OVERREACTION BEHAVIOR AND OPTIMIZATION TECHNIQUES IN MATHEMATICAL FINANCE

Ahmet Duran, PhD

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Overreactions and other behavioral effects in stock prices can best be examined by adjusting for the changes in fundamentals. We perform this by subtracting the relative price changes in the net asset value (NAV) from that of market price (MP) daily for a large set of closed-end funds trading in US markets. We examine the days before and after a significant rise or fall in price deviation and MP return and find evidence of overreaction in the days after the change. Prior to a spike in deviation we find a gradual two or three day decline (and analogously in the other direction). Overall, there is a characteristic diamond pattern, revealing symmetry in deviations before and after the significant change. Much of the statistical significance and the patterns disappear when the subtraction of NAV return is eliminated, suggesting that the frequent changes in fundamentals mask behavioral effects. A second study subdivides the data depending on whether the NAV or market price is responsible for the spike in the relative difference. In a majority of spikes, it is the change in market price rather than NAV that is dominant. Among those spikes for which there is little or no change in NAV, the results are similar to the overall study. Furthermore, the upward spikes are preceded by one or two days of declining market price while NAV rises slightly or is relatively unchanged. This suggests that a cause of the spike may be due to over-positioning of traders in the opposite direction in anticipation.

We propose a mathematical model by combining an implementation of a state-of-the-art optimization algorithm, a dynamic initial parameter pool and a system of nonlinear differential equations to describe price dynamics. Given n-day period of MPs and NAVs

from day i to day $i+n-1$, we get four optimal parameters in the Caginalp Differential Equations. Then, we solve the initial value problem to predict MP and return on day $i+n$ or later. The results of our statistical methods in real data confirm the model. We provide out-of-sample prediction that is more successful than random walk.

Keywords: numerical optimization, nonlinear optimization, overreaction, diamond pattern, over-positioning, price deviation, deviation model with partition, market price return prediction, computational finance, mathematical finance and economics, behavioral finance, differential equations, numerical solution of differential equations, data analysis, statistical methods in financial markets, market dynamics, bubble, algorithms, inverse problem of parameter estimation.