

Executive Summary

The presented thesis is attributed to evolutionary finance that examines the dynamics of interaction between investment strategies in financial markets and is inspired by Darwinian ideas and random dynamical systems theory. The market interactions based on diversity of individual's investment behavior generate a stochastic wealth dynamic through the fluctuation of asset prices and their random payoffs. Asset prices are endogenously determined by short-term market clearing. Investors' portfolio choices are characterized by investment strategies that provide a descriptive model of decision behavior. Generally, there are two evolutionary aspects affecting the diversity in the population of market participants. On the one hand, variety of investment strategies acting on market is reduced by the mechanism of selection. On the other hand, novelty in investment behavior is created by mutation. The market evolution is the focus of evolutionary financial market research and represents contradiction to the traditional financial market theory. The first evolutionary financial market models were based on computer simulations. Later the mathematical framework of the models given by random dynamical systems has been introduced, whereas firstly the model for short-lived assets, and afterwards the model for long-lived assets has been developed. Since then, the models have been examined under different assumptions and from different points of view, whereas in all of them, the dynamics of long-lived and short-lived assets are treated separately.

The aim of the presented work is to find out, what would be the impact of the implementation of the options on the investment strategies competitiveness in the evolutionary financial market model. Furthermore, the asset pricing and demand for options represented by investment strategies is also examined. All these aspects are analyzed in three different situations. Firstly, in order to show the dynamics of the model in its basic properties, the competitiveness of investment strategies in the conditions for only long-lived asset is reviewed. With that background the options are thereafter integrated into model, whereas the dynamics for long-lived and short-lived assets are combined. In order to demonstrate the competitive advantage, which results from the participation in the option market, there are two cases studied. In the first case, the investor of Kelly rule, as the best investment strategy, does not participate in the option market, whereas in the second case, he gives impact on the options in the market clearing. Further aim of this thesis is to discuss the applications of the obtained results for future research with the focus on arbitrage strategies and

their impact on the competition among the investment strategies and the asset pricing. To be able to answer the specified question, the stochastic mathematical model with two integrated dynamics is introduced and the investment rules for long-lived assets and options of 14 selected investment strategies are defined. In order to analyze this stochastic mathematical model, a simulation script in MATLAB® is programmed and executed. There are computed twenty runs of each simulation for the three study cases, whereas the presented results are based on the average data.

The results of computed simulations show that in situation, in which only long-lived assets are traded, the Kelly rule investor prevails over the market share period by period until he reaches the full dominance in the market. However, in the condition, where the options are included, but the Kelly rule investor does not participate in the option market, it is proven that some of the investment strategies are able to survive while they invest in options. Nevertheless, because the options are risky, the market selection is rapid, and the investment strategies without ability to survive are driven out of the market already after few periods. It is shown that the investment strategies with successful options investment rules receive the competitive advantage through investing in options and this makes them able to compete against Kelly rule investor. In this way, they survive in the market. Finally, in the situation, where all investment strategies trade options, similarity to the results as without options is obvious. Though wealth path of investment strategies is more volatile now because of more volatile asset prices. With the purpose to get the further advantage in competition with Kelly rule, the risk-less gains from arbitrage strategies may be considered. However, the application of arbitrage strategies may be limited by the properties and assumptions of the evolutionary model.