



## Trading rule discovery in the US stock market: An empirical study

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### ABSTRACT

This study develops a new template grid – rounding top and saucer – to detect buy signals. Most of the previous studies utilize historical data to derive the template grid, but do not clearly explain how to format weight values of the template grid. This makes the template a “black box” for users since it is difficult to infer the process of the template formation. Therefore, this study proposes a simple and explicit method for deriving the template grid. In addition, to more accurately detect buy signals, the trading rules are developed by capturing reversal of price trend. The empirical results indicate that the template grid and the proposed trading rules developed in this study have considerable forecasting power across tech stocks traded in the US, including MSFT, IBM, INTC, ORCL, DELL, APPLE and HP, since the average returns of the proposed trading rule are greater than the results of buying every day over the sample period. The method proposed here could therefore become an effective component of an expert system to assist investors in investment decisions.

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### 1. Introduction

Technical analysis involves the examination of past stock prices to identify patterns that can be exploited to achieve excess profits. Studies of technical analysis mainly look at quantitative indicators, such as relative strength index and moving average (e.g., Brock, Lakonishok, & LeBaron, 1992; Pruitt & White, 1988). Charting patterns, such as head-and-shoulder, flags, saucers, and rounding tops, have been much less studied, until Lo, Mamaysky, and Wang (2000).

Lo et al. (2000) use kernel regression to identify charting patterns, while Leigh, Purvis, and Ragusa (2002), Leigh, Modani, Purvis, and Roberts (2002), Leigh, Modani, and Hightower (2004), Bo, Linyan, and Mweene (2005), and Wang and Chan (2007) all implement a variation of the bull flag stock chart using a template-matching technique based on pattern recognition. These studies show that charting patterns can predict stock prices.

The method developed here differs from other studies in three respects. First, no previous study, to our knowledge, utilizes charting patterns (rounding top and saucer) to detect buy signals. In this study, we develop a new template grid to detect buy signals. Second, since previous studies have not clearly defined how to format weight values of the template grid (e.g., Bo et al., 2005; Leigh et al., 2004; Leigh, Modani, et al., 2002; Leigh, Purvis, et al., 2002; Wang & Chan, 2007), this makes the template a “black box” for users and might

lead to questions regarding data mining. In contrast to the extant literature, this study develops an alternative method for formatting the template grid using a template-matching technique based on pattern recognition. The advantage of the method developed here is that it is simple and explicit, and can generally be applied to other charting patterns' formation, while avoiding suspicions of data mining. Third, saucer and rounding tops are usually reversal patterns and are typically followed by substantial price movements. To more accurately detect buy signals, the trading rules are developed by capturing reversal of price trend. Moreover, to ensure that the performance is not decided by too few buying signals and that the trading rules have practical application; this study develops trading rules with numerous filter rules to detect buy signals.

This study uses daily stock prices to assess stock market purchasing opportunity. The proposed method is applied to the computer science tech stocks in the US with largest market cap. The selected stocks include Microsoft (MSFT), IBM, Intel (INTC), Oracle (ORCL), DELL, APPLE and Hewlett–Packard (HP). The empirical results demonstrate that trading using conditional trading rules yields significantly better returns than buying every day<sup>1</sup> during the sample period. Accordingly, the template grid and the conditional trading rules developed in this study have considerable forecasting power across tech stocks in the US.

The remainder of this paper is organized as follows. Section 2 describes the method used. Section 3 describes the design of the trading rules. Section 4 describes the data and results of the

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<sup>1</sup> The trading policies indicated as optimal by the efficient markets hypothesis.

empirical investigation. Finally, Section 5 summarizes the findings and offers conclusions.

**2. Method**

Charting, the method of technical analysis that we use, is based on the recognition of certain graphical patterns in price and/or volume time series data. This study concentrates on two kinds of charting pattern: rounding top and saucer. A rounding top occurs at a market peak, while a saucer develops at a market bottom. Pring (2002) defines a saucer as resembling a circular line under the lows, roughly approximating an elongated or saucer-shaped letter ‘U’. As the price drifts toward the low point of the saucer and investors lose interest, downward momentum dissipates. The price then gradually increases until eventually exploding in an almost exponential pattern. The price behavior for the rounding top is exactly opposite to that of the saucer pattern. Both rounding top and saucer indicate that the previous trend is gradually reversing. Consequently, it is difficult to obtain breakout points since they develop slowly and do not offer any clear support or resistance levels at which to establish a potential benchmark. Even so, Pring (2002) argues that it is worth trying to identify them since they usually follow substantial moves. Rounding top and saucer formation can be fitting as consolidation as well as reversal phenomena, taking as little as three weeks or as much as several years to form (Pring, 2002).

The template grids we use to identify the occurrence of rounding top ( $T_1$ ) and saucer ( $T_2$ ) are shown in Figs. 1 and 2, respectively. Fig. 1 illustrates the template used in our study to represent variation in the rounding top. This is a 10 by 10 grid with weights  $w_{ij}$  in the cells. The weighting values define areas in the template for confirming the upward wave band (the first three columns), the horizontal consolidation (fourth to seventh columns), and the downward tilting breakout (the last three columns) portions of the rounding top pattern. The saucer is exactly the opposite of the rounding top. The weights that define charting pattern in the template are indicated by the cells in gray. This study develops a new method, different from previous studies, to derive the weight values. This method is described in the following subsection.

**2.1. Specification of the template grid**

Most previous studies (e.g., Bo et al., 2005; Leigh et al., 2004; Leigh, Modani, et al., 2002; Leigh, Purvis, et al., 2002; Wang & Chan, 2007) directly utilize historical data – price and/or volume data – to derive the weight values of the template grid. However, they say little about how to derive the weight values of the template grid. This makes the template a black box for users since they cannot infer the procedure of template grid formation. This study proposes a simple and explicit method to derive a new template grid using the following steps:

-1.000	-0.538	0.375	1.000	1.000	1.000	1.000	0.375	-0.538	-1.000
-0.778	0.231	1.000	1.000	1.000	1.000	1.000	1.000	0.231	-0.778
-0.556	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.556
-0.333	1.000	1.000	1.000	0.643	0.643	1.000	1.000	1.000	-0.333
-0.111	1.000	1.000	0.524	0.286	0.286	0.524	1.000	1.000	-0.111
0.111	1.000	0.375	0.048	-0.071	-0.071	0.048	0.375	1.000	0.111
0.333	0.231	-0.250	-0.429	-0.429	-0.429	-0.429	-0.250	0.231	0.333
0.556	-0.538	-0.875	-0.905	-0.786	-0.786	-0.905	-0.875	-0.538	0.556
0.778	-1.308	-1.500	-1.381	-1.143	-1.143	-1.381	-1.500	-1.308	0.778
1.000	-2.077	-2.125	-1.857	-1.500	-1.500	-1.857	-2.125	-2.077	1.000

Fig. 1. Weights representing rounding top pattern variation ( $T_1$ ).

1.000	-2.077	-2.125	-1.857	-1.500	-1.500	-1.857	-2.125	-2.077	1.000
0.778	-1.308	-1.500	-1.381	-1.143	-1.143	-1.381	-1.500	-1.308	0.778
0.556	-0.538	-0.875	-0.905	-0.786	-0.786	-0.905	-0.875	-0.538	0.556
0.333	0.231	-0.250	-0.429	-0.429	-0.429	-0.429	-0.250	0.231	0.333
0.111	1.000	0.375	0.048	-0.071	-0.071	0.048	0.375	1.000	0.111
-0.111	1.000	1.000	0.524	0.286	0.286	0.524	1.000	1.000	-0.111
-0.333	1.000	1.000	1.000	0.643	0.643	1.000	1.000	1.000	-0.333
-0.556	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.556
-0.778	0.231	1.000	1.000	1.000	1.000	1.000	1.000	0.231	-0.778
-1.000	-0.538	0.375	1.000	1.000	1.000	1.000	0.375	-0.538	-1.000

Fig. 2. Weights representing saucer pattern variation ( $T_2$ ).

**Step 1:** The variation of object charting pattern is mapped to the corresponding cells and denotes the weight values,  $w_{ij}$ , in the corresponding cells as 1.

**Step 2:** The weight values for the other cells of each column are calculated at a linear decrement and the sum of weight values for all cells in each column should be equal to zero.

To illustrate the steps of template formation, we use Fig. 2 as an example. Fig. 2 is a 10 × 10 grid of weight values representing variation in the saucer charting pattern, and is used to detect the reversal of the price trend, i.e. upward-tilting breakout. The first step is to map the variation of the saucer charting pattern into the corresponding cells in a 10 × 10 grid, and denote the weight values as 1, as shown in Fig. 3a. Next, as outlined in Step 2, we calculate the weight values of the blank cells for each column in Fig. 3a. We use the third column of Fig. 3a (shown as Fig. 3b) as an example to illustrate the calculation steps for weight values. That is,

$$\begin{aligned} \text{Sum of the third column} &= (1 - 5d) + (1 - 4d) + (1 - 3d) \\ &\quad + (1 - 2d) + (1 - d) + 1 + 1 + 1 \\ &\quad + 1 + (1 - d) = 0 \end{aligned}$$

Therefore, we obtain  $d = 0.625$  and then derive the weight values of each cell in the third column (shown in Fig. 3c). Using the same steps we can derive the weight values of each cell in the other columns.

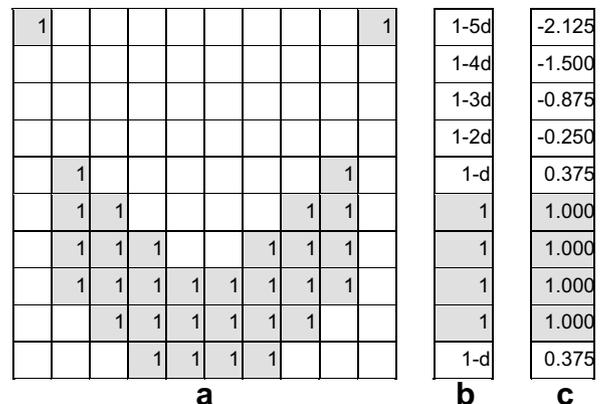


Fig. 3. Illustration for a template formation. (a) Represents the variation of the saucer charting pattern. (b, c) Represent the calculated weight values for each column.

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