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Hybrid methodology for technical analysis

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ABSTRACT

Hybrid methodology involving differential equations modeling and statistical regression is developed in order to test basic ideas in asset price dynamics. In particular, the method provides a mechanism for testing the relative importance of price trend compared with valuation. The significance of yearly highs in prices can also be understood through this procedure. A large data set of 52 closed-end funds comprising about 61,500 data points is used with the mixed effects model in SPlus. The model suggests that the role of the trend is as significant as the valuation. Upon determination of the coefficients, one has a model that can be used for short term forecasts of asset prices. The model incorporates the finiteness of assets and the importance of "liquidity", or "excess cash". The statistics utilize data on the number of shares and the national money supply. The methodology can easily be extended to other behavioral effects.

1. Introduction

Technical analysis is the endeavor of deducing information about future action of asset prices from past price and volume data (see, for example, [1]. While this methodology has been popular among practitioners for centuries, academics have generally been skeptical at best. With the advent of the Efficient Market Hypothesis (EMH) as the dominant financial theory several decades ago, the attack on technical analysis became even more strident. The EMH theory stipulates, in its weak form, that price histories are readily available to everyone, and so any advantage that is apparent from price behavior would be rapidly used by many market participants, thereby eliminating any advantage. Thus EMH asserts that the dynamics of stock prices are simply random movements about the valuation, which is unique since the information is available to everyone. Despite the dominance of EMH, particularly among academics, there has been growing evidence for market inefficiencies during the past decade. The huge internet/high-tech bubble of the late 1990's brought some stock prices to 100 times their valuation by any measure of standard finance. A similar bubble occurred in large Japanese stocks during the preceding decade. The subsequent declines were equally spectacular. These bubble/bust episodes suggest that markets are more complicated than random fluctuations about a unique valuation. In addition there have been academic studies on markets that have shed doubt on the basic axiom of classical finance, namely, that risk and reward are always inversely related [2].

The basis of technical analysis is that human behavior is repetitive and that people in similar situations with respect to their gains and losses will behave similarly. Although the behavior is often cast in terms of emotion, there may be purely rational reasons for the same actions. For example, one of the key ideas in technical analysis is that a trend has a tendency to continue in the absence of other factors. One reason for this is that a person who has a position in the direction of the trend observes that he is steadily making profits and is reluctant to close the position. A person who has a position in

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the opposite direction (e.g. holding stock that is steadily declining) has the opposite emotion. However, even if there is no emotion involved, a steady downtrend forces some participants to sell. These include traders who bought the asset on margin (i.e. partially on borrowed money) and must close their position at some point as their equity in the investment declines below a set percentage determined by securities law. In addition, many money managers are replaced when their performance falls behind the market averages by a percentage that is set by management. Thus, they have a rational reason to close positions when the trend is going against them.

There are several difficulties with testing trading strategies based upon technical analysis. In principle it does not seem very difficult to test scientifically whether there is really a statistically significant effect. Examination of data sets using price data have often found a positive short term trend effect, but the gains are often too small to be profitable for trading [3]. The central difficulty in testing such theories is that the market contains a great deal of "noise", that consists of new information that influences the price. For example, an oil company's stock may be on an uptrend, but news of weather damage to its refineries can easily derail the trend. Thus, without a methodology to extract this inflow of information and separate it from the "noise" in market fundamentals, it is difficult to obtain more significant results. In a special situation, one study [4] examined two closed-end funds that were essentially identical. A closed-end fund is one that trades on a stock exchange like an ordinary stock, while its net asset value (NAV) is determined by the current price of the underlying stocks. The two clone stocks, Future Germany Fund and Germany Fund, had NAV's that were essentially identical. Thus any change in their ratio could be attributed to trader behavior and not to underlying changes in fundamentals that would affect both funds equally. An examination of the temporal behavior of this ratio using ARIMA methods showed that the best predictor of tomorrow's price is halfway between yesterday's price and yesterday's derivative, thereby confirming a large trend effect. We will examine the issue of trend as part of our study in this paper using a model that we discuss in Section 2.

Beyond the issue of trend, technical analysis and behavioral finance both point to additional factors that influence investor decisions. One of these is the assertion of technical analysts that asset prices encounter a "support" as they approach a value that has been the low for a significant time, e.g., yearly low. Similarly, there is the assertion that prices move easily toward a yearly high but meet some resistance at the high. If prices cross the high, they meet less resistance, since there are no traders looking to sell upon recovering their losses. This should continue, argue the technicians, until prices have moved sufficiently above the high that profit taking dominates.

Behavioral finance at its current stage of development has not yet been integrated with these concepts, which is one of our long term goals. Research has shown that decision makers are motivated to "avoid regret" and to "anchor" [Shefrin] or "frame" their decisions based on their gains and losses.

As noted earlier, statistical testing of the concept of yearly highs and lows is extremely difficult due to the noise in the market. Thus it is fairly easy (as some academicians have noticed) to perform a quick statistical test on a stock index, for example, and assert that such concepts have no basis in fact. The focus of this paper is to demonstrate, using a large data set, that within a suitable hybrid model consisting of differential equations with statistical calibration, it is possible not only to validate these concepts, but to quantify them. Furthermore, this provides a model to predict future prices based upon price history and an update of valuation changes.

In the next section, we present the differential equations model, and the related difference equations. In Section 3 we introduce the data set and perform the statistical calibration of the coefficients. Sections 4 and 5 discuss the results and conclusions from this analysis.

2. The differential and difference equations

Classical finance is built largely on two idealizations. First, there is the assumption that a sufficiently large number of people have access to public information that one can assume the entire market has the same information. Furthermore, each trader knows that every other trader has access to all available information (such as price history and company statistics) and acts accordingly. With everyone having the same information, there is still the possibility of individuals making mistakes. However, the second assumption is that there is sufficiently large capital ready to exploit any deviations from the price that may arise from some traders who may not be informed. A series of papers dating back to 1990 (see [5] and references therein) derived a set of equations that retain the basic supply/demand price adjustment without making these two idealized assumptions. In particular, these asset flow equations assume that the total assets that can be used to trade the asset are finite, and that there may be various motivations that influence supply and demand in trading.

In a model of a single stock (or other financial instrument), we define $B(t)$ as the fraction of total assets of investors that is invested in the stock, so that $1 - B(t)$ is the fraction in cash. With $P(t)$ denoting the price of the stock, $M(t)$ denoting the total cash, and $N(t)$ denoting the number of shares at time t, one has the identities

$$B = \frac{NP}{NP + M}, \qquad 1 - B = \frac{M}{NP + M}. \tag{2.1}$$

The ratio of these is simply

$$\frac{B}{1 - B} = \frac{N}{M}P = \frac{P}{L}, \tag{2.2}$$