Final Project: Financial Markets Analytics 2022

1. In this group work, we want to better understand the structural characteristics that risk brings to real investment portfolios.

2. In order to understand this empirically, we need to build real portfolios that are concentrated/tilted with respect to a specific level and kind of risk.

3. Our reference will be the definition of "Total," "Systematic," and "Specific" risk as defined and introduced through the CAPM we studied. We will then rely on the SML to investigate the risk level of individual securities and then proceed to the subsequent groupings.

$$E(r_i) = r_f + \beta_i\big(E(R_M) - r_f\big) \qquad [1]$$

In pursuit of the analysis the above SML equation, must be reconsidered in the form of a regression equation as in the Market Model, also known as single index model. We can interpret such equation as the "ex-post" version of the SML.

$$r_i = \alpha + \beta_i(R_M) + e_i \quad \rightarrow \quad \text{we excluded the expectations}$$

it is usually applied, for equivalence, in excess returns form:

$$r_i - r_f = \alpha_i + \beta_i(R_M - r_f) + e_i. \qquad [2]$$

In this ex-post framework, we see two new parameters α_i and e_i.
Given that even in the "ex-ante" version of the SML, the Beta is derived from time series, then the $\beta_{SML(i)} = \frac{COV(R_M,R_i)}{\sigma_M^2}$ and the β_{MM} as the regression slope will match, but only if the time series are of same length.

In the setting of the Market Model we get two other coefficients, the α_i that should be zero if the CAPM hold and e_i proxying the specific risk.

In addition, the equation [2], since it is a regression, yields an R^2 informing on the goodness of fit.

This way there are many possible profiles on which to do stock groupings. Firstly, the profile of fitting based on R^2. Then going in more detail the relations between total risk decomposed in specific risk and systematic risk:

$$\textit{Total risk} = \textit{Systematic Risk} + \textit{Specific Risk}$$

$$\sigma_i^2 = \beta_i^2 \sigma_M^2 + \sigma_{ei}^2 \qquad [3]$$

The ratio of (Systematic Risk)/(Total Risk) is the R^2, but such a separation could lead to different characteristics in case of stocks with high or low level of total risk. The last profile interesting to investigate it is the one of excess returns represented by the α_i. Such a return could be positive, null, or negative, but also significant or not as expressed by the specific *t-test*. Also, the ratio between this potential excess return and the total stock return could be of interest.

Finally, the return/risk profile, varying the adopted measure of return and risk should be of interest.

Execution details

1. You must download the daily time series of prices of a set of stocks. Expected timespan must be at least 5 years. You also need the related market index.
2. The reference market, could be a specific country (ex. Italy) or a subpart of it (ex. FTSE MIB, only Italian Big stocks)
3. For each stock in the dataset you should execute a rolling regression of log-returns as prescribed by the Market Model.
4. The sample for the rolling regression must be 180 days. You will lose the first 180 days of the sample.
5. You must build tilted portfolios based on the R^2, σ_i^2, $\beta_i^2 \sigma_M^2$, σ_{ei}^2, α_i, r_i.
6. To get a tilted portfolio you should sort all the stocks in ascending or descending order depending on the feature or combination/ration of them.
7. If you have 100 stocks, when sorted you must select the upper and lower quantile, for example 10% or 20%.
8. To build a portfolio with the selected stocks you can simply set an equally weighted portfolio. For example, in case of 10 stocks, 10% is invested in each asset.
9. To get the returns of the portfolio, simply calculate the weighted average of stock returns involved.
10. The portfolios must be rebalanced weekly until the end of the sample.

11. Calculate final statistics to compare the different tilted portfolios together with the index. The typical output should be a price chart (price must be restored starting from 100) of the portfolio and the index, or all the portfolios with the index, and tables reporting average return of each portfolio, volatility, the ratio of the two.

Challenging tasks

You should try to combine a momentum strategy with the portfolio tilting already completed