Summary of doctoral thesis

"Investment decision making on the German Stock Exchange using mathematical methods of data analysis"

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Dynamically changing environment and growing uncertainty regarding micro and macroeconomic conditions cause that decision making becomes today more and more complex process. This concerns especially investment decisions taken on a stock exchange, as they are considered to be affected by many factors, including volatility of financial markets, huge amount of data as well as high risk. Moreover, a stock exchange is a source of strong emotions, and therefore decision making cannot be isolated from emotional state of a decision maker. Behavioural factors can induce investors towards less rational decisions, contributing thereby to the effect of herd instinct.

Complexity of the decision making on a stock exchange requires an increase of the level of objectivity and therefore raises a need for introducing appropriate methods to support decision making process. In this context one should understand the reasons, which led the author to choose the subject of the decision-making process support using mathematical methods of data analysis. These methods in turn limit an influence of psychological aspects on the decision-making. The dissertation emphasizes two stages of the decision-making support for investors. The first stage is a short-term trend prediction in the stock market, while the second is a direct decision support by indicating moments for trade in the derivatives market. There are two factors, highlighted in the literature, which have played an important role in formulating the subject of this research: (i) over-reliance of investors to commonly used decision support tools, such as typical investment strategies based on simple technical analysis indicators or "buy & hold" strategy, discounted cash flow analysis or trivial methods for testing quantitative scenarios, as well as, (ii) behaviour of financial markets as nonlinear dynamical systems. Therefore, it is reasonable to take advantage of the methods of artificial intelligence – artificial neural networks (ANN) – choosing the most suitable tool for decision-making support.

As a result of abovementioned considerations, the study is focused on elaborating a tool to support the first and second stages of the decision-making process. The most important arguments for applying ANN in the market prediction are as follows:

– inability of linear models to take into account stylized factors of the financial markets, which behave rather like nonlinear dynamical systems,

– advantage of ANN adoption in nonlinear time series prediction compared to statistical models due to combination of both linear and nonlinear elements of modelling.

To implement the second stage of decision support, a trading system has been designed, which is based on data obtained from the ANN and able to react by appropriate signals to the short-term changes in the market.

The presented direction of the research has determined the main objective of the doctoral thesis. The objective is to design a mathematical tool to support investment decisions in the futures market adjusted to the specific of German exchange market. The objective of the study enables to formulate the following main hypothesis. It is possible to design a mathematical tool based on the short-term prediction of the stock exchange index to make a profitable investment decision using derivative, whose pricing is related to that index.

The results of the research have confirmed the main hypothesis of this study. Designed mathematical tool based on the predicted tendencies of the German stocks indices of DAX family allowed to make profitable investment decisions with futures contracts on these indices. The highest gains are recorded for the DAX futures – the account balance has increased more than twice for all strategies. The lowest profit is observed while investing in the TecDAX index contracts. Moreover, investment strategies, programmed in the trade system, allowed for higher profits compared to the standard strategies, such as MACD or "buy & hold". Additionally conducted investigation using random strategies gave a positive evaluation of the selected strategies of the trade system and confirmed their effectiveness.

The study repeatedly emphasizes the supportive nature of the presented tool. Its usage does not relieve investors of the need to play an active role in the decision making process. They should then make the final decision, for which they are responsible. However, it should be preceded by accurate observation and analysis of the market developments during a trade day. Only this will allow investors to use the recommended tool effectively in the decision-making process.