Interest Rate Shock Model

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16 February 2017

What is the *Interest Rate Shock Model*?

Start with multi factor model with only two factors, being the benchmark equity index (B) and the bond index (F for fixed income):

$$r_t = \alpha + \beta_B r_{B,t} + \beta_F r_{F,t} + \theta_t$$

For every stock, I run a **multilinear regression** using three years of weekly historic data to determine the values of α and the two β's. The result is a simple linear model: plug in returns of the two factors to get an estimated return of the stock.

To build a complete *Interest Rate Shock Model*, we use simpler 1-factor models to estimate how yield changes affect the two factor returns, and plug those estimates into the above equation.

The factors and the shock parameter

For the benchmark, I use the *MSCI AC World* total return index.

For the bond, I use the total return of the *Citigroup US Broad Investment-Grade Bond Index* (as does Northfield).

For the yield, I use the *U.S. 10y Treasury Yield*.

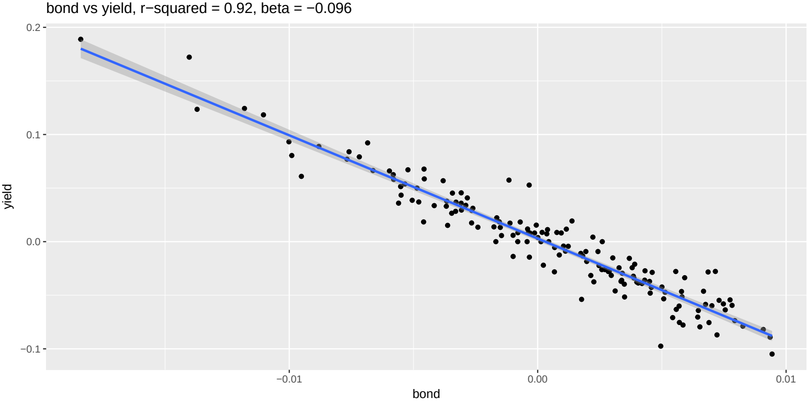
When I shock the yield (by increasing it by 100 bp), I actually compute the return of the latest yield:

$$3.39\%/2.39\% = 1.41841$$

is the "return of the yield" shock. I use this to estimate the returns of the benchmark and bond index.

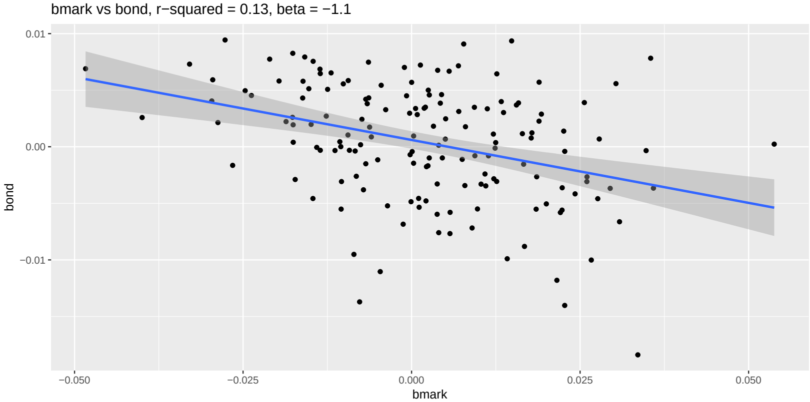
How yield affect bond index returns

Returns of the yield are highly correlated to bonds: saying "The (return of the) yield goes up $x\%$" is almost the same as saying "The bond index goes down $-0.096x\%$":



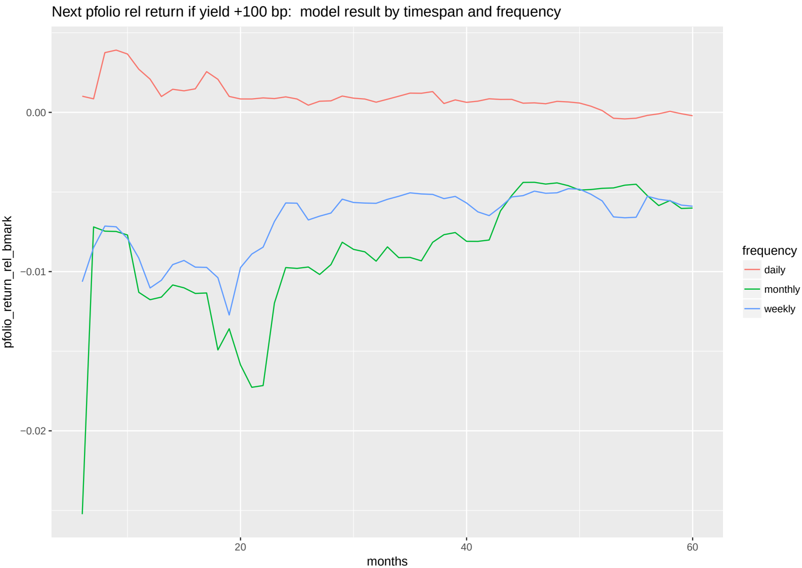
How yield affect benchmark returns

Don't forget correlation: If the bond changes, then the benchmark will change, too:



Why 3 years weekly?

We tried all timespans from six months to five years, with daily, weekly and monthly frequencies:



Now the results:

PCGLUF PCGPEN

How does this compare to Barra?

I also computed the model over the same timeframe which Barra did for us a couple of months ago (October 2013 to October 2016). I find:

- PCGLUF estimated return is +3.0%, while Barra computed +6.4%
- the benchmark estimated returns +4.2%, while Barra computed +8.0%
- My model says -1.2% underperformance, while Barra say -1.6%

The two main differences with a true risk model (by Northfield, Barra or UBS) are:

1. Most risk models use “exponentially decay weighted” observations. This means history has a half-life, and the model puts more emphasis on recent data than older data.
2. Other risk models have more factors, including:
    - GICS Sectors
    - Regions (or countries)
    - All currencies