Empirical Finance - Assignment 3

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5.1 Time-Series Regression

5.1.1

This section only refers to the coding assignment.

5.1.2

The result of this part is attached in Appendix A.

5.1.3

The result of this part is attached in Appendix A.

5.1.4

As indicated in the table in Appendix A, the five companies with the highest beta are Credit Suisse, Julius Bär, LafargeHolcim, UBS, and Swatch Group. The five companies with the lowest beta are Swisscom, Swiss Re, Nestle, Givaudan, and Geberit. By grouping the companies a bit broader, we can see that companies with a high beta are mostly banks. Then there is also Swatch which is a watch company and LafargeHolcim, which is a cement producer. These shares can be described as cyclical stocks because they perform better when the economy is performing well. The low-beta stocks can be described as defensive or acyclical stock as they will not be as severely affected by a recession (Yelamanchili, 2019).

5.1.5

The t-values for α and β can be found in the table in Appendix A. The vast majority of t-values for the α-estimates are low, indicating that our model is not very confident about the estimates. The t-values for the betas, on the other hand, are all quite high. This suggests that none of the true beta-values can be expected to be significantly different from the estimated values.

5.1.6

When we take a look at the plot in Appendix B, we can see a slightly positive correlation between the excess returns of Zurich Insurance and the market excess returns. The beta value of Zurich Insurance is near to 1. Therefore, the slightly positive correlation between Zurich Insurance and the SMI is plausible.

5.2 Cross-Sectional Regression

5.2.1

The Beta realized return relationship plot can be found in Appendix C.

It is hard to tell whether the beta realized return relationship within our sample is positive from looking at the plot alone. Most companies have a mean excess return of about 5 to 15% and their betas range from about 0.5 to 1.3. The stock with the highest beta is in fact the one with the lowest annual return and the stock with the highest return has a beta around 1.

5.2.2

In the cross sectional regression $\overline{R_j} = \gamma_0 + \gamma_1 \tilde{\beta}_j + \epsilon_j$, our estimated $\gamma_1 = -0.005702$ and $\gamma_0 = 0.013884$. This does not make much sense within the CAPM framework, as investors would get a negative compensation for taking on risk compared to the risk-free asset. However, this estimate is not statistically significant. If the CAPM were true, we would expect γ_1 to be equal to the market excess return $E(r_m - r_f)$ which is equal to 0.006712988. This estimate is higher than our estimate for γ_1 and is only part of its 99%-confidence interval but not of the 95%-confidence interval. So we can reject the CAPM at the 5%-level.

5.2.3

The t-value for the γ_0 estimate is 2.293 and the t-value for γ_1 is -1.013. The critical value with 17 degrees of freedom and two-sided 95%-confidence is 2.110. As the t-value of 2.293 is greater than 2.110, we reject the null hypothesis $H_0 : \gamma_0 = 0$. However, we fail to reject that $H_0 : \gamma_1 = 0$, as -1.013 is smaller than 2.110.

5.2.4

The graph for this exercise can be found in Appendix D.

The blue line shows the SML estimated in the cross section regression. The red line shows the SML with the risk-free rate as the intercept and the market excess return as the slope coefficient. We can see that the sample SML (blue line) has a negative slope, whereas the predicted SML has a positive slope. This tells us that in our sample the CAPM fails to predict the returns with systematic risk (beta) as the only predictor.

5.2.5

According to Mullins (1982), using past returns to estimate betas can be problematic because a beta can change over time as the company to which the stocks belong changes over time or its capital structure changes. Thus, betas estimated from past returns often have estimation errors or measurement errors which can lead to attenuation bias (pull the usually positive betas toward zero).

Another problem of using past returns to test the CAPM is, according to Brown and Walter (2013), that the CAPM is an ex-ante theory, however, tests of it are conducted ex-post. This makes the CAPM theoretically untestable with past returns.

5.2.6

The reason to include $\tilde{\beta}_j^2$ is to capture a potentially non-linear relationship between beta and the realized excess returns. If the CAPM were true, on the other hand, we would expect its effects to be 0.

To test these hypotheses we have to compare the t-values to the critical value of 2.131 (critical value for two sided t test and 95% confidence level, at 15 degrees of freedom).

$H_0 : \gamma_2 = 0$

The t-value of γ_2 is -1.497, thus, we fail to reject H_0.

$H_0 : \gamma_3 = 0$

The t-value of γ_3 is 2.338, thus, we can reject H_0.

The effect of $\tilde{\beta}_j^2$ is not significantly different from 0 on a 95%-confidence level. This is what we would expect in accordance to the CAPM. However, we cannot say the same thing for the effects of idiosyncratic risk σ_j^2 on excess returns. This means that idiosyncratic risk is priced in our sample.

5.3 Interpretation

5.3.1

All in all, we would argue that our results mostly contradict the CAPM. Already the first stage of the test in task 5.2.2 gave us rather unwelcome results. It yielded a γ_0-intercept that was statistically significant from 0, telling us that the variation in excess returns has other sources apart from the variation in beta. Then, our γ_1-slope coefficient was negative and significantly different at the 5%-level from the expected value equaling the market excess return.

These findings were confirmed by plotting the corresponding SML to the plot illustrating the relationship between betas and realized returns in task 5.2.4. It looked decisively different in comparison to the expected SML based on the risk-free rate and the mean market premium. While the regression-based SML had a rather large intercept and a negative slope, the expectation-based SML had a negative intercept (close to 0) and a positive slope. It appears as a rather bad fit to the scattered observations, however.

Finally, adding non-linearities and the idiosyncratic risk to the regression in task 5.2.6 brought further arguments against the CAPM. Not only was the coefficient for the linear beta statistically insignificant, but the coefficient for the idiosyncratic was statistically significant at the 5%-level, meaning that the idiosyncratic risk is additionally compensated.

5.3.2

There are several problems when regarding the validity of the CAPM. Two we already mentioned in task 5.2.5, where we said that testing an ex-ante theory like the CAPM with an ex-post test is conceptually wrong. Additionally, we could have measurement errors in our betas leading to attenuation bias.

Furthermore, we would need to know whether the true market portfolio is mean-variance efficient. Unfortunately, we cannot include this market portfolio but only use a proxy such as the SMI. This means that we are depending on the SMI's efficiency, even though we have no idea whether it is an accurate proxy for the true efficiency. Likewise, we could have much different results when using another proxy (e.g. SPI) (Roll, 1977).

An additional caveat comes from investors being restricted in their borrowing as discussed in the next task.

5.3.3

In our estimation, the SML is not only too flat compared to the expectation but even has a negative slope. Frazzini and Pedersen (2014) suggest that the explanation for flat slopes is that risk-loving investors cannot borrow at the risk-free rate. In order to get rewarded and maybe naively believing in the CAPM holding, they need to take greater risk and invest in stocks with higher betas. As a result, the prices of high-beta stocks increase, while those with lower betas decrease. Ironically, this yields higher returns for lower betas and lower returns for higher betas. Graphically, this becomes visible in an SML that is considered too flat.

A possible explanation for flat slope of the SML becoming even negative could be related to the negative interest rates in our data-set (starting in late 2014). With the interest rates dropping and becoming more negative, the gap between borrowing rates and the interest rates might have increased. This could then have potentially resulted in an even flatter and eventually negative slope of the estimated SML.

References

Brown, Philip and Terry S Walter (2013). *The CAPM: Theoretical validity, empirical intractability and practical applications.* Tech. rep. Faculty of Business - Papers (Archive). 1187.

Frazzini, Andrea and Lasse Heje Pedersen (2014). “Betting against beta”. In: *Journal of Financial Economics* 111.1, pp. 1–25.

Mullins, David W (1982). *Does the Capital Asset Pricing Model Work?.* Harvard Business Review.

Roll, Richard (1977). “A critique of the asset pricing theory’s tests Part I: On past and potential testability of the theory”. In: *Journal of Financial Economics* 4.2, pp. 129–176.

Yelamanchili, Rama Krishna (2019). “Impact of Consumer Sentiment on Defensive and Aggressive Stock Returns: Indian Evidence”. eng. In: *International journal of economics and financial issues* 9.4, pp. 109–114.

Appendix

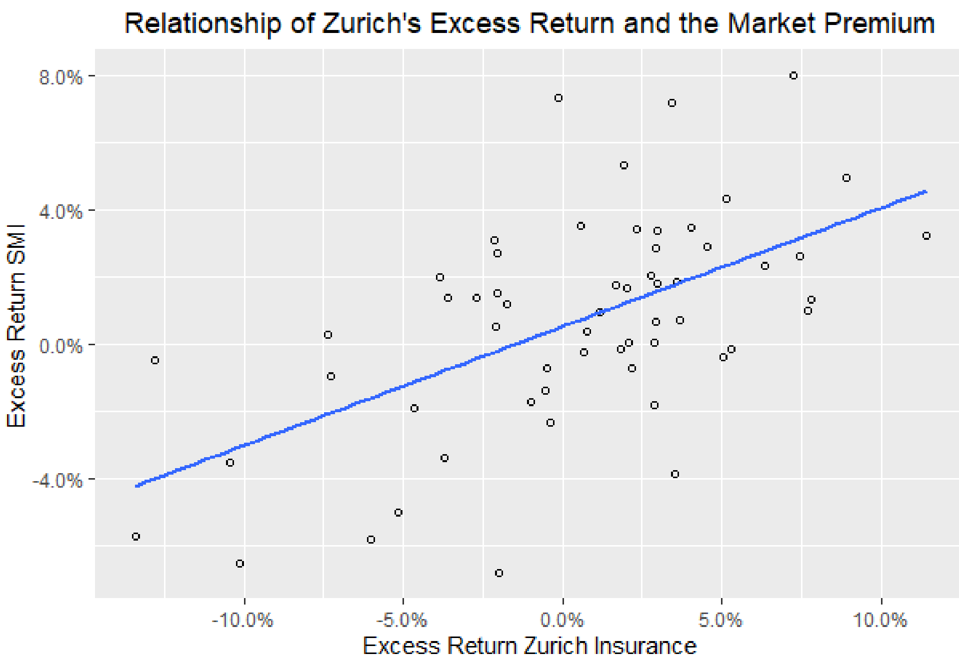
Appendix A

Solution to 5.1.2 , 5.1.3 , 5.1.4 and 5.1.5:

Company:	β	excess mean return	t-value of α	t-value of β
Swisscom:	0.511	0.003	-0.185	3.354
Swiss RE:	0.649	0.007	0.448	3.981
Nestlé:	0.774	0.005	0.103	8.048
Givaudan:	0.815	0.013	1.570	5.728
Geberit:	0.815	0.015	1.816	4.781
Adecco:	0.865	0.010	0.639	4.277
Zurich Insurance:	0.926	0.005	-0.268	5.221
Roche:	0.962	0.008	0.546	9.410
SGS:	0.985	0.004	-0.464	6.396
Actelion:	1.011	0.033	2.740	3.396
Syngenta:	1.048	0.006	-0.073	4.240
Novartis:	1.068	0.006	-0.146	9.784
Richemont:	1.115	0.008	0.118	4.573
ABB:	1.115	0.008	0.112	6.345
Swatch:	1.171	0.001	-0.767	4.517
UBS:	1.269	0.008	-0.094	4.773
LafargeHolcim:	1.291	0.003	-0.846	5.681
Julius Bär:	1.344	0.008	-0.168	6.128
Credit Suisse:	1.919	-0.001	-1.400	6.327

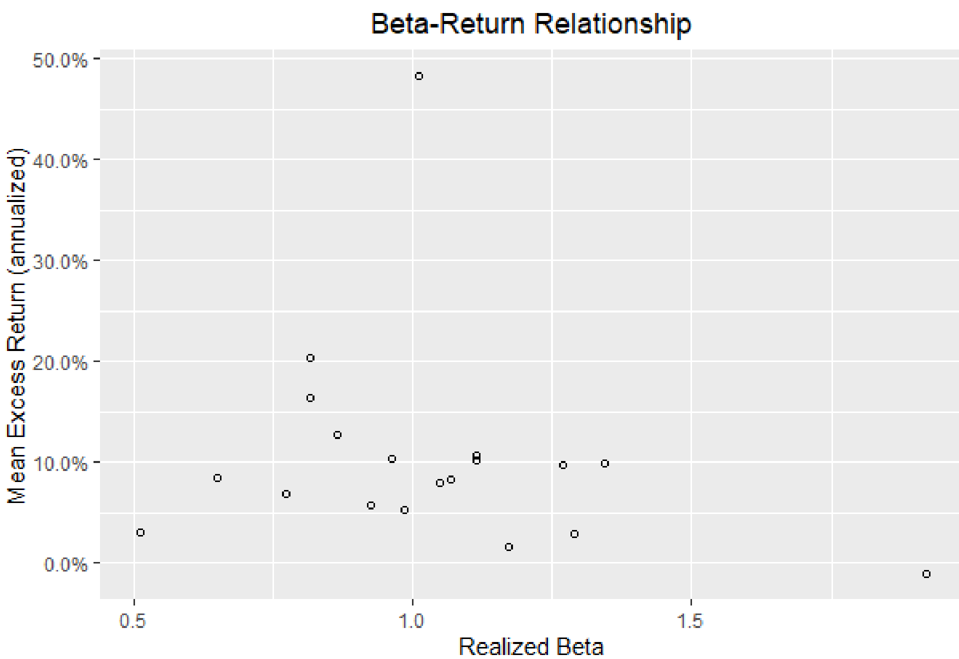
Appendix B

Solution to 5.1.6:



Appendix C

Solution to 5.2.1:



Appendix D

Solution to 5.2.4: