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Stock market trading rule discovery using pattern recognition and technical analysis

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Abstract

This study examines the potential profit of bull flag technical trading rules using a template matching technique based on pattern recognition for the Nasdaq Composite Index (NASDAQ) and Taiwan Weighted Index (TWI). To minimize measurement error due to data snooping, this study performed a series of experiments to test the effectiveness of the proposed method. The empirical results indicated that all of the technical trading rules correctly predict the direction of changes in the NASDAQ and TWI. This finding may provide investors with important information on asset allocation. Moreover, better bull flag template price fit is associated with higher average return. The empirical results demonstrated that the average return of trading rules conditioned on bull flag significantly better than buying every day for the study period, especially for TWI.
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1. Introduction

Developing a model for predicting returns is an important goal for academics and practitioners. Fundamental and technical analysis has longed aimed to devise trading rules suitable for application on stock markets. A significant body of literature exists on fundamental and technical analysis in various financial domains. Results obtained in the 1960s and 1970s supported the "Efficient Market Hypothesis", which states that the efficient nature of financial markets should mean that market data does not contain any discernable and exploitable patterns (Alexander, 1964; Fama & Blume, 1966; Jensen & Bennington, 1970). Therefore, impulses from new information cannot be predicted. The market prices are best described as a random walk, and past price and volume information are worthless for predicting future market price behavior. However, some recent results since the 1980s have appeared to indicate

otherwise. Well-known anomalies involve abnormal returns associated with: unexpected earnings announcements, firm size, the month of January, the day of the week, and so on. Additionally, the behavior finance literature uses a conservative bias and investor overconfidence to explain evidence of market underreaction or overreaction to information documented by DeBondt and Thaler (1985) and Jegadeesh and Titman (1993), among others. The studies of abnormal return and behavior finance indicated that historical prices can help in predicting future prices. Sharpe, Alexander, and Bailey (1995) summarized some observations regarding the recent evidence in technical analysis, stating "the apparent success of these (technical) strategies offers a challenge to those who contend that the stock market is highly efficient". Consequently, numerous financial researches have progressively employed a positive and careful attitude to probe into technical analysis. A fairly comprehensive literature related to technical analysis in various financial domains has addressed numerous effective evidences that trading success can be achieved with technical analysis.

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Technical analysis studies records or charts of past stock prices, hoping to identify patterns that can be exploited to achieve excess profits. Academic study of technical analysis has mainly adopted quantitative indicators as prediction variables, for example relative strength index, moving average and so on. Meanwhile, charting pattern, for example head-and-shoulder, flag, etc. are comparatively rare. Lo, Mamaysky, and Wang (2000) considered many technical quantitative indicators that may find it easier to detect algorithmically-moving average, support and resistance levels, oscillators, and so on, but that those charting patterns are most difficult to quantify analytically. Nevertheless, complying with the development of computer technology and cross-domain research, academic study has gradually paid increasing attention to pattern analysis for investment decision, including Lo et al. (2000) testing price charting patterns using kernel regression for the identification of ten patterns. Leigh, Purvis, and Ragusa (2002), Leigh, Modani, Purvis, and Roberts (2002) Leigh, Modani, and Hightower (2004) implemented a variation of the bull flag stock chart using a template matching technique based on pattern recognition. All of these researches showed that trading success can be achieved with charting patterns.

This study developed a new template grid, bull flag, and a method of calculating fit value using a template matching technique from pattern recognition. This study concentrates on identifying increasing price value, regardless of the nature of the preceding or accompanying news, using a version of the bull flag charting pattern. The detection of this bull flag pattern in the time series of index values for the Nasdaq Composite Index (hereafter NASDAQ) and Taiwan Weighted Index (hereafter TWI) becomes a buy signal. This study fills a gap in the literature, since no previous study has applied the bull flag trading rules to the Taiwanese market, which is an emerging market, and the NASDAQ, which is a developed market. This study also improved the methodology applied by previous studies on this area.[1] For empirical analysis, to minimize measurement error due to data snooping, this study applies the method of Brock, Lakonishok, and LeBaron (1992) to use a long data series for NASDAQ and TWI, and reports results for various fitting windows, holding horizons, and threshold values. Moreover, this study tests performance consistency for various non-overlapped sub-periods. The empirical results indicated that all of the technical trading rules correctly predict the direction of changes in the index series. These findings may provide investors with important asset allocation information. Additionally, the buy signal with better bull flag template price fit is associated with higher average returns. The empirical results demonstrated that trading rules based on bull flag (conditional trading rules) significantly better than buying every day (unconditional trading rules) of the study period, especially for TWI.

The remainder of this paper is organized as follows. Section 2 reviews the previous literature on technical trading rules. The proposed method is then described in Section 3. Next, Section 4 describes the data and results of the empirical investigation. Finally, Section 5 offers concluding remarks.

2. Previous studies

Alexander (1961) was the first to confirm the profitability of technical trading rules for individual US stocks. Later, Levy (1967) employed relative strength, and Pruitt and White (1988) developed the CRISMA trading system, which combined trading rules of on balance volume, relative strength, and moving average also confirmed the profitability of technical trading rules. Moreover, Brock et al. (1992), followed by Bessembinder and Chan (1995) and Ratner and Leal (1999), also demonstrated the profitability of simple trading rules, moving average and trading range break out.

Few, if any, empirical test used charting pattern analysis, until Lo et al. (2000). Neftci (1991) showed that the method of technical analysis that can capture the non-linearity of asset prices can potentially improve forecasts generated via the Wiener–Kolmogorov prediction theory. Neftci (1991) also noted that graphic methods specifically charting patterns, are not the best methods of determining classes of Markov times, and a better method is to use future information to issue buy and sell signals. Lo et al. (2000) solved the problem of the algorithm being unable to work for those patterns indicated by Neftci (1991), and designed an algorithmic approach to technical analysis. Lo et al. start by quantitatively defining ten commonly used charting patterns, including head-and-shoulder and inverse head-and-shoulder, broadening tops and bottom, triangle tops and bottom, triangle tops and bottom, rectangle tops and bottoms, and double tops and double bottoms. This study proposed a systematic and automatic method of technical pattern recognition using non-parametric kernel regression, and applied this method to numerous US stocks from 1962 to 1996 to evaluate the effectiveness of technical analysis. By comparing the unconditional empirical distribution of daily stock returns to the conditional distribution – based on specific technical indicators such as head-and-shoulder or double-bottoms – this study found that over the 31-year sample period, several technical indicators provide incremental information and may be useful. Subsequently, Leigh, Purvis et al. (2002) implemented a variation of the bull flag charting pattern using a template matching technique from pattern recognition, as shown in Fig. 1. This template fitting process tests a bull flag price pattern and volume pattern for the NYSE from 01/01/1981 to 12/31/1996. A 60-trading-day history of price and volume is used to forecast price movement for 20-day horizons. A selection of trading days based on 90% or better fitting value results in significantly

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[1] Leigh, Purvis et al. (2002), Leigh, Modani et al. (2002) and Leigh et al. (2004) implemented bull flag technical charting to discover trading rules for use on the NYSE, but the fitting windows are different with one being 60 trading days, while the other is 120 trading days. Simultaneously, the holding periods are also different.