Measuring Value-at-Risk:
An Overview of Different Methods

Bachelorarbeit

zur Erlangung des akademischen Grades „Bachelor of Science (B.Sc.)" im

Studiengang Wirtschaftswissenschaft der Wirtschaftswissenschaftlichen Fakultät der Leibniz Universität Hannover

vorgelegt von

Name: Benti Vorname: Sena

[redacted]

Prüfer: Prof. Dr. H.-J. von Mettenheim

Hannover, den 27. Juni 2017

Table of Contents

1 Introduction

History has shown that financial markets are dynamic and unforeseeable. With these characteristics come unknown risks when acting in these markets. It is vital that market participants know and understand the risks they are taking, in order to minimize losses and maximize profits. Here is where financial risk management comes at play.

Financial risk management is all about knowing and understanding the exposure to financial risks. Hereby risk measures can be helpful tools for risk managers to quantify the degree of the risk taken. A frequently used risk measure in practice is the so-called Value-at-Risk (VAR) which is referred to as the industry standard for measuring market risk. [1] There are numerous methods applied when calculating this downside risk measure. Disagreement occurs over which of these methods is the best used in practice by risk managers.

This thesis gives an overview of the various methods and thereby tries to provide guidance in selecting a suitable method. In doing so a theoretical background is provided in the initial step. This is followed by a demonstration of three commonly used methods: The Historical Simulation, the Exponentially Weighted Moving Average model and the Normal parametric VAR. These models are applied onto a portfolio consisting out of four geographically diversified indices: the German stock index DAX, the Standard & Poor's 500, the Dow Jones Industrial Average and the Japanese Nikkei 225.

Results of the proportion of failure test and the conditional coverage independence test show, that the chosen VAR models have shortcomings. These shortcomings are discussed considering potential alternatives. One of the main findings of this thesis is that there is no one method, which outperforms all the others. Instead it is important to take into consideration the different circumstances under which the VAR methods are conducted when comparing them to each other. As a basic principle for the practical usage of VAR for risk managers it can be concluded that VAR should be used with caution in regard to its limits.

[1] See Jorion (2007).

5 Conclusion and Further Research

This thesis introduced Value at Risk as a risk measure, which is commonly used in practice to measure the market risk exposure of a portfolio. It explains why and how VAR has become an industry standard and furthermore how throughout the years different models were developed to calculate this important risk measure. In this context, various methods have been categorized and introduced. For an empirical analysis the normal VAR, the Historical Simulation approach as well as the VAR calculated based on an EWMA model have been selected to demonstrate an application of VAR. The three univariate VAR models have been applied for a one-day forecast with two confidence intervals (95% and 97%). For validation two prominent back tests, the Proportion of Failure test and the Conditional Coverage Independence test have been conducted to test the validity of the three selected models.

The finding of this empirical analysis is that the chosen VAR models are not sufficient enough to accurately capture the market risk exposure of the chosen portfolio. Most of the models failed the back test because they underestimate the actual risk of the portfolio. This was the case, as the chosen models did not properly account for stylized facts of asset returns. Based on these findings alternative VAR models have been discussed for the given portfolio. However, the conclusion is that other VAR models, although better suited for the given portfolio have shortcomings. Thus, they cannot be considered as good alternative. In the discussion, it is made evident that comparing different VAR models in regard to their accuracy can be complicated. One important finding of the thesis is that the performance of VAR is strongly dependent on the choices made by the risk manager applying it. This in turn leads to the question of VARs capability to forecast risk. A conclusion draws the attention to the limits of statistical forecast models. As VAR, itself is a statistical model, the conclusion made is that overconfidence in VAR may leave a financial institution and the whole financial system in a situation where they underestimate the degree of risk coming from financial markets. Therefore, it is important to emphasize that good risk management does not only mean using the right model but rather knowing its limits.

Consequently, further research should be addressed at identifying the limits of existing risk forecast models.