Trading profitability from learning and adaptation on the Tokyo Stock Exchange

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Abstract

This paper proposes unexamined technical trading rules, which are dynamically switching strategies among filter, moving average, and trading-range breakout rules, and investigates their trading performances. The dynamically switching strategy is formulated based on a discrete choice theory, which is consistent with the concept of a myopic utility maximization. Our investors learn from the past experience and adjust their strategies to the one, which has produced higher trading performance in the past. The approach is motivated by real-world decision making as well as several assumptions and results in the literature on agent-based theoretical models that successfully replicate several empirical features in financial markets, such as fat tails of return distribution and volatility clustering. We utilize the transaction data of the individual stocks listed on Nikkei 225, covering from September 1, 2005 to August 31, 2007. We demonstrate that switching strategies produce positive returns, and the performances are better than those from the buy-and-hold strategy and strategies without switching over our sample periods. We also demonstrate the equivalent performances among switching with different learning horizons, implying that the behavioral heterogeneity of the stock investors would arise from the co-existence of different as strategies with varying degrees of learning horizons. However, once we take the effect of data-snooping biases into account, the superior performances of switching rules disappears.

JEL classification: G12; G17; G14

Keywords: Learning; Adaptation; Tokyo Stock Exchange; Agent-based model; High frequency technical trading

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Extended abstract

Research on agent-based models explores the causes of macroeconomic phenomena by investigating the behavior of dynamically interacting agents. The earlier research has successfully explained the roots of stylized facts in financial markets, such as behavioral heterogeneity of financial investors, fat tails of asset returns, long-memory features of financial variables, and volatility clustering.[1] Understanding the dynamic features of asset prices helps investors for better risk managements in financial markets. Heterogeneous agent models originally developed by Brock and Hommes (1997), in which agents interchangeably switch a set of predictors over time based on the past relative forecast performance, provide theoretical explanations for several empirical features in financial markets. Certain agent-based theoretical models, such as Cont (2005), LeBaron, Arthur, and Palmer (1999), and LeBaron (2001), emphasize the importance of learning and adaptive investors on strategies as well as investors' learning speed for characterizing time-series features in financial markets. Furthermore, it is little doubt that people in the real economic system learn from past experiences and adapt their behavior to the changing environments. However, an empirical investigation on an economic rationale and its justification for the learning and adaptation by stock investors is still lacking. Moreover, the adjustment speed of their strategies that produces positive returns is not known.

The present paper thus makes a unique contribution by proposing unexamined technical rules, which are dynamically switching rules based on learning and adaptation, and empirically investigating the profitability of technical rules as a result of learning and adaptation. In addition, we compare the performances of switching strategies with those from our benchmark strategies, that is to say, the strategies *without* switching and the buy-and-hold strategy. We achieve this goal by using the series of individual stocks listed on the Nikkei 225 from September 1, 2005 to August 31, 2007.[2] We evaluate the profitability of our trading strategies first by comparing the average performances over our sample periods, and then by applying the Superior Predictive Ability (SPA) bootstrap procedure proposed by Hansen (2005), which reduces the effect of data snooping, which may occur if profitable rules are discovered by pure chance. We demonstrate that strategies with different speeds of learning and adaptation can generate certain positive profits, and the performances are better on average than those from the buy-and-hold strategy as well as the non-switching rules. However, the superior performances tend to disappear once considering data-snooping biases. The result indicates that the switching strategies are useful for

[1] Among several survey papers, Hommes (2006) and LeBaron (2006) survey the theoretical success on agent-based models.

[2] This series was distributed by Nikkei Media Marketing, Inc., an information vendor in the Nikkei Group.

producing positive returns, but small to statistically beat our benchmark rules. We also demonstrate that the evolutionary rules generate similar returns across different learning horizons, implying that investors are indifferent on selecting switching rules among different learning horizons. The result implies behavioral heterogeneity in actual stock markets arising from the coexistence of the varying strategies.

Following a discrete choice theory introduced by Brock and Hommes (1997), our investors endogenously switch their strategies to the ones, which have generated higher returns in the recent past. This setup on learning and adaptation is consistent with the concept of myopic utility maximization, and resembles real-world decision making. Previous experimental studies show that people adapt their behaviors by learning from successful strategies of their own and/or others in the past. For example, an experimental work by Offerman and Sonnemans (1998) demonstrates that individuals learn from their own experience as well as from imitating successful others. Apesteguia, Huck, and Oechssler (2007) also illustrate that individuals are more likely to imitate successful actions as the payoff differences among actions increase. The strategies in this paper contain a substantial set of technical strategies that have been popularly examined in the literature on technical analysis and in the real finance world. Thus, the strategy switching in this paper should reflect a certain form of switching among one's own strategy set as well as across the strategies of others. Moreover, the previous experimental works imply that learning and adaptation are prevalent when the environment becomes more complex or largely unknown. Thus, learning and adaptation should be observed in financial markets, because the financial markets are quite complicated.

The studies of survey data conducted by Lui and Mole (1998), Menkhoff and Taylor (2007), and Menkhoff (2010) demonstrate the widespread use of technical analysis by market participants to form their own trading plans. The result indicates that certain technical rules should be profitable in reality and therefore have survived in the actual stock markets. However, most of the recent empirical studies on technical analysis, which utilizes matured market indices, matured industries, and/or more recent data, for example the data after 2002, find no superior profitability of the technical trading rules.[3] This is possibly because the previous studies evaluate the profitability of technical rules by assuming that an investor utilizes the same technical rule throughout the investment periods *without switching*. Investors, in reality, should update their information over time and dynamically adjust their investment strategies as shown in this paper. Therefore, this paper attempts to fill the gap among the results from the survey studies and the empirical studies on technical analysis.

[3] See, for example, Shynkevich (2012) and Park and Irwin (2007).

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