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A novel, rule-based technical pattern identification mechanism: Identifying and evaluating saucers and resistant levels in the US stock market

Achilleas Zapranis *, Prodromos E. Tsinaslanidis

Department of Accounting and Finance, University of Macedonia of Economic and Social Sciences, 156 Egnatia Str., P.O. Box 1591, Thessaloniki 54006, Greece

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ABSTRACT

This paper has two main purposes. The first one is the development of a rigorous rule-based mechanism for identifying the rounding bottoms (also known as saucers) pattern and resistant levels. The design of this model is based solely on principles of technical analysis, and thus making it a proper system for evaluating the efficacy of the aforementioned technical trading patterns. The second aim of this paper is measuring the predictive power of buy-signals generated by these technical patterns. Empirical results obtained from seven US tech stocks indicate that simple resistant levels outperform saucers patterns. Furthermore, positive statistical significant excess returns are being generated only in first sub-periods of examination. These returns decline or even vanish as the experiment proceeds to recent years. Our findings are aligned with the results reported by various former studies. The proposed identification mechanism can be used as a component of an expert system to assist academic community in evaluating trading strategies where technical patterns are embedded.

1. Introduction

The efficient market hypothesis is under academic scrutiny since it was firstly introduced by Fama (1970). The easy accessibility to databases with historical-prices makes the weak-form market efficiency test an easier task to implement compared with the efficiency tests of the other two forms (semi-strong and strong form). Temporary market anomalies (e.g., Banz, 1981; Gibbons & Hess, 1981; Keim, 1983) and technical analysis are the most known theories not consistent with the efficient market hypothesis. The tools of technical analysis are mainly classified firstly into technical indicators, such as relative strength index (RSI), moving average convergence-divergence (MACD) and moving average crossovers (e.g., Brock, Lakonishok, & Lebaron, 1992; Marshall, Qian, & Young, 2009), and secondly into charting patterns such as head-and-shoulders, cup-with-handle, saucers, and flags. For a more comprehensive description of the technical analysis we suggest (Achelis, 1995; Edwards & Magee, 1997; Murphy, 1986; Pring, 2002).

Unfortunately, studies testing the predictive power of chart patterns constitute only a minor fraction of the existing bibliography on testing the profitability of technical analysis at all. This dismal size of bibliography on charting can be mainly attributed to the difficulty that lies in the creation of an efficient and robust pattern identification mechanism that integrates all the relevant subjective principles of technical analysis. Levy (1971) provided one of the first (to our knowledge) chart studies, and evaluated the predictive performance of 32 five-point chart patterns, among them variations of the head-and shoulders pattern, triple tops and triple bottoms. His main finding was that neither the best nor the worst of those patterns performed very differently from the market. Chang and Osler (1999) examined the head-and-shoulders pattern in a 21-year period of daily spot exchange rates versus the US dollar. They found that the aforementioned pattern, when used as a trading rule on the mark and yen, could be characterized as profitable but not efficient since it is being outperformed by other simpler trading rules such as moving averages. Lo, Mamaysky, and Wang (2000) use nonparametric kernel regression to identify 10 different technical patterns and provide indications that technical analysis may include predictive power. Specifically they state: "*Although this does not necessarily imply that technical analysis can be used to generate 'excess' trading profits, it does raise the possibility that technical analysis can add value to the investment process*". The same trading rules were used by Dawson and Steeley (2003) on UK data and their results corroborate the previous statement. In addition Curcio, Goodhart, Guillaume, and Payne (1997), Lucke (2003) provide limited evidence of the profitability of the technical patterns they examined.

Variations of a template-matching technique are presented in Bo, Linyan, and Mweene (2005), Leigh, Frohlich, Hornik, Purvis, and Roberts (2008), Leigh, Modani, and Hightower (2004), Leigh, Modani, Purvis, and Roberts (2002), Leigh, Paz, and Purvis (2002), Leigh, Purvis, and Ragusa (2002), and Wang and Chan (2007) that identify cases of the bull flag technical pattern, whereas Leigh, Hightower, and Modani (2005) and Leigh and Purvis (2008) identify volume spikes. Finally Wang and Chan (2009) use a different

* Corresponding author. Tel.: +30 2310 891690; fax: +30 2310 844536.
E-mail addresses: zapranis@uom.gr (A. Zapranis), tsinpro@uom.gr (P.E. Tsinaslanidis).

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from the aforementioned template grid in order to identify rounding bottoms and rounding tops.

This study presents a novel rule-based approach for identifying the rounding bottoms technical pattern. The uniqueness of this study resides in the manner that principles of technical analysis are incorporated in the identification mechanism. To be more precise from different official descriptions of the saucers, and with simple geometric rules, a new rule-based identification mechanism is developed which extracts a great proportion of subjectivity included in technical pattern recognition process. The advantage of this method is that it is simple and it can identify simultaneously patterns of different size (both width and depth) where in case of template-matching techniques the user has to define the size of the template window before the identification process starts. This paper has two main objectives. The first is the presentation of the identification mechanism. The second is the evaluation of the rounding bottoms pattern's forecasting power, and not the discovery of a new profitable trading rule. For this reason no optimization based on generated excess returns is utilized.

The rest of this paper is organized as follows. Section 2 describes the design of the rule-based identification mechanism. Section 3 explains the trading rules employed. Section 4 presents the data and the empirical results. Finally Section 5 makes a conclusion.

2. Method

Till now only Wang and Chan (2009) (to our knowledge) utilize saucers to detect buy signals. The explanation for this limited bibliography on recognizing the rounding bottoms pattern is that its identification is generally considered as a difficult task to implement. Murphy (1986) states "*There are no precise measuring rules for the saucer bottom*". Also Edwards and Magee (1997) say "*It is difficult to set precise rules for trading on these gradual changes of trend*".

There is evidence in the pattern's description that the evolution of the price is gradual and should form a semicircle. Again, referring to (Murphy, 1986) "*This pattern represents a very slow and gradual change in trend*". Achelis (1995) confirms: "*Rounding bottoms occur as expectations gradually shift from bearish to bullish*". Finally, according to Pring (2002) "*A saucer is constructed by drawing a circular line under the lows…, if the volume is plotted below the price, it is almost possible to draw a complete circle…*".

The description of the proposed identification mechanism begins with an optimal case of the saucers pattern and then more flexibility is added. For the pattern's identification, three major characteristic points are necessary: two points at about the same level (P_1 and P_2) and a local trough (T_1) approximately in the middle of them. In an ideal case (Fig. 1) points P_1 and P_2 would be at the exact same level, and the local bottom would be at the midpoint of them. The general rule implemented in this study is that the vast majority of closing prices between the points (P_1 and P_2) must fluctuate, within specific circular bound limits; around the lower half part of the circumscribed circle (semicircle) defined by the isosceles triangle $P_1T_1P_2$.

In an ideal saucers case the three critical points form an isosceles[1] triangle (Fig. 2). For simplicity we denote the triangle $P_1T_1P_2$ as. The sides of the triangle are noted with small caps (a, b and c). From trigonometry it is known that every triangle has a circumscribed circle,[2] which center (point K) is the meeting point of the triangle's three perpendicular bisectors.[3] The radius (R) of the circumscribed circle is given by the following equation:

$$R = \frac{\alpha}{2\sin(A)} \tag{1}$$

where "a" is the triangle's side opposite of the vertex "A" and sin is the sine.

At this point the aforementioned triangle is placed on a Cartesian coordinate system in two dimensions. Thus each point would be defined by a pair of coordinates; the time and the stock's closing price. Given the coordinates of two points, the distance (D) between those two points is given by:

$$D = \sqrt{dx^2 + dy^2} \tag{2}$$

where dx (dy) is the difference between the x-coordinates (y-coordinates) of those two points.

Taking for granted that the coordinates (time and stock price) for points B and C are known, the calculation of the length (or distance) for the side "a" is feasible. Also sin (A) equals with the side BM divided by the side AB (or c). Side "c" equals with side "a" which is already known and side BM equals with the difference of the y-coordinates (prices) of points A (or C) with B. From the above analysis the radius (R) of the circumscribed circle is calculated and the coordinates of the circumscribed circle's center (point K in Fig. 2) result. To be more precise, if (Kx,Ky) and (Bx,By) are the coordinates of the points K and B respectively, then $Kx = Bx$ and $Ky = By + R$.

So far the radius and the center of the circumscribed circle have been determined. The next step is the calculation of the corresponding y-coordinates (Y_i) for all the available trading days (X_i) between points A and C. The following equation results from the previous analysis and the combination of Eqs. (1) and (2):

$$R = \sqrt{dx^2 + dy^2} = \sqrt{(Kx - X_i)^2 + (Ky - Y_i)^2} \tag{3}$$

Solving by Y_i gives the following second order equation[4]:

$$Y_i^2 - 2K_yY_i + Ky^2 - R + (X_i - Kx)^2 = 0, \quad \forall i \in I[Ax, Cx] \tag{4}$$

The points with the coordinates (X_i,Y_i), for every integer between the x-coordinates of points A and C, correspond to the circle's points that the stock price should fluctuate on in the case of a rounding bottoms pattern (circle 1 in Fig. 1). Pattern's confirmation occurs when prices are constrained within the bounds set by two other homocentric circles (circles 2 and 3 in Fig. 1). The bounds used are expressed as a percentage of the radius of the initial circle (circle 1). For example if 20% bounds are used then circles 2 and 3 would have a radius of 0.8R and 1.2R respectively.

At this point we have to specify the way we seek for the three pattern's characteristic points (P_1, T_1 and P_2). Before the initial downtrend a short local peak (P_1) must occur. With a rolling window as the one used in (Zapranis & Tsinaslanidis, 2010) short term local peaks are being identified.[5] Each peak identified sets a horizontal price level. For each peak identified we can easily find the first forthcoming day that stock's price (P_2) overcomes this level. In an ideal pattern these two points would have the same value but in reality this situation is extreme rare. What it is for sure is that these two points would be at about the same level and should also have a local minimum between them. We do not have to check if this point is at the midpoint between P_1 and P_2, because it is also extreme rare to be at exact the half distance between the two "leaks" of the "bowl".

The next step is a scaling process that has to take place, in order to simulate the way a technical analyst seeks for a pattern in a

[1] An isosceles triangle is any triangle that has exact two sides of the same length.

[2] A circumscribed to a triangle circle is a circle passing through all three triangle's vertices.

[3] A perpendicular bisector of a triangle's side is a straight line passing through the side's midpoint and being perpendicular to it.

[4] Eq. 4 gives two solutions for every X_i. For drawing the homocentric semicircles, the minimum value of each pair of solutions is kept.

[5] This study employs a rolling window of 5 days. This means that a closing price is characterized as a local peak if it is greater than the previous and the forthcoming 2 closing prices.