Spectrum range volatility and exposure analysis

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1 Introduction

This added work explores the relationship between the differnt funds allocation in the Spectrum range and the volatility of returns computed using the mid price official quote. The underlying dataset is the same as the previous job; the funds type allocation is collected from the Vivaldi SQL database directly via a standard query over an ODBC channel. In order to perform those queries reading rights on the Vivaldi database are needed. The resulting dataset is available as a *.Rda* file with all the other relevant resources.

The raw data and all the relevant R scripts are published on http://www.github.com/mcastagnaa/SpectrumAnalysis and available there for replication to anybody interested. This is an R Markdown document[1].

The relevant R packages used (with all the relevant dependencies) are:

```
library(PerformanceAnalytics)
library(scales)
library(reshape2)
library(ggplot2)
```

2 The dataset

Spectrum funds prices are taken as delivered by Citi to OMGI. The Spectrum prices are available by class on a Bid/Mid/Offer basis. For this exercise the Mid price was used for the OA class. Using a specific quote instead of the official one (where the quote might be subject to swings between bid and offer) seems to be the logical option in order to avoid any excess volatility; the OA class was used given it has the longest time series (TS).

From the prices TS the returns TSs are built for the Spectrum funds using the following sintax (i.e. computing simple returns):

```
########################################
Returns - pseudo code
########################################

FundPRes$SpecXRet <- c(NA, FundPRes$Mid.SKSPECX[2:n]/FundPRes$Mid.SKSPECX[1:n-1]-1)
... # where X is 3:8
```

The Spectrum funds returns and the VIX index levels[2] are part of the data frame saved with name *CombByDate.Rda*.

The relevant funds allocation and risk allocations are obtained using the following code which stores the relevant information in a data frame saved with name *SpecExpSet.Rda*.

[1] Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

[2] This is actually a difference vs. the same data set which was used for the previous work. The VIX index levels (a measure of the S&P implied volatility for each day) are sourced from Bloomberg - the relevant .csv file is part of the resources.

```
########################################
SpecExpSet.Rda - pseudo code
########################################

library(RODBC)
rm(list =ls(all=TRUE))

channel <- odbcConnect("SQLServerVivaldi")
SpecX <- as.data.frame(sqlQuery(channel, "EXEC spS_GetFoFTypeLoading1Y '2015 Apr 30', ID"))
SpecX$Fund <- as.factor("SpecX")
...
# where X = 3:8 and ID = 126:131

SpecExpSet <- rbind(Spec3, Spec4, Spec5, Spec6, Spec7, Spec8)
SpecExpSet$DetsDate <- as.Date(SpecExpSet$DetsDate)

rm(list=ls()[ls() != "SpecExpSet"])
save(SpecExpSet, file = "SpecExpSet.Rda")
```

The two dataset are then combined to generate the data frame used for the rest of this analysis.

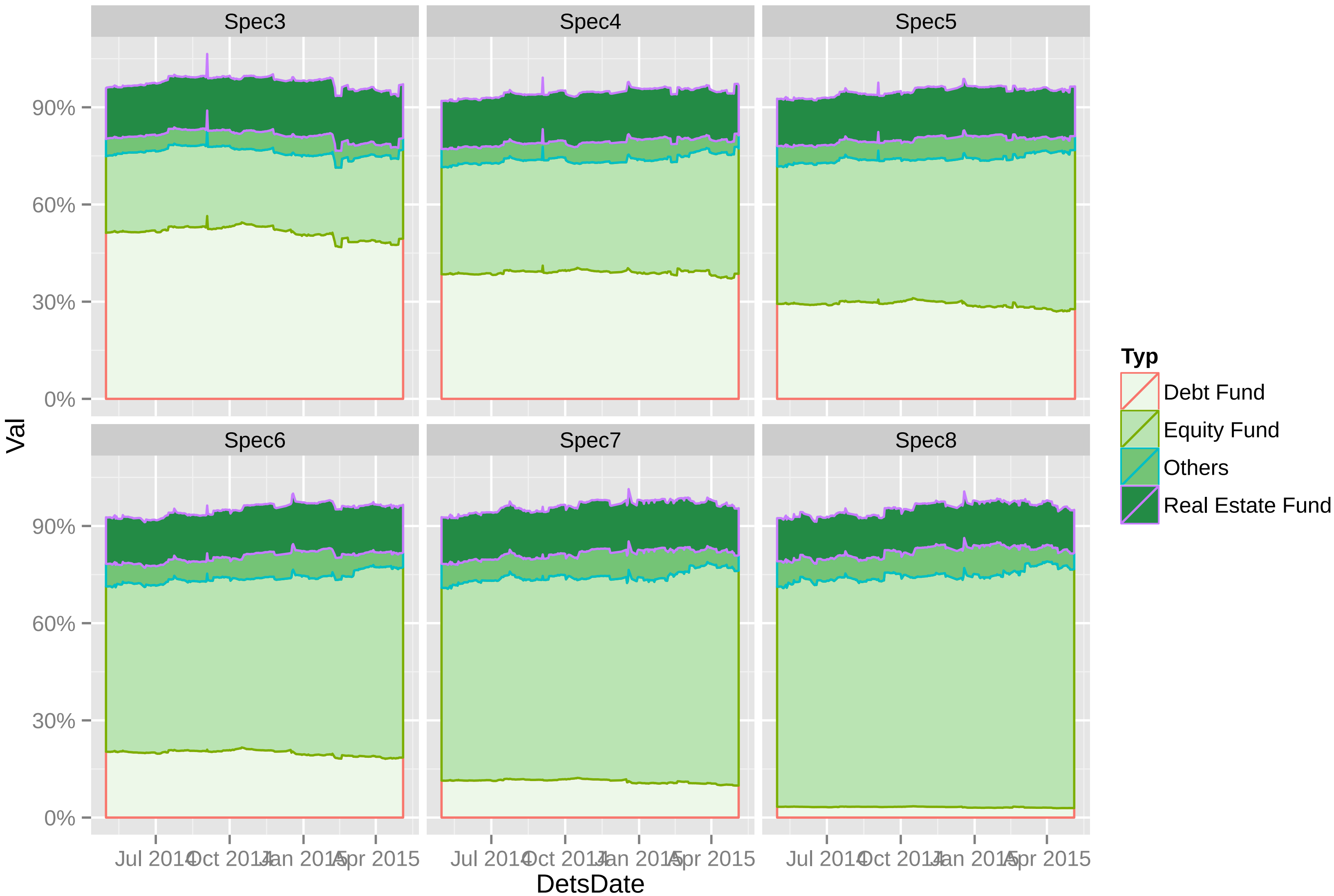
Couple of notes on the dataset just created:

1. The asset class for the funds held in each Spectrum fund is the one provided by Bloomberg;
2. Volatility of the Spectrum funds returns is calculated using 20 rolling observations of daily returns (without annualizing);
3. The asset allocation and the VIX level is averaged over the same number of observations

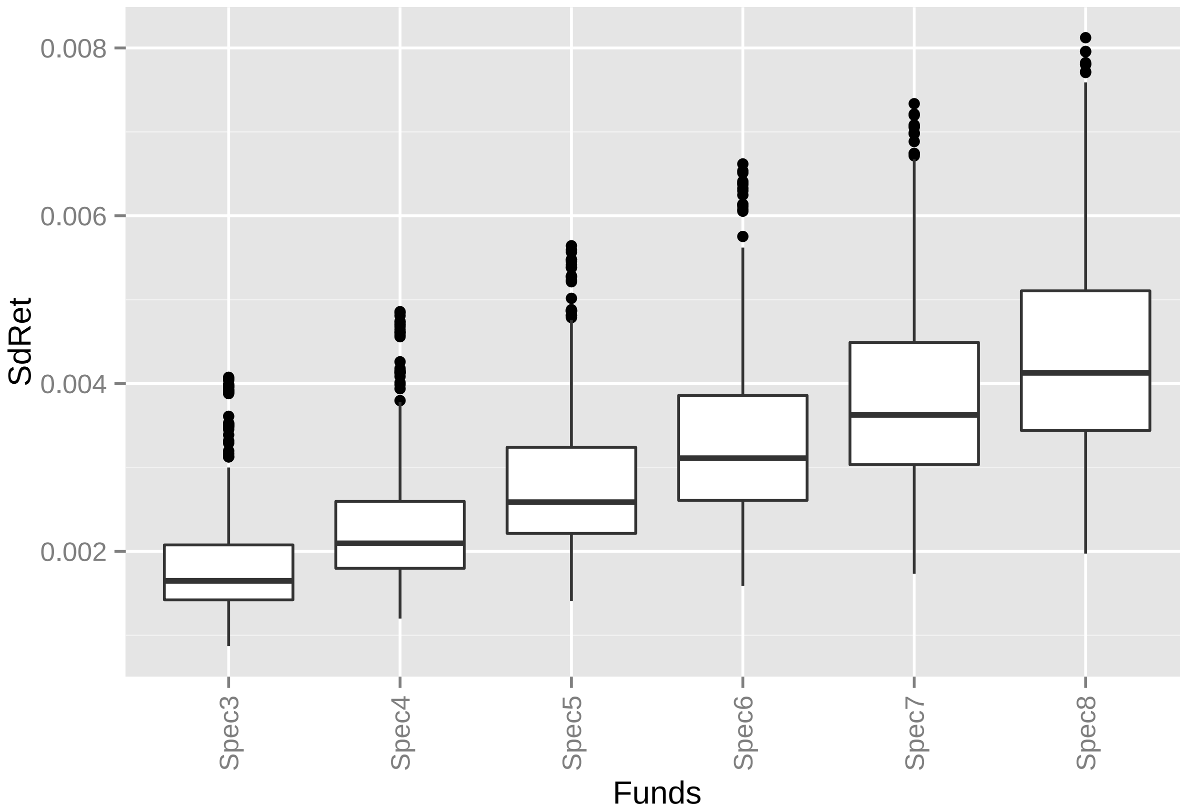
3 Data inspection

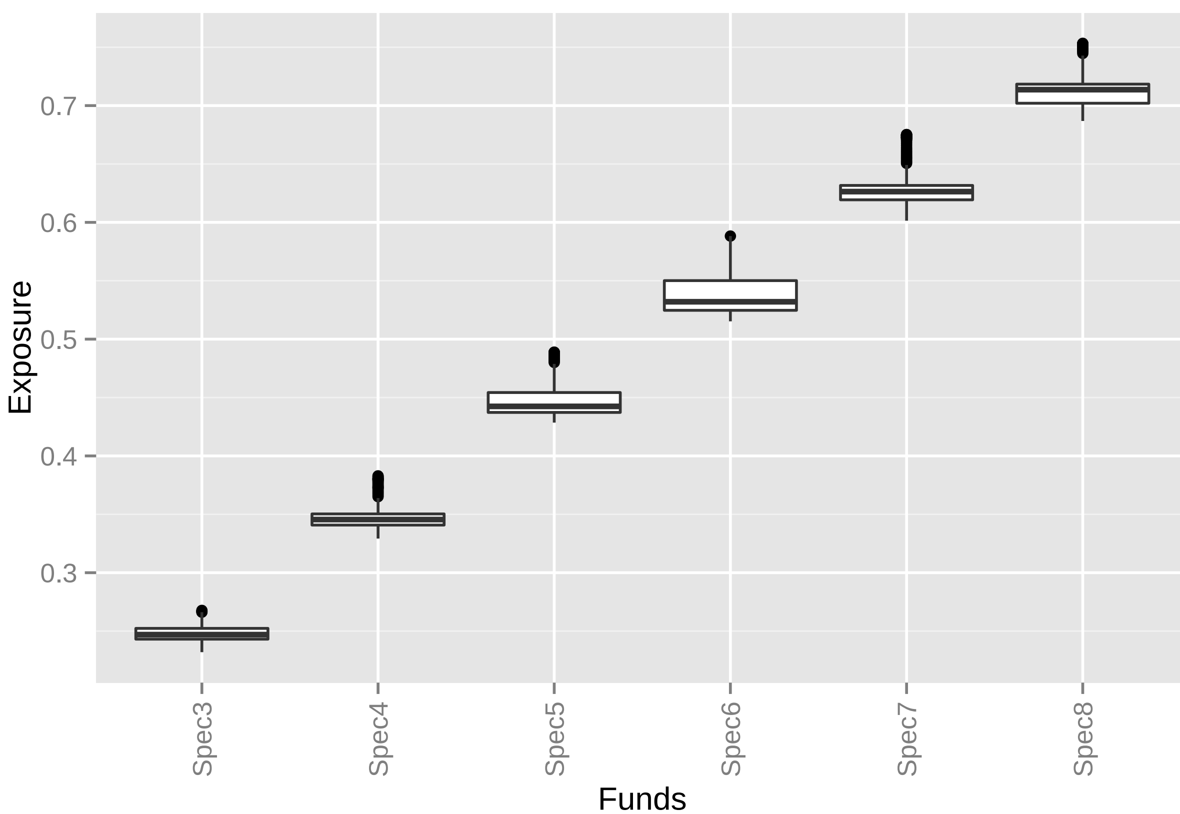
The relevant asset allocation for the different funds can be described by **panel 1**. It's quite clear that it is pretty much constant over the period observed. The relevant differences are concentrated in the percentage of equity funds and debt funds.

Panel 1: Spectrum funds - fund type allocation



Running boxplots reveals that there are no particular outliers for the rolling volatility observations and the Equity funds exposure ones.





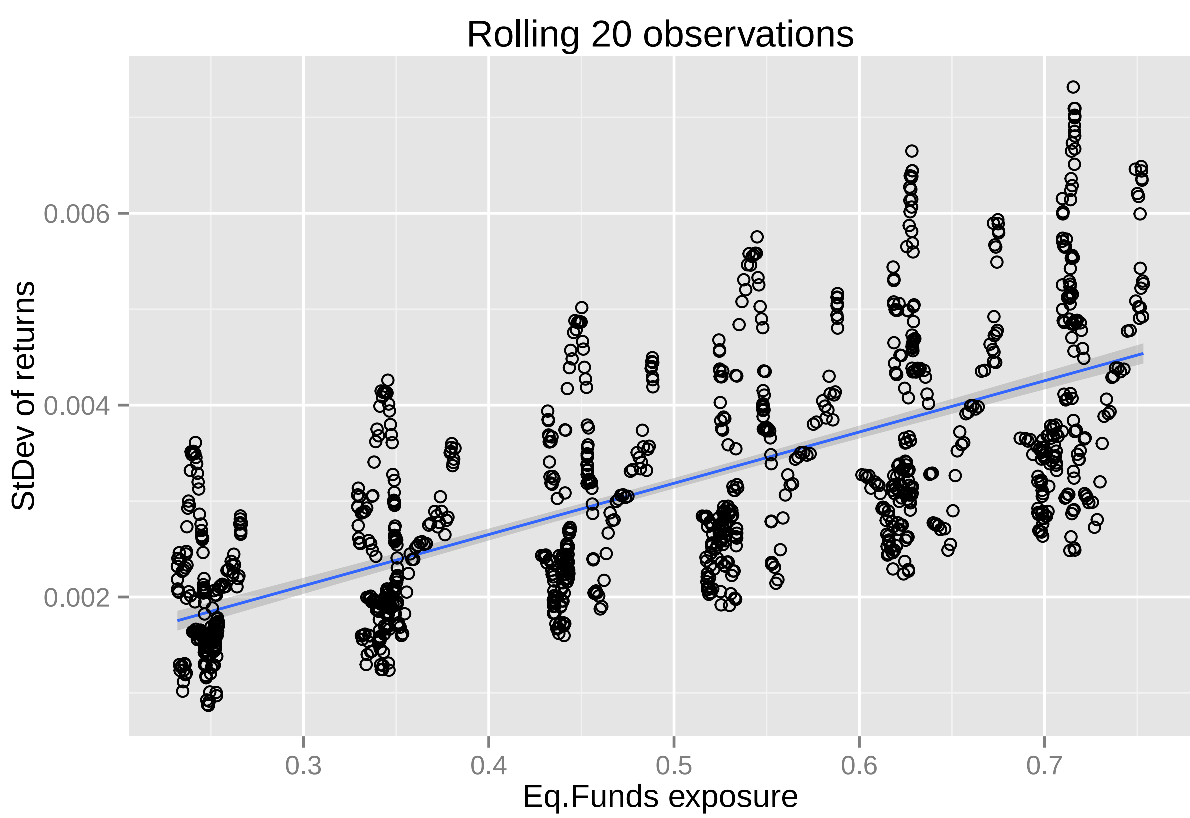
4 Analysis

Without adding any state variable we have immediately a pretty good idea about what is going on:

```
##
## Call:
## lm(formula = SdRet ~ Exposure, data = RegSet)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0018522 -0.0006875 -0.0002336  0.0005712  0.0029786
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 5.137e-04  8.892e-05   5.777 9.79e-09 ***
## Exposure    5.343e-03  1.730e-04  30.890  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0009448 on 1150 degrees of freedom
##   (90 observations deleted due to missingness)
## Multiple R-squared:  0.4535, Adjusted R-squared:  0.453
## F-statistic: 954.2 on 1 and 1150 DF,  p-value: < 2.2e-16
```

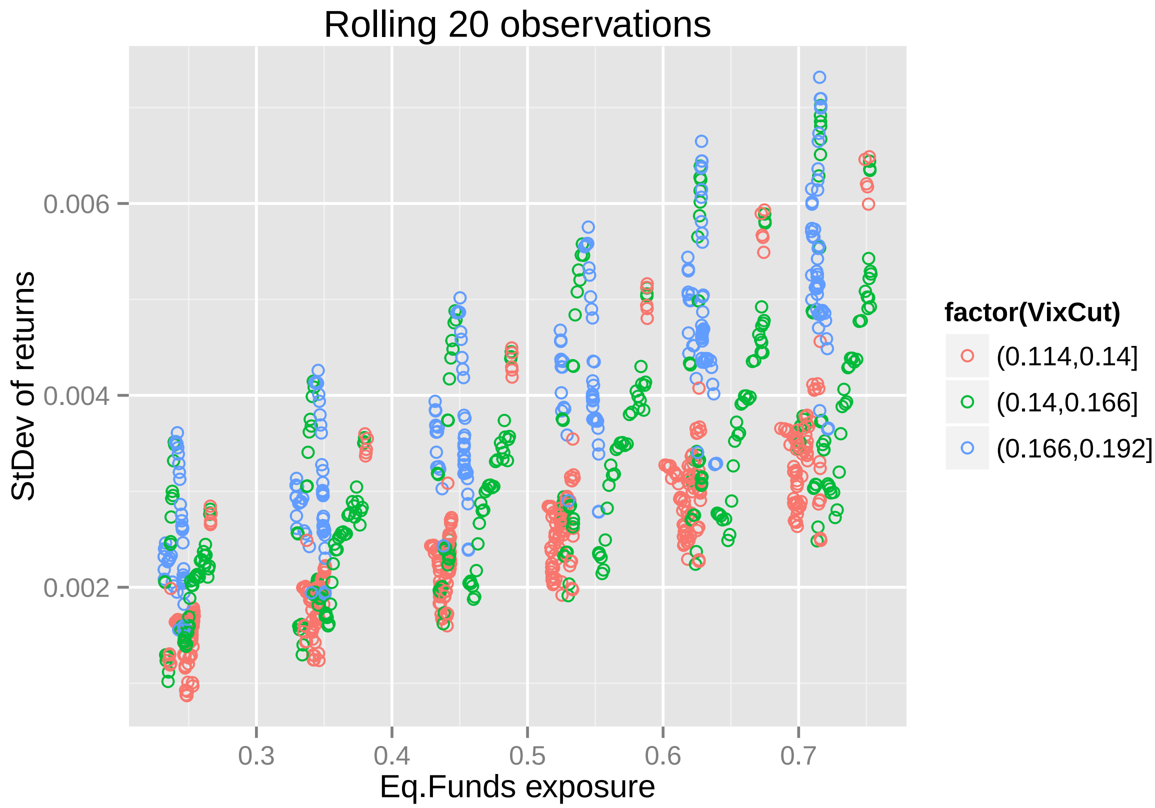
What we have is that regressing the whole Spectrum range volatility on the equity funds exposure provides a very decent fit.

This is the relevant graphical representation.

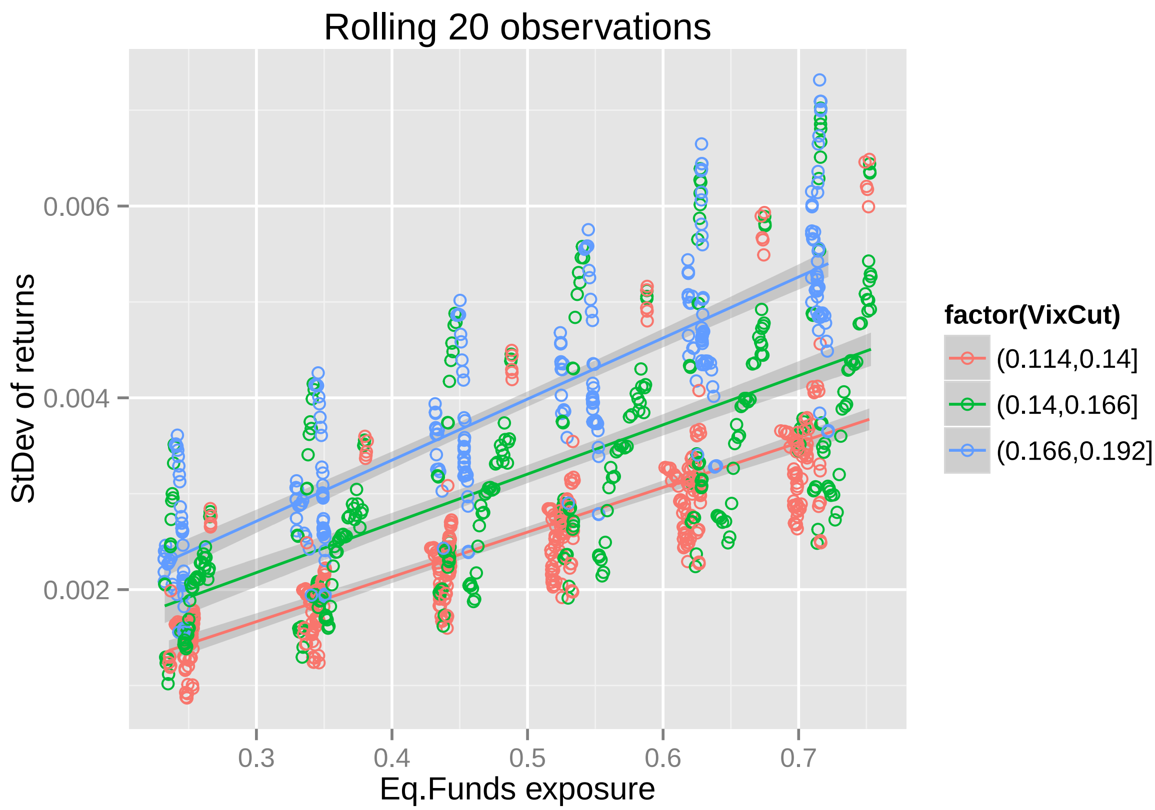


What the regression results are telling us is that if we rise the allocation to equity funds by 0.1 (e.g. from 20% to 30%) the resulting standard deviation of returns increases by 5.3bps (daily).

It is fairly obvious to think that there is also a market variable that performs a powerful effect on the resulting fund volatility. Higher market volatility will lead *coeteris paribus* to a higher fund volatility. This is immediately visible if we split the sample by three different level of the VIX index:



Effectively three different lines can be drawn:



Running again a linear regression and adding the VIX level as explanatory variable greately enhance the amount of Spectrum volatility of volatility explained:

```
##
## Call:
## lm(formula = SdRet ~ Exposure + VIX, data = RegSet)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -1.700e-03 -4.582e-04 -8.257e-05  3.028e-04  2.353e-03
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.0031300  0.0001518  -20.62   <2e-16 ***
## Exposure     0.0052978  0.0001353   39.14   <2e-16 ***
## VIX          0.0246573  0.0009128   27.01   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0007392 on 1149 degrees of freedom
##   (90 observations deleted due to missingness)
## Multiple R-squared:  0.6658, Adjusted R-squared:  0.6652
## F-statistic:  1144 on 2 and 1149 DF,  p-value: < 2.2e-16
```