Assignment 4: Factor Models

MOEC0550 Empirical Finance (S)

Spring Semester 2021

1 Introduction

The goal of this assignment is to calculate the Fama-French and the Carhart momentum factors for Switzerland (from 1990 to 2019) and to evaluate whether these factors can explain the cross-section of stock returns.

You will find all the necessary information and the data for the empirical part of this assignment in the folder "Assignment 4" on OLAT.

Deadline All deliverables, which are defined more distinctively in Section 2, have to be turned in on OLAT by Friday 28th 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_assignment4.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_assignment4.pdf"

3 Data

On OLAT you will find six different data sets, four of them contain monthly data from 01.12.1989 to 01.12.2019 and are used to create the factor-mimicking-portfolios. Additionally you find the risk-free rate from 01.01.1990 to 01.12.2019 and the returns of international factors from 01.01.1991 to 01.12.2019.

- A4_dataset_01.txt
  This dataset contains the adjusted stock prices of the companies. You should use it to calculate the momentum and the returns of the portfolios. Please note that the ticker of the companies is given as the header.

- A4_dataset_02.txt
  This dataset contains the book-values for the stocks. You should use this dataset to compute the book-to-market ratio. Please note that the ticker of the companies is given as the header.

- A4_dataset_03.txt
  This dataset contains the number of shares of the companies. You should use it to calculate the market capitalization. Please note that the ticker of the companies is given as the header.

- A4_dataset_04.txt
  This dataset contains the unadjusted prices of the stocks. You should use it together with the number of shares to calculate the market capitalization. Please note that the ticker of the companies is given as the header.

- A4_dataset_05.txt
  This dataset contains the annual risk-free rate (1 year Swiss Government Bond). You should use it to compute the Sharpe ratios.

- A4_dataset_06.txt
  This dataset contains the returns of the European, North-American and Japanese four factors.

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:

Controls	SMB
Annualized mean return (ex. 5.1.3)	-0.01717163
Annualized mean return (ex. 5.2.4)	-0.008389979
Annualized mean return (ex. 5.3.2)	-0.01191475

Table 1: Annualized mean returns for the SMB portfolio of the three exercices

5 Problems

5.1 Introduction

The first objective is to estimate the returns, the Market value, the Book-to-Market and the Momentum of the companies in the dataset. You will use these estimates later on in order to create the factor-mimicking-portfolios. **Calculate all returns of the factor-mimimicking-potfolios from 01.02.1991 to 01.12.2019, rebalancing the portfolios on a monthly basis.**

Size

1. Calculate the Market Capitalization of the companies in the dataset.
2. Calculate the monthly median value of the Market Capitalization and assign to portfolio "S" (Small) the companies with a Market Capitalization below the median value and to portfolio "B" (Big) the companies with a Market Capitalization above the median.
3. Create an equal-weighted zero-investment-portfolio where you go long on Small Companies and short on Big companies. Remember to use the sorting of one month before in order to avoid look-ahead bias. Plot the cumulative returns, calculate the annualized mean return and the Sharpe ratio.

Value

4. Calculate the Book-to-Market of the companies by dividing the book value of the company by its market capitalization. By doing so make sure to use the six-month prior measure of the Book-value. (Book value$_{(t-6)}$ / Market capitalization$_t$)
5. Why should you use a prior measure of the book-value for calculating Book-to-Market?
6. Could you think of other measures that could capture the "value" factor. Why do you think we are using Book-to-Market?

7. Calculate the monthly median value of the Book-to-Market and assign to portfolio "L" (Low) the companies with a Book-to-Market below the median value and to portfolio "H" (High) the companies with a Book-to-Market above the median.

8. In which portfolio do the big four (Nestlé, UBS, Roche and Novartis)[1] appear on January 1998 and on January 2008.

9. Create an equal-weighted zero-investment-portfolio where you go long on Value (L) Companies and short on Growth (H) companies. Remember to use the sorting of one month before in order to avoid look-ahead bias. Plot the cumulative returns, calculate the annualized mean return and the Sharpe ratio.

Momentum

10. Calculate the returns of the companies in the dataset.

11. Calculate the Momentum factor for each company. Momentum is computed as the one-year past return from month t-12 to t-1. Could you think of a reason why do you exclude the last month in computing Momentum? What does an Investor get with Momentum?

12. Calculate the monthly median value of the Momentum and assign to portfolio "D" (Down) the companies with a Momentum below the median value and to portfolio "U" (UP) the companies with a Momentum above the median.

13. Create an equal-weighted zero-investment-portfolio where you go long on Winner (U) companies and short on Loser (D) companies. Remember to use the sorting of one month before in order to avoid look-ahead bias. Plot the cumulative returns, calculate the annualized mean return and the Sharpe ratio.

14. You may have noticed that many stocks have missing data since they are not listed anymore. Why do you think it is important to include them?

[1] Use the tickers to find the companies in the dataset. Nestlé: NESN, Roche: ROG, UBS: UBSG, Novartis: NOVN

5.2 Equal-weighted portfolios

The objective of this section is to sort the companies in 8 different groups according to their market capitalization, their Book-to-Market ratio and their Momentum. Once the companies are sorted, you will use the groups to create the three factor-mimicking portfolios: SMB (Small minus Big), HML (High minus low) and MOM (Up minus Down). The portfolios are rebalanced on a monthly basis (Hint: portsort package can be useful)

1. Use the 2x2x2 split you have created to assign the stocks to 8 intersectional subportfolios: SLD, SLU, SHD, SHU, BLD, BLU, BHD, BHU. Portfolio SHD will contain all the stocks that are at the same time in groups "Small", in group "High" and in group "Down". Portfolio BLU will contain all stocks that are in group "Big", "Low" and "Up". As before remember to use the sorting of one month before to avoid look-ahead bias.

2. Complete the following table:

	SLD	SLU	SHD	SHU	BLD	BLU	BHD	BHU
Mean Size (number of companies)								
Average Turnover								

3. Create the factor-mimicking-portfolios using the 8 subportfolios as follows:

   SMB= 1/4*((SHU-BHU)+(SHD-BHD)+(SLU-BLU)+(SLD-BLD))

   HML= 1/4*((SHU-SLU)+(SHD-SLD)+(BHU-BLU)+(BHD-BLD))

   MOM= 1/4*((SHU-SHD)+(SLU-SLD)+(BHU-BHD)+(BLU-BLD))

4. Complete the following table:

	SMB	HML	MOM
Annualized Return			
Sharpe Ratio			

5. Plot the cumulative returns of the factor-mimicking-portfolios.

5.3 Value-weighted portfolios

1. The goal of this exercise is to repeat 5.2 but this time using value-weighted portfolios. Make sure that the weight of the stock corresponds to the weight inside its subportfolio and not to its weight in the whole set of stocks. (Hint: you may use the tibble format instead of xts format)

2. Complete the following table:

	SMB	HML	MOM
Annualized Return			
Sharpe Ratio			

3. Plot the Cumulative returns of the factor-mimicking-portfolios.

4. Interpret your results. What do your risk-factors mean? (If you do not obtain any result use the returns calculated in 5.2)

5. How do you they compare to factors in other countries (North America, Europe and Japan)? Explain the high or low correlation using dataset A4_dataset_06.txt. Do you think the result obtained would be different with different breakpoints instead of using the median value?

6. Which of the factor-mimicking-portfolio do you consider riskier? Why? Justify your answer using two appropriate risk measures.

7. An important debate in finance is whether the value and the size premium are risk-based or a behavioral anomaly. List two reasons in favor of both arguments and explain how could one or the other be proved. (Hint: Cochrane "New facts in finance" vs Chan, Karceski, and Lakonishok "The Level and Persistence of Growth Rates")

8. Different recent academic studies and factor-investors report that returns to value investing have fallen sharply, referring to the fact that value-investing is dead. Do you agree? Could you think about possible reasons for that?

5.4

Suggestions for improvement of this exercise?