Trends and volatility of stock prices following occurrence of specific technical patterns

James A. Shine, US Army Corps of Engineers (retired)
James E Gentle, Professor Emeritus, George Mason University
Charles R. Perry, US Department of Agriculture (retired)
JSM 2017, Baltimore, MD, USA
3 August 2017

Abstract

A well-known heuristic in financial time series is that a "head and shoulders" pattern (a small peak, a larger peak, and a second small peak) after a long upward trend is a predictor of a future downward trend. We look to assess this and other heuristics against actual financial time series data. We define specific technical patterns and then detect these patterns on real stock data over multiple stocks, time intervals and step sizes. We then compare trend and volatility measures of the stock after the pattern occurs. Our results and their comparison with other studies will be presented and discussed.

Key Words: financial data, time series, prediction, trend, pattern detection, volatility

Introduction

Financial time series have been the subject of statistical analysis for close to a century, dating back to the early 1900s. One topic of interest is the modeling of patterns and the use of these models for prediction. Analysis of stock prices is easily the most popular example of this, as many believe that the results of successful models can be used to earn money by buying and selling stocks.

Certain patterns of prediction have become very popular in the mainstream analysis of stock prices. One such pattern is the "head and shoulders" pattern, used by television analysts such as Jim Cramer of CNBC. [1]

A head and shoulders pattern can be defined broadly by a long upward trend to a small peak, a small valley, a taller peak, another small valley, and a second small peak. An inverse head and shoulders pattern is the reverse: a long downward trend to a small valley, a small peak, a lower valley, another small peak, and a second small valley. According to the predictive model, the prices will then begin a downward trend (or upward trend for an inverse head and shoulders). This is thus a good time to sell (or buy) a stock before it drops (or rises) in value, assuming the model is accurate.

Osler expressed doubt about the validity of such a model in the late 1990s [2,3]. More recently, Lo has examined the head and shoulders model and is more positive in his evaluation [4].

We have examined the head and shoulders pattern in previous work [5,6] and have developed our own algorithm for detection of these patterns. Examples from our paper at

JSM 2015 indicated that the head and shoulders is not a good predictive model, but we wanted to examine this more rigorously [6]. This paper is the result of those efforts.

Methodology

Our main algorithm is called Alternating Trends Smoothing (ATS). The algorithm takes in sequential data such as a financial time series and draws alternating lines based on change points, or break points. The output is thus a series of points which denote endpoints of lines with alternating positive and negative slopes. The algorithm has step size as its main smoothing parameter; it has other parameters as well but these were not pertinent to this work. The algorithm is discussed in greater detail in Shine, Gentle and Perry, 2015 [6].

The output from the ATS algorithm (the break points) is then used as input to another algorithm, called Patterns, which then looks for instances of particular patterns using the break points. We can display the patterns visually on a graph and mark the point in the data where the patterns occur.

For our work in this paper, we aggregated the results from multiple stocks to look at two specific indicator values: trends after the detected patterns, and a comparison of historical volatility before and after the pattern. Checking the percentage of upward or downward trends for various periods of time after the detected pattern should give an indication of whether these patterns match the specific models (head and shoulders and inverted head and shoulders) or not. Historical volatility will give an indication of whether the model conclusions are valid or whether volatility issues cloud the ability to make other inferences.

Results

We performed our analysis on stock data from the Standard and Poor (S&P) 500 index, which we obtained from yahoo.com. We used data over the period from January 2010 through December 2016. The data was daily adjusted closing prices.

We had some difficulty getting consistent results, including those presented at the conference, since Yahoo kept changing their data format and there were 10 stocks which originally had missing data. However, fortunately the Yahoo data seems to have stabilized (without missing data) in mid-September 2017, and we obtained reproducible results with our algorithm.

We looked for head and shoulders patterns, and inverse head and shoulders patterns, at step sizes of 5, 10, 20, 30 and 50. The results are shown in Tables 1 and 2.

If the predictive hypothesis of a head and shoulders holds, we would expect the trend of the following data to be down. For an inverted head and shoulders, we would expect this trend to be up.

Table 1 indicates that while the trend is down in the short term (T = 4 and T = 10 have low percentages of an upward trend) as time goes on the percentage of upward trends

begins to rise (except for a step size of 50). Certainly there is not significant evidence to support the predictive claim of a downward trend.

The difference of the volatility of the data during the following 25 and 100 trading days, and the previous 25 and 100 days, does not seem to be statistically significant one way or the other. We use historical volatility in this paper.

Table 2 shows slightly different results. Here an upward trend supports the prediction, and the upward trend does seem to hold even up to 100 days at least for the smaller step sizes (5, 10 and 20). Again, volatility difference of the data before and after 25 and 100 trading days does not seem to be statistically significant either way.

Step Size	Number of Patterns	Trend Up After 4 Days	Trend Up After 10 Days	Trend Up After 25 Days	Trend Up After 100 Days	Volatility 25 Days	Volatility 100 Days
5	573	28	40	51	68	52	54
10	288	31	33	47	66	40	52
20	132	26	26	29	52	53	71
30	63	22	33	44	56	38	56
50	21	38	38	48	29	57	67

. .

Table 1: Results from S&P 500 stocks for a basic head and shoulders pattern
(January 2010 thru December 2016)

Step Size	Number of Patterns	Trend Up After 4 Days	Trend Up After 10 Days	Trend Up After 25 Days	Trend Up After 100 Days	Volatility 25 Days	Volatility 100 Days
5	322	62	62	61	74	48	46
10	141	58	63	63	80	59	57
20	75	51	53	54	70	51	64
30	43	51	47	47	54	44	42
50	12	67	67	67	64	42	33

Table 2: Results from S&P 500 stocks for an inverted head and shoulders pattern
(January 2010 thru December 2016)

Conclusions and Future Work

Based on our analysis, the detection of a head and shoulders does not seem to predict a downward trend. For an inverted head and shoulders, there is some indication of predicted upward trends being found, but it is not strong.

Based on this study, we have definite reservations on the accuracy of the head and shoulders model.

For future work, our method depends on alternating trends. We are modifying the algorithm to allow trends that are not strictly alternating. We are also adding restrictions on the pattern such as symmetry, limits on the slope of the line between the two small valleys, and time constraints. Other future work could include examination of other patterns such as the cup and handle.

References

[1] Jim Cramer, "Mad Money", CNBC Television.

[2] C.L. Osler, "Identifying Noise Trackers: The Head and Shoulders Pattern in US Equities", Staff Report, Federal Reserve, 1999.

[3] P.H.K. Chang and C.L. Osler, "Methodical Madness: Technical Analysis and the Irrationality of Exchange-Risk Forecasts", Economic Journal, Volume 109 # 458, 1999.

[4] A.L. Lo, H. Mamaysky and J. Wang, "Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation. The Journal of Finance, Volume 55, # 4, August 2000.

[5] J.A. Shine, J.E. Gentle and C.R. Perry, "Identifying Patterns in Financial Time Series", JSM 2014, Boston, MA, August 2014.

[6] J.A. Shine, J.E. Gentle and C.R. Perry, "Discovering and evaluating trend patterns in Financial Time Series", JSM 2015, Seattle, WA, August 2015.