Valuation of Structured Products

Bachelor Thesis in Quantitative Finance

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EXECUTIVE SUMMARY

PROBLEM

Since the launch of the GROI (Guaranteed Return on Investment) on the Swiss market in 1991, structured products have become increasingly more popular not only among institutional investors and asset managers but in recent years they also began to get the attention of private investors. Structured products made financial markets, regions and trading strategies including short selling accessible even for smaller market participants thereby substantially widening their investment horizon. Not surprisingly, investment banks increased supply of different structured products to meet the fast growing demand of their clientele. As the variety of these financial instruments is immense and each investment bank name their products differently it is challenging for everyone to figure out how they function, which inherent risks they include or which structured product would be the most appropriate for a given market expectation. However in order to understand the nature of a structured product, the investor should know besides the underlying assets the product consists of, how market variables affect each single component and also see what interactions exist between the parts of the structured product. A thorough understanding is essential to comprehend not only the pricing of these financial products but also to understand how price movements come about due to changes in relevant pricing parameters.

PROCEDURE

The thesis starts with a short definition of the term *structured product* followed by the four principal parts. Attached, there will be two appendices. Whereas in the first, mathematical derivations and pricing formulas are reported, the second lists Matlab codes, which had been used to conduct numerical valuations.

Part I

Gives an overview of the market for structured products in Switzerland which includes turnover figures, growth rates of trading volume and market size estimations.

Part II

Options are the general components of all the structured products discussed. Therefore a brief introduction in basic option pricing is given, followed by an overview on nonstandard options, so called *exotic options* which are increasingly used in the engineering of structured products in order to equip them with additional features.

Part III

Shows the construction of several structured products. The categorization follows the one proposed by the Swiss Structured Products Association. Furthermore this section graphically displays payoff profiles and delivers analytical pricing formulas often illustrated by numerical examples.

Part IV

A case study consisting of four different scenarios is conducted, where two of the currently most popular structured products are compared. For the simulation of asset prices, a discrete version of the geometric Brownian Motion is implemented on the Matlab software. After each scenario, the return distributions of the two structured products have been compared with each other and a brief statistical summary of relevant parameters is presented.

RESULTS

The simulation results nicely highlighted the strengths and weaknesses of the two structured products in different market environments. Furthermore, changing relevant pricing parameters from one scenario to the other discloses some information on the sources of price as well as return differences. The permanently alternating market environment numerically shows how the components of these structured products react and more over, which dependencies exist between the input parameters and the derivatives incorporated in the structured product.

Despite the evaluation of four different simulations no structured product could outperform the other perspicuously. However, the return profiles were heterogeneous in each simulation, which were indicated by the large difference between the computed return standard deviations of the two financial products. This can also be seen in all the graphics displaying the distribution of returns. Furthermore, return profiles in one structured product seemed to be robust even though the volatility of the underlying asset has been increased substantially. These payoff patterns show little changes from one simulation to the other. Contrary to the former, the return distribution of the other structured product had varied considerably after each scenario. The typical pattern of previous scenarios almost completely disappears in the last scenario and simultaneously exhibiting high variation around the average return. However, overall neither contradicting nor abnormal results can be observed as the analysis conducted in *Part III* can be confirmed numerically.

GENERAL EVALUATION

Given the broad range of the theme, there are numerous possibilities of extensions or more detailed analysis' both qualitatively and quantitatively which can be conducted. As there is a sheer infinite number of combining a derivative with an other financial asset such as a share or a bond new research topics immediately arise. Besides the already known and traded structured products several new products may be designed at least theoretically. For example, a capital protection product, where instead of a standard option a power option is used, could be developed. This would lead to a partially nonlinear but capped payoff profile. Furthermore, an in-depth analysis of the markets for structured products in various countries could be investigated. To this date there are several studies available examining different markets of structured products but only little literature that studies and compares these market among themselves. Another research topic is the legal treatment of structured products, which has only been briefly touched in this thesis. However, as the yield on these financial instruments is greatly affected by legal regulations, this area draws not only academics but also practitioners' attention.

In addition, there exist various papers on the pricing of the financial instrument used in the construction of structured products which make use of advanced mathematics. For a rigorous pricing, a more in-depth mathematical analysis is needed including a full derivation of pricing formulas and their proofs. However, this mathematical approach to pricing is mainly done by researches with a strong background in mathematics or physics and not by economists.