Low Volatility Effect

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```r
setwd("~/dropbox/robeco")
#read in the data after deleting the heading
data1<- read.csv("48_Industry_Portfolios.CSV",header = TRUE)
#use value weighted data
data1<-data1[1:1074,2:49]
# a function to transform n industry portfolios into 10 portfolios
myfunction <- function(x,y) {
  B=NULL
  A=NULL
  if (x == 40){
    A=split(y, rep(1:10, c(4,4,4,4,4,4,4,4,4,4)))

  } else if (x==41) {
    A=split(y, rep(1:10, c(5,4,4,4,4,4,4,4,4,4)))

  } else if (x==42) {
    A=split(y, rep(1:10, c(5,5,4,4,4,4,4,4,4,4)))

  } else if (x==43) {
    A=split(y, rep(1:10, c(5,5,5,4,4,4,4,4,4,4)))

  } else if (x==47) {
    A=split(y, rep(1:10, c(5,5,5,5,5,5,5,4,4,4)))

  } else {
    A=split(y, rep(1:10, c(5,5,5,5,5,5,5,5,4,4)))

  }
  for (i in 1:10){
    B[i]= mean(as.numeric(unlist(A[i])))
  }
  return(B)
}
# build up 10 dynamic portfolios based on past 36 month volatility
M<-NULL
library(OpenMx)
```

```
## Loading required package: digest
## Loading required package: MASS
## Loading required package: parallel
## OpenMx is not compiled to take advantage of computers with multiple cores.
```

```r
for (i in 37:1074){
  record=NULL
  diag=NULL
  n=NULL
  #colleted data from period t to t+36 (month)
  record = data1[(i-36):i, ]
```

```r
  #exclude portfolios with missing data at time t
  record = record[which(record[1,]!=-99.99)]
  n=ncol(record)
  sort= matrix(1:(2*n),nrow=2)
  #sort matrix: first row: volatility, second row: return at period t+36
  sort[1,]=as.numeric(t(diag2vec(cov(record[1:36,]))))
  sort[2,]=as.numeric(record[37,])
  #sort the portfolios based on volatility
  final= sort[,order(sort[1,])][2,]
  #transform to 10 decile portfolios
  M=rbind(M,myfunction(n,final))
}
data=data.frame(M)
#excess return & risk-free rate & market return
Fama<- read.csv("F-F_Research_Data_Factors.CSV",header=T)
MEx<-as.numeric(paste(Fama[37:1074,2]))
Rf<-as.numeric(paste(Fama[37:1074,5]))
MarRe<-MEx+Rf

#panel A
Result<-NULL
index<-NULL
n=10
#market sharp ratio
SR<-sqrt(12)*mean(MEx)/sd(MarRe)
# statistics for 10 decile portfolios
for (i in 1:n){
  Q<-NULL
  Result$ExRe[i]<-12*mean((data[,i]-t(Rf)))
  Result$StDe[i]<-sqrt(12)*sd((data[,i]))
  Result$ShRa[i]<-Result$ExRe[i]/Result$StDe[i]
  Q <-2*(1-cor(data[,i],MarRe))+(Result$ShRa[i]^2 + SR^2-
Result$ShRa[i]*SR*(1+cor(data[,i],MarRe)^2))/2
  Result$t_value[i]<-sqrt(nrow(data))*(Result$ShRa[i]-SR)/sqrt(Q)
  Result$beta[i]<-lm(data[,i]~MEx)$coefficients[2]
  Result$alpha[i]<-12*lm(data[,i]~MEx)$coefficients[1]
  Result$t_value1[i]<-summary(lm(data[,i]~MEx))$coefficients[1,3]
}
panelA<-data.frame(Result)
colnames(panelA)=c("Exc Ret(%)","Sta Dev(%)","Sharp Ratio","t value","beta","alpha(%)","t value")

#panel B
Result1<-NULL
dataT<-NULL
for(i in 1:n){
  dataT<-data[,i]
  Result1$up[i]<-mean(dataT[which(MarRe>0)] )
  Result1$down[i]<-mean(dataT[which(MarRe<0)] )
  Result1$Max_down[i]<-min(dataT)
}
panelB<-data.frame(Result1)
colnames(panelB)=c("Return up (%)","Return down (%)","Max drawdown(%)")
```

Panel A: Decile Portfolios Based on Historical Volatility (Annual)

```r
round(panelA, digits = 4)
```

```
##    Exc Ret(%) Sta Dev(%) Sharp Ratio  t value   beta alpha(%) t value
## 1      7.2904    14.6873      0.4964   7.3759 0.6951   5.6544  7.7831
## 2      8.1667    17.6747      0.4621   6.3116 0.8704   5.2699  7.2744
## 3      9.4407    19.2750      0.4898   9.0992 0.9606   5.8956  8.0622
## 4      8.7578    20.1286      0.4351   4.3294 0.9979   4.9443  6.2468
## 5      8.9605    21.4695      0.4174   2.7850 1.0605   4.6968  5.4353
## 6      8.1804    23.9834      0.3411  -3.2402 1.1693   3.1341  3.0138
## 7      9.0907    23.9313      0.3799  -0.2729 1.1628   4.0912  3.8744
## 8      8.2103    24.6608      0.3329  -3.8181 1.1991   2.9496  2.7205
## 9      8.8454    26.0810      0.3392  -3.1206 1.2515   3.2074  2.6297
## 10     4.4127    34.5614      0.1277 -11.5453 1.4072  -2.3450 -0.9738
```

```r
a=data.frame(t(c(12*mean(MEx),sqrt(12)*sd(MarRe),sqrt(12)*mean(MEx)/sd(MarRe))))
colnames(a)=c("Exc Ret(%)","Sta Dev(%)","Sharp Ratio")
rownames(a)=c("Market")
print(a)
```

```
##        Exc Ret(%) Sta Dev(%) Sharp Ratio
## Market   7.192601   18.75507   0.3835018
```

Panel B: Risk Analysis of Portfolios Based on Historical Volatility (Month)

```r
round(panelB, digits = 4)
```

```
##    Return up (%) Return down (%) Max drawdown(%)
## 1         2.9626         -2.4533        -21.6840
## 2         3.5405         -3.2002        -29.3950
## 3         3.9258         -3.5370        -27.5800
## 4         4.0353         -3.8699        -27.0650
## 5         4.2030         -4.0923        -31.0675
## 6         4.3895         -4.5623        -35.3050
## 7         4.5412         -4.6399        -33.7375
## 8         4.5770         -4.8610        -32.1550
## 9         4.8180         -5.1079        -30.2225
## 10        4.6346         -5.7867        -37.2675
```

```r
b=data.frame(mean(MarRe[which(MarRe>0)]),mean(MarRe[which(MarRe<0)]),min(MarRe))
colnames(b)=c("Return up (%)","Return down (%)","Max drawdown(%)")
rownames(b)=c("Market")
print(b)
```

```
##        Return up (%) Return down (%) Max drawdown(%)
## Market      3.899578       -3.986398           -29.1
```

Reference

Blitz, David, and Pim Van Vliet. “The volatility effect: Lower risk without lower return.” Journal of Portfolio Management (2007): 102-113.