The cross-section of volatility and expected returns on the Swiss stock market

Bachelor Thesis

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Executive Summary

Problem Definition

Ang et al. (2006) write that it is well known that the volatility of stock returns changes over time. While considerable research has investigated the time-series relation between the volatility of the market and the expected return on the market (see, among others, Campbell and Hantschel (1992) and Glosten, Jagannathan and Runkle (1993)), the question of how aggregate volatility impacts the cross-section of expected stock returns has received less attention (Ang et al.). Time-varying market volatility causes changes in the investment opportunity set by modifying the expectation of future market returns or by varying the risk-return trade-off (Ang et al.). The arbitrage pricing theory or a factor model predicts that aggregate volatility should also be priced in the cross-section of stocks, if the volatility of the market return is a systematic risk factor (Ang et al.).

The purpose of this thesis is firstly, to analyse the cross-section of volatility and expected returns on the Swiss stock market and secondly, to detect if the aggregate volatility, measured with a volatility index, illustrates a relevant price factor for Swiss stocks, which is not covered by the CPAM. In contrast to Ang et al., I do not estimate the price of aggregate volatility risk and I do not examine the cross-sectional relationship between idiosyncratic volatility and expected returns.

Many option studies have evaluated a negative price of risk for market volatility using options on an aggregate market index or options on individual stocks. Using the cross-section of stock returns, rather than options on the market, allows me to construct portfolios of stocks that have different sensitivities to changes in market volatility. If the price of aggregate volatility risk is negative, then stocks with large, positives sensitivities to volatility risk should have low average returns. (Ang et al.)

Methodology

The focus in this thesis is on listed Swiss companies for which more than 17 daily stock prices per month are available for the period from January 1999 to December 2011. All companies included in the data sample have been members of the *SPI* (Swiss Performance Index), which makes 217 companies in total. For the regression analysis the impact of daily data of changes in a volatility index, here $\Delta VSMI$, and a market factor, here SPI, on stock returns of those mentioned companies above, are considered. To test the research hypothesis several panel data regressions using different determinants are run.

I first regress the excess stock returns towards daily changes in aggregate volatility and the excess market return over the past month with daily data. Afterwards firms are sorted by $\beta_{\Delta VSMI}$, which are the loadings on aggregate volatility risk. They were split in five quintile portfolios according to their reached $\beta_{\Delta VSMI}$. The first quintile includes the lowest values, while firms in quintile five have the highest coefficients. In all five quintile portfolios the excess stock returns are now weighted with the market capitalisation and were used as right-hand variables to regress over each quintile to gain one pre-formation $\beta_{\Delta VSMI}$ for each quintile. In addition to each beta coefficient, the simple average stock returns, CAPM and FF-3 alphas are calculated for each portfolio.

The differences in average returns and alpha coefficients corresponding to different $\beta_{\Delta VSMI}$ coefficients are interesting. However, I cannot yet claim that these differences are due to systematic volatility risk. For this reason I compute an ex post factor that mimics aggregate volatility risk, named $FVSMI$. I replace the $\Delta VSMI$ with $FVSMI$ and I make the same regression over the past month with daily data for each quintile to receive pre-formation β_{FVSMI} loadings and finally 5 β_{FVSMI} coefficients.

In this paragraph I describe how post-formation factor loadings are computed. For the post-formation $\beta_{\Delta VSMI}$ loadings the quintile portfolios at time t are used to calculate daily returns over the next month, from t to $t+1$. Those new weighted daily returns are inserted in the regression equation and replace the old weighted returns as the right-hand variable. The results are post-formation $\beta_{\Delta VSMI}$ values for each month, which were averaged over each quintile.

For the last regression, I need monthly data, the above used mimicking factor and the FF-3 model's market, size and value factors, which leads to the post-formation β_{FVSMI} coefficients.

Finally, I calculate daily correlation between the $FVSMI$ and $\Delta VSMI$, as well as monthly correlations between $FVSMI$ and $\Delta_m VSMI$ plus correlations of these variables with other cross-sectional factors.

Results and Conclusion

The first regression brings me increasing pre-formation $\beta_{\Delta VSMI}$ loadings between -0.0032 for quintile 1 and -0.0023 for quintile 5, neglecting results from quintile 2. The corresponding simple average stock returns, CAPM and FF-3 alphas to each quintile do all form a v-shaped graph. The differences of the values of the quintile portfolios for those variables are disappointingly very small and the average returns and alphas coefficients do not decrease with the quintile number.

Therefore my results are not consistent with the negative price of systematic volatility risk found by the option pricing studies, where the results are lower average returns, CAPM and FF-3 alphas with higher past values of $\beta_{\Delta VSMI}$.

By checking if these differences of values are due to systematic volatility risk, I calculate $FVSMI$ that mimics changes in market volatility and I conduct a regression with $FVSMI$ to obtain pre-formation β_{FVSMI} coefficients. My pre-formation β_{FVSMI} coefficients are not at all similar to the pre-formation $\beta_{\Delta VSMI}$ values and they are not increasing with the quintile number.

Also the post-formation beta coefficients do not bring the expected result of increasing values. Especially the regression for the post-formation β_{FVSMI} factor loadings shows that I cannot reject the hypothesis that the ex post β_{FVSMI} coefficients are equal to zero.

Hence, sorting stocks on past $\beta_{\Delta VSMI}$ provides weak, insignificant spreads in ex post aggregate volatility risk sensitivities. However, the computed correlation between $FVSMI$ and the market return reaches a value of -0.44 what reflects the fact that when volatility increases market returns are low.

All my results up to now support the case that aggregate volatility might not be a priced risk factor in the cross-section of Swiss stock returns, but I should conduct a series of robustness checks to make a clear statement and to eliminate that low average returns to stocks with high past sensitivities to aggregate volatility risk cannot be explained by size, book-to-market, liquidity, volume or momentum effects.