Assignment 3: Testing the CAPM

MOEC0550 Empirical Finance (S)

Spring Semester 2021

1 Introduction

The purpose of this assignment is to examine whether there is a positive linear relation between risk (Beta) and return in Switzerland. To reflect the Swiss stock market, we have chosen the Swiss market index (SMI) as our index of reference. Additionally, further aspects of CAPM testing are discussed.

You will find all the necessary information and the data for the empirical part of this assignment in the folder "Assignment 3" on OLAT.

Deadline All deliverables, which are defined more distinctively in Section 2, have to be turned in on OLAT by Friday 7th May 2021 at 21:00 the latest. Ensure that you submit the deliverables before the deadline, since late reports will receive a grade of 1.

2 Deliverables

You hand in your work by uploading it on OLAT with the following two documents attached:

- **R Code:** Turn in the R-Script including all your calculations and relevant comments for the code. The file should be named as followed: "groupname_assignment3.R"
- **Report:** The report provides answers **to the questions** asked in the problem set on a **maximum of five DIN A4 pages** without the cover page nor tables/graphs and should be handed in as a PDF. Please put your tables/graphs in the appendix. Structure the report with subtitles according to the questions in the problem set. Use 11pt font size at least. Please make sure that you note the names and Matrikel-Nr. of all members of your group on the cover page. The file should be named as followed: "groupname_assignment3.pdf"

3 Data

On OLAT you will find three different data sets, each of which contains monthly data to calculate returns from 31 July 2012 to 28 April 2017.

- A3_dataset_01.txt
  This data set contains the historical prices of 19 stocks that have been part of the SMI over the observation period.

- A3_dataset_02.txt
  This data set contains the historical monthly prices of the SMI Index over the observation period. You should use this data set to calculate the market return, which is needed for the regression in order to estimate the Betas.

- A3_dataset_03.txt
  This data set contains the interest rates of Swiss government bonds with a maturity of 1 year. Please note that although the data here is provided on a monthly basis, the interest rates are the annual interest rates.

4 Controls and Hints

Below you find sample solutions for certain values to check your work progress and make sure that you are on the right track:

Question 1	Monthly log yield of 1 Year Swissbond on 31. July 2012	0.0000316607
	ABB Beta over the 58-month period	1.11515

5 Problems

As we aim to replicate a classic CAPM test, this exercise consists of two parts. First a time-series regression (first pass) is conducted where the main output is stock Betas. The second pass regression relates the mean excess return of the stock to its first stage beta. The point estimate of the Beta represents the market risk premium. For simplicity and due to data availability, the assignment has been restricted to 58 return periods and 19 companies.

5.1 Time-series regression

The time-series regression aims to test the following equation for each stock j:

$$R_{jt} = a_j + b_j R_{Mt} + e_{jt}$$

Where;

- R_{jt} is the excess return of stock j in month t
- R_{Mt} is the excess return of the market
- e_{jt} is the regression error

1. Calculate the excess returns of all the 19 stocks. Also calculate, the excess return on the market. Throughout this assignment use log returns.
2. Estimate the Betas of stocks by regressing the excess returns of stocks on the market premium.
3. Calculate mean excess return for each stock over the 58 periods.
4. Rank the companies according to their Betas. What companies have the lowest and highest value over the period? What could be a possible explanation for that?
5. Report the t values of your calculated Alphas and Betas. Do any of them indicate to be significantly different than expected by our model?
6. Plot the excess returns of Zurich_Insurance_Group_N and the market excess return. Use a scatter plot with the returns of Zurich on the x-axis and the market excess returns on the y axis. Does your plot indicate a relation between the two parameters?

5.2 Cross-sectional regression

1. Plot the Beta realized return relationship, using a scatter plot with estimated Betas on the x-axis and realized mean excess returns on the y axis. Based on the plot, does it look like there is a positive Beta-return relation? You may want to annualize quantities to make them more intuitive.

2. Estimate the following cross-sectional regression:

$$\bar{R}_j = \gamma_0 + \gamma_1 \tilde{\beta}_j + \epsilon_j$$

   Regress the mean excess returns ($\bar{R}_j$) of the stocks against the previously estimated stocks Betas ($\tilde{\beta}_j$). Interpret your estimate of γ_1. Calculate the sample mean excess return of the market $\overline{r_m - r_f}$, is it reasonable? Relate the $\overline{r_m - r_f}$ to your estimated γ_1.

3. Report the t values $t(\hat{\gamma_0})$, $t(\hat{\gamma_1})$ and test the hypotheses that $\gamma_0 = 0$ and $\gamma_1 = 0$.

4. To your existing scatter plot add two SMLs: (i) the SML estimated from your cross-sectional regression. Use the estimated intercept and the slope coefficient. (ii) a predicted SML based on (a) the mean risk-free and (b) the mean excess return on the market. How do the two SML's differ and what does it tell you?

5. In the test that you have undertaken, betas estimated using the entire time series have been related to past returns. Could this be problematic? Explain.

6. Squared Beta and residual risk. Estimate the following expanded cross-sectional regression:

$$\bar{R}_j = \gamma_0 + \gamma_1 \tilde{\beta}_j + \gamma_2 \tilde{\beta}_j^{\,2} + \gamma_3 \sigma_j{}^2(e_j) + \epsilon_j$$

   Where;

   - $\tilde{\beta}_j^{\,2}$ is the squared estimate of Beta from the first pass
   - $\sigma_j{}^2(e_j)$ is the residual stock variance from the first pass regression

   What could be the motivation for including $\tilde{\beta}_j^{\,2}$? Test the hypotheses that $\gamma_2 = 0$ and $\gamma_3 = 0$. Interpret your results.

5.3 Interpretation

In this exercise we would like you to follow up on your CAPM test with a text. Use the following subtasks as guidance.

1. Overall, do your results support the CAPM? Explain with reference to your regressions.
2. If your results do not support the CAPM why do you think that this is the case?
3. In the existing literature researchers often report that the estimated SML is too flat. Do your tests indicate the same? What could explain this?

5.4

Suggestions for improvement of this exercise?