset.Class Weight.... Price Shares
## 39325 39325    ZTS ZOETIS INC CLASS A      Equity     0.1649 51.10   2377
## 39326 39326    ZTS ZOETIS INC CLASS A      Equity     0.1695 52.01   2397
## 39327 39327    ZTS ZOETIS INC CLASS A      Equity     0.1600 47.80   2472
## 39328 39328    ZTS ZOETIS INC CLASS A      Equity     0.1608 50.38   2847
## 39329 39329    ZTS ZOETIS INC CLASS A      Equity     0.1706 53.53   3015
## 39330 39330    ZTS ZOETIS INC CLASS A      Equity     0.1690 53.93   3015
##       Market.Value Notional.Value      Sector  SEDOL         ISIN
## 39325    121465000      121464.7 Health Care B95WG16 US98978V1035
## 39326    124668000      124668.0 Health Care B95WG16 US98978V1035
## 39327    118162000      118161.6 Health Care B95WG16 US98978V1035
## 39328    143432000      143431.9 Health Care B95WG16 US98978V1035
## 39329    161393000      161393.0 Health Care B95WG16 US98978V1035
## 39330    162599000      162599.0 Health Care B95WG16 US98978V1035
##                           Exchange       Date
## 39325 New York Stock Exchange Inc. 2016-08-31
## 39326 New York Stock Exchange Inc. 2016-09-30
## 39327 New York Stock Exchange Inc. 2016-10-31
## 39328 New York Stock Exchange Inc. 2016-11-30
## 39329 New York Stock Exchange Inc. 2016-12-30
## 39330 New York Stock Exchange Inc. 2017-01-05
```

```r
summary(usa)
```

```
##        X            Ticker                      Name
##  Min.   :    1   CB     :  102   3M CO                :   64
##  1st Qu.: 9833   NLSN   :   65   ABBOTT LABORATORIES  :   64
##  Median :19666   A      :   64   ACCENTURE PLC        :   64
##  Mean   :19666   AAP    :   64   ACTIVISION BLIZZARD INC:  64
##  3rd Qu.:29498   ABC    :   64   ADOBE SYSTEM INC     :   64
##  Max.   :39330   (Other):38939   ADVANCE AUTO PARTS INC : 64
##                  NA's   :   32   (Other)              :38946
##       Asset.Class       Weight....          Price            Shares
##  Cash         :   66   Min.   :-0.3905   Min.   :  0.56   Min.   :-174670
##  Equity       :39240   1st Qu.: 0.0542   1st Qu.: 35.08   1st Qu.:    805
##  Money Market :   23   Median : 0.1236   Median : 55.21   Median :   1563
##  NA's         :    1   Mean   : 0.1626   Mean   : 72.05   Mean   :   3566
##                        3rd Qu.: 0.1638   3rd Qu.: 83.77   3rd Qu.:   3199
##                        Max.   : 4.6773   Max.   :953.00   Max.   : 873628
##                                          NA's   :47
##   Market.Value       Notional.Value                 Sector
##  Min.   :0.000e+00   Min.   :-174670   Financials           :6909
##  1st Qu.:5.321e+07   1st Qu.:  55505   Consumer Discretionary:6703
##  Median :8.418e+07   Median :  75582   Information Technology:5590
##  Mean   :1.607e+08   Mean   :  91931   Industrials           :4765
##  3rd Qu.:1.435e+08   3rd Qu.: 118997   Health Care           :4138
```

```
##  Max.   :6.804e+09   Max.   :2106050   Energy               :3253
##  NA's   :7           NA's   :22930     (Other)              :7972
##      SEDOL                ISIN
##  2000019:   64   AN8068571086:   64
##  2002305:   64   BMG0450A1053:   64
##  2005973:   64   BMG0692U1099:   64
##  2008154:   64   BMG169621056:   64
##  2011602:   64   BMG3223R1088:   64
##  (Other):38920   (Other)     :38952
##  NA's   :   90   NA's        :   58
##                                           Exchange
##  New York Stock Exchange Inc.                  :27970
##  NASDAQ                                        : 9405
##  Boerse Berlin                                 :  427
##  Deutsche Boerse Ag                            :  395
##  Bolsa Mexicana De Valores (Mexican Stock Exchange):  266
##  (Other)                                       :  661
##  NA's                                          :  206
##         Date
##  2015-06-30:  641
##  2015-08-31:  641
##  2015-05-29:  639
##  2015-09-30:  639
##  2015-10-30:  639
##  2015-11-30:  638
##  (Other)   :35493
## Summary statistics of USMV Data
head(minvol)
```

```
##   X Ticker   Name Asset.Class Weight....   Price Shares Market.Value
## 1 1    MMM 3M CO        Equity    0.7488   79.02    244        19281
## 2 2    MMM 3M CO        Equity    0.7592   81.04    244        19774
## 3 3    MMM 3M CO        Equity    0.2892  109.35  94494     10332919
## 4 4    MMM 3M CO        Equity    0.3000  117.43  59406      6976047
## 5 5    MMM 3M CO        Equity    0.2999  113.58  57686      6551976
## 6 6    MMM 3M CO        Equity    0.3095  119.41  52611      6282280
##   Notional.Value      Sector   SEDOL         ISIN
## 1             NA Industrials 2595708 US88579Y1010
## 2             NA Industrials 2595708 US88579Y1010
## 3             NA Industrials 2595708 US88579Y1010
## 4             NA Industrials 2595708 US88579Y1010
## 5             NA Industrials 2595708 US88579Y1010
## 6             NA Industrials 2595708 US88579Y1010
##                      Exchange       Date
## 1 New York Stock Exchange Inc. 2011-10-31
## 2 New York Stock Exchange Inc. 2011-11-30
## 3 New York Stock Exchange Inc. 2013-06-28
## 4 New York Stock Exchange Inc. 2013-07-31
## 5 New York Stock Exchange Inc. 2013-08-30
## 6 New York Stock Exchange Inc. 2013-09-30
```

```
tail(minvol)
```

```
##         X Ticker                 Name Asset.Class Weight....  Price
## 9498 9498    ZBH ZIMMER BIOMET HOLDINGS INC    Equity    0.1391 104.95
```

```
## 9499 9499    ZTS        ZOETIS INC CLASS A      Equity    0.1002 30.89
## 9500 9500    ZTS        ZOETIS INC CLASS A      Equity    0.0962 29.81
## 9501 9501    ZTS        ZOETIS INC CLASS A      Equity    0.0972 29.15
## 9502 9502    ZTS        ZOETIS INC CLASS A      Equity    0.1021 31.12
## 9503 9503    ZTS        ZOETIS INC CLASS A      Equity    0.0992 31.66
##      Shares Market.Value Notional.Value    Sector   SEDOL         ISIN
## 9498 163220     17129939      17129939 Health Care 2783815 US98956P1021
## 9499 115890      3579836            NA Health Care B95WG16 US98978V1035
## 9500  75069      2237807            NA Health Care B95WG16 US98978V1035
## 9501  72889      2124714            NA Health Care B95WG16 US98978V1035
## 9502  66567      2071565            NA Health Care B95WG16 US98978V1035
## 9503  66458      2104060            NA Health Care B95WG16 US98978V1035
##                      Exchange       Date
## 9498 New York Stock Exchange Inc. 2017-01-05
## 9499 New York Stock Exchange Inc. 2013-06-28
## 9500 New York Stock Exchange Inc. 2013-07-31
## 9501 New York Stock Exchange Inc. 2013-08-30
## 9502 New York Stock Exchange Inc. 2013-09-30
## 9503 New York Stock Exchange Inc. 2013-10-31
```

```r
summary(minvol)
```

```
##       X             Ticker                           Name
##  Min.   :   1   CB     :  82   ABBOTT LABORATORIES        :  64
##  1st Qu.:2376   ABT    :  64   ALTRIA GROUP INC           :  64
##  Median :4752   ACGL   :  64   ARCH CAPITAL GROUP LTD     :  64
##  Mean   :4752   ADP    :  64   AT&T INC                   :  64
##  3rd Qu.:7128   AMT    :  64   AUTOMATIC DATA PROCESSING INC:  64
##  Max.   :9503   (Other):9134   AUTOZONE INC               :  64
##                 NA's   :  31   (Other)                    :9119
##       Asset.Class      Weight....          Price
##  Cash        :  66   Min.   :-0.3451   Min.   :  0.56
##  Equity      :9413   1st Qu.: 0.2697   1st Qu.: 48.35
##  Money Market:  24   Median : 0.5922   Median : 71.56
##                      Mean   : 0.6730   Mean   : 92.93
##                      3rd Qu.: 1.0116   3rd Qu.:100.98
##                      Max.   : 2.8287   Max.   :953.00
##                                        NA's   :6
##      Shares            Market.Value       Notional.Value
##  Min.   :-20891956   Min.   :      1138   Min.   :-20891956
##  1st Qu.:     62755   1st Qu.:   5184586   1st Qu.: 18801242
##  Median :    240777   Median :  18738857   Median : 39482427
##  Mean   :    525786   Mean   :  31303694   Mean   : 52633035
##  3rd Qu.:    590304   3rd Qu.:  40420826   3rd Qu.: 71639502
##  Max.   : 38506545   Max.   :240885300   Max.   :240885300
##                       NA's   :8           NA's   :5064
##                    Sector        SEDOL              ISIN
##  Health Care           :1664   2002305:  64   BMG0450A1053:  64
##  Financials            :1569   2005973:  64   BMG3223R1088:  64
##  Information Technology :1510   2065308:  64   BMG7496G1033:  64
##  Consumer Staples      :1246   2065955:  64   US00206R1023:  64
##  Consumer Discretionary:1071   2073390:  64   US0028241000:  64
##  Utilities             : 628   (Other):9093   (Other)     :9126
##  (Other)               :1815   NA's   :  90   NA's        :  57
##                      Exchange            Date
```
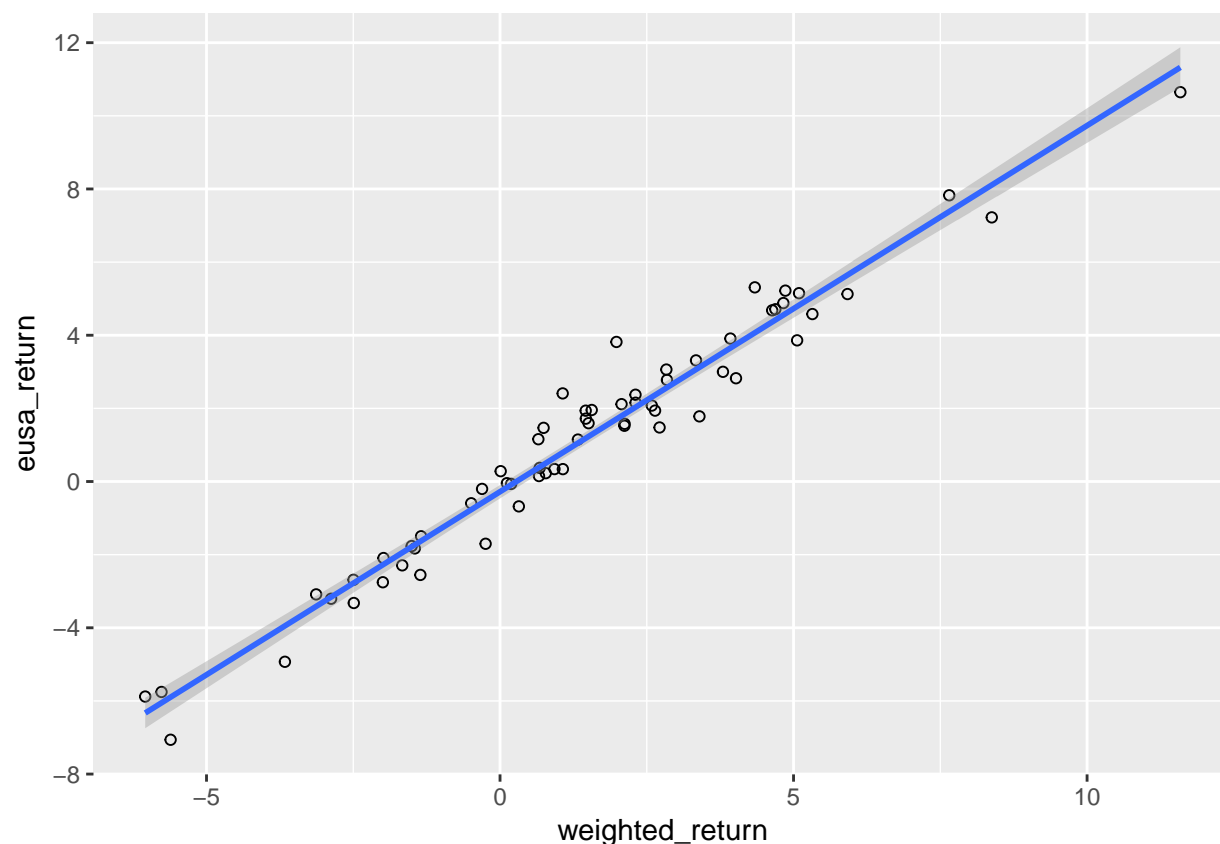
```
##  New York Stock Exchange Inc.:7158    2016-11-30: 187
##  NASDAQ                      :1926    2016-12-30: 187
##  Deutsche Boerse Ag          :  58    2017-01-05: 186
##  Spot Regulated Market - Bvb :  58    2016-05-31: 180
##  Boerse Berlin               :  32    2016-06-30: 179
##  (Other)                     : 164    2016-07-29: 179
##  NA's                        : 107    (Other)    :8405
```

Before taking the data as given, some checks were done to ensure the data was accruate. First, we wanted to check how our weighted returns compared to the ETF returns. Though we did not expect it to be perfectly correlated, we wanted to aim for a 98% or higher correlation between the weighted returns we calculated, and the ETF returns, on a monthly basis. The results for the usa data are shown below.

```
# USA data
data(returns1)
summary(returns1)
```

```
##       date             weighted_return    eusa_return.Delt.1.arithmetic
##  Min.   :2011-10-31   Min.   :-6.0439   Min.   :-7.061848
##  1st Qu.:2013-02-14   1st Qu.:-0.3983   1st Qu.:-1.088819
##  Median :2014-05-30   Median : 1.4592   Median : 1.524721
##  Mean   :2014-05-30   Mean   : 1.3886   Mean   : 1.111701
##  3rd Qu.:2015-09-15   3rd Qu.: 3.3678   3rd Qu.: 3.031121
##  Max.   :2016-12-30   Max.   :11.5892   Max.   :10.647011
```

```
ggplot(returns1, aes(x=weighted_return, y=eusa_return)) + geom_point(shape=1) +  geom_smooth(method=lm)
```



```
cor(returns1$eusa_return, returns1$weighted_return)
```

Table 4.1: USA Returns

date	weighted_return	eusa_return
2011-10-31	11.5892350	10.64701065
2011-11-30	-0.2456645	-1.70244264
2011-12-30	1.0671034	2.40963855
2012-01-31	5.0610248	3.86029412
2012-02-29	4.3400696	5.30973451
2012-03-30	3.3970199	1.78151261
2012-04-30	-0.4906636	-0.59445178
2012-05-31	-6.0439231	-5.88039867
2012-06-29	4.0198762	2.82386163
2012-07-31	1.5618633	1.95674562
2012-08-31	2.3092650	2.15488215
2012-09-28	2.5853910	2.07646671
2012-10-31	-1.6654955	-2.29254117
2012-11-30	0.6531763	1.15664243
2012-12-31	0.7794097	0.22868344
2013-01-31	5.0931233	5.14993481
2013-02-28	1.3265195	1.14693118
2013-03-28	3.7977193	3.00030647
2013-04-30	2.0699705	2.11550478
2013-05-31	1.9830989	3.81701632
2013-06-28	-1.3567937	-2.55402750
2013-07-31	5.3210605	4.57949309
2013-08-30	-2.8771461	-3.20572845
2013-09-30	3.3385738	3.31189894
2013-10-31	4.6359683	4.68190581
2013-11-29	2.8436501	2.77821626
2013-12-31	2.7175078	1.47826755
2014-01-31	-3.1322783	-3.08625626
2014-02-28	4.6903592	4.71108798
2014-03-31	0.6637837	0.14914243
2014-04-30	0.6756760	0.37230082
2014-05-30	2.3076650	2.37363996
2014-06-30	1.5081588	1.59444830
2014-07-31	-1.3446626	-1.49738469
2014-08-29	3.9244135	3.90970838
2014-09-30	-1.5046634	-1.76538908
2014-10-31	2.6410836	1.93899267
2014-11-28	2.8336728	3.06193459
2014-12-31	-0.3058795	-0.20256583
2015-01-30	-2.4954545	-2.68831755
2015-02-27	5.9196423	5.12654121
2015-03-31	-1.4516707	-1.83002646
2015-04-30	0.9272040	0.34066998
2015-05-29	1.4618722	1.71972356
2015-06-30	-1.9847732	-2.09240924
2015-07-31	2.1216832	1.57801299
2015-08-31	-5.7662469	-5.75471448
2015-09-30	-3.6642971	-4.92957746
2015-10-30	7.6518942	7.82716049
2015-11-30	0.1175917	-0.04579803
2015-12-31	-2.4910425	-3.32187858
2016-01-29	-5.6115203	-7.06184834
2016-02-29	0.7419356	1.46813225
2016-03-31	8.3766775	7.22289092
2016-04-29	2.1189998	1.52472106

```
##                         [,1]
## Delt.1.arithmetic 0.9805503
```
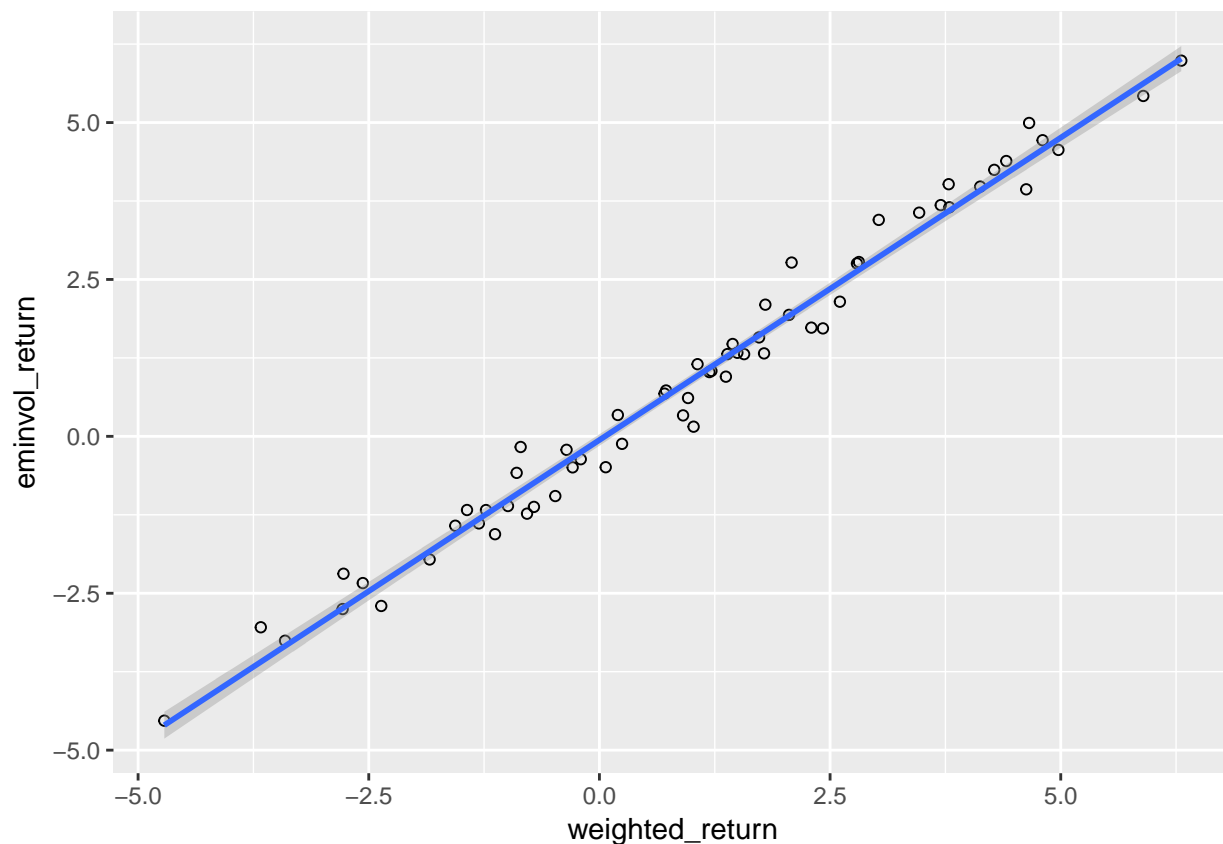
As we can see, the returns seem pretty consistent and have a correlation greater than 0.98.

Shown below is the data for the min vol index.

```r
# USA data
data(returns2)
summary(returns2)
```

```
##       date               weighted_return    eminvol_return.Delt.1.arithmetic
##  Min.   :2011-11-30   Min.   :-4.7156    Min.   :-4.530281
##  1st Qu.:2013-03-07   1st Qu.:-0.8364    1st Qu.:-1.070307
##  Median :2014-06-14   Median : 1.1278    Median : 0.987327
##  Mean   :2014-06-15   Mean   : 1.0234    Mean   : 0.927892
##  3rd Qu.:2015-09-22   3rd Qu.: 2.7451    3rd Qu.: 2.765673
##  Max.   :2016-12-30   Max.   : 6.3064    Max.   : 5.986360
```

```r
ggplot(returns2, aes(x=weighted_return, y=eminvol_return)) +
    geom_point(shape=1) +  geom_smooth(method=lm)
```



```r
cor(returns2$eminvol_return, returns2$weighted_return)
```

```
##                         [,1]
## Delt.1.arithmetic 0.9906848
```

Table 4.2: Min Vol Returns

	date	weighted_return	eminvol_return
2	2011-11-30	1.0207211	0.1540832
3	2011-12-30	2.0832643	2.7692308
4	2012-01-31	1.5682330	1.3098802
5	2012-02-29	1.7985326	2.0982638
6	2012-03-30	2.6064008	2.1455966
7	2012-04-30	1.3875986	1.3106160
8	2012-05-31	-2.7737073	-2.1887347
9	2012-06-29	3.0274691	3.4491510
10	2012-07-31	2.0550335	1.9353902
11	2012-08-31	-0.8537533	-0.1694915
12	2012-09-28	1.3709153	0.9507640
13	2012-10-31	-0.9913378	-1.1099899
14	2012-11-30	0.1997206	0.3401361
15	2012-12-31	-1.1313053	-1.5593220
16	2013-01-31	4.6572484	4.9931129
17	2013-02-28	2.7913166	2.7550016
18	2013-03-28	4.9746988	4.5643154
19	2013-04-30	2.8126037	2.7777778
20	2013-05-31	-2.5643787	-2.3379863
21	2013-06-28	-0.4782116	-0.9512572
22	2013-07-31	3.6996474	3.6843721
23	2013-08-30	-3.4070922	-3.2573290
24	2013-09-30	2.4226946	1.7202326
25	2013-10-31	4.8035140	4.7183438
26	2013-11-29	1.7845074	1.3218391
27	2013-12-31	0.7058349	0.6806580
28	2014-01-31	-3.6699298	-3.0422535
29	2014-02-28	4.4096304	4.3869843
30	2014-03-31	0.9065562	0.3339827
31	2014-04-30	1.4951304	1.3314840
32	2014-05-30	1.0635132	1.1497399
33	2014-06-30	0.7224467	0.7307172
34	2014-07-31	-1.5620464	-1.4239656
35	2014-08-29	4.1272757	3.9792859
36	2014-09-30	-0.7844910	-1.2319790
37	2014-10-31	4.2794278	4.2462845
38	2014-11-28	3.4656171	3.5641548
39	2014-12-31	0.0684333	-0.4916421
40	2015-01-30	-0.2904233	-0.4940711
41	2015-02-27	3.7922662	3.6494538
42	2015-03-31	-1.4350491	-1.1736527
43	2015-04-30	-0.8969496	-0.5816772
44	2015-05-29	1.1920250	1.0238908
45	2015-06-30	-2.3645382	-2.7027027
46	2015-07-31	3.7854982	4.0178571
47	2015-08-31	-4.7156114	-4.5302814
48	2015-09-30	-0.7096045	-1.1238761
49	2015-10-30	6.3064130	5.9863602
50	2015-11-30	-0.3562819	-0.2144900
51	2015-12-31	0.2454774	-0.1194172
52	2016-01-29	-1.3065154	-1.3868962
53	2016-02-29	1.2139996	1.0426770
54	2016-03-31	5.8946529	5.4235661
55	2016-04-29	-0.2021128	-0.3642158
56	2016-05-31	1.7304525	1.5764222

Chapter 5

Data Analysis

Chapter 6

Bibliography