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Bachelor Thesis

Advances in Statistical Arbitrage and the Impact of the Financial Crises on its Success

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Executive Summary

Problem Statement

Since a team of traders at Morgan Stanley started to trade stocks in pairs, statistically derived trading strategies have not ceased to be developed. With the evolution in information technology it became able to trade stock based on statistical factors (Pole (2007)). Statistical arbitrage strategies, how these types of trading schemes are known, were successful and popular until the end of the 20th century.

However, the popularity of statistical arbitrage industry started to decline as the excess returns decreased. The global financial crisis starting in 2007 meant the ultimate end for this trading strategy as major funds had to liquidate their assets (Avellaneda & Lee (2010)). The thesis shall qualitatively investigate which effects during the crisis had a negative effect on statistical arbitrage strategies. Moreover, the results of this analysis shall be used to develop an adjusted trading strategy that accounts for the specific weaknesses of statistical arbitrage trading strategies during the crisis. The thesis shall deliver insights into why statistical arbitrage strategies failed during the financial crisis, something that has not been done specifically until now.

Approach

After an introduction to the central terminology of statistical arbitrage, the two major groups of statistical arbitrage strategies are introduced: Classical time series models and factor models. Presenting the models, the focus lies on the mayor factors that influence the success of these trading models. In a next step, the developments of the Dow Jones Industrial Average during the financial crisis are analyzed. Therefore, the historical and implied volatility, the distribution of daily returns, and the correlation matrix of the components are calculated. The calculations of the different factors are done with data from Datastream and focusing on the period between 2004 and 2009. Thereby, the pre-crisis phase is defined as the time between the 1st of January 2004 and 31st of December 2006, and the crisis phase as the time phase between the 1st of August 2007 and the 31st of December 2009. In a next step, the different conclusions from the previous two steps are taken together: the developments of the different factors are analyzed with regard to their impact on the models presented. This qualitative part is supported by quantitative tests: Auto-correlations, a residual analysis, and a DCA analysis underline the ideas presented. Accounting for the results of the previous analysis, an adjusted trading model is developed, whereas we specially focus on accounting for market volatility and liquidity (trading volume). Thereby, the Khandani & Lo (2007) model is chosen as the basic framework, which we adjust for our purposes. In a last step this model is tested, comparing the pre-crisis and crisis phase returns. Moreover, the performance of our adjusted model is compared to the unadjusted model in the period between 2003 and 2010, inclusive. In these last two steps we construct our portfolio using the components of the S&P 500. All calculations are done with MATLAB.

Results

The qualitative and quantitative analyses have delivered mixed results. Firstly, the developments in equity markets were analyzed. The results showed, that during the financial crisis market volatility, the single stock return volatility, and the correlation between stocks of the Dow Jones Industrial Average increased significantly. Comparing these developments to the factors that influence the success of statistical arbitrage strategies, it could be shown that these factors influenced negatively statistical arbitrage strategies. Yet, the way how other crucial factors like inter-stock volatility or the speed variance of mean-reversion influenced statistical arbitrage strategies could not been conclusively proven.

The quantitative analysis strengthened the theory that the financial crisis had a negative impact on classical time series models. The results suggest that before the crisis, the excess returns were considerably higher than during the crisis. However, the results were statistically not significant at any common significance level. Moreover, the quantitative test of the adjusted trading strategy during the period between 2003 and 2010 yielded much higher returns than did the unadjusted model. The unadjusted model yielded negative returns in every observation phase. With the adjustments, the strategy yielded positive returns. It showed that during the financial crisis starting in 2007 accounting for market volatility and liquidity had a positive effect on statistical arbitrage models. Again, statistically it could be not proven that the returns are significantly different from zero.