



Profitable candlestick trading strategies—The evidence from a new perspective

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ABSTRACT

This paper aims to investigate the profitability of two-day candlestick patterns by buying on bullish (bearish) patterns and holding until bearish (bullish) patterns occur. Our data set includes daily opening, high, low, and closing prices of component stocks in the Taiwan Top 50 Tracker Fund for the period from 29 October 2002 through 31 December 2008. We examine three bullish reversal patterns and three bearish reversal patterns. We find that three bullish reversal patterns are profitable in the Taiwan stock market. For robustness checks, we evaluate the applicability of our results to diverse market conditions, conduct an out-of-sample test and employ a bootstrap methodology.

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1. Introduction

Academicians have been skeptical of technical analysis (Malkiel, 1981). In practice, however, traders generally adopt technical analysis in their daily trading. Billingsley and Chance (1996) find that about 60% of commodity trading advisors heavily or exclusively rely on computer-guided technical trading systems.

Emotion and irrational beliefs have been documented as important factors affecting market prices and technical analysis could purportedly gauge the extent of emotional components in the markets (Nison, 1991). From the growing body of literature on behavioral finance, it seems that investors do not behave completely rationally as they face gain and loss. Technical analysts can transform investors' mental emotion into charts to demonstrate investors' real fear and greed. In this way, technical analysis appears to be consistent with behavioral finance. For example, positive feedback rules (De Long, Shleifer, Summers, & Waldmann, 1990) probably could explain trend-chasing in price movements. The anchoring effect (Tversky & Kahneman, 1974) seems to be in accordance with the support and resistance trading rules in technical analysis.

Candlestick analysis originated from Japan in 1700s and was initially used for rice forward contracts trading (Nison, 1991). It is the oldest technical analysis method and now is used to reveal the shifts in supply and demand forces by tracking daily price movements.

The motivation for this research is to fill in the gap in the literature on candlestick analysis. Prior studies generally focus on the short-term profitability of candlestick analysis, probably because candles have value with the maximum holding period of ten days (Morris, 1995). Our research contributes to the literature by examining the long-term profitability of candlestick trading strategies. Unlike prior technical analysis literature on candlesticks, this study is the first study that rigorously investigates these strategies by buying on bullish (bearish) patterns and holding until bearish (bullish) patterns occur. Moreover, early empirical studies (Alexander, 1964; Fama & Blume, 1966) find that profits made through technical analysis are eroded by transaction costs. We therefore examine and report the average profit after commissions and taxes.

For robustness, we further test the predictive power of six reversal patterns by dividing entire sample into three market conditions. We also conduct an out-of-sample test and employ a bootstrap methodology. Our empirical results reveal that the three bullish reversal patterns, especially the *Piercing* pattern, are significantly profitable in the Taiwan stock market.

The rest of this paper is structured as follows. Section 2 reviews the literature. Section 3 describes the data and the methodology. Section 4 discusses the empirical results. Section 5 extends the additional evidence. The last section concludes the paper.

2. Literature review

There is no general consensus on the effectiveness of candlestick charting in the literature. Marshall, Young, and Rose (2006) propose an empirical framework for predictive power of candlesticks. They employ the bootstrap methodology to retest the results, and find

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that candlestick technical analysis cannot help investors make a profit. Marshall, Young, and Cahan (2008) use a similar approach in analyzing the Japanese stock market by dividing 100 stocks listed on the Tokyo Stock Exchange into three ten-year sub-periods. They find that candlesticks have no value for traders in the Japan stock market. Horton (2009) observes nine candlestick patterns for 349 stocks listed in the S&P 500 index and finds that the use of *Stars*, *Crows*, or *Doji* in trading individual stocks is not recommended.

Fock, Klein, and Zwergel (2005) examine the predictive power of candlesticks by employing intraday rather than daily data. Their data are from the index futures on the German stock index and the futures on German government bonds. They investigate 19 patterns and find negative results. Furthermore, they use four technical analysis methods, including moving average, momentum, relative strength index, and moving average convergence/divergence indicators and find that the forecasting power of candlesticks can be improved by combining these Western technical analysis methods.

The work by Caginalp and Laurent (1998) is the first study that shows in great detail how to define trends and recognize candlestick patterns. In their paper, they claim that the returns could be compounded over 200% for a year after transaction costs. Most of the eight three-day candlestick reversal patterns that were examined appear to generate large profits. Additional evidence in support of candlestick charting is provided by Goo, Chen, and Chang (2007). They compare average returns of various patterns and holding days and find that investors can gain an average return of 9.99% by using the *Bullish Harami* pattern for a ten-day holding period. Meanwhile, the performance of candlesticks seems to be improved by implementing stop-loss strategies. Using a quantile regression, Shiu and Lu (2011) employ daily data on Taiwan 69 electronic securities to test the predictive power of the two-day candlestick patterns. They find that the *Bearish Harami* pattern possesses genuine predictive power.

Little research, if any, has been published on candlesticks from a long-term perspective. By a long-term perspective, we mean that investors buy on bullish patterns and hold until bearish patterns occur. We attempt to ascertain the profitability of candlesticks in a new manner. Our research differs from previous studies in that we examine long-term strategies for candlesticks.

Caginalp and Laurent (1998) argue that candlestick analysis has several advantages such as precise definitions of patterns and fixed time intervals of analysis. Moreover, candlestick analysis is more robust to the criticism of data snooping than other technical trading rules, because it was first developed for an entirely different market, i.e., the Japanese rice market (Marshall et al., 2006).

Using the fixed holding period method, prior studies reveal that the performance of candlesticks can be improved in conjunction with other methods such as technical indicators (e.g., momentum) (Fock et al., 2005) or stop-loss strategies (Goo et al., 2007). In this paper, we use a variable holding period method and find that candlestick reversal patterns are themselves useful without recourse to these methods.

3. Data collection and methodology

3.1. Data

Our data consist of daily prices, including opening, high, low, and closing prices, for the individual stocks that comprise the Taiwan 50 for the period 29 October 2002 (the date when Taiwan 50 launched) to 31 December 2008. Fig. 1 shows the Taiwan Capitalization Weighted Stock Index during the period from 29 October 2002 to 31 October 2011. As shown in this figure, the diverse market conditions provide an interesting setting for conducting our analysis to examine the profitability of candlestick patterns. Additionally, we use the data from 5 January 2009 to 31 October 2011 for an out-of-sample test.

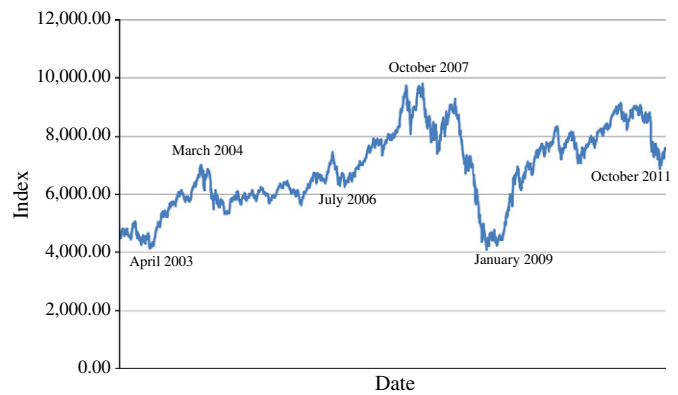


Fig. 1. Taiwan Capitalization Weighted Stock Index for the period October 2002 through October 2011.

3.2. Pattern definitions

Candlesticks are more frequently used with daily data than intraday data (Nison, 1991). Presumably investors' reaction takes some time to be incubated. Popular daily candlestick patterns include single lines, two-day patterns, and three-day patterns. Several consecutive single lines can combine to form a pattern. Patterns can be then divided into continuation and reversal patterns. In general, investors pay more attention to reversal patterns. In this paper, we consider three two-day bullish patterns and three two-day bearish patterns. The precise definitions are shown below, while their statements and shapes are presented in Fig. 2.

1. The *Piercing*: in a downtrend, $O_1 > C_1$, $O_2 < C_2$, $O_2 \leq C_1$, $C_2 < O_1$, and $C_2 > C_1 + 0.5(O_1 - C_1)$.
2. The *Bullish Engulfing*: in a downtrend, $O_1 > C_1$, $O_2 < C_2$, $O_2 \leq C_1$, and $C_2 \geq O_1$.
3. The *Bullish Harami*: in a downtrend, $O_1 > C_1$, $O_2 < C_2$, $O_2 > C_1$, and $C_2 < O_1$.
4. The *Dark-cloud Cover*: in an uptrend, $O_1 < C_1$, $O_2 > C_2$, $O_2 \geq C_1$, and $C_2 < C_1 - 0.5(C_1 - O_1)$.
5. The *Bearish Engulfing*: in an uptrend, $O_1 < C_1$, $O_2 > C_2$, $O_2 \geq C_1$, and $C_2 \leq O_1$.
6. The *Bearish Harami*: in an uptrend, $O_1 < C_1$, $O_2 > C_2$, $O_2 < C_1$, and $C_2 > O_1$.

where O_1 and C_1 indicate the opening and closing prices of the first day of the pattern, and O_2 and C_2 refer to the opening and closing prices of the second day of the pattern.

3.3. Identifying trends

The first issue about defining reversal patterns is to identify uptrends/downtrends. Following Caginalp and Laurent (1998) and Shiu and Lu (2011), we employ the five-day moving average over six days. The moving average on day t is defined by:¹

$$MA_5(t) = \frac{C(t-4) + C(t-3) + C(t-2) + C(t-1) + C(t)}{5}$$

where $C(t)$ refers to the closing price on day t .

¹ The number of signals will change when we employ other than the five-day MA. For instance, using the three-day (ten-day) MA will decrease (increase) the number of signals. Since the average of shorter duration is more volatile than the average of longer duration, it is therefore more difficult for the shorter-duration MA to satisfy the trend criteria. Take the *Piercing* for example. Its frequencies are 13 for the five-day MA, six for the three-day MA, and 25 for the ten-day MA.

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